June 18, 1984

Docket No. 50-199

Dr. Ronald S. Kane, Reactor Administrator
Zero Power Reactor
Manhattan College
c/o Mechanical Engineering Department
Riverdale, New York 10471

Dear Dr. Kane:

We are in receipt of your letter of January 12, 1984, enclosing the Technical Specifications, your annual financial statement and the letter from your President regarding the College's intent to continue funding from the reactor. We find that the financial information still does not yet fully satisfy the requirements of 10 CFR 50.33(f)(1)(ii). Enclosed is a copy of the specific items of financial information required for research reactor operating license renewals (Enclosure 1). Please address these requirements and submit the information as a supplement to your financial statement.

Your license renewal application must also include an environmental report which contains the necessary information and data for the staff to prepare an Environmental Impact Appraisal. We are enclosing an example of an acceptable environmental report from the University of Kansas (Enclosure 2).

Please submit your supplemental financial information and your environmental report within 30 days of the date of this letter. Should you have any questions, please contact the Project Manager for your facility, Angela Chu, at (301) 492-9798.

Sincerely,

/s/

Cecil O. Thomas, Chief
Standardization and Special
Projects Branch
Division of Licensing

Enclosures:
As stated

cc: See next page

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ENCLOSURE 1

Financial Information Required for Research Reactor Operating Licenses and Operating License Renewals

The provisions of 10 CFR 50.33(f)(1)(ii) require that certain financial information be submitted to demonstrate financial qualifications for an operating license or renewal thereof. Specifically, the applicant must demonstrate that it possesses or has reasonable assurance of obtaining the funds necessary to cover estimated operation costs for the period of the license, plus the estimated costs of permanently shutting the facility down and maintaining it in a safe shutdown condition (decommissioning). Submittal of the following information will assist the staff in determining whether the applicant makes the required demonstration.

1. Detailed estimates of the total annual operating costs for each of the first five years of operation of the facility (or the first five years of the renewal period). Include underlying assumptions to the extent that reasonableness of the cost estimates can be determined.
2. Detailed estimates of the costs of permanently shutting down the facility and maintaining it in a safe shutdown condition (decommissioning). Include underlying assumptions to the extent that reasonableness of the cost estimates can be determined.
3. Detailed explanation of the projected sources of funds to cover costs identified in items 1 and 2 above. Include underlying assumptions to the extent that reasonableness of the projected sources of funds can be determined.
4. Most recent annual and periodic financial statements for the applicant or licensee.

ENCLOSURE 2

Environmental Impact Appraisal

This section deals with the environmental effects which can be attributed to the operation of the University of Kansas (Lawrence) Training Reactor since its initial criticality in 1961. It will also address potential future environmental effects.

A. Facility, Environmental Effects of Construction

The KU Training Reactor is housed in the Nuclear Reactor Center which is located toward the west side of the KU campus. The nuclear reactor occupies the south end of the Center and the Radiation Biophysics Program now occupies the north end. There have been no significant effects on the terrain, vegetation, wildlife, nearby water or aquatic life due to the operation of the reactor.

There are no exterior conduits, pipelines, electrical or mechanical structures or transmission lines attached to the nuclear reactor facility other than utility service facilities which are similar to those required in other campus facilities, especially laboratories. Heat dissipation is accomplished by evaporation and conduction from the pool. There is no external cooling system on the KU Training Reactor.

Make-up water for the cooling system is readily available and is obtained from the City of Lawrence water supply. Radioactive gaseous effluents consist of very small quantities of Ar-41. There are minimal radioactive liquid effluents (less than a liter per year) associated with the production of isotopes in the KU reactor. These solid and liquid radioactive wastes are generated through the irradiation of samples to be used on campus for neutron activation analysis, classroom projects with radioactive materials, or for tracer studies. These radioactive samples are normally of such short half life that disposal is by decay. There is one Kansas Department of Health and Environment approved field study involving the use of small amounts of Tantalum.

