COLLEGE OF ENGINEERING

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

NUCLEAR REACTOR LABORATORY

23 May 1984

Director,
Nuclear Reactor Regulation
c/o DL/SSPB ms 340
Nuclear Regulatory Commission
Washington, D.C. 20555

Re: VPI&SU Research Reactor (VTAR),
Facility License No. R-62
Docket No. 50-124

Dear Sir:

Persuant to 10 CFR parts 50.51 and 2.109, we respectfully request a change to previous licensing requests submitted to the Nuclear Regulatory Commission.

We request that the Commission rescind all prior amendment requests (material dated 19 August 1981 and 15 May 1981) as these requests were made prior to this university allocating monies for an equipment and systems upgrade.

We also request that the enclosed material supercede the applicable portions of reactor license R-62 renewal documentation dated 2 October 1979 and subsequent documents dated 25 August 1980, consisting of a complete re-application for class 104 license.

In summary, we request that the Commission amend the original application and revew the reactor license R-62 at 100 kWt power only.

Sincerely,

Donald R. Krause

Donald R. Krause, Supervisor
Nuclear Reactor Laboratory

T F Parkinson

T. F. Parkinson, Director
Nuclear Reactor Laboratory

W R Van Dresser

W. R. Van Dresser
Vice President for Administration
and Operation

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Facility License R-62
Docket No. 50-124
23 May 1984
page 2

enclosures: SAR (13)
EIA (13)
Summary of Facility Changes (13)
Financial Statement (13)
List of Campus Licenses (13)
SAR Cover Letter

cc: Dr. R.A. Teekell, Chairman
Reactor Safety Committee

Signatures of Donald R. Krause and William R. Van Dresser
Notarized by Gail S. Kyler, Notary Public for Montgomery county
on this 23rd day of May, 1984.

1-13-87 Gail S. Kyler
exp. date signature

Summary of Facility Changes

In July of 1983, the Virginia Tech Argonaut Reactor (VTAR) commenced a major equipment upgrade. In past years equipment and systems were repaired as necessary with very little being done to upgrade the components. As such, most equipment was original, dating back to the time of facility construction (1959). In the following paragraphs, a summary of the changes is discussed.

The primary coolant system has been extensively modified, leaving as before, the dump tank, the six-inch fill line, and the four-inch return line. Two-inch aluminum pipe has replaced the original smaller diameter pipe and a larger primary coolant pump installed (90 gpm vs 25 gpm). The original tube-and-shell heat exchanger was replaced with a larger more-efficient parallel plate type heat exchanger. As much of the equipment as possible was contained within the process pit area, however, unlike the old primary system, the upgraded heat exchanger could not be placed in the process pit. This made it necessary to run some primary piping (to and from the heat exchanger) out of the process pit.

The core area has not been modified at this writing, however, there is a planned modification to increase the outlet pipe oriface from the core tanks, from its present 2½ inch diameter to a minimum size of 3½ inches in diameter. This change is necessary to minimize a noted difference in core tank levels at flow rates greater than 40 gpm.

The secondary coolant system is an entirely new system. Previously, secondary coolant was supplied from the city water main; now however it is a closed, isolated system. Six inch steel pipe was installed between the cooling tower on the roof of Robeson Hall and the parallel plate heat exchanger in the reactor room. The cooling tower has been in place since 1980 along with the pipe run into the reactor room. During the upgrade the heat exchanger and the pipe run within the reactor room were put in place. Because the old secondary system used city water there had been no need for a secondary pump. The new system however, required the installation of a 750 gpm pump. This pump was placed on the cold leg of the system, in the reactor room.

The emergency core cooling system was the final piping upgrade to be completed. From very conservative calculations it was shown that in a worst case scenerio at 500 kWt a cladding melt might occur. Because of the extensive piping work being scheduled and the plan for an eventual power upgrade, it was decided to install the system at this time. The E.C.C.S. is totally new as the system goes, but components from the old primary were used where possible. Except for the boron injection tank (B.I.T.) and the piping between it and the E.C.C.S. pump, the system is contained within the process pit. The system contains the B.I.T., the E.C.C.S. pump (old primary pump), the E.C.C.S. heat exchanger (old primary heat exchanger), and the interconnecting aluminum pipe. Cooling water for the E.C.C.S. heat exchanger is supplied by the city water main which was used with the old primary system.

