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Re: Annual Report for License R-52, Docket 50-113

This is our Annual Report covering the period July 1, 2007, through June 30, 2008, for the activities of the TRIGA Mark I Reactor at the University of Arizona, Tucson, Arizona. This report is submitted in compliance with Section 6.7e of the Facility Technical Specifications and Section 50.59 of Title 10, Code of Federal Regulations.

1. During the reporting period, we operated our reactor for education and for neutron activation analysis under contract with the Lawrence Livermore National Laboratory. We continued using the extended pneumatic transfer system, the "Rabbit," to deposit irradiated samples down into a storage pit equipped with an ion chamber for measuring dose rate and decay. The extended rabbit, first mentioned in last year's report, automatically ejects an irradiated sample capsule immediately after a reactor pulse. During operation of our extended rabbit system we became perplexed when some samples failed to eject. The system had performed reliably for almost a year. During the September to December 2007 time frame rabbit capsules often would not eject and the capsules remained somewhere within the metal tubing of the rabbit system. This required a reactor shutdown and using a 'snake' to extricate the sample capsule. We thoroughly examined the pneumatic supply system. The pump, air filter, and hose connections were clean and functioning properly. There was sufficient air volume. During continued troubleshooting we discovered one of the four solenoid operated air valves within the pneumatic system was slow to move to a new position. We oiled the moving valve parts with household '3-in-1 Oil.' This resolved the problem. The system has operated reliably since January 2008.

We calibrated the power channel by the calorimetric method. We found our settings read 2¼% high. We measured the worths of the Regulating, Shim, and Transient control rods finding them to be \$4.03, \$3.09, and \$2.46, respectively. The largest change in worth was 2¾ % of total worth on the Regulating control rod.

Our maximum reactivity insertion rates were \$0.17/sec, \$0.10/sec, and \$0.17/sec for the Regulating, Shim, and Transient rods, respectively. All three insertion rates met the facility technical specification requirements.

We measured the rod drop times from full out to full insertion to be 0.35, 0.39, and 0.81 seconds for the Regulating, Shim, and Transient rods, respectively. The Regulating rod fell 6% slower, the Shim rod fell 11% slower this year; the Transient rod 15% faster. All three rod drop times met the facility technical specifications requirements.

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We inspected the three control rods in May 2008 finding no differences from the previous inspection. We twice inspected the Transient control rod drive assembly during the reporting period. Both piston seals were found in satisfactory condition with no wear or rust accumulation present in the air cylinder.

Per existing procedures we calibrated the area radiation monitors, the pool activity monitor, and the pool conductivity meter during the reporting period.

2. The reactor was critical for a total of 71.6 hours, producing 1,702.5 kW-hours (0.071MW-days) of thermal energy. Our cumulative energy output since the facility was commissioned is 10.083 MW-days.

We performed 94 pulses or reactivity insertions greater than $1.00 during this reporting period. We have performed 2,468 pulses since 1958. Our five-year inspection and measurement of all fuel rods was not due during this period.

The reactor was in operation 65 days during the reporting period, with 92.7 hours of operating time, as recorded by the console clock.

3. We recorded an inadvertent reactor SCRAM on July 16, 2007. The operator manually increased reactor power, with an eight to ten second period, towards 90 kW with the <u>%-Demand Flux Control</u> positioned at 95%. After the power rose above 90 kW the operator placed the <u>Mode Selector</u> switch to AUTOMATIC. The operator heard the automatic control mechanism lower the Regulating Rod, as the linear power indication (red pen) commenced leveling off just below 95 kW, as expected. The operator planned to incrementally bump the reactor up to 100 kW from 95 kW by making small manual Regulating Rod withdrawals. With the reactor power indicating 95 kW, the operator returned the <u>Mode Selector</u> to MANUAL and momentarily tapped the Regulating Rod UP (withdrawal) button. The reactor SCRAM'd with the right <u>% PWR</u> lamp illuminated. All three events—switching to MANUAL, nudging the Reg rod UP, and the reactor SCRAM—happened rapidly, within a second or two. The operator secured the reactor and notified the laboratory director. The subsequent investigation revealed the chart recorder's green (logarithmic power) pen blocked the red (linear power) pen from sliding past and reading the actual reactor power above 95 kW. Interference between the red and green pens caused the unreliable linear power indication above 95 kW on July 16 which led to the reactor SCRAM. The cause of this incident and remedial action were reviewed by the Reactor Committee. No reoccurrence of the fault has occurred.

There was one item of interest during this reporting period.

A. For two decades our pool water conductivity remained below 3.0 $^{\mu mhos}/_{cm}$. In May the conductivity rose above 3.0 and running the filtration system continuously would not bring the conductivity back under 3 $^{\mu mhos}/_{cm}$. We remain within our Tech Spec requirements. However, our ion exchange resins are slowly failing, and we envision replacing them during the next academic year.

4. Major maintenance included:

A. On November 8, 2007, we replaced the filter cartridges in the pool water circulation system. Pumping efficiency slowly fell over the past year to just above four gallons per minute. With the University's Radiation Control Office we scheduled this maintenance for a comfortable fall morning. The filter replacement went routinely. The filters were indeed packed with bug residue and goo. We collected the filters and 1800 ml of pool water within plastic buckets allowing the moisture to evaporate into the environment over the next 45 days. We disposed of the dried filters through our Radiation Control Office. After filter cartridge replacement the circulation flow rate was 12+ gallons per minute which we throttled back to 9 gpm. We disassembled, inspected, reassembled, and oiled the air transport portion of the pneumatic transfer system to include the pump and motor, air filter, plenum, and solenoid valves previously documented above.

5. The Reactor Committee met four times during the reporting period: August 30 and December 10 in 2007, and March 11 and May 8 in 2007.

