(10)

KANSAS STATE
UNIVERSITY

TRIGA Mk II Nuclear Reactor Laboratory

Testimony
Joint Committee on Kansas Security
Dr. Jeffrey Geuther, TRIGA Mk. II Nuclear Reactor Facility Manager
Department of Mechanical and Nuclear Engineering
College of Engineering
Kansas State University
November 5, 2015

Chairman Goico and Members of the Joint Committee on Kansas Security, I am Dr. Jeffrey Geuther, TRIGA Mk. II Nuclear Reactor Facility Manager at Kansas State University. Thank you for the opportunity to appear before you today.

The Kansas State University TRIGA Mk. II Nuclear Reactor Facility consists of a 1.25 MW (steady state power) fission reactor fueled with low-enriched (i.e., 20%-enriched) uranium, cooled and shielded by water. The reactor core is located inside a 22' high, 8' thick concrete biological shield inside a protected building. The purpose of the reactor is to provide research support, education, operator training, and STEM outreach support for Kansas State University and other regional institutions. The KSU reactor fuel is comprised of uranium zirconium hydride (UZrH) clad in stainless steel. UZrH has a very strong prompt negative feedback mechanism that causes the reactivity of the core to decrease as the fuel is heated. For this reason, it is not credible for the reactor to melt down or to have any other accident due to a power transient. In fact, the reactor can be "pulsed," i.e., a control rod can be ejected to cause a transient resulting in power going from approximately 10 W to 1,000,000,000 W in one hundredth of a second. Due to the strong negative temperature feedback associated with UZrH fuel, the reactor safely returns to a normal steady-state power level in another hundredth of a second without any operator intervention. Note as well that the reactor would immediately shut down if building power is lost or if the shielding water is drained.

The reactor Physical Security Plan contains the minimum requirements for the physical security of the reactor and is approved by the Nuclear Regulatory Commission. The detailed specifications of the reactor security system, including the Physical Security Plan, are protected safeguards information. This information will therefore not be disclosed in this testimony; I can, however, give general details about the regulations pertaining to our safety and security, our policies with regard to reactor access, and information about our Emergency Plan and safety analysis. Many upgrades were made to reactor security following the events of September 11th and a subsequent voluntary security enhancement program funded by the Global Threat Reduction Initiative. The reactor fuel is insufficiently enriched to be used in a nuclear weapon, and is in a physical form that would make it very difficult to use as a radiological dispersion device. The facility is federally-licensed (license R-88). Therefore the physical security and protection of safeguards information are regulated under 10CFR-73, Physical Protection of Plants and Materials. The NRC uses a graded approach to regulate research reactor security. In other words, security measures must be commensurate with the radiological risk to the public represented by the facility. The KSU reactor has a high license power level compared to most other research reactors, but by other metrics, such as fuel enrichment and total uranium inventory, would be considered to be of low risk.

Visitors, experimenters, and workers who access the reactor control room and reactor confinement bay must either hold unescorted access privileges or be under the direct cognizance of someone who does have unescorted access. In order to obtain unescorted access privileges, one must go through a rigorous process involving fingerprinting and a criminal records check through the FBI, a personal history statement, a background investigation conducted by contacting at least six personal contacts, and a training session and examination. The unescorted access process is very similar to what would be employed at a nuclear power reactor such as Wolf Creek. Escorted visitors may not bring large jackets, purses, backpacks, or other parcels that could contain a hidden weapon or explosive into the reactor control room or confinement bay unless those items are inspected by a staff member with unescorted access. Kansas state legislation allowing firearms to be carried in public buildings does not apply to the KSU reactor, as it is a federally-licensed facility and federal regulations prohibit firearms to be carried inside the facility. In other words, notwithstanding state laws that may permit firearms, 10CFR-73 states that "the willful unauthorized introduction of any dangerous weapon, explosive, or other dangerous instrument or material likely to produce substantial injury or damage to persons or property into or upon these premises is a Federal crime."

