UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION AND ENVIRONMENTAL IMPACT APPRAISAL BY THE OFFICE OF NUCLEAR REACTOR REGULATION SUPPORTING AMENDMENT NO. 10 TO FACILITY OPERATING LICENSE NO. R-25 THE INSTITUTIONAL COUNCIL OF THE UNIVERSITY OF UTAH

DOCKET NO. 50-72

Introduction

By letter dated July 8, 1977, The Institutional Council of the University of Utah (the licensee) requested that Facility Operating License No. R-25 for their AGN-201M research reactor, Serial No. 107, be renewed for a period of twenty years. This would extend the expiration date of the license to September 12, 1997. In response to our request, the licensee provided additional information in support of this renewal application by letters dated March 3, 1978 and January 2, 1979. The proposed revised Technical Specifications (TS) submitted with the renewal application have been modified to meet regulatory requirements. The modifications have been discussed with and accepted by the licensee.

Discussion

This AGN-201M reactor is located in the Merrill Engineering Building, the University of Utah, Salt Lake City, Utah, and is of a design developed by Aerojet-General Nucleonics. The reactor was first licensed to operate on September 12, 1957, for a period of twenty years. The reactor is currently licensed to operate up to a steady state power level of 5 watts thermal. A number of AGN-201M reactors have been licensed to operate at this power level and greater. Moreover, considerable operating experience to date indicates that the AGN-201M reactor parameters can be accurately predicted. No unusual problems have arisen or are anticipated from operation of The University of Utah AGN-201M reactor in the manner authorized by the license.

Reactor Description

The AGN-201M is a small research reactor designed to operate at power levels up to 20 watts. This type of reactor has been used extensively for education and training and for experimental programs requiring a low neutron flux level. The reactor core consists of a number of polyethylene disks impregnated with uranium dioxide enriched in U-235. The inherent design features of this reactor and the low power level at which it is operated preclude the buildup of significant amounts of fission products.

I. Safety Evaluation

The present facility has not significantly changed from that described in the licensee's application for License Amendment No. 4, January 3, 1962, when the reactor was moved to its permanent location in the Merrill Engineering Building on the University's campus at Salt Lake City, Utah.

By virtue of their power, negligible fission product inventory and strong negative temperature coefficient of reactivity, the AGN-201M reactors do not present significant hazards to the public. Their safety and reliability have been demonstrated in several facilities for many years.

The proposed TS have been reviewed and revised. The TS generally incorporate the design features, characteristics, and operating conditions described in the original Hazards Summary Report for the AGN-201 Reactor(1) submitted in support of Dockets F-15 and F-32 and referenced in the licensee's application. Inclusion of comprehensive surveillance requirements and administrative controls will assure acceptable performance of safety related equipment and require safety related reviews, audits, and operating procedures. Record keeping and reporting requirements will provide sufficient information to permit an assessment by the Commission of safety related activities and changes.

There are, however, several differences between the accompanying TS and the original AGN documentation. These are discussed below.

The AGN-201 Preliminary Design Report(2), submitted on the F-15 docket, mentioned thermal fuses in the control and safety rods and a boron-loaded polyethylene sheet surrounding the graphite reflector. The function of the thermal fuses in the control and safety rods was to cause the rods to fall from the core in the event of excessive temperatures produced in a nuclear excursion. They would, therefore serve as a backup to the core thermal fuse which already serves as a backup to the normal scram system. The function of the boron-loaded sheet was to absorb thermal neutrons thereby reducing gamma ray production fron neutron capture in the shield water and the resulting radiation level outside the shield.

These design features were not mentioned in subsequent submittals, including the Hazards Summary Report(1), the AGN-201 Reactor Manual(3), and the Shield Design Report(4). They were not referred to in the original AEC Hazards Analysis(5) or subsequent safety evaluations. They were not incorporated into the assembled AGN reactors and are not included in the existing or proposed TS.