The sanitary waste systems associated with the Nuclear Reactor facility are similar to those at other univeristy reactors. The design excludes the possibility of discharging un-monitored liquids into the sanitary waste system.

B. Environmental Effects of Facility Operation

The KU Nuclear Reactor has a maximum power output of 250 KWt limited to an average of 10 KWt and a maximum of three hours at 250 KWt. The environmental effects of thermal effluents of this order of magnitude are negligible. The waste heat is rejected to the atmosphere through the roof of the Nuclear Reactor building. Replacement water is equal to that lost by evaporation at the top of the 6000 gallon reactor tank with a top surface area of 45 ft^2 This amount of water loss by evaporation has minimum effects on the environment.

The room in which the reactor is located is continuously monitored for gamma-ray fields. The gamma detectors are Jordan ion chambers, three of which are mounted on the walls of the reactor bay and one of which is attached to the ceiling directly above the reactor tank.

At 10 KWt, none of the alarms have ever been unexpectedly triggered. The south wall and ceiling monitor do exceed five mR/hr at 250 KWt. The maximum rate has never exceeded 100 mR/hr.

The reactor has been used above 10 KWt an average of six hours per year for the past five years.

Air samples are obtained in and near the reactor building on a weekly basis during periods in which the reactor is being routinely used. (Samples are not normally taken when the reactor is not being operated.) A low volume air sampler is used to draw air through a filter with the volume determined by a flow meter. Gross beta activity is determined by 2 π gas flow counting and gross gamma activity with a NaI scintillation counting system.

Table I summarizes the data for the last five years and is representative of results throughout the life of the reactor.

The demineralizer regeneration effluent is held in a hold-up tank for a period of time to allow for decay. The gross beta and gamma activity in the effluent is determined before it is released to the sanitary sewer system.

Table 2 gives the total amount released to the sewer system in each of the past five years. The concentrations as the effluent enters the drain is less than 9×10^{-5} µCi/ml of beta plus gamma and less than 4×10^{-7} µCi/ml alpha. Thus the dilution factor obtained by averaging these concentrations with the normal sewage volume causes the disposal to be far below Appendix B, Table I, Column 2.

Water samples from the reactor tank are obtained on a periodic basis and analyzed for gross alpha, beta and gamma activity. The maximum activities recorded were $6.\underline{5} \times 10^{-7}$, 2×10^{-6}, and 1×10^{-6} µCi/ml respectively with averages of 7×10^{-8}, $1.\underline{6} \times 10^{-7}$, and $7.\underline{0} \times 10^{-7}$ µCi/ml. Of course, in this case, the sampling time relative to reactor operations does make a difference. It is seen that the values are extremely small.

Radioactive samples made in the reactor are normally allowed to decay to extremely small values following which they may be disposed of via the sewer in the case of liquid samples. Indium foils and other such materials are kept and reused.

The number of samples of radioactive materials produced in the reactor over the past five years are given in Table 3. This table also gives the total activity produced.

C. Environmental Effects of Accidents

Accidents ranging from failure of experiments to the insertion of 1.5% excess reactivity result in doses of only a small fraction of 10 CFR Part 100 guidelines and are considered negligible with respect to the environment.

D. Effects of Facility Operation

No adverse impact on the environment is expected from the operation of the reactor based on the analysis given above.

E. Alternatives to Operation of the Facility

There are no suitable or more economical alternatives which can accomplish both the educational and the research objectives of this facility. These objectives include the training of students in radiation protection aspects of nuclear reactors, the production of radioisotopes, its use as a source of neutrons for neutron activation analysis, and also its use as a demonstration tool to familiarize the general public with nuclear reactor operations.

F. Long-Term Effects of Facility Construction and Operation

The long-term effects of a research facility such as the KU Nuclear Training Reactor are considered to be beneficial as a result of the contribution to scientific knowledge and training. This is especially true in view of the relatively low capital costs ($147,000) involved and the minimal impact on the environment associated with a facility such as the KU Training Reactor.

