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February 4, 1999
**Docket No. 50-151**

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-137
Washington, DC 20555

Dear Sir,

SUBJECT: ANNUAL REPORT: Illinois Advanced TRIGA Reactor
License No. R-115 / Docket No. 50-151

The following is written to comply with the requirements of section 6.7.f of the Technical Specifications and the conditions of 10CFR50.59. The outline of the report follows the numbered sequence of section 6.7.f of the Technical Specifications.

Sincerely,

Richard L. Holm
Reactor Administrator

c: Regional Administrator, Region III, USNRC
Nuclear Reactor Committee
American Nuclear Insurers
File

IE47

STATE OF ILLINOIS

COUNTY OF CHAMPAIGN

Richard L. Holm, being first duly sworn on oath, deposes and says that he has affixed his signature to the letter above in his official capacity as Reactor Administrator, University of Illinois Nuclear Reactor Laboratory; that in accordance with the provisions of Part 50, Chapter 1, Title 10 of the Code of Federal Regulations, he is attaching this affidavit; that the facts set forth in the within letter are true to his best information and belief.

Richard L. Holm
Reactor Administrator

Subscribed and sworn to before me, a Notary Public, in and for the County of Champaign, State of Illinois, this 1st day of March, A.D., 1999.

Notary Public of Illinois

8-19-2000
My Commission Expires

OFFICIAL SEAL
KATHLEEN M. DYSART
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 8-19-2000

ANNUAL REPORT
JANUARY 1, 1998-DECEMBER 31,1998
ILLINOIS ADVANCED TRIGA
FACILITY LICENSE R-115

# I. SUMMARY OF OPERATING EXPERIENCE

## A. Summary of Usage

During 1998 the reactor was operated an average of 4.9 hours per week during the period of January 1 to August 6, 1998. Operations consisted of normal irradiations and training. The reactor permanently shutdown on August 7, 1998. The remainder of 1998 was spent preparing the facility for a SAFSTOR status due to the inability to ship fuel.

| CATEGORY | PERCENT OF OPERATION |
|---|---|
| Research Projects | 8.0% |
| Irradiations | 60.7% |
| Education & Training | 12.8% |
| Maintenance & Measurements | 18.5% |

During 1998 there were four individuals with a Senior Operator License. The facility operated with a 40 hour week schedule, a staff of 3.5 full time equivalent individuals of which one is a full time reactor health physicist.

## B. Performance Characteristics

### 1. Fuel Element Length and Diameter Measurements

These checks were made on the B and C rings during the month of January. The pulse number at the time of the checks was 11,436. For the eighteen elements in these rings, there was an average increase in the length of about 18.5 mils over the original installed measurements. The accuracy of a given measurement is estimated at ±5 mils. There was no measurable change in the diameter of the fuel elements checked. During the months of October and November all of the elements in the core were measured as fuel was moved to the Bulk Shielding Facility for storage. There was an average increasein the length of about 6.9 mils over the original installed measurements. There was no measurable change in the diameter of the fuel elements checked.

There were 40 pulses in 1998, bringing the total since 1969 to 11,477. For a standard $3.00 pulse, the values for pulse height, reactor period and fuel temperature were consistent with those measured in previous years.

### 2. Reactivity

Control Rods: The measured reactivity values have not changed significantly due to fuel insertions and movements. The relative worth of each rod has maintained approximately the same as previous values.

Core Reactivity: The net loss of reactivity attributed to fuel burnup during the year was $0.20. This value was determined by a comparison of the cold critical xenon-free control rod position at the beginning and at the end of the year and correcting for core reactivity gained by the addition and movement of fuel during the year. A certain inaccuracy is inserted here in that the rod worth calibrations are performed in April and October. As the period since the calibration has been performed lengthens, the inaccuracy obviously increases.