Many years of experience operating AGN-201 research reactors without thermal fuses in the control and safety rods and without a boron-loaded polyethylene sheet surrounding the graphite reflector has established that these reactors can operate safely, as assembled, at licensed power within acceptable radiation levels to both operating personnel and the general public. Based on our review and the above considerations, we have concluded there is reasonable assurance that operation without thermal fuses in control and safety rods and the boron-loaded polyethylene sheet referred to in the Preliminary Design Report will not endanger the health and safety of the public.

The original AGN-201 documentation[1-3] limited the total available excess reactivity to 0.2% $\Delta k/k$. As a result of a detailed test and evaluation conducted at Georgia Tech and subsequent NRC staff evaluation, AGN-201 reactor licensees were advised that increases in the excess available reactivity, including contributions from positive worth experiments, to 0.65% $\Delta k/k$ could be authorized. Because of the self-limiting action of the large negative temperature coefficient, an instantaneous reactivity insertion as high as 2.0% $\Delta k/k$ would not result in core damage or radioactivity release. Limiting the total available excess reactivity to 0.65% $\Delta k/k$ assures that the reactor will not become prompt critical and that the reactor periods will be sufficiently long such that the reactor protection system and/or operator action can effectively scram the reactor well before any safety limits are exceeded.

From an NRC staff-evaluated postulated most severe accident resulting from the instantaneous addition of 1.0% $\Delta k/k$ in reactivity, it was determined that a step reactivity addition of this magnitude would result in an energy release of 0.905 megajoules. There would be no significant radiation damage to the polyethylene moderator from the excursion, and any fission products which diffuse from the UO_2-polyethylene matrix would be retained in the sealed core tank. Even assuming the most pessimistic release of fission products, no person would receive a dose in one week which would exceed the limits specified in 10 CFR Part 20 for restricted areas. We have concluded, therefore, that the postulated excursion will not endanger the health and safety of the public.

Experience with similar reactors has indicated that gaseous fission products and hydrogen are released from the fuel matrix when operated at 20 watts. The University of Utah recognizes that gas evolution could occur as a result of operation at 5 watts for extended periods and there could be a pressure buildup within the core tank or control rod cans. To preclude such a pressure buildup, the licensee has established procedures to measure the core tank pressure every kilowatt-hour of operation and vent if necessary to maintain an acceptable low system pressure. In addition, prior to opening the core tank, pressure and fission gas activity will be measured. If a high level of gaseous activity is measured, appropriate radiological procedures will be instituted to preclude personnel hazards from the release of radioactive effluents. We have concluded that those precautions are acceptable measures to prevent excessive personnel exposures or pressure buildup within the reactor core tank due to the production of radioactive gases; and that for the normal operating cycle experienced during the past 20 years of operation, it is very remote that any gas evolution will occur.

The fuel consists of polyethylene material with uranium dioxide (enriched to less than 20% in U-235) uniformly dispersed throughout the polyethylene. Polyethylene is an organic material that can sustain radiation damage when exposed to fission product bombardment. Test data was provided by Aerojet-General Nucleonics of samples of core material exposed in the Argonne National Laboratory CP-5 reactor. The CP-5 reactor is a 5 megawatt (Flux-10^{12} n/cm^2-sec) reactor. Tests included exposures at full power for periods up to one week continuous operation. Analyses of these tests revealed that radiation damage was evident in a reduced density and there was some loss of hydrogen from the polyethylene. An extrapolation of these results, assuming that the integrated flux-time (nvt) is responsible for the damage, for continuous operation at 100 watts equates to a core life of six years prior to any damage occurring. At 5 watts continuous operation the core life would be approximately 120 years and at 0.1 watt continous operation about 6,000 years. As the normal operating cycle is less than 40 hours per/week, or less than 24%, the projected life approaches 25,000 years at 0.1 watt and 500 years at 5.0 watts. Form this analysis it is reasonable to conclude that the AGN-201M core operating 40 hours per week at 5 watts (flux - 2.5 X 10^8 n/cm^2-sec) would sustain no radiation damage over the 20 years of reactor operation requested by the licensee's application.

