August 30, 2007

Mr. Paul M. Whaley, Manager
KSU Nuclear Reactor Facility
Department of Mechanical and
Nuclear Engineering
112 Ward Hall
Kansas State University
Manhattan, KS 66506-5204

SUBJECT: NRC ROUTINE INSPECTION REPORT NO. 50-188/2007-202

Dear Mr. Whaley:

This letter refers to the inspection conducted on August 21 through 23, 2007, at your Nuclear Reactor Facility. The inspection included a review of activities authorized for your facility. The enclosed report presents the results of that inspection.

Areas examined during the inspection are identified in the report. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations of activities in progress. Based on the results of this inspection, no safety concerns or noncompliance with NRC requirements were identified. However, one un-resolved item was identified which will be revisited in a future inspection. No response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Should you have any questions concerning this inspection, please contact Marcus H. Voth at 301-415-1210.

Sincerely,

/RA/

Johnny Eads, Branch Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-188
License No. R-88

Enclosure: NRC Inspection Report No. 50-188/2007-202
cc w/enclosure: See next page

cc:

Office of the Governor
State of Kansas
Topeka, KS 66612

Mayor of Manhattan
P.O. Box 748
Manhattan, KS 66502

Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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U. S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

Docket No: 50-188

License No: R-88

Report No: 50-188/2007-202

Licensee: Kansas State University

Facility: TRIGA Mark II

Location: Manhattan, Kansas

Dates: August 21-23, 2007

Inspector: Marcus H. Voth

Approved by: Johnny Eads, Branch Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

EXECUTIVE SUMMARY

Kansas State University TRIGA Mark II
NRC Inspection Report No.: 50-188/2007-202

The primary focus of this routine, announced inspection was the on-site review of selected aspects and activities since the last NRC inspection of the licensee's Class II non-power reactor safety programs including: organization and staffing; logs and records of operations; procedures; experiments; health physics; design changes; committees, audits and reviews; maintenance logs and records; transportation; and follow-up on an issue from a previous inspection.

The licensee's programs were acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements.

Organization and Staffing

- The organization and staffing were consistent with Technical Specification requirements.

Operations Logs and Records

- The operating logs and records were being maintained in accordance with applicable requirements.

Procedures

- The licensee was effectively meeting the Technical Specification requirement for preparation and approval of written instructions.

Experiments

- Experiments were reviewed in accordance with Technical Specification requirements. The licensee had terminated demonstrations of operating electrical equipment in low conductivity water except under special conditions.

Health Physics

- The licensee conducted routine reactor operations and special maintenance with low exposures to personnel. Solid and liquid waste disposal processes were found acceptable except for one unresolved item regarding license provisions for reactor waste in the campus waste storage facility.

Design Changes

- The licensee demonstrated that facility changes were being effectively processed pursuant to regulations.

Committees, Audits and Reviews

- The review and audit responsibilities of the Reactor Safeguards Committee were being executed pursuant to Technical Specification requirements.

Maintenance Logs and Records

- The licensee demonstrated the ability to perform integrated outage maintenance work in a safe and ALARA manner.

Transportation

- The licensee occasionally transported radioactive material under the R-88 reactor license but had not done so in recent years.

Follow-up on Previously Identified Issues

- Inspector follow–up item 50-188/2007-201-02 was discussed but left open pending action by the Radiation Safeguards Committee.

REPORT DETAILS

Summary of Plant Status

The licensee's 250 kilowatt (kW) Training Research Isotope Production General Atomics (TRIGA) Mark II research reactor has been operated in support of educational demonstrations, experiments, reactor operator training, and periodic equipment surveillance. During the inspection the reactor was operated in support of this mission.

The findings of this routine, announced inspection are documented using the traditional topical inspection areas identified below. However, the licensee had performed major cross-discipline maintenance activities during the annual spring break. Specifically, the rotary specimen rack (RSR) was removed, a fourth control rod was installed, and holes for an in-core instrumentation experiment were restored. The findings for each of these projects may therefore be addressed in more than one section of this report.