Other mechanical upgrades include the change over of three of four rod drive mechanisms to the same design as the fourth rod. This fourth rod had been changed in 1982 and had worked better than expected during the testing period. Another upgrade item will be the construction of a raised area (dike) near the outside equipment doors. This dike is to be used in case of a secondary system rupture, to contain the water within the reactor room.

The instrumentation and electrical systems were in the worst shape of any components or systems upgraded. Besides the installation of new wire runs needed because of the systems added during this upgrade, the vast majority of the old wiring, for equipment and console, required replacing. This aspect of the upgrade had not been anticipated. As a result of this, 90% of the previously installed wire has been removed and replaced with wire and runs, following National Electric Code guidelines.

The control console, which was the newest item in use (circa 1969) was given an overhaul and new paint, along with the addition of a sloped bench panel section and installation of a new cabinet section. The instruments which have been modified or redesigned include start-up interlock and scram bus circuitry, the nuclear instrumentation and the rod control and position indication circuitry. New installations included flow monitors for primary, secondary and emergency cooling systems, temperature monitors for the secondary cooling system, back-up source range and micro-micro ammeter nuclear instruments, and an uninteruptable power supply unit for vital load electrical distribution. Except for some internal component wiring and nuclear detector cables, all console wiring is being replaced.

In completing the changes discussed, the reactor and its associated systems will be operable for the next licensing period and longer if needed.

ENVIRONMENTAL IMPACT APPRAISAL

Facility

The Virginia Tech Argonaut Reactor (VTAR) is located in Robeson Hall on the northwest corner of the main campus of Virginia Polytechnic Institute and State University (Virginia Tech), between the Appalachian and Blue Ridge Mountains in southwest Virginia, approximately 40 miles northwest of Roanoke, Virginia. The total population, including both the town of Blacksburg and the student population at Virginia Tech, is 30,638 according to 1980 census data.

The VTAR is a 100kWt Argonaut Reactor built by the American Standard Company for Virginia Tech in 1959. The reactor is used as part of the Nuclear Engineering curriculum for basic research in neutron physics, neutron radiography, neutron activation analysis, technical training and Reactor Operator training, as well as experiments associated with health physics and nuclear engineering. Operation of the VTAR is generally limited to eight hours per day, five days per week, or approximately 2000 hours per year. The facility is located in close proximity to nearly all technical and administrative support facilities, which provides for easy access to the wide variety of technical expertise available at the University.

Robeson Hall was designed in 1957 as the Physics building and Nuclear Reactor Laboratory. Robeson Hall is architecturally identical to the other buildings on the main campus and blends with the general Neo-Gothic motif of most of the campus.

There are no exterior conduits, pipelines, electrical or mechanical structures or transmission lines attached to or adjacent to the VTAR other than the utility services provided for other campus facilities, buildings and laboratories. Heat dissipation is accomplished by a cooling tower located on the roof of Robeson Hall. The cooling tower dimensions are 15' x 7.5' x 11'. The size and weight of the cooling tower are comparable to the air-conditioning units located atop various campus administration buildings. Make-up for the cooling system is from the Blacksburg municipal water supply.

Radioactive gaseous effluents are limited to argon-41. Radioactive liquid effluent release is carefully monitored and controlled. Any liquid wastes are isolated and can be monitored and properly diluted before being shipped (as are solid wastes) or released to the Blacksburg Sewer System in accordance with 10 CFR and local procedures. Solid radioactive wastes are identified, monitored and prepared for shipment off-site to a Nuclear Regulatory Commission (NRC) approved storage and disposal area. All waste transportation is done according to Federal Regulations and in NRC/DOT approved storage containers. Chemical and sanitary waste disposal facilities are similar to those of other Virginia Tech facilities.