G. Costs and Benefits of Facility and Alternatives

The annual operating cost for a facility such as the KU Training Reactor is approximatley $29,000 with negligible environmental impact. The benefits include, but are not limited to: training of radiation protection students, performance of activation analysis; production of short-lived radioisotopes; and education of students and public. Some of these activities could be conducted using particle accelerators or radioactive sources, but these alternatives are at once more costly and less efficient. There is no reasonable alternative to a nuclear training reactor of the type presently used of the University of Kansas - Lawrence Campus for conducting the broad spectrum of activities previously mentioned.

Approximately an average of five graduate degrees a year have been awarded in Radiation Biophysics with emphasis on radiation protection. In addition, two to three undergraduate degrees are completed per year. All of these students receive training involving the reactor.

It is possible to have a Radiation Biophysics degree program without a Nuclear Reactor Facility. However, past experience for most disciplines show a much better understanding when experiments and experience accompany a lecture/problem learning system.

Another example of the benefits recovered from a facility of this type is the visitors tours. Approximately 2000 people have visited the facility in the last five years and have either been shown by demonstration or by lecture/tour, the purpose of nuclear reactors in our society.

Table I.

AIR SAMPLES
(Vicinity of Nuclear Reactor Center)

Year	# Samples	Average Beta Activity (μCi/ml)	# Samples	Average Gamma Activity (μCi/ml)
7/1/73 - 6/30/74	32	$<4.0 \times 10^{-12}$*	32	$<1.8 \times 10^{-11}$*
7/1/74 - 6/30/75	37	$<3.4 \times 10^{-12}$*	37	$<2.2 \times 10^{-11}$*
7/1/75 - 6/30/76	84	$<3.4 \times 10^{-12}$*	84	$<2.2 \times 10^{-11}$*
7/1/76 - 6/30/77	45	$<3.4 \times 10^{-12}$*	45	$<2.2 \times 10^{-11}$*
7/1/77 - 6/30/78	23	$<2.0 \times 10^{-12}$*	27	$<2.0 \times 10^{-11}$*
7/1/77 - 6/30/78	5	1.2×10^{-11}	1	4.1×10^{-11}
7/1/78 - 6/30/79	46	$<2.8 \times 10^{-12}$*	46	$<3.2 \times 10^{-11}$*
7/1/78 - 6/30/79	5	2.4×10^{-12}	5	4.0×10^{-11}

*Represents the average minimum detectable activity for the samples collected.

Table 2.

HOLD UP TANK
(Demineralizer Regeneration Effluents)

Year	Gross Beta Activity	Gross Gamma Activity
7/1/73 - 6/30/74	0.9 µCi	22.1 µCi
7/1/74 - 6/30/75	8.0 µCi	19.9
7/1/75 - 6/30/76	2×10^{-7}	1×10^{-7}
7/1/76 - 6/30/77	Less than Minimum Detectable	0.34
7/1/77 - 6/30/78	1.7	3.8
7/1/78 - 6/30/79	0.012	0.079

Table 3.

PRODUCTION OF RADIOISOTOPES

Years	No. of Samples	Activity (µCi)
7/1/73 - 6/30/74	12	< 44 + 630 ^{182}Ta
7/1/74 - 6/30/75	23	< 456 (of which ~ 200 ^{80}Br)
7/1/75 - 6/30/76	30	< 460 (of which ~ 300 ^{80}Br) + 4300 ^{66}Cu
7/1/76 - 6/30/77	22	< 133 + 690 ^{182}Ta + 6200 ^{69}Zn
7/1/77 - 6/30/78	10	< 25 + 1370 ^{182}Ta
7/1/78 - 6/30/79	11	< 62

Isotopes produced included ^{60}Co (calibration foils), ^{24}Na, ^{116m}In (foils reused), ^{38}Cl, ^{64}Cu, ^{66}Cu, ^{50}Fe, ^{198}Au, ^{69}Zn, ^{122}Sb, ^{124}Sb, ^{80}Br, ^{80m}Br, ^{82}Br, ^{42}K, ^{32}P(traces) and traces of other isotopes.