Moreover, due to the fact that: (1) no unusual problems have arisen during over 20 years of authorized operation at 0.1 watt(T) and 5.0 watts(T), (2) the revised TS require surveillance and periodic testing of safety related equipment to assure continued safe operation of the reactor and to assure that any significant component degradation will be detected in a timely manner, and (3) other AGN-201M reactors of this type also have considerable operating experience without evidence of any unusual problems, we have concluded that The University of Utah AGN-201M reactor can continue to be operated in a safe manner for the requested 20-year period. Furthermore, based on these considerations, we have concluded that the estimated useful life of the facility will extend at least to the end of the requested 20-year period. Therefore, from a reactor safety standpoint the renewal requested is acceptable.

The licensee submitted a revised safety analysis report in the renewal application that incorporates the foregoing changes. No changes made to the facility have resulted in a decrease in margins of safety.

Furthermore, reactors virtually identical to this one with similar TS have been licensed for operation for periods of up to 40 years. Hence, the bases and conclusions with respect to the safety of operation that were determined in our Safety Evaluation supporting the original license, as amended, and in support of the current operating license, remain unchanged. The revised TS are more definitive than the original TS and will provide the necessary controls and surveillance requirements to ensure safe operation during the period of the license renewal.

The subject facility has been in operation since September 1957 for education and training and for experimental programs requiring a low neutron flux level. The current facility staff consists of four reactor operators and two senior reactor operators with effective licenses. Familiarity with the facility is maintained through facility operation and active programs in operator training and requalification. The licensee's Operator Requalification Program has been reviewed and found to be acceptable.

Financial Considerations

Based on The University of Utah's financial information submitted with the application dated July 8, 1977, and the additional information provided March 3, 1978, in response to NRC staff request of January 26, 1978, we have concluded that the licensee possesses or can obtain the necessary funds to meet the requirements of Section 50.33(f) of 10 CFR Part 50 and that the licensee is financially qualified to continue operation of the facility over the 20-year renewal period requested.

Emergency Planning

Emergency procedures were submitted with the application dated July 8, 1977. We have reviewed these procedures and conclude they provide a basis for an acceptable state of emergency preparedness. Although the procedures are acceptable, they do not conform with the guidance provided. The University of Utah has agreed to resubmit emergency procedures in an overall Emergency Plan that will include both the AGN-201M and the TRIGA reactors. The licensee has stated that this resubmittal will be provided as soon as possible.

Security Planning

We reviewed the current security plan dated August 4, 1972, and Revision 1 dated July 16, 1974, and by letter dated January 26, 1979, we informed the licensee of our approval of the plan and issued Amendment No. 9 to Facility License No. R-25 to incorporate the security plan as part of the license conditions to conform with 10 CFR 50.54(p). The security plan and our evaluation findings are in the Commission's files and are withheld from public disclosure pursuant to the provisions of 10 CFR 2.790(d).

Conclusion on Safety

We have concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

II. Environmental Impact Appraisal

The environmental impact associated with operation of research reactors has been generically evaluated in the attached memorandum(6). This memorandum concludes that there will be no significant environmental impact associated with the licensing of research reactors to operate at power levels up to 2MWt and that no environmental impact statements are required to be written for the issuance of construction permits or operating licenses for such facilities. We have determined that this generic evaluation is applicable to operation of The University of Utah AGN-201M reactor and that there are no special or different features which would preclude reliance on the generic evaluation. Consequently, we have determined that the conclusion reached in the generic evaluation is equally applicable to this license renewal action and that an environmental impact statement need not be prepared. Furthermore, based on our review of specific facility items which are considered for potential environmental impact, discussed below, we have concluded that this license renewal action is insignificant from the standpoint of environmental impact.

