



North Carolina State University

Nuclear Reactor Program
Department of Nuclear Engineering

Box 7909
Raleigh, NC 27695-7909
(919) 515-2321
FAX (919) 515-5115

14 September 1994

U.S. Nuclear Regulatory Commission
Region II
Attn: J. Philip Stohr
101 Marietta Street, N.W.
Atlanta, GA 30323

Subject: Status of the NCSU PULSTAR Reactor Coolant System Water Leakage
Docket No.: 50-297
License No.: R-120

Reference: Letter, *Water Leakage from Reactor Coolant System*, J.P. Stohr, USNRC Region II, to P.B. Perez, NCSU, dated 24 November 1993

Dear Sir:

The NCSU PULSTAR reactor facility has complied with all the applicable actions outlined in the reference letter of understanding and we are currently constructing an underground vault to enclose the subterranean PULSTAR reactor primary system components. NRC Region II has been kept up to date of our status by telephone discussions with Mr. Craig Bassett of your office. However, approximately ten months have elapsed since the reference letter was written and it is our intention to discuss each of the subject actions and request changes or deletions as necessary to reflect the progress achieved to date. In addition, this letter will formally update your staff on our progress.

Letter of Agreement

The reference letter documented the Commission's understanding of the activities or actions planned by the NCSU Nuclear Reactor Program (NRP) staff. Each of these points will be discussed below:

- **Maintain the reactor in shutdown condition until the Radiation Protection Council (RPC), with input from the Reactor Safeguards Advisory Group (RSAG), has met and agreed to a course of action that you [NRP] will develop to identify potential leak paths and possible corrective options.**

The NCSU PULSTAR Reactor was shutdown on 23 November 1993 and was not re-started until receiving permission from the Radiation Protection Council on 21 January

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1994 and informing the USNRC Region II of the RPC approval to re-start. During the shutdown period, the NRP developed soil sampling plans and corrective action options.

On 10 January 1994, two 27 foot deep borings were drilled in close proximity to the ends of the N-16 tank where the leak is suspected. Twenty soil samples were obtained from the borings and analyzed for radionuclides by gamma spectroscopy. The gamma spectroscopy results from all samples indicated the presence of naturally occurring radionuclides such as Uranium and Thorium decay products and Potassium-40. No activation/corrosion products or fission products were detected. Some of the samples were analyzed by two other independent laboratories. Results from both of these laboratories confirmed the presence of only naturally occurring radionuclides. Gross beta activity concentration of the soil samples were reported by the NCSU Radiation Protection Office as ranging from 25 to 50 pCi/gm. This activity is associated with naturally occurring radionuclides. The surveys performed support the conclusion that no activity associated with the PULSTAR reactor operation has been detected in the soil samples.

The NCSU Nuclear Reactor Program staff and RSAG members discussed possible corrective options for the suspected leak location. On 3 January 1994, an engineering firm was retained to estimate cost and construction time for the corrective options. The members of RSAG reviewed the options and approved the subterraneous vault option on 7 February 1994.

- **Isolate the reactor pool from the piping leading to the N-16 Hold-up Tank which may be the source of the leak, and increase the frequency of the pool water sampling and analyses to once per week.**

The reactor pool was isolated on 23 November 1993 by closing the primary system pool isolation valves. Pool water sampling and analysis frequency was increased to once per week. In addition, the NRP increased the pool water balance measurement frequency to daily including weekends and University holidays. The water balance measurements indicated soon after the pool isolation that the leak was terminated. These daily water balance measurements continue to support the effectiveness and integrity of the pool isolation valves.

Water sampling and analysis have been performed weekly since 23 November 1993 and continue to show the PULSTAR pool water meeting 10 CFR 20 limits for release to unrestricted areas.

The pool water balance measurements and sampling and analysis results show the PULSTAR pool water is not a radiological threat to the environment. As a result, the Nuclear Reactor Program requests the following:

Return to our normal monthly pool water sampling and analysis surveillance frequency as required per Technical Specification 4.6.

Return to our normal pool water balance measurement frequency which is Monday through Friday excluding University holidays.

- **Operate the reactor in the natural convection mode in accordance with the facility's Technical Specifications only if it can be shown that isolating the reactor pool reduces the water loss rate with level consistent with normal evaporation rates seen in the past.**

The reactor has operated in the natural convection cooling mode since 21 January 1994 when the RPC authorized the re-start. The RPC decision was partly based on RSAG's recommendation following a review of the pool water balance results which demonstrated a reduction in the unaccounted water loss following the pool isolation.

- **If it is determined that there is a leak associated with the N-16 Hold-up tank loop, formulate a plan to excavate the soil around the piping leading to the N-16 Hold-up Tank to expose the flanges NCSU suspect to be the source of the leak. These will be examined and repaired, as necessary, by either replacing the gaskets between the flanges in that system or by removing the flanges and welding the piping.**

Construction is currently underway to build an underground vault to enclose all subterranean PULSTAR primary system components. The Nuclear Reactor Program performed a safety evaluation for this facility modification and concluded the design change meets the criteria for a 10 CFR 50.59 modification. The analysis was reviewed by NCSU's RSAG and submitted to the Commission as a courtesy copy.