Environmental Effects of Facility Operation

1. Thermal Effluent

The release of waste heat from the VTAR to the environment is accomplished through the cooling tower located on the roof of Robeson Hall. This waste heat is rejected to the atmosphere where the effect is not significant, but is similar to the effect produced by a large air conditioner. Extensive drift or fog is not expected, even at maximum power.

2. Solid, Liquid and Gaseous Effluents

Solid radioactive wastes will be shipped to an authorized disposal site in NRC/DOT approved containers. The VTAR facility will normally produce only a few shipping containers of such waste in a year, most of which is low level waste such as plastic gloves, paper, etc. Liquid effluents are carefully monitored and controlled such that all releases shall be in compliance with NRC and local regulations and procedures. Any liquid wastes which cannot be released locally are shipped to an approved disposal site in a manner similar to that used for solid wastes. Routine release of gaseous effluent is limited to argon-41, which is generated by neutron activation of air and has a 1.84 hour half-life. Yearly doses of argon-41 to unrestricted areas are below the established limits as set forth in 10 CFR 20 Appendix B. More detailed information on this subject is contained in Chapter 12 of the VTAR Final Safety Analysis Report.

3. Chemical Releases

No release of harmful chemical substances will occur during normal facility operation. Laboratory experiments may cause small amounts of chemical waste to enter the Blacksburg Sewer System. Some solid-content water may enter the sewer system when the cooling tower is cleaned. These releases are expected to have no more impact than that from releases from other structures on campus.

Other potential environmental effects of the facility, such as aesthetics, noise, social, or ecological impacts are no more than those from other campus facilities.

Environmental Effects of Accidents

These are a wide variety of possible accident scenarios for the VTAR, ranging from experimental apparatus failure to major system failures and core damage. Projected exposures and doses resulting from the release of fission products from even the most severe design basis accident are low. For both two hour and twenty-four hour event durations, projected doses outside the site boundary are well below those requiring protective action according to the Virginia Radiological Emergency Response Plan and the Protective Action Guides of the United States Environmental Protection Agency. Doses requiring protection action are 1 Rem whole body and 5 Rem to the thyroid. As a result, even under severe accident conditions, there appears to be no danger to the general public and protection of the general public would consist of closing the site boundary (Robeson Hall) to all but radiation safety and decontamination personnel. Under these conditions, maximum doses would range from 20 to 100 mRem whole body and 120 mRem to 1 Rem thyroid. For these reasons, it is felt that no permanent environmental damage would result from even the worst case scenario and that no significant immediate environmental damage would result. A more detailed treatment of accidents and their effects may be found in the Virginia Tech Argonaut Reactor Final Safety Analysis Report.

Unavoidable Effects of Facility Construction and Operation

Unavoidable effects of facility construction and operation are limited to non-recoverable materials used in construction of the core areas and the fissionable materials inside the reactor.

Upon decommissioning of the reactor, the materials in the core area must be treated as high level radiological waste and disposed of in accordance with 10 CFR and NRC regulations and procedures. The fuel can be reprocessed to recover the significant amounts of fissionable materials. The waste from such reprocessing must then be treated in a manner similar to that used for disposal of core construction materials noted above.

None of these conditions is expected to have adverse environmental impact to an extent greater than that from any similar facility.

Alternatives to Operation of the Facility

To accomplish the objectives associated with the VTAR facility, there are no reasonable alternatives. Non-reactor alternatives to accomplish the operational objectives of research and training would be prohibitively expensive if available.

Long-Term Effects of Facility Operation

Long-term effects of this facility are expected to be positive because of the contributions the VTAR will make to the nuclear industry and to scientific knowledge in general. No significant local environmental impact is to be expected in the operation of the facility. The only expected environmental impact outside the local area is that from the disposal of waste materials and fuel. This effect would be approximately constant over the lifetime of the facility and would not be made larger by continued operation of the VTAR.