Facility

There are no pipelines or transmission lines entering or leaving the site above grade. All utility services (water, steam, electricity, telephone and sewage) are below grade and are comparable to those required for typical campus laboratories. Heat dissipation is accomplished by radiation in a large water tank which serves as the heat sink and is a sealed unit. The reactor is designed as a sealed system, and in normal operation does not have any gaseous or liquid radioactive effluent. Solid, low-level radioactive waste generated in the research effort will be packaged in accordance with USNRC and Department of Transportation (DOT) regulations and shipped for storage at NRC approved sites. The transportation of such waste will be done in accordance with existing NRC-DOT regulations in approved shipping containers. Chemical and sanitary waste systems are similar to those existing at other university laboratories and buildings.

Environmental Effects of Facility Operation

Release of thermal effluents from a reactor of 5.0 watts will not have a significant effect on the environment. This small amount of waste heat is rejected to the surrounding water tank and eventually to the atmosphere by means of conduction and radiation. There will be no release of gaseous or liquid effluents. Yearly doses to unrestricted areas from external radiation will be at or below established limits.* Solid radioactive wastes generated in the research program will be shipped to an authorized disposal site in approved containers. These wastes should not amount to more than a few shipping containers a year.

No release of potentially harmful chemical substances will occur during normal operation. Small amounts of chemicals and/or high-solid content water may be released from the facility through the sanitary sewer from laboratory experiments.

Other potential effects of the facility, such as esthetics, noise and societal or impact on local flora and fauna are expected to be too small to measure.

Environmental Effects of Accidents

Accidents ranging from the failure of experiments up to the largest core damage and fission product release considered possible result in doses of only a small fraction of 10 CFR Part 100 guidelines and are considered negligible with respect to the environment.

Unavoidable Effects of Facility Operation

The unavoidable effects of operation involve the fissionable material used in the reactor. No adverse impact on the environment is expected from these unavoidable effects.

Alternatives to Operation of the Facility

To accomplish the objectives associated with research reactors, there are no suitable alternatives. Some of these objectives are training of students in the operation of reactors, production of radioisotopes, and use of neutron and gamma ray beams to conduct experiments.

*10 CFR 20

Long-Term Effects of Facility Construction and Operation

The long-term effects of research facilities are considered to be beneficial as a result of the contribution to scientific knowledge and training. There is no construction planned during the renewal period; and therefore, no construction is authorized under this licensing action.

Because of the relatively low amount of capital resources involved and the small impact on the environment very little irreversible and irretrievable commitment is associated with such facilities.

Costs and Benefits of Facility and Alternatives

The monetary costs involved in operation of the facility are less than $5,000/year. There will be very limited environmental impacts. The benefits include, but are not limited to, some combination of the following: conduct of activation analyses, conduct of neutron radiography, training of operating personnel and education of students. Some of these activities could be conducted using particle accelerators or radioactive sources which would be more costly and less efficient. There is no reasonable alternatives to a nuclear research reactor for conducting this spectrum of activities.

Conclusion and Basis for Negative Declaration

Based on the foregoing analysis, we have concluded that there will be no significant environmental impact attributed to this proposed license renewal. Having made this conclusion, we have further concluded that no environmental impact statement for the proposed action need be prepared and that a negative declaration to this effect is appropriate.

Dated: May 2, 1979

References

1. "Hazards Summary Report for the AGN-201 Reactor," Aerojet General Nucleonics, February 1962 (see Docket F-15).

2. "AGN Model 201 Reactor, Preliminary Design Study," Aerojet General Nucleonics, May 1956 (see Docket F-15).

3. "AGN-201 Reactor Manual," Aerojet General Nucleonics, July 1957 (see Docket F-15).

4. "Shield Design for the AGN-201 Reactor," Appendix F to Reference 1, September 1956 (see Docket F-15).

