GENERAL ATOMICS

TRIGA Reactors Facility
Telex: 695065 GENATOM SDG
Fax: (619) 455-3621
Phone: (619) 455-3277

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Document Control Desk
U. S. Nuclear Regulatory Commission
Washington D.C. 20555

Subject: Docket No. 50-163: Reactor Facility License No. R-67; Reportable Occurrence

Gentlemen:

At approximately 1730 hours on Friday, September 28, 1990, General Atomics (GA) notified the NRC Operations Center by telephone of an occurrence involving GA's TRIGA Mark F reactor (License R-67) which had occurred earlier that afternoon. The occurrence was an apparent violation of a Tech Spec condition requiring automatic scram on temperature of the containment tube used to house a direct conversion (thermionic) device [Tech Spec Section 10.2.6 (f)(1)(i)]. This report was made to Mr. Bill Mattingly at NRC, by Dr. Junaid Razvi, Physicist-in-Charge (PIC) and Mr. William E. Hood, Associate PIC of GA's TRIGA Reactors Facility. The occurrence was reportable because the temperature limit on the thermocouple used to meet this scram requirement in the Tech Spec had apparently been exceeded without causing a reactor scram. There was no release of radioactivity, nor did the temperature of the containment actually exceed the Tech Spec limit of 1000 deg.C at any time, since a location inside the containment, on the device itself was being used to meet this Tech Spec requirement. The containment tube temperature typically runs as much as 400 deg.C cooler than the collector itself.

This written report is being submitted within 10 days as required by the applicable license, as amended. Relevant details of this occurrence are given below.

Sequence of Events

The GA TRIGA Mark F reactor is currently in a round-the-clock operating mode to perform in-pile irradiations on thermionic devices. There are presently three 1H series test articles in the core, Capsules 1H1, 1H2 and 1H3. On Friday, September 28, 1990, with the reactor operating at about 1450 kilowatts, weekly scram checks on required experimental safety system scrams were initiated by a thermionics test engineer. During the scram checks, it was observed that the collector temperature B on Capsule 1H1 - one of two thermocouples used to monitor collector temperature and provide the signal to the scram loop to meet the Tech Spec criteria on containment temperature, was alarming on the on-line computers used for real-time data acquisition, showing a value of 1026 deg.C. At the same time collector temperature A, which is measured 180 degrees across from the temperature B thermocouple, showed a temperature of 910 deg.C. Since either one of the collector temperatures should have opened the scram loop if the temperature exceeded 1000 deg.C, the engineer notified the Associate PIC. Since

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the scrams are generated by analog, hardwired temperature readouts with trip capabilities, the APIC noted the reading on the analog meters, and found that the meter was reading approximately 950 deg.C, about 75 deg.C lower than the corresponding computer value. The PIC was informed of this abnormality at this time. An independent verification of the temperature from thermocouple B indicated that the analog meter was reading erroneously, and the value indicated by the on-line computer was within 1 deg.C. In other words, one of the two temperatures (only one is required by the Tech Specs) used to generate an automatic scram was actually above the scram limit of 1000 deg.C.

Analysis

Numerous thermocouples are used to monitor the temperature profile of the thermionic devices during the radiations. Since a thermocouple is not placed directly on the primary containment, it was decided to monitor the collector temperatures in order to provide the license required scram. Since thermal analysis shows that the primary containment is typically 400 deg.C **colder** than the device collector location, monitoring this temperature for the experimental safety system scram was acceptable. Thermal analyses show that to a first approximation, the primary containment temperature is no more than 500 deg.C with the collector temperature around 1000 deg.C. Therefore, the temperature of the primary containment itself at no time exceeded the limiting safety system setting. Further, only one of two thermocouples exceeded 1000 deg.C, indicating a localized hot spot on the collector, rather than an increase in overall collector temperature. Also, from the real-time data monitoring performed on the capsules, there are indications of either erratic thermocouple behavior, or abberations in the electrical behavior of the test device itself.

Corrective Actions

An immediate action initiated by the PIC was the lowering of the reactor power to a level sufficient to reduce collector temperature as measured by thermocouple B to less than 1000 deg.C. Since the analog meter generating the necessary trip signal to open the scram loop was reading lower than the actual temperatures as measured by this thermocouple, the scram set point on the meter was set correspondingly lower to compensate for the difference between actual and indicated temperatures. To accomplish a collector temperature of less than 1000 deg.C on Capsule 1H1, reactor power was lowered to about 1400 kilowatts.

The primary consideration in this occurrence is the presence in the scram loop of an indicating and trip device reading incorrectly. Our investigation revealed that the analog trip meter used by the experimenters had not undergone periodic

electronic calibration by the thermionics test staff. The reactor operations staff will now monitor on a periodic basis, the calibration of experimental equipment used to meet the requirement of the R-67 Tech Specs. This will be done as part of routine calibrations performed on other reactor instrumentation.

Finally, with the approval of the Safety Committee, a different thermocouple has now been included in the scram loop to meet the Tech Spec requirement of 10.2.6 (f)(1)(i). This thermocouple, on the collector heater block, is located between theoutside sheath of the collector, and the primary containment wall. As such, it is a far more representative measurement of actual primary containment wall temperature which needs to be monitored as part of experimental safety system. This change was implemented on October 2, 1990, and on October 3, 1990 the reactor was returned to the operating conditions that existed on Friday, September 28. Prior to this change, all thermionic instrumentation temperature meters were calibrated. Using simulated temperature inputs, scrams were then checked to ensure that a reactor trip will occur at temperatures of 1000 deg.C or less on all meters.

We trust that you will find the above description of the reportabie occurrence and corrective actions satisfactory. If you have any questions concerning this occurrence, you may contact me at (619)455-2441.

Very truly yours,

Junaid Razvi, Director
Radiation Services and
Physicist-in-Charge

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cc: Mr. John B. Martin, Administrator, NRC Region V