## II. TABULATION OF ENERGY AND PULSING

A. Hours Critical* - Energy - Pulsing

Hours Critical = 142
Energy (MW-hrs) = 79
# of Pulses = 40

*Because of the type of operation, the Hours Critical time includes the time during continuous pulsed operation between pulses when the reactor is not critical in the normal sense.

## III. REACTOR SCRAMS

There were 58 unplanned scrams and no emergency shutdowns during this time period. These scrams were all attributed to Instrument Malfunction (58) This is down from 1997 due to less frequent operation of the reactor. All of these scrams are due to problems with the General Atomics digital control console.

***Instrument Malfunction (58)***

CSC/DAC Watchdog Scram (52) : This scram is required by the Technical Specifications. These scrams occurred due to the Control System Console screen locking up and thus causing the watchdog circuit to time out and initiate a scram. The initiation of this scram has various manifestations with little pattern to assist troubleshooting. Various methods have been tried to reduce the frequency of these scrams with little success.

Database Time-out (6): This scram is not required by Technical Specifications. This scram occurs if for some reason the CSC computer cannot talk to its database. This scram usually occurs in conjunction with a CSC/DAC watchdog scram.

## IV. MAINTENANCE

It is estimated that about 400 hours were spent on maintenance related activities. These hours account for time spent carrying out repairs and scheduled surveillance activities. The significant items of maintenance are given below.

NM-1000 Troubleshooting: The NM-1000 has a considerable amount of noise in the output that various methods have been tried to correct with little success.

Console Lockup Troubleshooting: The control console locks up with great regularity causing reactor scrams. Troubleshooting continues in this area but is hobbled by the design of the system and availability of support.

## V. CONDITIONS UNDER SECTION 50.59 OF 10CFR50

In 1998 two analysis were performed under the auspices of a 50.59 review.

SAFSTOR Spent Fuel Storage – This evaluation was in support of rearranging the fuel racks in the Bulk Shielding Facility in support of defueling the reactor for SAFSTOR.

Labtech Computer Control System Inputs – These 50.59 reviews were in support of providing instrumentation to the Labtech control system to monitor the facility during the SAFSTOR period. Signal inputs required were tank level detectors, continuous air monitor, water temperature, intrusion alarm status, area radiation monitors, retention tank alarm, tunnel and vault sump alarms and multiple conductivity inputs.

## VI. RELEASE OF RADIOACTIVE MATERIAL

A. Gaseous Effluents

1) $^{41}Ar$

a. The average concentration released via the Exhaust Stack was **1.3 $E^{-8}$ μCi/ml**.
b. The total activity released was **736 mCi** or **0.74 Ci**.
c. The monthly range of activity released was **17** to **244 mCi**.

2) $^{3}H$

The estimated release of $^{3}H$ (Tritium) to the Reactor Building atmosphere (and consequently out the Exhaust Stack) from the evaporation of water in the Primary Tank (PT) and the Bulk Shielding Tank (BST) was **420 μCi**. This was based on the measure of the activity of $^{3}H$ in the Primary Tank (BST makeup water is supplied from the Primary Tank) multiplied by the total volume of makeup water additions since the tanks were last sampled (yearly) calculated as follows: concentration of the Primary Tank (2.2 $E^{-5}$ μCi/ml) multiplied by the evaporative loss volume (1.91 $E^{7}$ ml) equals
420 μCi. The Average Concentration released via the Exhaust Stack is calculated as follows: assume an average stack flow of 1200 fpm * 2 $ft^2$ = 2400 $ft^3$/ min * 2.83 $E^4$ ml/$ft^3$ = 6.792 $E^7$ ml/min * 5.256 $E^5$ min/yr = 3.57 $E^{13}$ ml/yr. Then, 420 μCi estimated release divided by 3.57 $E^{13}$ ml = 1.2 $E^{-11}$ μCi/ml Average Concentration.

