PROPOSED CONSTRUCTION PERMIT

9-13-67

SAFETY EVALUATION BY THE DIVISION OF REACTOR LICENSING

DOCKET NO. 50-288

REED COLLEGE

INTRODUCTION

By application dated April 15, 1967, and supplements thereto dated July 5 and August 22, 1967, Reed College requested authorization to construct and operate a TRIGA Mark I Nuclear Reactor at Portland, Oregon. The reactor is intended for use in educational and research programs and will be operated at steady-state power levels up to a maximum of 250 kilowatts therm (kwt). Pulsed operation of the reactor is not planned.

The TRIGA Mark I reactor proposed by the applicant is of a design developed by the General Atomic Division of the General Dynamics Corporation. It is a heterogeneous pool-type reactor with fuel-moderator elements composed of a mixture of zirconium hydride and 8 to 8.5 weight percent uranium (20% enriched), clad with aluminum. This type of fuel element has been used successfully in other TRIGA reactors, and has demonstrated a prompt negative temperature coefficient of reactivity which inherently limits the reactor power to safe levels during transients.

DESCRIPTION

The reactor core will be located at the bottom of a welded aluminum tank whose cross-section is an oval approximately 10 ft. by 15 ft. with a depth of 25 ft. The reactor tank will be installed in a reinforced concrete pit below the grade level of the reactor building. Approximately 16 feet of water above the core will provide shielding in the vertical direction. Surrounding the core radially will be a one-foot thick graphite reflector enclosed in a welded aluminum can. Experimental facilities will include a rotary specimen rack adjacent to the core, a central thimble, and a pneumatic transfer system for the production of short-lived radioisotopes. These irradiation facilities are similar to those installed in other research reactors.

The fuel loading of the core will provide a maximum of 2.25% $\delta k/k$ above the cold, clean, critical condition. The reactor will be controlled by three rack and pinion control rods with a total reactivity worth of about 6.6% $\delta k/k$. The control rod drives are similar to those provided in other TRIGA installations.

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The reactor will be housed in a building to be constructed adjacent to the present chemistry building. The reactor control console will be located in a separate room from the reactor. All doors to the reactor room will be weather-stripped and, with exception of a truck door, will be equipped with closers to permit a negative pressure to be maintained in the room by the ventilation system.

The ventilation system for the reactor room will be independent of that for the existing radiochemistry laboratory. Air will be exhausted from the reactor room through a short stack on the building roof. A continuous air monitor located near the reactor tank will provide an alarm in the event of an accidental release of the activity and will automatically shut down the ventilation air supply fans to the room. Automatically operated dampers will then direct exhaust air from the room through absolute filters to the stack at a low purge rate sufficient to maintain a slight negative pressure in the room.

SITE EVALUATION

The proposed site for the TRIGA Mark I reactor does not present any special problems from a hydrological or meterological standpoint. There are no permanent residences within 700 feet of the reactor site. Although situated in a seismically active area, there are no known faults in the vicinity of the site. Nevertheless, the reactor building and reactor pit will be constructed in accordance with the requirements of the Uniform Building Code for Zone II areas (moderate seismic activity) as is the practice in the Portland, Oregon area. Moreover, as discussed further below, in the event that an earthquake were to cause the reactor tank to rupture, with the resultant loss of reactor cooling water, it is unlikely that a significant quantity of fission products would be released. On the basis of these considerations, we have concluded that the site is suitable for a reactor of this type and power level.

DISCUSSION

A TRIGA reactor, which is considered a prototype of the proposed reactor, has operated for several years at the General Atomic Laboratory in San Diego, California. In addition, many other reactors of the TRIGA design have been constructed and are operating in a manner similar to that proposed by the applicant. The operating experience with these reactors has demonstrated that the important reactor parameters can be accurately predicted.

The applicant has analyzed various potential hazards associated with the operation of the reactor. These include: (1) release of argon-41, (2) reactivity accident, (3) fuel element cladding failure, and (4) a loss of pool water accident.

Radioactive argon-41, which is produced by neutron activation of the air in the various irradiation facilities, could be released to the reactor room and to the environment. The applicant's calculations and our analysis indicate that the release of argon-41 will not exceed the concentrations specified in 10 CFR 20 as limits for restricted and unrestricted areas.

The reactivity accident considered by the applicant is the rapid insertion of all the excess reactivity available in the core. Analysis indicates that no damage to the core will result from this unlikely accident. The core will be loaded to provide a maximum of 2.25% excess reactivity above a cold, clean, critical condition. The prototype TRIGA reactor at General Atomic has operated in the pulsed mode with several thousand reactivity insertions of 2.25% and greater. In each case the measured fuel temperatures were considerably below the point that would cause damage. On the basis of experience gained from operation of the prototype TRIGA reactor, we have concluded that there would be no undue hazard associated with the sudden insertion of all the excess reactivity available in the core.

The applicant has considered an accident involving the release of fission products following the rupture of the cladding of a fuel element. In this event, the reactor room ventilation system would automatically begin to purge the room air through absolute filters following a high activity alarm, as described above, and personnel would be evacuated immediately. Calculations indicate that a person would remain in the reactor room for about an hour without exceeding the radiation dose limit of 10 CFR Part 20. Ample time would exist, therefore, for safe evacuation of personnel. Futhermore, the leakage of fission products from the reactor room would result in extremely small doses to the public.

The effect of a complete loss of pool water has been investigated, although such an accident is considered extremely unlikely. Siphon breaks prevent the pool from being pumped dry accidently, and only a rupture of the aluminum pool tank and its surrounding concrete shell could allow tank drainage. Nevertheless, the applicant has calculated and we concur that, even if all the pool water were lost, no damage to the core would result. We have also concluded that even if a fuel element cladding failure were to accompany such an accident, or if an element were to be damaged while being handled in the open, ample time would still remain for evacuation of the reactor room and the dose to the public would be within acceptable limits.

The General Atomic Division of General Dynamics Corporation has installed many TRIGA type reactors and has demonstrated that it is technically qualified to construct the proposed reactor. The members of the Reed College Staff who will be concerned with operation of the reactor are experienced in the handling of radioactive materials and the present Reactor Project Director is a licensed senior operator for a similar TRIGA reactor. The applicant's plans for administering and operating the proposed reactor, as well as proposed technical specifications for the facility, will be reviewed prior to issuance of a license to operate the facility.

CONCLUSION

On the basis of our review, we have concluded that there is reasonable assurance that the proposed TRIGA Mark I reactor can be constructed and operated on the Reed College campus without endangering the health and safety of the public.

Donald J. Skovholt
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Date: September 13, 1967