5. AEC Memorandum accompanying License R-10, March 29, 1957 (see Docket F-32).

6. D. Muller to D. Skovholt memorandum "Environmental Considerations Regarding the Licensing of Research Reactors and Critical Facilities" dated January 28, 1974(attached).

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

JAN 28 1974

D. Skovholt, Assistant Director for Operating Reactors, L

ENVIRONMENTAL CONSIDERATIONS REGARDING THE LICENSING OF RESEARCH REACTORS AND CRITICAL FACILITIES

Introduction

This discussion deals with research reactors and critical facilities which are designed to operate at low power levels, 2 MWt and lower, and are used primarily for basic research in neutron physics, neutron radiography, isotope production, experiments associated with nuclear engineering, training and as a part of the nuclear physics curriculum. Operation of such facilities will generally not exceed a 5 day week, 8 hour day or about 2000 hours per year. Such reactors are located adjacent to technical service support facilities with convenient access for students and faculty.

Sited most frequently on the campus' of large universities, the reactors are usually housed in already existing structures, appropriately modified, or placed in new buildings that are designed and constructed to blend in with existing facilities.

Facility

There are no exterior conduits, pipelines, electrical or mechanical structures or transmission lines attached to or adjacent to the facility other than utility service facilities which are similar to those required in other campus facilities, specifically laboratories. Heat dissipation is generally accomplished by use of a cooling tower located on the roof of the building. These cooling towers are on the order of 10' X 10' X 10' and are comparable to cooling towers associated with the air-conditioning system of large office buildings.

Make up for this cooling system is readily available and usually obtained from the local water supply. Radioactive gaseous effluents are limited to Ar 41 and the release of radioactive liquid effluents can be carefully monitored and controlled. These liquid wastes are collected in storage tanks to allow for decay and monitoring prior to dilution and release to the sanitary sewer system. Solid radioactive wastes are packaged and shipped off-site for storage at AEC approved sites. The transportation of such waste is done in accordance with existing AEC-DOT regulations in approved shipping containers.

Chemical and sanitary waste systems are similar to those existing at other university laboratories and buildings.

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Environmental Effects of Site Preparation and Facility Construction

Construction of such facilities invariably occurs in areas that have already been disturbed by other university building construction and in some cases solely within an already existing building. Therefore, construction would not be expected to have any significant affect on the terrain, vegetation, wildlife or nearby waters or aquatic life. The societal, economic and esthetic impacts of construction would be no greater than that associated with the construction of a large office building or similar university facility.

Environmental Effects of Facility Operation

Release of thermal effluents from a reactor of less than 2 MWt will not have a significant effect on the environment. This small amount of waste heat is generally rejected to the atmosphere by means of small cooling towers. Extensive drift and/or fog will not occur at this low power level.

Release of routine gaseous effluent can be limited to Ar 41 which is generated by neutron activation of air. This will be kept as low as practicable by minimum air ventilation of the tubes. Yearly doses to unrestricted areas will be at or below established limits. Routine releases of radioactive liquid effluents can be carefully monitored and controlled in a manner that will ensure compliance with current standards. Solid radioactive wastes will be shipped to an authorized disposal site in approved containers. These wastes should not amount to more than a few shipping containers a year.

Based on experience with other research reactors, specifically TRIGA reactors, operating in the 1 to 2 MWt range, the annual release of gaseous and liquid effluents to unrestricted areas should be less than 30 curies and 0.01 curies respectively

No release of potentially harmful chemical substances will occur during normal operation. Small amounts of chemicals and/or high-solid content water may be released from the facility through the sanitary sewer during periodic blowdown of the cooling tower or from laboratory experiments.

Other potential effects of the facility, such as esthetics, noise, societal or impact on local flora and fauna are expected to be too small to measure.