1. Organization and Staffing

a. Inspection Scope (Inspection Procedure [IP] 69001)

The inspector reviewed the following to verify compliance with the staffing requirements in Technical Specifications (TS) Section H, Administrative Requirements:

- Kansas State University (KSU) TRIGA Mark II (KSUTMII) reactor organizational structure and staffing
- management and staff responsibilities and qualifications
- staffing requirements for the safe operation of the facility
- Reactor Console Logbooks covering operations from December 9, 2006 through August 21, 2007
- KSUTMII Operations Manual, Rev. February 2003
- KSUTMII Reactor Administrative Plan, approved by the Reactor Safeguards Committee (RSC) January 31, 2001

b. Observations and Findings

The KSUTMII organizational structure and the responsibilities of the reactor management and staff had not changed since the last inspection (see NRC Inspection Report No. 50-188/2007-201). The Reactor Manager (RM), who also held a Senior Reactor Operator License (SRO), directed the day-to-day operation of the facility. Reporting to the RM were seven student operators, four who held SRO licenses and three who held Reactor Operator (RO) licenses. TS H.2.5 required that an SRO be designated as Reactor Supervisor (RS). The reactor console logbook clearly identified the individual designated RS at all times. Likewise, the individual operating the reactor, if not the RS, was designated in the logbook.

c. Conclusion

The organization and staffing were consistent with TS requirements.

2. Operations Logs and Records

a. Inspection Scope (IP 69001)

The inspector reviewed the following to verify that operations were being conducted in accordance with regulatory and license requirements:

- Reactor Console Logbooks covering operations from December 9, 2006 through August 21, 2007
- KSUTMII Operations, Test and Maintenance Procedures, Revised June 22, 2006
- KSUTMII Experiment File
- Completed checklists and records of past operations

b. Observations and Findings

The inspector observed that reactor operations were conducted using a procedures manual consisting of 27 approved procedures. The logbook recorded the number of each operating procedure, maintenance procedure, or experiment that was performed. Console logbook entries were legible, complete, clear, and concise.

The reactor console logbook is used to record both operational and maintenance activities. Therefore, documentation of maintenance activities will be addressed in Section 8 of this report, Maintenance Logs and Records.

The spring break maintenance outage work required significant changes to the core such as fuel and control rod drive removal. Activities followed a specially prepared procedure which had prior Reactor Safeguards Committee (RSC) review and approval. Logbook entries documented pre-job briefings, individual fuel element movement, post-modification control rod worth measurements, and other significant activities to document the work being performed.

c. Conclusion

The operating logs and records were being maintained in accordance with applicable requirements.

3. Procedures

a. Inspection Scope (IP 69001)

The inspector reviewed the following to verify compliance requirements of TS H.1:

- KSUTMII Reactor Administrative Plan, approved by the Reactor Safeguards Committee (RSC) January 31, 2001
- KSUTMII Operations Manual, Rev. February 2003
- KSUTMII Operations, Test and Maintenance Procedures, Revised June 22, 2006
- KSUTMII Experiment File
- KSU Reactor Management Orders File
- Work and Test Plan for KSU Reactor Outage, Rev. 0, March 7, 2007

b. Observations and Findings

The licensee met the TS H.1 requirement for written instructions, approved by the RSC, with the above series of instructions. The administrative plan delineated roles, responsibility, and authority for the management hierarchy of the reactor. The operations manual expanded on roles and instruction in such matters as the planning and scheduling of experiments, operational practices such as visitor policies, operating limits, logbook entries, and use of checklists, safety, and security. The operation, test, and maintenance procedures consisted of the traditional procedures to operate and maintain the reactor, including the campus radiation safety manual. The procedures related to experiments, which is discussed is greater detail in Section 4 of this report, is a compendium of all procedures approved for use in the reactor. The reactor management orders addressed the processing of temporary orders, provided a compendium of standing orders, and recorded authorized shielding configurations.

In addition to the traditional standing procedures discussed in the previous paragraph, the inspector reviewed a special maintenance procedure prepared for the spring break outage, a one-time maintenance evolution. The evolution consisted of three integrated tasks; removal of the rotary specimen rack (RSR) from the reactor core and transfer to the bulk shield tank (BST); addition of a fourth control rod for a future rated power increase; and restoring the nominal sizing of holes in the grid plate to accept a fixture for performing in-core measurements. The 25-page work and test plan for this evolution provided a step-by-step procedure for critical aspects of the work along with a statement of applicable limitations, precautions, and pre-requisites. The RSC reviewed and approved the procedure, cognizant that much of work would be performed by student operators and should therefore address both their limited experience and the educational value of their involvement.

c. Conclusion

The licensee was effectively meeting the TS requirement for preparation and approval of written instructions.