At its meetings and in individual reviews by Committee members, the Committee reviewed operations and operational records of the facility as specified by the Committee charter. This included audit of preliminary check sheets, pulsing check sheets, approach to critical and termination check sheets, operations and maintenance log books, monthly and annual check sheets, irradiation records, and experiments performed with the reactor.

The reactor committee approved five modified administrative and operational procedures. There were no changes to our facility that required 10CFR50.59 review.

6. We discharged no liquid or solid waste from the facility during the reporting period. We transferred two bags of dry, solid waste with only background radioactivity to technicians from the University's Radiation Control Office for final disposal. We, additionally, conveyed two 55-gallon drums of reactor waste--mildly radioactive irradiation products, experimental hardware, reactor facilities replaced decades ago, and sealed calibration sources--to RCO. In a lined cask we handed over roughly 10 Curies of cobalt sources no longer used at our facility.

Measurements of the Argon-41 concentration in the reactor pool water have demonstrated that the maximum rate of release of Argon-41 from reactor pool water is less than 0.74 μCi per kilowatt-hr of reactor operation. The pneumatic transfer system produces approximately 0.05 μCi of Argon-41 per kW-min of reactor operation, some of which is released when the system is operated. Presented below are the calculations of the maximum semiannual releases of Argon-41 from the reactor pool surface, the pneumatic transfer system, and the totals.

Period	Argon-41 from Pool Surface (µCi)	Argon-41 from Pneumatic Transfer System (µCi)	Argon-41 Total (µCi)
July to December 2007	775.6	448.3	1223.9
January to June 2008	265.8	259.8	525.6
TOTAL	1041.4	708.1	1749.5

The calculations for Argon-41 release from the pneumatic transfer system include no decay of the isotope prior to release and, therefore, over-estimate our Argon-41 release. The maximum total estimated Argon-41 release from the facility during the reporting period is 1.8 milliCuries. There were no other gaseous effluents from the facility during the reporting period.

7. Five (5) persons were issued film badges on a monthly basis for all or part of the reporting period in the Nuclear Reactor Laboratory. The persons receiving badges included all reactor operators and staff members and student employees using the reactor laboratory. The most an individual received was a 30-milliREM shallow dose equivalent exposure.

We admitted 108 non-badged persons to the Reactor Laboratory for tours, inspections, maintenance, or other official business during the twelve-month reporting period. Pocket dosimeters issued to all visitors indicated that no exposure was received.

The University's Radiation control Office conducted monthly direct measurement and wipe radiation surveys of the reactor room, control room, and experiment set-up room. The results show little detectable activity except where expected (i.e., irradiated samples in storage areas and internal wall surfaces of the irradiation facilities). Members of the reactor laboratory staff performed other radiation surveys when necessary. No radiation exposure attributable to reactor operations was detected outside the reactor laboratory.

8. Three environmental TLD monitors on the roof of the Engineering Building and ten environmental TLD monitor sites on the roofs of ten buildings provide a radio-dosimetry perimeter around the Engineering Building where the UARR is located. Two control TLD monitors are maintained in the Radiation Control Office to give a campus background. For calendar year 2007-the period for which RCO data exists-the dose rate, after subtraction of the average background reading for 12 of these 13 TLDs were zero mR/yr. The TLD atop the Art Building read 3.5 mR/yr. We attribute this higher reading to building materials. It remains consistent with the elevated radiation doses found in prior years at this location.

We continue to see that radiation exposures in the vicinity of the reactor remain normal. Eight TLD monitors were placed at the periphery of the restricted area, and two TLD monitors were placed in an office area far removed from the restricted area to provide a baseline reference for the Engineering Building background. The exposures recorded by TLDs on the periphery of the NRL ranged from 3 mR/yr to 97 mR/yr. The areas where monitors exceeded 100 mR/yr were surveyed using a calibrated ion chamber quarterly by the Radiation Control Office with the reactor operating at 100 kW. Our Radiation Control Office detected no radiation levels exceeding background level (<0.01 mR/hr).

Two background monitors are in Room 111 of the Engineering Building. The minimum detectable dose for these monitors is 1.0 mREM/qtr for photon radiation. Area monitors are placed in and around the Reactor Room to monitor the beta dose.

Environmental TLD monitors at three locations on the roof of the Engineering Building showed no radiation level exceeding background (0.01 mR/hr.). Additionally these areas are not continuously occupied, and instrument dose rates demonstrate exposure rates to be <0.01 mR/hr.

10CFR20.1301 mandates the total effective dose to the public must not exceed 100 milliREM/year or 2.0 mR/hr. With the reactor operating at maximum power (100kW), all instruments read under 0.01 mR/hr. To estimate the radiation dose from external and internal radiation sources, the highest environmental monitor reading is summed with the ^{41}Ar estimated dose and multiplied by an occupancy factor (0.25). The dose in Room 124A, the middle of the North wall, adjacent to the secured electrical transformer enclosure is 97 mR/year. Our COMPLY Code estimated dose 0.20 mR/year. These are summed and multiplied by the occupancy factor (0.25) to yield an estimate dose to the public of 24.3 mREM/year. This meets the requirements as stated above.

In writing this report, I have tried to be both complete and as brief as is reasonable, and still satisfy the requirements of 10CFR50.59, our Technical Specifications, and the needs of the Commission. If other or more detailed information is needed, please contact me at your convenience.

Sincerely,

John G. Williams, Director
Nuclear Reactor Laboratory

cc:
Mr. John Nguyen, U.S. Nuclear Regulatory Commission
Dr. Leslie Tolbert, Vice President for Research, University of Arizona
Dr. Michael Cusanovich, Director Arizona Research Laboratories