July 17, 2008

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: KANSAS STATE UNIVERSITY - NRC NON-ROUTINE INSPECTION REPORT NO. 50-188/2008-201

Dear Mr. Whaley:

This letter refers to the inspection conducted June 12 through June 20, 2008, at the Kansas State University Reactor Facility. The inspection included a review of activities authorized for your facility. The enclosed report presents the results of this inspection.

The inspection examined tornado damage to the facility and repair activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspector reviewed selected procedures and records, observed activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified.

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 Greg Schoenebeck at 301-415-6345.

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. 50-188/2008-201

cc w/enclosure: See next page

cc:

Office of the Governor
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Topeka, KS 66612

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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:	50-188/2008-201
Licensee:	Kansas State University
Facility:	TRIGA Mark II
Location:	Manhattan, Kansas
Dates:	June 12-June 20, 2008
Inspectors:	Steve Cochrum — Wolf Creek Senior Resident Inspector Greg Schoenebeck — Research and Test Reactor Inspector Marcus Voth — Research and Test Reactor Inspector
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
Report No.: 50-188/2008-201

On June 11, 2008, at approximately 2300 CDT, a tornado caused significant damage to the Ward Hall Building and the reactor confinement structure. The primary focus of this non-routine, unannounced inspection was the onsite review of selected aspects and activities of the licensee's response to facility damage caused by the tornado.

The licensee's actions adequately addressed concerns for the protection of public health and safety, the environment, and compliance with NRC requirements. The inspector reviewed a broad selection of inspection topics to ensure that the facility was cognizant of safety during recovery operations:

Confinement Repair Activities

- The tornado had removed a substantial amount of siding material from the confinement structure. The inspector verified that the licensee was meeting all of the applicable regulatory requirements and applied judicious steps for recovery in order to ensure that the facility could return to operations.

Reactor Pool Cleanup

- With a breech into confinement, a substantial amount of debris (e.g., leaves, insulating material, etc.) had been introduced into the pool. The inspector observed the cleanup operations to successfully return the pool to pre-tornado condition.

Water Ingress

- The breech into confinement allowed to a substantial inundation of rain water into the facility. The inspector verified the functionality of electronic equipment relating to reactor operations, radiation protection, and security of the facility.

Health Physics

- Surveys were being completed and documented as required.
- Radiation monitoring equipment functionality was confirmed.
- The radiation protection program satisfied regulatory requirements.
- Environmental monitoring satisfied license and regulatory requirements.

Procedures

- Operational activities were consistent with applicable Technical Specification and procedural requirements. This included the convening of a Reactor Safety Council Meeting to ensure proper actions taken for a return to normal reactor operations.

REPORT DETAILS

Facility Background Information

The licensee's 1250 kilowatt (kW) Training, Research, and Isotope Production, General Atomics (TRIGA) Mark II research reactor at the Kansas State University (KSU) has been operated in support of educational demonstrations, experiments, reactor operator training, and periodic equipment surveillance.

The reactor core is positioned with its vertical axis orientation near the base of a cylindrical water tank that is 1.98 m (6.5 ft) diameter and 6.25 m (20.5 ft) deep. The reactor coolant system provides several functions, such as: (1) removing and dissipating heat generated in the reactor; (2) maintaining cleanliness of the primary water through a skimmer unit to remove debris settling on the pool surface and through primary piping that is directed through a mechanical/ion exchange filtration.

The reactor bay is surrounded by a roughly dome-shaped building that encompasses a free volume of 144,000 ft^3. The confinement dome consists of a steel frame to which large composite panels are attached. The confinement and ventilation systems are intended to control the level of airborne radioactive contaminants in the restricted area, and to release reactor bay air in unoccupied areas at the top of the confinement structure.

There are three personnel access points into the reactor bay. Two are from the interior of Ward Hall, the third is a vehicle access through two standard double doors with a roll-up truck door. The reactor bay is maintained at a slightly negative pressure; the measurement is obtained across the separation of the control room and the reactor bay. The truck door relieves this differential pressure, so during reactor operations the truck door remains closed. Personnel doors remain closed during reactor operations except during transit.

A series of plate glass windows surround the reactor bay which allows ambient light into the reactor bay. Metal girders are in place to prevent damage to the windows and unauthorized access. A security fence restricts access around the periphery of the confinement.

Kansas State University Reactor Tornado Event

On June 11, 2008, at approximately 2300 CDT, a tornado caused significant damage to the Ward Hall Building and the reactor confinement structure.