IMAGE EVALUATION
TEST TARGET (MT-3)

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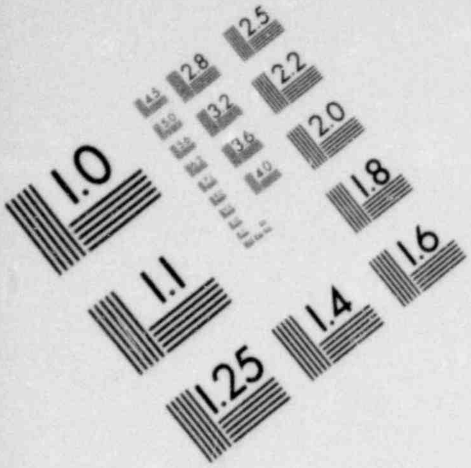
MICROCOPY RESOLUTION TEST CHART



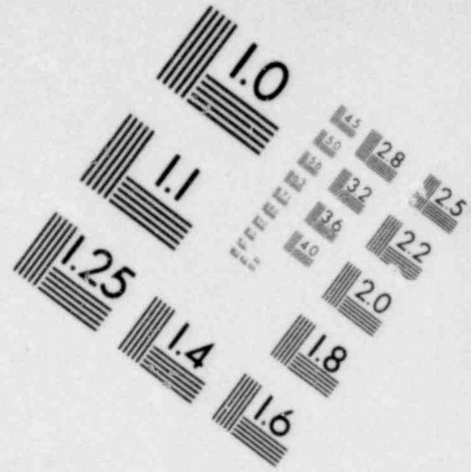
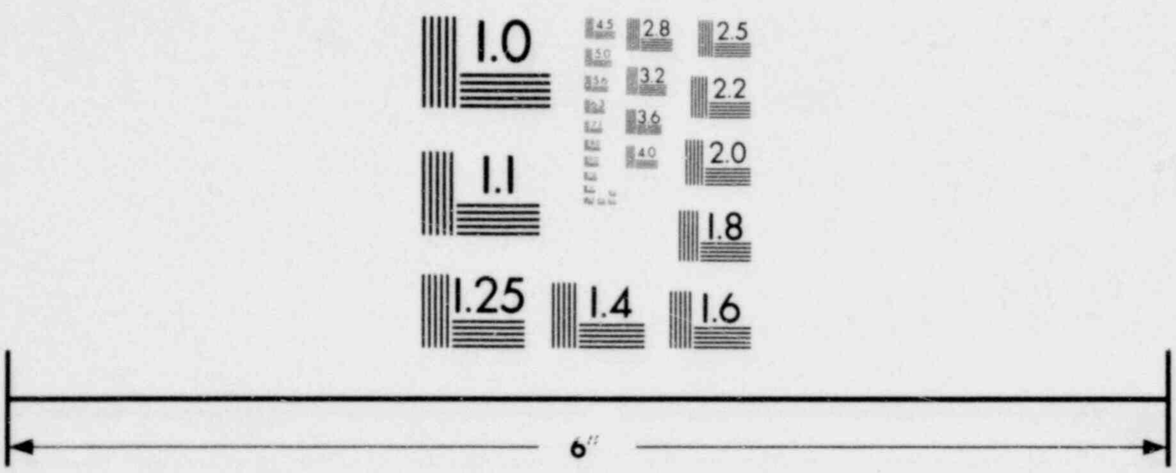


IMAGE EVALUATION
TEST TARGET (MT-3)



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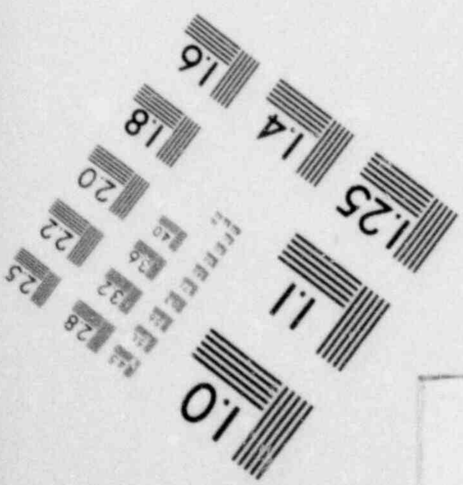