3) Summary of Gaseous Effluents Released

A Summary of all gaseous effluents for 1998 (Sections 1+2 above) is shown in the following table, which includes for each isotope; the total activity released, the average concentration, the 10 CFR 20, Appendix B, Table 2 limit, and the fraction of the limit released. The sum of the fractions for all isotopes released is listed at the end of the table.

| Isotope | Total Ci | Ave Conc. (μCi/ml) | App. B Table 2 limit | Ave. Conc. / limit |
|---|---|---|---|---|
| $^{41}$Ar | 0.74 | 1.3 E$^{-8}$ | 2.0 E$^{-6}$ * | 0.0065 |
| $^{3}$H | 0.42 E$^{-3}$ | 1.2 E$^{-11}$ | 4.0 E$^{-8}$ | 0.0003 |
| | | | **Sum =** | **0.0068 < 1.0** |

*** Ar-41 Concentration Limit is specified by the facility Technical Specifications.**

B. Liquid Effluent

1) Waste Water discharged to the municipal sanitary sewer system

Waste Water is collected in the Reactor Building Retention Tank. When the Tank becomes full it is pumped over to a Holdup Tank. The water passes through a coarse and a fine filter assembly on route to the Holdup Tank where it is then sampled. The water is discharged from the Holdup Tank into the municipal sanitary sewer system when the soluble activity results are satisfactory and it is verified that no insoluble activity is present. If insoluble activity is detected before the discharge then the contents of the Holdup Tank can be recirculated through a 0.4 micron process filter until the insoluble activity has been removed and it is verified that no insoluble activity is present.

The Average Concentration of all soluble beta-gamma activity released in 1998 was **4.3 E$^{-8}$ μCi/ml**. This is well below the 10 CFR 20, App. B, Table 3, "Releases to Sewers" limit of 9.0 E$^{-6}$ μCi/ml for the most restrictive isotope not known to be absent, $^{134}$Cs. The Average Concentration $^{3}$H released concurrently with the above was **3.9 E$^{-6}$ μCi/ml**. This is well below the 10 CFR 20 "release to sewer" limit of 1.0 E$^{-2}$ μCi/ml for $^{3}$H.

## VII. ENVIRONMENTAL SURVEYS

Continuous Radiation Monitoring utilizing Thermoluminescent Dosimeters (TLDs) supplied by a vendor (Landauer, Inc.) was conducted at the Site Boundary and in the surrounding Environs.

A. Site Boundary

The site boundary is established at the Reactor Building Walls with extensions at the fence around the Cooling Towers and the perimeter of the roof over the Mechanical Equipment Room. This is also defined as the boundary between the Restricted and Unrestricted Areas. The **average annual dose** at this perimeter was **126 mRem** with a range of **60 mRem to 270 mRem**. However, pursuant to 10 CFR 20.1302 (b) (1) an Annual Site Boundary Dose Calculation for Members of the Public, based on Occupancy Time, was performed. The highest calculated dose at the site boundary for 1998 was **0.8 mRem for the Year.** These calculations are maintained and updated in the files of the Reactor Health Physicist.

B. Surrounding Environs

The Environs and University Owned Buildings in near proximity to the Reactor Building were monitored. The **average dose** recorded was **30 mRem** with many locations equal to or less than the Lower Limit of Detection (LLD = 10 mRem/Quarter). The **highest location** reading for 1998 was **80 mRem** for the year.

## VIII. PERSONNEL RADIATION EXPOSURE AND SURVEYS WITHIN THE FACILITY

### A. Personnel Exposure

#### 1) Whole Body

A total of 2 individuals who were assigned Film Badges at the facility received a measurable Whole Body exposure (LLD = 10 mRem/month). There were 3 full time employees working 40 hours/week, and 1 student working 20 hours/week. All others averaged less than 20 hours/week in the facility. The badges are read by Landauer, Inc.; a National Voluntary Laboratory Accreditation Program (NVLAP) accredited Dosimetry Vendor. The tables and explanations below outline the Whole Body Dose received by the 2 individuals who received a measurable exposure.

| Whole Body Exposure (mRem) | Number of Individuals |
|---|---|
| 10 to 100 | 2 |
| > 100 to 250 | 0 |
| > 250 | 0 |
| Total | 2 |

ManRem Total: **0.060** Average: 30 mRem

Summary: The highest individual Whole Body Exposure was 50 mRem. This exposure was received by the Reactor Health Physicist. All of this exposure was received as a result of handling: radioisotopes and preparing them for shipment, radwaste, and/or experimental devices.