When the reactor is operating, the on-duty Reactor Operator is cognizant of the reactor conditions and is responsible for granting or denying access to the reactor bay. Visitors and reactor staff are required to wear dosimetry, although two visitors may be assigned to the same badge. It is not common for a reactor staff member to receive a significant radiation dose over the course of a year. Last year, the highest dose received by an individual on staff was only about 1% of the NRC limit of 5000 mrem deep dose equivalent (DDE). When visitors are present on the reactor deck, the reactor is operated at a power level corresponding to a dose rate not in excess of 2 mrem / hour where the visitors are standing. The dose rate in uncontrolled areas immediately outside the facility boundary with the reactor at full power is measured annually, and does not exceed 2 mrem per hour. In fact, the dose rate at the facility boundary is typically too low to distinguish from background radiation with our survey instruments. Note that the minimum acute dose, i.e., dose received in a short period of time, associated with observable health effects is approximately 25,000 – 50,000 mrem.

The operating license of the reactor was granted on the basis of a Safety Analysis Report (SAR) issued by KSU, which was submitted to the NRC to demonstrate that the reactor can operate in both normal and emergency conditions without undue risk to the public. The SAR contains a description of the facility site characteristics, core physical parameters, control and experimental equipment, in addition to other information necessary for the NRC to perform a safety evaluation. Four specific accident conditions are considered in the SAR, representing four credible but severe accidents deemed to be bounding for the KSU reactor facility. These are a prompt supercritical reactivity transient (pulse) from two power levels, the total and sudden loss of shielding water following long-term operations at the full licensed steady state power level of 1.25 MW, and the failure of a fuel element in air. The analysis of these accidents shows that they either represent no risk to the public or staff at all, in the case of the two pulses, or that they result in minimal risk to the public, but would pose a risk to the reactor staff that can be adequately managed through the use of appropriate radiological controls. There is no risk of fuel meltdown due to radiological decay heat or any other mechanism. The amount of decay heat at a nuclear fission reactor is only 6% or less of the pre-shutdown power level. Due to the large volume of water in the KSU reactor tank and the relatively low power of the reactor, the water cannot be boiled nor can the fuel be melted by the decay heat. The NRC Safety Evaluation Report corresponding to the KSU reactor operating license is available on the NRC website, using accession number ML080450597.

The reactor facility's response to an emergency would follow the KSU reactor Emergency Plan (EP) and Emergency Plan Procedures (EPP). Both of these documents are issued by the KSU reactor and approved by the NRC and represent part of the reactor license basis. The EP gives general guidance for how to identify the severity, or class, of the emergency, and what will be the responsibilities of both reactor staff and other responders in the event of an emergency. Broadly speaking, due to its low radiological risk the

KSU reactor is considered by the NRC to only have two credible emergency classes, Unusual Events and Alerts. Larger facilities, such as power reactors, must also protect against Site Emergencies and General Emergencies. An Unusual Event is a substantial degradation of a safety or security system that may escalate to an Alert, but would otherwise not result in the release of radiation. In the event of an Unusual Event, the reactor staff would form an emergency response organization and notify offsite response organizations of the event, but no offsite response would typically be required unless the event were to escalate. Examples of Unusual Events include a fire that takes longer than 15 minutes to extinguish, but does not affect safety or security systems, or an earthquake that does not cause apparent damage to the facility. An Alert consists of actual damage to the facility, but would result in only a small release of radioactivity. Offsite agencies would be notified and expected to respond. Examples of Alerts include tornado damage to the reactor facility or acts of sabotage. The EPP gives guidance for how to mitigate a number of credible emergency scenarios, but the Emergency Director is expected to use judgment in cases where an emergency is of an unforeseen nature. Memoranda of understanding are maintained between the reactor facility and outside agencies which may be expected to respond to emergencies.

In any case involving the possibility of damage to the reactor fuel or dispersion of radioactive isotopes, the reactor exhaust fan and cooling pumps are secured to retain the radioisotopes inside the reactor bay. Radiological dispersion would be inhibited by "defense in depth" including the fuel cladding, cooling water, confinement building, and controlled facility boundary as layers of defense preventing the public from receiving dose from a reactor emergency. In the maximum hypothetical accident in the SAR, the dose to a person standing at the edge of the reactor bay roof for one year following the failure of a fuel element in air is calculated to be 3.6 mrem, far lower than the NRC limit of 100 mrem to members of the general public due to the operation of a reactor facility.

This concludes my testimony regarding the safety and security of the KSU reactor facility.