APPENDIX A

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-072/88-01
50-407/88-01

Operating Licenses: R-25
R-126

Docket: 50-072
50-407

Licensee: University of Utah (UofU)
Salt Lake City, Utah 84112

Facility Name: Nuclear Engineering Laboratory (NEL)

Inspection At: University of Utah, Merrill Engineering Building, Salt Lake City, Salt Lake County, Utah

Inspection Conducted: February 16-19, 1988

Inspectors: Blaine Murray 3/21/88
H. D. Chaney, Radiation Specialist, Facilities Radiological Protection Section — Date

for
3/21/88
R. Evans, Reactor Inspector, Operational Programs Section — Date

Dale A. Powers 3/21/88
D. A. Powers, Enforcement Officer — Date

Approved: Blaine Murray 3/21/88
B. Murray, Chief, Facilities Radiological Protection Section — Date

Inspection Summary

Inspection Conducted February 16-19, 1988 (Report 50-072/88-01 and 50-407/88-01)

Areas Inspected: Special, unannounced team inspection of the licensee's reactor operation, emergency planning, physical security, and radiological controls associated with the TRIGA reactor, and the physical security and decommissioning status of the AGN-201 reactor.

Results: Within the areas inspected, 7 violations, 1 unresolved item, 1 deviation, and 15 open items were identified.

DETAILS

1. Persons Contacted

Licensee

*R. E. Stephenson, Reactor Administrator
*J. S. Bennion, Senior Reactor Operator (SRO)
*J. M. Byrne, Reactor Safety Committee (RSC) Member
*C. M. Fejer, Radiation Safety Analyst
*T. C. Gansauge, SRO
*G. M. Sandquist, Reactor Supervisor
K. J. Schiager, University of Utah (UofU), Radiation Safety Officer (RSO)
*N. L. Smith, Radiation Safety Analyst

*Denotes those present at the exit interview on February 19, 1988.

2. Open Items Identified During This Inspection

An open item is a matter that requires further review and evaluation by the NRC inspector. Open items are used to document, track, and ensure adequate followup on matters of concern to tne NRC inspector. The following open items were identified:

Open Item	Title	See Paragraph
407/8801-10	Reactor Program Support	6
407/8801-11	Operator Requalification Tests	7
407/8801-12	Operator Requalification Program Check Lists	7
407/8801-13	Reactor Modifications Training	7
407/8801-14	Documentation of Scram Test Times	8
407/8801-15	Excess Reactivity Reference Value	8
407/8801-16	Response to RSC Audit Findings	9
407/8801-17	Pen and Ink Changes to Documents	10
407/8801-18	Procedure Control and Distribution	11
407/8801-19	Set Point Limits and Tolerances	11

407/8801-20	Leaking Fuel Element Followup	13
407/8801-21	Police Department Procedures	16
407/8801-22	Police Department Use of Area Radiation Monitor (ARM)	17
407/8801-23	ARM and Intrusion Alarm Backup Power Supply Batteries	17
407/8801-24	Fuel Inventory Review	19

3. Unresolved Items

An unresolved item is a matter about which more information is required in order to determine whether it is in an acceptable item, a violation, or a deviation. The following unresolved item was identified:

Unresolved Item	Title	See Paragraph
407/8801-08	Missing Documentation of Monthly Intrusion Drill	17

4. Licensee Action on Previously Identified Inspection Findings

(Open) Violation 407/8601-06: Operator Requalification Program - This item was discussed in NRC Inspection Report 50-407/86-01 and involved the licensee's failure to fully implement the TRIGA reactor operator requalification program (ORP). This item was reviewed in NRC Inspection Report 50-407/87-01 and the requalification program was found to be improved, but no personnel had successfully completed the operator licensing program other than the Reactor Supervisor. Therefore, no assessment of the implementation of the requalification program could be made at that time. During this inspection, the ORP was reviewed again, and the NRC inspector determined that the operator requalification examinations that were administered did not contain all of the topics listed in 10 CFR 55.21 and 22. Topics listed in 10 CFR 55.21 and 22, but not found on the examinations, include fuel handling procedures, reactor theory, core alterations, and alarm setpoints. This item remains open pending licensee evaluation and modification of the ORP.