4. Experiments

a. Inspection Scope (IP 69001)

The inspector reviewed the following to verify compliance with requirements in TS Section I. Experiments:

- KSUTMII Experiment File
- Form KSU TRIGA Mark II - 2 File, Requests for Operations Forms
- KSUTMII Byproduct Log
- Reactor Console Logbooks covering operations from December 9, 2006 through August 21, 2007
- Email from P. M. Whaley, Reactor Manager, to Reactor Operators, stating policy on hair dryer demonstration, August 23, 2007

b. Observations and Findings

The licensee maintained a file of experiments that had been reviewed and approved over the life of the facility. Along with this was the byproduct log, a compilation of the various substances irradiated and the anticipated byproducts. Experiments were initiated by submitting a request for operations form, generally requesting that samples be irradiated under a previously analyzed experiment authorization with anticipated activation products similar to those listed for the same substance in the byproduct log. The inspector reviewed the requests for operation forms for experiments performed since the previous inspection and found that they were complete. Section 10 of this report discusses a follow-up item from the previous inspection when this was not the case.

The inspector also reviewed a recent practice regarding a demonstration that had been performed by the licensee, submersing an operating electric hair dryer in the reactor tank to demonstrate the low conductivity of reactor water. The licensee had considered this a demonstration of safety; the fact that an electrical appliance could be safely operated in reactor water, contrary to the well-known danger of mixing electricity and ordinary water, demonstrated the high purity (low conductivity) of reactor water. The demonstration was not performed for young children and when done, was accompanied with words of caution. Upon hearing of the demonstration, the NRC had contacted the licensee in May of 2007 to express concern for the apparent disregard for electrical safety and the potential inferred perception of disregard for nuclear safety. The inspector verified that the licensee had terminated the practice of initiating this demonstration. In the event that a visitor who had previously seen the demonstration requested that it be repeated, the licensee did perform the demonstration but only after explaining the principle being demonstrated and the inherent dangers if ordinary water were involved; this was done on only two occasions since the policy was changed. The licensee's action to avoid even a potential perception of disregard for safety attested to the strong, positive safety culture that existed at the facility, a culture that the licensee wished to communicate as part of its educational mission.

c. Conclusion

Experiments were reviewed in accordance with TS requirements. The licensee had terminated demonstrations of operating electrical equipment in low conductivity water except under special conditions.

5. Health Physics

a. Inspection Scope (IP 69001)

The inspector reviewed the following to verify compliance with TS and regulatory requirements:

- Reactor Waste Disposal file
- Personnel Dosimetry Records from vendor for 2006 and 2007
- Monthly Reactor Radiation Surveys.

b. Observations and Findings

In the area of health physics the inspector focused attention in four specific areas; personnel exposure and in particular exposure during the spring break maintenance outage; monitoring of radiation levels in occupied reactor areas; solid radioactive waste disposal; and liquid radioactive effluents.

The inspector reviewed dosimetry records of reactor personnel for the years 2006 and 2007 to assess exposures received during routine operations and during special maintenance. Special attention was given to the doses received by student reactor operators. These were contrasted to those of the reactor manager (RM), the only full-time staff member who worked with and directed the work of operators. For 2006 the annual whole body dose of the RM was 61 millirem (mrem); the maximum student reactor operator dose was 112 mrem; and the range of other student operators was 13 to 66 mrem. For the month of March 2007, when outage maintenance was performed, the RM received 11 mrem, the maximum student operator exposure was 11 mrem, and the remaining operators ranged from the minimum level of detection (MLD) to 6 mrem. The RM's policy was to perform tasks involving a potential for exposure to extremities himself, rather than delegating those tasks to students, and he wore finger dosimetry to record extremity dose. For 2006 the RM's annual extremity dose (shallow dose equivalent) was 121 mrem; for the first quarter of 2007 it was 80 mrem. Based on these results the inspector considered the licensee's as-low-as-reasonably-achievable (ALARA) program and radiation protection practices to be very effective during both normal operation and special maintenance.

Reactor operators performed monthly radiation surveys of the reactor area. Twice per year the campus radiation safety officer (RSO) observed this procedure to assure that it was being performed properly. The inspector reviewed the data recorded during surveys since the previous inspection and found them to be appropriate.

Solid waste collected in the reactor building was segregated as either clean or potentially contaminated. Waste that was radioactive or contaminated with radioactive material was considered contaminated. Reactor operators frisked the clean waste and if any radiation was detected it was considered contaminated; if not, it was removed from the building and placed in a dumpster for disposal with other campus waste and shipped to a regional waste landfill. The volume of solid contaminated waste generated under the reactor license was so small that it required years to accumulate a reasonable sized shipment. Since a similar situation existed for radioactive waste generated throughout campus under the state broad byproduct license, the university had built a decay-in-storage radioactive waste storage building that was managed by the campus RSO. This allowed waste to be transferred from the numerous work areas on campus to a common, well-managed, low occupancy storage area. The inspector observed about 20 to 30 cubic feet of waste of reactor origin being stored in the waste storage building and noted that the reactor license did not identify the waste building as a location for material under the reactor license. While the state license allowed for the receipt of radioactive material, it prohibited the transfer of waste onto that license. This will be considered as an un-resolved item (URI) subject to follow-up action (50-188/2007-202-01).