As the storm subsided, graduate students working in Ward Hall observed the impact to the confinement dome and performed an initial area radiation survey outside of the confinement to assess any radiological implications. It was determined that there were no radiation levels above background level. The students remained on scene until the arrival of the NRC-licensed reactor operator who performed a radiation survey of the confinement interior along with a general inspection for damage in licensed material storage areas.

06/11/2008 (2357 CDT)

The reactor operator notified Kansas State University Police Department (KSUPD), and the KSUPD notified the Reactor Manager at approximately 2400 hours.

06/12/2008 (0010 CDT)

The Reactor Manager arrived on scene. Support staff were on scene with KSUPD, and maintained security access to the area surrounding Ward Hall. Electrical power was unavailable to campus; emergency lights in Ward Hall were active. The Reactor Manager reviewed the facility status with support staff, and assumed the responsibilities of Emergency Director.

06/12/2008 (0020 CDT)

The Emergency Director notified the USNRC Operations Center that the KSU reactor was under conditions that constitutes an ALERT. Section 8.2 of the KSU Emergency Plan identifies "damage to the Reactor Facility due to…tornado" as an initiating condition for ALERT; therefore, the Emergency Director requested that KSUPD activate the call list identified in Emergency Plan Procedure 2.

The Emergency Director and one reactor operator inspected the facility. Twenty panels in four sections were displaced by the event. With the confinement breech, the storm swept a moderate amount of debris (e.g., leaves and insulation) into the pool. Some of this debris settled at the bottom of the pool and on top of the core and reflector region. Rainwater continued to inundate the facility through exposed regions of the confinement, and drained into the basement sump.

06/12/2008 (0135 CDT)

KSU Facilities was requested to provide support for securing the confinement dome to prevent further rain ingress. Facility staff and KSU Facilities personnel commenced covering the openings with plastic and secured the material to the confinement dome with lumber plywood.

06/12/2008 (0456 CDT)

The ALERT was cancelled with the stabilization of facility conditions. KSUPD officers securing the scene from the outside were released to other duties supporting campus emergency response, with one officer posted in Ward Hall. The intrusion alarm system functionality was tested to be satisfactory; UPS capacity was observed to be sufficient.

06/12/2008 (0600 CDT)

The NRC Senior Resident Inspector (SRI) at Wolf Creek arrived at the KSU facility. The SRI observed the recovery activity throughout the day and provided periodic updates to NRC management. The SRI followed up on licensee actions taken to ensure facility security is maintained and that confirmatory surveys had been conducted to ensure that radiological material was not released to the environment outside the confinement.

06/12/2008 (1200 CDT)

Two inspectors from NRC headquarters (HQ) were dispatched to the KSU facility.

06/12/2008 (2030 CDT)

The lead HQ inspector arrived at the site. The SRI and the lead inspector toured the facility and conducted a proper turnover of the conditions at Ward Hall and ongoing activities that needed to be addressed.

Recovery Activities

From 6/13/2008 to 6/20/2008, an NRC inspector was present to focus on the following salient issues as a result from the tornado event:

- Confinement Repair Activities
- Reactor Pool Cleanup
- Water Ingress
- Health Physics
- Procedures

1. Confinement Repair Activities

After the temporary installation of plywood panels to close the reactor bay dome, it was determined that several large gaps could be observed which were providing a pathway for the ingress of air. Subsequently, this pathway was attributed to the inability to achieve a negative differential pressure (dP). Being a limiting condition for operation per KSU Technical Specification 3.5.3, there is a requirement to have a measurable dP within the confinement during reactor operations. The facility staff applied commercial grade sealing foam to the gaps of the plywood panels. On June 20, 2008, the facility staff sealed the confinement sufficiently to achieve and maintain 1.0 mm H_2O dP.

Conclusion:

During the course of the Kansas State University reactor facility event and recovery, the inspector determined that the licensee was meeting technical specifications and Reactor Safety Committee (RSC) requirements for return to normal operations.

2. Reactor Pool Cleanup

The facility commenced pool cleanup with a standard swimming pool vacuum cleaner/filter unit. Due to the moderate amount of debris and foreign material on the top of the core and dispersed throughout the deep reactor pool, the suction capacity of the pool vacuum was limited and made cleanup slow. The licensee later configured a sump pump which aided with the cleanup and by the afternoon of June 17, 2008, the primary system could be started for further filtration. With the termination of cleaning efforts, water clarity was significantly improved and pool chemistry was within technical specification.

Conclusion:

The licensee cleaned the pool to conditions that were acceptable for an RSC-approved reactor startup. Throughout the evolution, the facility staff demonstrated good health physics practices.