5. Background

AGN-201 - The AGN reactor was being decommissioned. The reactor had not been operated since February 1985. The licensee had performed periodic surveillance on the integrity of the AGN core and shield water vessel. The licensee had removed the 25 tons of brick that were used both as a radiation shield and a physical security barrier for protection of the AGN fuel. The licensee had surveyed the bricks for radioactivity and the NRC inspector performed confirmatory measurements on the bricks. The bricks apparently did not contain any activated materials or radioactive

contamination and have been released by the licensee for unrestricted use. The licensee was currently evaluating the method to be employed for removal and shipment of the AGN fuel to a Department of Energy repository. Once the AGN fuel is removed, the licensee will submit a decommissioning plan to the NRC for approval. At the time of the inspection, only Dr. Sandquist was licensed to operate the AGN reactor.

TRIGA - The TRIGA reactor was being used for education and research purposes. The reactor was operated for approximately 369 hours during the 1985-1986 reporting period and approximately 142 hours during the 1986-1987 reporting period. The licensee had recently (December 1987) become aware of a fuel integrity problem with the current core configuration and had been operating the reactor for short periods and shuffling fuel in an attempt to locate the faulty fuel element. No significant radiological problems have been observed, and the indicators of leaking fuel are evident by small increases in the fission product inventory within the reactor coolant (RC) and the RC cleanup demineralizers. The licensee was limiting full power runs to short periods of time since the fission product increases were only detected after several hours of full power operation. At the time of the inspection, Dr. Sandquist and two graduate students were licensed to operate the TRIGA reactor.

6. Management Organization and Controls (40750)

The NRC inspectors reviewed the licensee's management organization to determine compliance with the requirements of TRIGA Technical Specification (TS) 6.1, 6.2, 6.5.1, 6.5.3, and 6.5.4 and agreement with the TRIGA Safety Evaluation Report (SER/NUREG-1096).

The licensee's organization and assignment of responsibilities are contained in the NEL Operations Manual. The NRC inspectors compared the existing organization to the requirements in the TRIGA TS. Dr. Sandquist was found to be filling TS Figure 6.1 positions of both Laboratory Director and Reactor Supervisor. Dr. Sandquist was found to have a teaching load that included seven courses per year and was currently advisor to 12 graduate students. Dr. Sandquist devotes approximately 15 to 25 percent of his time to TRIGA/AGN reactor activities. The NRC inspectors found very little support by the Reactor Administrator whose only activity in regard to the TRIGA/AGN reactor programs was to chair the RSC meetings. The TRIGA/AGN programs were, for the most part, carried out by the two SRO graduate students who were also pursuing advanced degrees at the UofU. The NRC inspectors expressed their concern about the lack of active support for the TRIGA/AGN reactor programs. This is considered an open item pending licensee review of program support for the TRIGA/AGN reactors. (407/8801-10)

The RSC's charter and membership were reviewed. The NRC inspectors also reviewed NEL procedures. Since late 1986, the licensee had been performing a detailed review of NEL operating procedures and developing a master administrative plan for the operation and management of NEL

activities related to the two reactors. The master plan was being prepared by a graduate student as a thesis project.

No violations or deviations were identified.

7. Qualification and Training (40750)

Personnel qualification and training were reviewed to determine compliance with the requirements of TRIGA TS 6.3, 6.4, and 6.5.2; Appendix A to 10 CFR Part 55; and agreement with industry standard ANSI/ANS-15.4-1977.

The NRC inspectors noted that previous requalification examinations administered to the operators were almost identical each time an individual took an examination. Several examinations answers were found to be typed, and at least one examination quoted the TS word for word, which indicated an open book examinations was given. NRC I&E Information Notice (IEIN) 87-22 addresses the subject of take-home or open-book examinations. IEIN 87-22 clearly indicates that take-home or open-book examinations are not an acceptable means for certifying individual performance. IEIN 87-22 states, in part, "The integrity of the requalification examination is essential because it is used to certify that the operator's performance is adequate to warrant renewal of his or her license." The examination process at the NEL TRIGA facility does not ensure operator knowledge of the required material. This is considered an open item pending licensee evaluation and action. (407/8801-11)