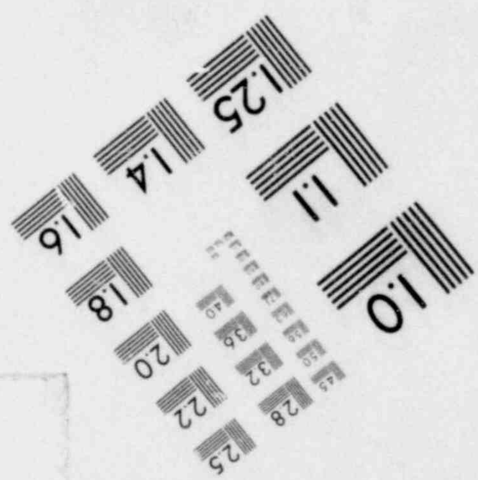

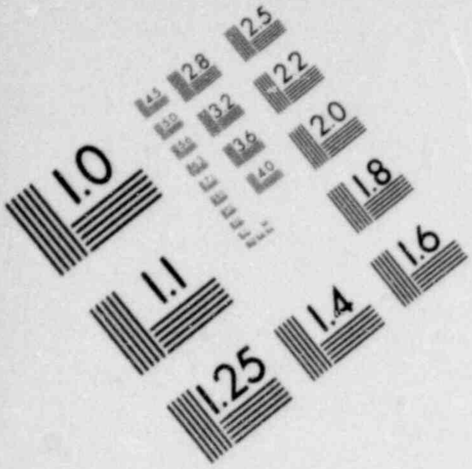

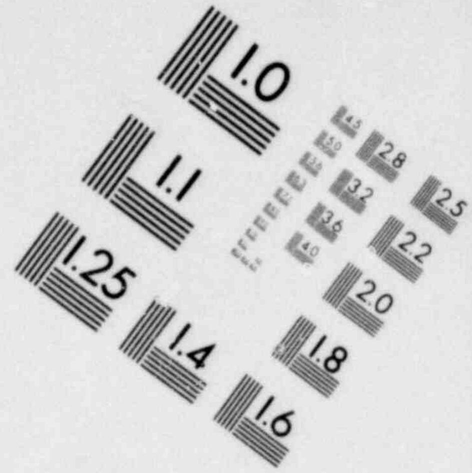

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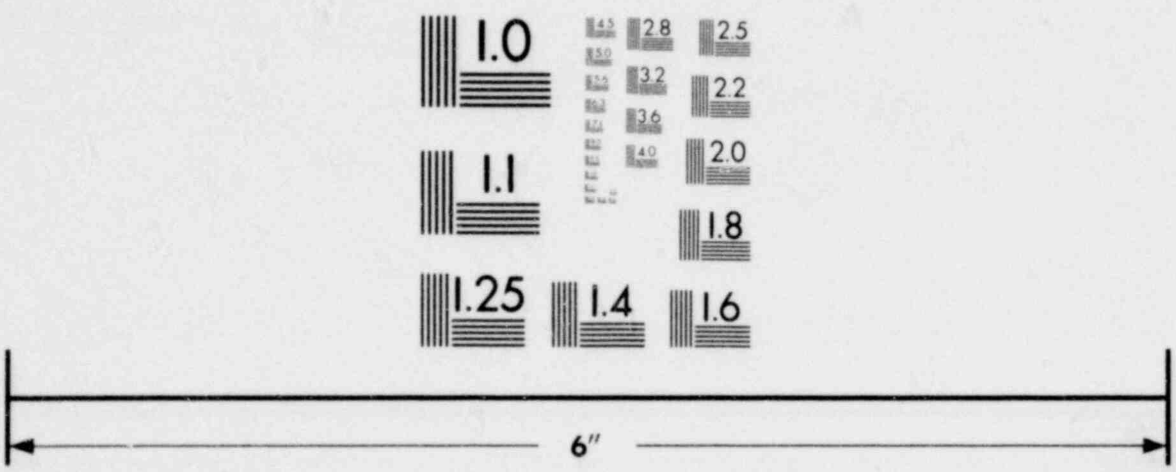