Costs and Benefits of Facility Alternatives

The total costs of construction, operation and eventual decommissioning of the VTAR are on the order of several million dollars. The environmental impact of operation is small, if any, while that of decommissioning is somewhat larger. The benefits from the facility include, but are not limited to, conduct of neutron activation analysis for the academic and commercial communities, possible production of radioisotopes, conduct of neutron and gamma ray experiments and radiography, education of students and training of operating personnel. Some, but not all, of these operations could be conducted using particle accelerators or radioactive sources. These alternatives would be less efficient, more costly, and could not meet all the objectives of facility operation. The environmental impact of such alternative facilities could be greater than that of the VTAR. For example: a linear accelerator would take up a relatively large land area, demand a dedicated structure and use large amounts of electricity, not to mention the large capital cost. The research reactor represents the only reasonable alternative for the type of nuclear research, training, and analysis in which Virginia Tech is involved.

FINANCIAL CONSIDERATIONS

To satisfy the requirements of 10 CFR 50.33, the information listed below will show that the licensee possess the funds necessary to cover the estimated cost of operating the Virginia Tech Argonaut Reactor. The licensee will also show that there is reasonable assurance of obtaining funds for permanent shutdown and maintenance of this facility.

Estimated Annual Costs

The estimated annual cost of operating the VPI&SU Nuclear Reactor Laboratory is given in the following table. These costs are for fiscal year 1983.

Director (half-time)	27,000	
Reactor Supervisor	21,700	
Senior Reactor Operator (half-time)	8,600	
Secretary (half-time)	4,500	
Total Salaries		$61,800
Equipment and Expenses	18,000	
Total Cost		$79,800

No fringe benefits are included in the above compilations. The ten year operating costs of operating the reactor (in 1983 dollars), is estimated to be 1.03 million dollars at a 4% rate of inflation. The estimated annual budget of the Nuclear Reactor Laboratory is $80,000 and therefore shows the ability to upkeep the laboratory in at least its present state for the license period. Also in the event of a severe abnormal financial situation the entire resources of the University are available to rectify the situation.

Estimated Cost of Permanent Shutdown

The estimates below are based upon the following major assumptions:

(1) The moth-ball option will be chosen initially

(2) Moth-balling will include fuel removal and disposition, removal and decontamination of piping and process equipment external to the core, leveling the shield tank to the top of the reactor and providing cover for the same, general decontamination and decontamination and removal of auxiliary facilities such as the Rabbit system and exhaust ventilation system.

(3) The moth-balling can be accomplished in 18 months with a 6-man VPI&SU labor force including health-physics surveillance

(4) The core contents (except for fuel removal) will remain undisturbed for an additional 18 month period (minimum). The reactor room will remain a controlled radiation area under a possession-only license and health-physics surveillance, security, maintenance, and demolition planning will continue through this 18 month interval with a two-man labor force.

(5) Core removal and demolition will commence no sooner than three years after the last reactor run. The cost of this last phase has been estimated by Rockwell International Corporation for the UCLA reactor (refer to UCLA application for class 104 license dated February 1980, the UCLA facility to similar to the VPI&SU reactor).

None of the foregoing should be regarded as a scheduling commitment by VPI&SU. The plan is partially designed to retain a force of experienced radiation workers for a period plausible for fuel removal and shipment. Other arrangements are possible and might be employed; in particular, the high demolition cost vs. the low annual maintenance costs suggest that the reactor room be used indefinitely as a controlled radiation area, housing instructional and experimental facilities appropriate to such an area (sigma piles and subcritical assemblies). In any event VPI&SU has established a ten year project of revenues for the reactor facility which initiated a sinking fund account that will be used, in the eventual decommissioning of this facility. This project of revenues has been designed to place approximately 65% of the annual revenues generated by the Nuclear reactor laboratory into the decommissioning sinking fund. In the ten year life of this project the sinking fund would accumulate approximately, $400,000.00 toward decommissioning, having the balance of the cost made up from University assets.