Part of the requalification training process, as stated in the requalification program, includes lectures and on-the-job training. The operator requalification training checklist/signoff sheet (this checklist was developed to resolve NRC Violation 407/8601-03) was reviewed by the NRC inspectors to ensure all items stated in the lectures and on-the-job training sections of the approved requalification program were on the checklist. The review indicated several subjects were not on the checklists. In the lectures section of the checklist, the "Operational Characteristics, Use, and Storage Locations of Existing and New Radiation Safety Equipment" sections were not referenced. In the on-the-job training section, the "Fuel Inspection," "Fuel Temperature Measurement," "Control Rod Worth Measurements," and "Annual Maintenance Shutdown Program" sections were not referenced. This is considered an open item pending licensee evaluation and action. (407/8801-12)

During the inspection, licensee personnel were interviewed about a December 28, 1987, letter that the licensee had submitted to NRC. The letter commented on an examination answer that an SRO candidate had given during a written examination administered by an NRC licensing examiner on June 23, 1987. The particular examination was the second SRO examination for the candidate. Although the candidate did not make a perfect score on the second examination, the test score was a passing grade. In the licensee's December letter, the licensee submitted for NRC consideration an explanation as to why NRC should accept the candidate's answer to

question number J.10, which the examiner had marked as incorrect. Question number J.10 was as follows:

> Assuming no operator action, what is the most likely cause of a reactor scram during a continuous rod withdrawal at normal rod speeds. INCLUDE THE SETPOINT OF THE TRIP.

The candidate's answer was as follows:

> The percent power trip at 120 percent of licensed power (120 kW).

The licensee's post-test comment (December letter) was as follows:

> The percent power setpoint is presently set at 115 percent of licensed power (115kW). However, the most likely cause of a reactor scram would be the linear recorder which would actuate at 100 percent of full scale and, therefore, scram slightly greater than 100 kW. UU SER Section 7.3.1, P. 7-8 (Safety Evaluation Report, NUREG-1096) states:
>
> > "If the power level increases to 100 percent of full scale of the recorder on any power range, a linear power level scram occurs."

The licensee's letter went on to say that they recommend acceptance of the examinee's answer on the basis of actual operating conditions that presently exist.

The NRC inspectors determined that the licensee's comment was confusing because the licensee had previously reported to the NRC by letter dated July 3, 1987, that the linear power channel scram circuit had been disconnected in January 1986. Previously, the licensee had self-identified, as a result of an RSC audit on June 3, 1987, that a facility modification had disabled the linear power channel scram resulting in a violation of the facility TS. This was because the reactor no longer had the TS 3.3.3 required scram channels (2) set to a limit of less than 120 percent of full power (e.g., 100 kW). The licensee corrected this situation and reset the scram channels as required by the TS. (See NRC Inspection Report 50-407/87-01, paragraph 5.a.) This problem was not a repeat violation. Consequently, in NRC Inspection Report 50-407/87-01, the licensee was not cited for a violation pursuant to the provisions of the NRC Enforcement Policy for licensee identified Severity Level IV and V violations.

When licensee personnel were questioned about the physical nature of the scram circuitry, varying degrees of understanding were evident. Subsequent discussions with licensee personnel and a review of the scram circuitry wiring schematics, along with a test demonstration of the reactor, verified that the January 1986 facility modification had only partially disabled the linear power scram channel. Specifically, scram circuitry for the 1-watt power range, which initiates from signals on the

fission chamber, was operable; however, when the power range selector switch was increased beyond the 1-watt power setting, scram signals arising from the uncompensated ion chamber were directed to a computer console, thus not resulting in reactor scrams. Therefore, the SRO candidate's answer to question J.10 and the licensee's December letter on the candidate's answer were both based on an incorrect understanding of the actual reactor control circuitry and were both incorrect. This incident demonstrated a need for the licensee to improve management controls on reactor modifications and the training of operators on the full affects of such modifications. This is considered an open item pending licensee evaluation and action. (407/8801-13)

No violations or deviations were identified.

8. Operations (40750)

The NRC inspectors reviewed the licensee's reactor operating program for compliance with the TRIGA license and TS conditions requirements. The licensee's operations were reviewed also for agreement with the commitments contained in the licensee's application for a 20-year renewal of the TRIGA operating license dated March 8, 1983, and subsequent November 29, 1984, supporting documentation in response to NRC questions.

The NRC inspectors inspected the licensee's facilities; operational, maintenance, and access logs; procedures; reactor safety committee meeting minutes; experiments; interviewed reactor operators; and observed the licensee operate the TRIGA reactor at low power levels to verify reactor protection systems operation.