#### 2) Extremity Exposure

A total of **4** individuals who were assigned Finger Rings at the facility received a measurable Extremity Exposure (LLD = 10 mRem/month).

ManRem Total: **0.440** Average : 0.110

#### 3) Skin Dose

There were no significant deviations between the Shallow Dose and Deep Dose reported by the vendor for any personnel.

#### 4) Internal Exposure

There were no incidents or events that required investigation or assessment of internal exposure. Contamination levels are acceptably low and areas few (see B. below). There were no evolutions performed or events that occurred which caused, or could have caused, the presence of Airborne Radioactivity.

5) Visitor Exposures

All recorded exposures for Visitors were 0 mRem by Electronic Pocket Dosimeter (EPD).

B. Contamination Surveys

Smear surveys from various locations around the laboratory were taken Routinely; weekly, monthly, and quarterly as appropriate to the area of concern; and Specifically; to assess experimental devices, tools and equipment, potentially contaminated areas, or to evaluate adverse trends. The removable contamination was determined by counting the smears on an Eberline BC-4 Beta Counter, RM-14/HP-210T, and/or a SAC-4 Scintillation Alpha Counter.

The maximum gross Beta/Gamma Contamination was usually found in the two posted contamination areas where irradiated sample containers are handled. There were **593** samples irradiated and handled during the year. In the sample unloading bin (1.5 $ft^2$) the average removable activity was 4K dpm/100 $cm^2$ with a high of 13K dpm/100 $cm^2$. In the sample preparation area (5 $ft^2$) the average removable activity was 1,700 dpm/100 $cm^2$ with a high of 13K dpm/100 $cm^2$. The balance of the posted contamination area, the reactor bridge (11.5 $ft^2$), had average removable activity of 134 dpm/100 $cm^2$. Smears from other areas of the laboratory, within the restricted area; and the Control Room and other clean areas, outside the restricted area; were less than or equal to a Minimum Detectable Activity (MDA) of 84 dpm/100 $cm^2$.

Routine surveys for Alpha Contamination were all less than or equal to a MDA of 15 dpm/100 $cm^2$.

Total contaminated surface area = 18 $ft^2$

## IX. NUCLEAR REACTOR COMMITTEE

Dr. David Miller (Illinois Power Company and Adjunct Assistant Professor of Nuclear Engineering) continued as Chairman of the Nuclear Reactor Committee for the 1998-1999 Academic Year. The following members remained on the Committee: Mr. Daniel Hang (Professor Emeritus of Nuclear Engineering), Dr. Brent Heuser (Assistant Professor of Nuclear Engineering), Dr. Erik Wiener (Assistant Professor of Nuclear Engineering), Mr. David Scherer (Campus Radiation Safety Officer), Mr. Rich Holm (Reactor Administrator), and Mr. Mark Kaczor (Reactor Health Physicist and ex-officio member).

The committee held 5 meetings during the calendar year. Major topics reviewed were: a) Reactor Operations, Surveillances, and Health Physics Procedures and Activities; b) NRC Annual Report, Inspection Report, and a Procedural/Technical Specification Violation; c) 50.59 Reviews for a variety of activities related to placing the Facility in a SAFSTOR Condition; and d) Reports on - Reactor Committee Audit of Operations and Annual Review of the Radiation Protection and ALARA Programs, the Emergency Plan Exercise Critique, and Operations Quarterly Reports.