In a similar manner to the solid waste segregation, liquid effluents from the reactor were segregated. Sources of liquid waste that were potentially radioactive or suspect of being radioactive were collected in a sump in the reactor building. Periodically the sump was sampled, the data logged, and the content released to the municipal sewer system. The reactor water had a low equilibrium level of tritium, a small amount of which could enter the sump and therefore be identified in releases, albeit in much lower concentrations than the release limit. The licensee had recently added a collection tank for condensate from the air conditioning, which was sampled and released rather than draining directly to the reactor building sump. The only radioactivity content of the condensate was a trace amount of tritium from water evaporated from the reactor tank. This change resulted in many fewer liquid discharges from the reactor building sump.

c. Conclusion

The licensee conducted routine reactor operations and special maintenance with low exposures to personnel. Solid and liquid waste disposal processes were found acceptable except for one unresolved item regarding license provisions for reactor waste in the campus waste storage facility.

6. Design Changes

a. Inspection Scope (IP 69001)

The inspector reviewed the following to verify with compliance regulatory and license requirements for facility changes:

- SOM-5, Configuration Management: Equipment Changes

- KSU Radiation Safeguards Committee Reactor Review Agenda, January 18, 2007
- KSU Radiation Safeguards Committee Meeting for Review of Proposed Outage Work, March 12, 2007
- KSU Radiation Safeguards Committee Semi-Annual Review Agenda, August 21, 2007

b. Observations and Findings

The licensee maintained a facility change process in the form of Standing Order SOM-5 referenced above. As part of this procedure proposed changes were screened pursuant to 10 CFR 50.59 to determine if they impacted a documented safety analysis such that they required further safety evaluation and if so, whether they required NRC approval prior to making the change. Nine such screening summaries were included with the agenda for an upcoming RSC Semi-Annual Review cited above, none of which required further evaluation. The inspector also reviewed the change package for the RSR removal process which was reviewed at a previous RSC meeting. Since the reactor was designed to be operated with or without the RSR in place, the focus of the change package was the actual removal procedure. The facility change procedure called for the licensee to report changes that could be implemented under 10 CFR 50.59 without prior NRC approval in a periodic report of changes at intervals not to exceed two years.

c. Conclusion

The licensee demonstrated that facility changes were being effectively processed pursuant to regulations.

7. Committees, Audits and Reviews

a. Inspection Scope (IP 69001)

The inspector reviewed the following to verify compliance with TS H.2 requirements for the RSC:

- Minutes of the January 25, 2007, RSC Meeting
- KSU Radiation Safeguards Committee Reactor Review Agenda, January 18, 2007
- KSU Radiation Safeguards Committee Meeting for Review of Proposed Outage Work, March 12, 2007
- KSU Radiation Safeguards Committee Semi-Annual Review Agenda, August 21, 2007

b. Observations and Findings

The inspector verified from minutes that the RSC conducted meetings at the required frequency with a quorum present, pursuant to TS requirements. A new member was recently appointed to the committee to fill a vacancy. The RM

provided complete reports with meeting agendas; summarizing the status of the facility providing an overview of operations; analyzing proposed facility changes under review; and reporting on the progress of previously approved procedures.

c. Conclusion

The review and audit responsibilities of the Reactor Safeguards Committee were being executed pursuant to TS requirements.

8. Maintenance Logs and Records

a. Inspection Scope (IP 69001)

The inspector reviewed the following to verify compliance the maintenance requirements of TS H.1.f:

- Reactor Console Logbooks covering operations from December 9, 2006 through August 21, 2007
- KSUTMII Operations, Test and Maintenance Procedures, Revised June 22, 2006
- Work and Test Plan for KSU Reactor Outage, Rev. 0, March 7, 2007
- KSU Radiation Safeguards Committee Reactor Review Agenda, January 18, 2007
- KSU Radiation Safeguards Committee Meeting for Review of Proposed Outage Work, March 12, 2007
- KSU Radiation Safeguards Committee Semi-Annual Review Agenda, August 21, 2007

b. Observations and Findings

Because of the significant and complex nature of work performed during the recent spring break maintenance outage, the majority of the inspector's time and attention to maintenance during this inspection focused on the outage work activity. Numerous statements regarding the execution of this work appear in other topical areas of this report. In summary, the project was proposed for approval by the RSC along with stated reasons for the work, analysis of the safety implications, precautions, prerequisites, and detailed procedures. When available, existing operational procedures for activities such as fuel movement and reactivity measurements were incorporated into the work plan. In the end, radiation monitoring results showed that the work was accomplished in accordance with ALARA principles.

