Kansas State University Reactor License Renewal Experience

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On August 15, 1961, the United States Atomic Energy Commission (AEC) issued Construction Permit CPRR-66 (Docket number R-188) to Kansas State University based on the *Hazards Summary Report for the Kansas State University TRIGA Mark II Reactor*. The last paragraph of the construction permit specified that, upon completion of required actions, KSU would be issued a Class 104 license with a term of 40 years from the date of the construction permit. On August 22, 1962, the Notice of Proposed Issuance of Facility License for 100 kW operations was issued, with an effective expiration date of August 15, 2001. The Facility License (R-88) was issued on October 16, 1962 effective as of date of issuance and expiring on August 15, 2001. Initial criticality occurred on October 16, 1962 at 8:25 p.m. Therefore, the facility operating license was issued 14 months prior to initial criticality. In 1968 (based on a *Safety Analysis Summary 1968 License Upgrade to 250 kW Power and Pulsing capability KSU TRIGA MkII Nuclear Reactor License R-88, Docket 50-188*) the Facility Operating License was revised to permit 250 kW operation and pulsing. Almost immediately the facility began to explore the possibility with General Atomics for operations at 1 MW, with a preliminary request to the Atomic Energy Commission (AEC) Division of Licensing in 1969 for an increased maximum steady state power limit. The AEC did not find sufficient reason for the power upgrade.

Because the original Facility Operating License expiration dated from the construction permit, a recovery of the 14 months of construction time was granted, moving the license expiration date one year and two months. The renewal request included a proposed new maximum steady state power level of 500 kW. The renewal request was completed and submitted in September of 2002, with the facility currently operating under the timely renewal provision. The 2002 submission included the Safety Analysis Report, Technical Specifications, Requalification program, and referenced the extant Radiation protection Program and Emergency Plan. The Technical Specifications was developed using the USNRC Standard Technical Specifications as a model. A substantial revision to the Emergency Plan was complete, but review by the State of Kansas delayed submission until November; the current approved Emergency Plan was referenced with the notice that a new Plan would be submitted by a specific date in November.

USNRC review resulted in three Requests for Additional Information (RAI): one applicable to the proposed KSU Reactor Safety Analysis Report (including the Technical Specifications) in 2004 and a second for the KSU Reactor Emergency Plan in 2005. The third RAI addressed the Environmental Report.

The response to the 2004 RAI required significant effort, including revised analysis to establish a maximum power level that provided a margin to intended operations, thus avoiding potential for operations outside Technical Specifications limits. To expedite KSU response, the 2004 RAI was addressed in two parts; the first part included items applicable to the Safety Analysis Report (excluding the Technical Specifications), with

the second part principally addressing Technical Specifications. The Safety Analysis Report was revised to reflect responses to the RAI and submitted in 2004. To support review, a tabulation of changes from the 2002 submission was transmitted with the Safety Analysis Report.

Technical Specifications was then revised to incorporate RAI responses. A tabulation of changes from the original 2002 submission, and an additional tabulation comparing the current Technical Specifications to the proposed Technical Specifications were provided informally in January 2005. Formal transmission of this correspondence and enclosures completed formal transmission of responses to the RAI documents related to the SAR and Technical Specifications. Enclosures included (A) items addressing the RAI for Technical Specifications, (B) responses to the RAI related to the KSU Reactor Emergency Plan, and (C) minor and editorial changes identified in subsequent review. The response to the final RAI concerning the Environmental Review is pending.

Major Changes

The Safety Analysis Report replaces the original Hazard Summary Report, with format and information the largest change and commitment of resources for the license renewal process. Based on recommendations in an on-site NRC review, the submission was revised for a power level with significant margin to intended operations. Limiting thermal hydraulic analysis in the 2002 SAR submission demonstrated operations up to 1900 kW did not exceed critical heat flux, and 750 kW was initially (arbitrarily) selected as the power level limit. However, since the work supporting analysis for 750 kW is essentially the same as for analysis supporting higher power levels, 1.25 MW was selected as the maximum steady state power level with adequate margins.

A new Emergency Plan addressing requirements of the Nuclear Regulatory Commission, State of Kansas, and other relevant requirements was developed and tested in an emergency exercise. Negotiation with the State of Kansas and letters of agreement for emergency response support was challenging.

A new format for Technical Specifications was used, modeled on the NRC Standard Technical Specifications (STS) that offers significant potential improvement for facility operations. This effort was based on previous experience in Technical Specification development at the High Flux Isotope Reactor. The NRC has invested significant effort in the STS program incorporating human factors and lessons learned from a broad range of experiences. Although technically STS does not strictly apply to the research reactor environment, the philosophy, methodology and format used to develop the specifications is compatible with the applicable standard for research reactors. The benefits of the STS program can be translated to the research reactor environment. While a complete description of the process to apply the STS model is beyond the scope of this work, the NRC web site has examples of STS for the varieties of commercial nuclear power plants. Material describing the format, use, and application of STS is contained in each example. Briefly, the major advantages of this approach include:

- Safety objectives associated with defined modes of operation
- Unambiguous definition of Technical Specification violation related directly to safety
- Defined times for transition between operating modes
- Defined methods for meeting the objective
- Permissible compensatory measures for defined periods of time if the primary method cannot be met to permit troubleshooting and repairs
- One-to-one correspondence between requirements and surveillances
- A built-in flow to guide application
- A model more tuned to nuclear power plant practice for education and training

Except for the last two items, "old style" technical specifications can be backfit specifically to accrue these benefits, but development of technical specifications in the STS model develops the benefits naturally, integrating the Safety Analysis Report and operational safety.

Issues

Security issues have, at times, absorbed virtually all available resources.

The higher power level in the final revision to the proposed SAR submitted with responses to the RAI was not correctly integrated in all locations within the SAR, and was not initially distributed to the other applicable documents. The inconsistencies were not identified in review.

Security related requirements have caused some delays as security issues impacted the documents to be posted with the Notice. Parts of the Safety Analysis Report are being redacted to exclude information that might be considered security sensitive; this was not originally anticipated, and delayed the ability to publish the SAR.

KSU resources are extremely limited, and change control was difficult.

The philosophies and lessons learned incorporated in STS were somewhat foreign and difficult for some KSU reviewers.

Lessons Learned

Communication with the NRC prior to issuance of the RAI for the Safety Analysis Report and Technical Specifications was helpful in removing some legacy requirements

that did not make sense. This communication also helped to clarify acceptable responses for RAIs concerning the Safety Analysis Report, Technical Specifications and the Emergency Plan. The RAI on the Environmental Report was not coordinated in the same way, and was consequently more difficult.

Because of resource limits, reviews were not as thorough enough to identify and correct all inconsistencies and editorial issues.

The KSU license submission is nearly complete, with a Notice of Intent for action likely to be posted to the Federal Register immediately.

To incorporate answers to the RAIs in the governing documents, it was helpful to tabulate the question, excerpts of the original text beside excerpts of the new text (identifying new text, deletions, and revisions), and an explanation of how the revision answers the question.

Resolving some RAIs required multiple changes across documents not necessarily identified in the RAI.

Conclusion

The KSU relicense request was submitted in September 2002. Regulatory review has been conducted by the NRC in-house. The process has been complicated by unrelated events that stressed resources for both KSU and NRC beyond reasonable expectation, yet is nearing completion as the end of the third year approaches.