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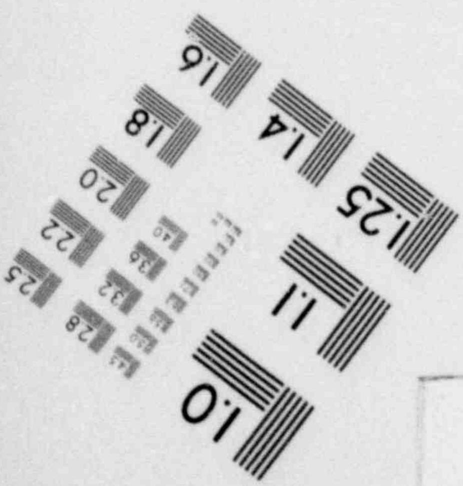

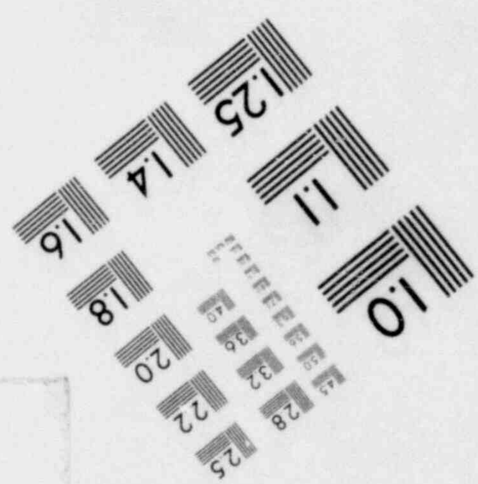

IMAGE EVALUATION
TEST TARGET (MT-3)

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MICROCOPY RESOLUTION TEST CHART

Environmental Effects of Accidents

Accidents ranging from the failure of experiments up to the largest core damage and fission product release considered possible result in doses of only a small fraction of 10 CFR Part 100 guidelines and are considered negligible with respect to the environment.

Unavoidable Effects of Facility Construction and Operation

The unavoidable effects of construction and operation involves the materials used in construction that cannot be recovered and the fissionable material used in the reactor. No adverse impact on the environment is expected from either of these unavoidable effects.

Alternatives to Construction and Operation of the Facility

To accomplish the objectives associated with research reactors, there are no suitable alternatives. Some of these objectives are training of students in the operation of reactors, production of radioisotopes, and use of neutron and gamma ray beams to conduct experiments.

Long-Term Effects of Facility Construction and Operation

The long-term effects of research facilities are considered to be beneficial as a result of the contribution to scientific knowledge and training.

Because of the relatively low amount of capital resources involved and the small impact on the environment very little irreversible and irretrievable commitment is associated with such facilities.

Costs and Benefits of Facility and Alternatives

The costs are on the order of several millions of dollars with very little environmental impact. The benefits include, but are not limited to, some combination of the following: conduct of activation analyses, conduct of neutron radiography, training of operating personnel and education of students. Some of these activities could be conducted using particle accelerators or radioactive sources which would be more costly and less efficient. There is no reasonable alternative to a nuclear research reactor for conducting this spectrum of activities.

Conclusion

The staff concludes that there will be no significant environmental impact associated with the licensing of research reactors or critical facilities designed to operate at power levels of 2 MWt or lower and that no environmental impact statements are required to be written for the issuance of construction permits or operating licenses for such facilities.

Daniel R. Muller

Daniel R. Muller, Assistant Director
for Environmental Projects
Directorate of Licensing

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