- **Perform tests to verify that the repairs have acceptably controlled the leakage.**

This action item remains to be performed and NCSU continues its commitment to perform the necessary tests to verify the leakage has been repaired. A report will be submitted to the Commission following approximately one month of data collecting.

Progress Report

Approximately ten (10) months have elapsed since the discovery of the PULSTAR unaccounted water loss. The NRP staff during this time has been expeditiously involved in soil sampling, safety analyses supporting the design change, and supporting the present construction effort. Table I summarizes the major accomplishments to date.

The construction project for the underground vault began on 22 August 1994 and is scheduled for 17 weeks. The project may be separated into the following phases:

- Relocation of Underground Utilities
- Shoring construction for excavation
- Excavation
- Inspection and repairs of subterraneous PULSTAR primary system components
- Construction of the vault
- Back-fill and landscape
- Testing

Relocation of the underground utilities was completed on 10 September 1994. Shoring for the excavation began on 12 September 1994. The excavation should reach the N-16 tank in early to mid October. The project is schedule for completion in early January 1995. The Nuclear Reactor Program will continue to update the Commission with periodic telephone discussions with Mr. Craig Bassett of your office.

The excavation phase of the project will be carefully monitored by the Reactor Health Physicist (RHP) to ensure the displaced soil is suitable for unrestricted use. The RHP has developed a soil sampling program which is summarized below:

One (1) 250 ml sample per 200 cubic feet for soil within 5 feet of the N-16 tank and one (1) 250 ml sample per 500 cubic feet for all other locations. Samples are to be analyzed by gamma spectroscopy system(s) sensitive to 10CFR20 Appendix B, Table 2, Column 2 concentrations. Sample analysis will be reviewed by the RHP.

Conclusions

The Nuclear Reactor Program at North Carolina State University has complied with all applicable actions outlined in the Commission's letter of understanding. We request permission to return to our normal surveillance frequency for pool water sampling and analysis and pool water balance measurement. Our request is based on over nine months of data collected indicating the measured water loss rate has been consistent with normal

USNRC Region II
Mr. J. Philip Stohr

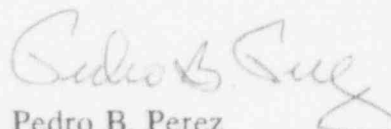
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evaporation rates seen in the past. This confirms the pool has been isolated from the subterranean primary system components. Additionally, the PULSTAR pool water continues to meet 10 CFR 20 limits for release to unrestricted areas.

Please feel free to contact me at (919) 515-4602 or Mr. Gerry Wicks, CHP (919) 515-4601 if you have any questions or comments.

Sincerely yours,



Pedro B. Perez
Associate Director, NRP

Enclosure: As stated

cc: Mr. Alexander Adams, Jr. (USNRC)
Dr. C.W. Mayo, Director, NCSU Nuclear Reactor Program
Dr. D.J. Dudziak, Head, Department of Nuclear Engineering
Dr. J.A. Knopp, Chairman, NCSU Radiation Protection Council, RPC
Dr. C.R. Gould, Chairman, NCSU Reactor Safety and Audit Committee, RSAC
(formerly RSAG)

Table I

Summary of Events

October 16, 1993	A trend was noticed indicating a possible unaccounted water loss from the PULSTAR Research Reactor pool. Experiments started to verify the trend.
November 19, 1993	Experiments completed and results confirm the possibility of a small water loss from the reactor pool.
November 23, 1993	PULSTAR reactor is voluntarily shutdown and the reactor pool is isolated from the environment. NRC Region II and NRC Headquarters are notified.
November 24, 1993	N.C. State Division of Radiation Protection, Wake County Emergency Management, and the City of Raleigh were notified. News release is issued by NCSU.
December 21, 1993	Associate Director of the Nuclear Reactor Program completes safety analysis supporting natural convection operation of the reactor.
January 10, 1994	Soil samples obtained in the vicinity of the possible leak location which is approximately 20 feet below grade.
January 19, 1994	Gamma spectroscopy analysis of the soil samples show no evidence of ground contamination.
January 24, 1994	PULSTAR Reactor re-started under natural convection cooling mode following RSAG and RPC review and approval of safety evaluation analysis.
February 2, 1994	Law Engineering issues preliminary cost and time estimate report for repair options.
February 7, 1994	RSAG reviews Law's preliminary report and approves full vault option.
April 4, 1994	Law Engineering completes design drawings and specifications. NCSU's review process begins.
June 22, 1994	Pre-bid meeting held with invited contractors.
July 7, 1994	Sealed bids received by NCSU. Barnhill Contractors of Raleigh, N.C. selected for the project.
August 8, 1994	Pre-construction meeting held with Barnhill.
August 22, 1994	Construction commences.