The costs associated with each phase of the hypothetical shutdown are as follows:

<u>Moth-ball option</u> (in 1983 dollars)

Shipment of 24 irradiated fuel bundles @ $1300 per bundle	$ 31,200
Other shipping costs*	26,000
9 man years @ $33,280/man year	299,520
Miscellaneous supplies and expenses	6,500
Coordination and Administration @ 15% of the direct cost	54,483
Total Moth balling cost	$417,703

<u>Ultimate Demolition</u> (1983 dollars)

Dismantling of Core	$400,400
(Refer to UCLA Application for Class 104 license dated February 1980)	
Add: Demolition planning and supervision, and health physics surveillance, 3 man years	124,108
Total cost of Demolition phase	$524,508

<u>Shutdown (Moth-ball) maintenance costs</u>

One man-year equivalent per year for maintenance of a controlled area (radiation monitoring, key control, maintenance) per year	46,020

In summary, the cost of maintaining an operating facility is $80,000/year, the moth-ball option will cost $417,703 initially plus $46,020/year after 18 months for controlled area up-keep, and finally the cost of a total decommissioning will be $942,211 at the end of 3 years. All of the forecast figures are for 1983 dollars (current salary cost, etc.) and no attempt has been made to introduce adjustments for future inflation. Costs were based on 1980 figures and on average inflation rate of 9% was used over the 3 year period.

List of all NRC licenses on VPI&SU Campus

License No. 45-09475-30
expiration date: 6/30/87 Amendment #09
Description of license:
Any by-product material with atomic numbers between 3 and 83 inclusive. Included in the license are specific amounts and degraded uses for certain byproduct materials as well as conditions for container leak testing and transportation.

License No. SUB-790 Doc. #080-06586
expiration date 10/31/88, Amendment #02
Description of license:
Natural Uranium Only, not to exceed 30 kg for storage only in Room 10 Robeson Hall (Reactor Room)

License No. SUD-120 Doc. #040-02833
expiration date: 3/31/87, Amendment #02
Description of license:
Natural uranium and thorium. The uranium to be used in subcritical or neutron spectrum experiments. The thorium is storage only

License No. SNM-1309 Doc. #070-01335
expiration date: 12/31/87 Amendment #02
Description of license:
Uranium 235, less than 100 mg for tracer studies

License No. SNM-138 Doc. #070-00137
expiration date: 11/30/84, Amendment #02
Description of license:
SNM foils, fission chambers and sources to be used for teaching and training students contains conditions for testing scaled sources.

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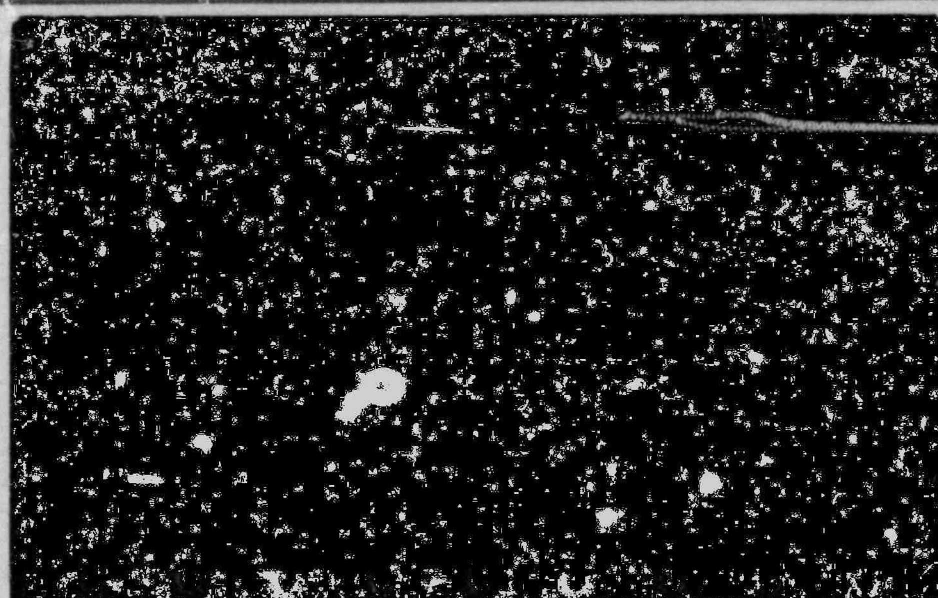

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