Regarding execution of the work, the inspector reviewed written and photographic records of the work and interviewed numerous staff members regarding their assessment of the project. The work appeared to be well-planned and organized. The RSO specified activities during which he was to be present. Movable shielding was used effectively to minimize personnel doses. Pre-job briefings were used effectively to instruct workers and allow for questions and clarification of responsibilities and work activities. While the inspector was

not present to observe the work evolution, information available consistently indicated that work was done in a safe and efficient manner, a conclusion supported by the low radiation exposure reported on personnel dosimetry.

c. Conclusion

The licensee demonstrated the ability to perform integrated outage maintenance work in a safe and ALARA manner.

9. Transportation

a. Inspection Scope (IP 86740)

The inspector discussed the licensee's radioactive material transportation practices with the RM and the RSO. Since shipments had not been made under the R-88 reactor license in recent years there were no records to inspect.

b. Observations and Findings

The licensee explained that they do very little shipping of radioactive material and when necessary, it is done on the broad byproduct (state) license under the direction of the campus RSO. However, since reactor waste material cannot be transferred to the state license, it is accumulated under the reactor license and shipped for disposal on the same carrier but under a separate license designation as state-licensed waste. The last such shipment was reportedly made approximately ten years ago.

c. Conclusion

The licensee occasionally transported radioactive material under the R-88 reactor license but had not done so in recent years.

10. Follow-up on Previously Identified Issue

a. Inspection Scope (IP 92701)

The inspector reviewed progress on an inspector follow-up item (IFI) from a previous inspection, 50-188/2007-201-02, "Failure to complete Reactor Operation Request Forms for late 2006."

b. Observations and Findings

The licensee had a proposal on the RSC agenda to resolve this item but the RSC meeting was the day following the inspection. Therefore, the item was left open pending RSC action.

c. Conclusion

Inspector follow–up item 50-188/2007-201-02 was discussed but left open pending action by the Radiation Safeguards Committee.

11. Exit Meeting

The inspection scope and observations were summarized on August 23, 2007, with members of licensee management. The inspector described the areas inspected and discussed in detail the preliminary inspection findings. No dissenting comments were received from the licensee. The licensee did not request that any of the information proposed to be discussed in the inspection report be withheld from public disclosure.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

R. Bridges	Head of Radiation Safety Office, Environmental Health and Safety Division and Campus Radiation Safety Officer
M. Donis	Mechanical and Nuclear Engineering Department Head and Reactor Safeguards Committee Chairman
K. Shultis	Mechanical and Nuclear Engineering Department, Nuclear Program Director and Reactor Safeguards Committee Backup Chairman
P. Whaley	Reactor Manager

INSPECTION PROCEDURES USED

IP 69001	Class II Non-Power Reactors
IP 86740	Transportation
IP 92701	Follow-up

ITEMS OPENED, CLOSED, AND DISCUSSED

OPENED:

50-188/2007-202-01	URI	Storage of reactor waste at campus decay-in-storage facility

CLOSED:

None

OTHER ITEMS DISCUSSED:

50-188/2007-201-02	IFI	Failure to complete Reactor Operation Request Forms for late 2006

LIST OF ACRONYMS USED

10 CFR	Title 10 of the Code of Federal Regulations
ADAMS	Agencywide Document Access and Management System
ALARA	As Low As Reasonably Achievable
BST	Bulk Storage Tank
IFI	Inspector Follow-up Item
IP	Inspection Procedure
KSU	Kansas State University
KSUTMII	Kansas State University TRIGA Mark II
kW	KiloWatts
LCO	Limiting Conditions for Operation
MLD	Minimum Level of Detection
MREM	Millirem
NCV	Non-Cited Violation
NRC	Nuclear Regulatory Commission

NRF	Nuclear Reactor Facility
Rev	Revision
RM	Reactor Manager
RO	Reactor Operator
RS	Reactor Supervisor
RSC	Reactor Safeguards Committee
RSO	Radiation Safety Officer
RSR	Rotary Specimen Rack
SRO	Senior Reactor Operator
TS	Technical Specifications
TRIGA	Training Research Isotope Production General Atomics
URI	Unresolved Item