UNITED STATES ATOMIC ENERGY COMMISSION

SAFETY EVALUATION BY THE DIRECTORATE OF LICENSING

DOCKET NO. 50-59

TEXAS A&M UNIVERSITY

POWER INCREASE

INTRODUCTION

By application dated September 27, 1972, Texas A&M University (TA&M) requested an amendment to Facility License No. R-23 which would (1) permit operation of the AGN-201 nuclear reactor at power levels up to 5 watts, and (2) permit modification of the reactor's instrumentation and control system.

Most of the existing reactor facility systems and components have the capability for operation at 5 watts (thermal); therefore, only minor modifications will be required. Upon completion of the modifications for 5-watt operation, the reactor will be designated Model AGN-201M, Serial No. 106.

DISCUSSION

The AGN-201 reactor is a portable, self-contained reactor using a homogeneous fuel mixture of uranium oxide and polyethylene enriched with U-235. The reactor is presently authorized to operate at a maximum power level of 100 milliwatts (thermal). In preparation for 5-watt operation, the University proposes to consider any location within the reactor room, other than the shielded hallway, as a high radiation area. An audible and visual alarm will be installed to warn the reactor supervisor and personnel upon entrance to this area. A radiation area will exist in the work area around the thermal column in the accelerator room. Entrance from the accelerator room to the reactor room will be prevented by a floor grating around the thermal column tank; with this tank removed, entrance will be prevented by installation of floor grating or closing and securing the accelerator room door. During the most sevère accident, the dose in the area outside the reactor room is calculated to be 0.0366 mR maximum.

TA&M has stated that the reactor room will be an exclusion area during reactor operations and, based on previous gamma and neutron dose calculations and operational surveys, the total radiation level in the control room and M.E. laboratory when operating at 5 watts would not exceed 1.0 mRem/hr, which is considerably lower than the limits set forth in 10 CFR Part 20 for restricted areas.

Although the instrumentation and control system would require only minor modification to operate at the neutron flux level resulting from the 5-watt operation, TA&M proposes to upgrade their instrumentation by the installation of an improved scram system, annunciator system, and new electronic components for channels 1, 2 and 3. The count rate meter (channel 1) will only be used for subcritical count rate determinations and startup flux monitoring since the single, fixed postion BF_3 detector cannot monitor the range required for 5-watt operation. The operating range for safety channels 2 and 3 will be expanded to accommodate the requirements of 5-watt operation. The instruments proposed for safety channels 2 and 3 have electronic trip circuits which will significantly improve the trip time response and setting accuracy over the present sensitrol relay system. The new reactor console will provide switches in the magnet current supply lines of each safety and shim (or coarse) rod to permit individual rod drop. TA&M proposed changes to the reactor scram interlock system provide alarms (light and bell) for high reactor tank temperature, earthquake, shield water level low, channels 1, 2 or 3 low level, reactor core tank high pressure, thermal column removed and low voltage from channels 2 and 3 high voltage power supplies. The scram interlock circuit will be broken if any of the following occur: rod drive system plug removal, high reactor tank temperature, earthquake, shield water level low, relay chassis (control console) removal and channels 1, 2 or 3 low level. The revised system, as proposed, provides an improvement in the protection system and additional information for reactor operation. Based on our review of the proposed modifications, we conclude that they are acceptable.

The most severe accident that could be postulated from operation of the AGN-201M reactor at 5 watts would result from the instantaneous addition of 1.0% delta k/k in reactivity. A step reactivity addition of this magnitude would result in an energy

release of 0.905 megajoules of energy. 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. TA&M 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, TA&M proposes to provide an alarm when the core tank pressure reaches 5 psig. If the core tank pressure reaches 5 psig, the reactor will be scrammed manually and flux, temperature, radiation levels, and pressure observed. If the pressure reading remains abnormal, the head of the Nuclear Engineering Department or his designated alternate will be notified. If a high level of fission gas activity is observed, appropriate radiological procedures will be followed during the opening of the core tank to preclude exposure to personnel from the release of radioactive effluents. We have concluded that the proposed precautions are acceptable measures to prevent excessive personnel exposures or pressure buildup within the reactor core tank due to the production of radioactive gases.

The changes in the Technical Specifications of Facility License No. R-23 which are necessary to accommodate the proposed 5-watt operation are set forth below:

1. Revise page 2 paragraph 3.3 to read:

   3.3 Each of the safety channels in Table I shall be operating whenever any control or safety rod is not in its fully withdrawn position. Each of the operating safety channels shall sound an alarm and cause reactor shutdown if the limiting safety system setting is reached.

2. Change Table I to read as follows:

TABLE I

Nuclear Instrumentation

Function	Safety Channel	Limiting Safety System Setting
Low count rate	Nuclear Safety No. 1	$\geq$ 10 cps
Low power	Nuclear Safety Nos. 2&3	Loss of signal ($\geq 1 \times 10^{-12}$ amps)
High power	Nuclear Safety Nos. 2&3	$\leq$ 200% of licensed power
Short reactor period	Nuclear Safety No. 2	5 second minimum period

CONCLUSION

Based on the above considerations, we have concluded that there is reasonable assurance that the health and safety of the public will not be endangered by the proposed modifications to the facility and its subsequent operation in the manner proposed at 5 watts (thermal).

FOR THE ATOMIC ENERGY COMMISSION

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for Operating Reactors
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Date: December 13, 1972