3. Water Ingress

A significant amount of water entered the facility covering many horizontal surfaces. Small leaks caused water to seep into the roof of the control room, but not in the vicinity of the control panel. No instrumentation related to reactor operation and safety was affected.

At the time of storm, the reactor sump was high due to the collection of HVAC drains. The reactor sump had overflowed into and was contained within the tracks used for thermal column access. The licensee conducted the appropriate contamination analyses of the sump for discharge into the city wastewater system, verifying minimal detectable activity and less than 10 CFR Part 20, Appendix B limits.

In addition to the reactor sump, the spent fuel storage pits were accessed and determined to be free of standing water. Several auxiliary pits contained water (which do not contain spent fuel), had an appreciable amount of water from either the storm or condensate run off from the HVAC system. The licensee planned to pump the water to the reactor sump.

It was, however, noted by the inspector that several survey meters were not operational. One universal survey meter stored inside confinement had digital display readouts that were difficult to read. The SRI responding to the scene noted that there was difficulty in finding an operational survey meter upon arrival. It is uncertain, but likely that the storm may have affected the functionality of one or more survey meters.

The inspector will leave the survey meter operational determination as an Inspector Follow-up Item (IFI) 50-188/2008-201-01

Conclusion:

Despite the large inundation of rain water through the confinement penetrations, the majority of electrical equipment (e.g., fixed radiation monitors) was unaffected. However, the inspectors determined that several portable radiation survey meters were non-operational. The inspector will leave the survey meter operational determination as an Inspector Follow-up Item (IFI) 50-188/2008-201-01.

The inspector verified that the licensee had performed contamination samples for the reactor sump that are in accordance with discharge procedures and regulations.

4. Health Physics

During the reactor pool cleanup, the facility properly disposed all debris as radioactive material and maintained appropriate accountability. The inspector observed the applicable radiation/contamination surveys that were performed for said operation and for other recovery activities (e.g., entry into the spent fuel storage pits).

With regard to radioactive source material, the inspector verified the licensee's determination that there was no detectable uncontrolled release of radioactive material to the environment.

Conclusion:

The licensee verified proper control and accountability of radioactive material after the event. New material generated from cleanup efforts was accounted for in accordance with the

licensee's procedures. General health physics practices were employed in accordance with procedures and training.

5. Procedures

During the early phases of event recovery, the KSU facility staff demonstrated the proper execution of the Emergency Plan and Emergency Plan Procedure 7.

Having a significant amount of rainwater enter confinement provided grounds for concern regarding the operability of security equipment. During the afternoon of June 13, 2008, the NRC inspectors observed KSU reactor staff performing a surveillance, to demonstrate that each alarm initiating device functioned satisfactorily.

Over the course of recovery, the licensee was cognizant of the criteria for reactor startup. Section 8.4 of the KSU Emergency Plan requires the Reactor Safeguards Committee (RSC) to approve resumption of normal operations following an emergency. On June 17, 2008, the RSC convened for a briefing that covered the extent of damage to the facility, the ongoing recovery activities, and the steps needed to return to normal reactor operation.

Conclusion:

The inspector observed that the licensee was proficient with the knowledge and use of applicable plans, procedures and technical specifications.

KEY POINTS OF CONTACT

Licensee Personnel

E. Bridges	Head of Radiation Safety Office, Environmental Health and Safety Division and Campus Radiation Safety Officer
M. Donis	Mechanical and Nuclear Engineering Department Head
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

REFERENCES USED

Technical Specifications (TSs) for the KSU TRIGA Mark II Technical Specifications
KSU Emergency Plan, dated August 2006
KSU Emergency Procedures, dated August 2006
KSU TRIGA MARK II Operations, Test, and Maintenance Procedures Manual
Reactor Console Logbooks covering June 12, 2008 to June 20, 2008
KSU TRIGA MARK II Reactor Facility Operations Manual, February 2003
KSU Safety Analysis Report, May 2008

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-188/2008-201-01	URI	Follow-up on the status of portable radiation survey equipment affected by the storm.

Closed

None

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
ALARA	As Low As Reasonably Achievable
AOP	Auxiliary Operating Procedure
CFR	Code of Federal Regulations
EP	Emergency Procedure
IP	Inspection Procedure
KSU	Kansas State University
LCO	Limiting Conditions for Operation
NRC	Nuclear Regulatory Commission
Rev.	Revision
RS	Reactor Supervisor
RSC	Reactor Safeguards Committee
RSO	Radiation Safety Officer

SOP	Standard Operating Procedure
SRI	Senior Resident Inspector
TS	Technical Specification
TRIGA	Training, Research, and Isotope Production, General Atomics
URI	Unresolved Item