The NRC inspectors determined that, except for some confusion over the technical details of the integrated computer console for monitoring selected TRIGA reactor functions, the reactor operators were familiar with the reactor and its support systems and demonstrated an adequate ability to properly and safely operate the reactor.

An inspection of the TRIGA reactor TS surveillance requirements was performed. The surveillance requirement specifications (TS 4.0) and licensee documentation were examined to ensure TS surveillances were being performed within the required time intervals. During the inspection, the following problem areas were noted:

> TS 4.5 requires the conductivity and pH of the primary coolant water to be measured monthly. The current monthly checklist ensures that the conductivity and pH are recorded on a monthly basis. Prior to this checklist revision (November 16, 1987), verification of performance of the required surveillances could not be established for water pH. The water conductivity was recorded on the TRIGA Preliminary Check Sheet each time a reactor startup was performed. The water pH was not a checkoff item on the TRIGA Preliminary Check Sheet and therefore was not recorded. This problem was self-identified by the licensee during a June 6, 1987 internal audit

by the RSC. This audit finding resulted in the revision to the Monthly Inspection Checklist.

The failure to perform monthly pH surveillances during the period of April 17, 1985 (when TS were last revised Amendment 5) to October 1987 (Monthly Inspection Checklist revised in November 1987) would normally be considered an apparent violation of TS 4.5. However, the licensee's actions satisfied the criteria in 10 CFR Part 2, Appendix C for licensee-identified violations.

TS 4.2(3) requires a channel check of the fuel element temperature measuring channel to be made each time the reactor is operated. This is performed by comparing the indicated instrumented fuel element temperature with previous values for the current core configuration and power level.

Contrary to the above, the NRC inspectors determined on February 19, 1987, that the licensee had not fully implemented the requirements of TS 4.2(3) in that a review of operation documents failed to verify that TS 4.2(3) was being performed each time the reactor was being operated. The licensee was only evaluating cold shut down temperature and a partial evaluation of fuel temperature during power operator. Additionally, no acceptance criteria for comparison of various fuel temperature versus power levels was found to exist. This apparent violation was also identified in a June 6, 1987, RSC audit. However, no action was taken to resolve the identified violation.

The failure to implement adequate procedures and to perform the fuel temperature comparison is an apparent violation of TS 4.2(3). (407/8801-01)

TS 4.3.2(1) requires reactor control and safety system scram times to be measured annually, but at intervals not to exceed 15 months. The scram time measurements were being added to the "Procedure for Semi-annual Control Rod Worth Determination" data sheets as a handwritten step 7. The licensee relies on writing of the TS 4.3.2(1) surveillance requirement each time the procedure is performed. The handwritten step was not found on the procedure data sheets dated October 8, 1985, and February 12, 1986. However, the scram time information was available on the scram graphic record attached to the procedure data sheets.

The performance and recording of the scram times should be a permanent part of the "Procedure for Semi-annual Control Rod Worth Determination" and should not be a handwritten step. This is considered an open item pending evaluation and action by the licensee. (407/8801-14)

During the review of the licensee surveillance documents, three data sheets were found to reference an out-of-date TS value. The

following forms referenced an excess reactivity TS value of $3.00: (The TS limit is currently $2.80 as per the facility operating license issued April 17, 1985.)

- Control Rod Worth Calculation Sheet
- Biennial Control Rod Check Sheet (This sheet also references TS 4.2.c, which is not a current TS paragraph number), and
- Control Rod Movement or Repair Procedure

The error in the excess reactivity value on the "Control Rod Movement or Repair Procedure" was discussed in the RSC meeting minutes of June 4, 1987. The NRC inspectors determined that the licensee had not responded to the RSC input concerning the error on the Control Rod Movement or Repair Procedure. A revision of the affected procedures is required because the values on the data sheets are less conservative than TS requirements. A review of recorded data indicated that the $2.80 value was not exceeded. The licensee revised the three documents during the inspection and they were to be presented to the RSC for approval.

This is considered an open item pending approval of the forms by the RSC. (407/8801-15)

In the TRIGA reactor license renewal documentation (licensee to NRC 1983 and 1984), the licensee stated in response to NRC question 46 that the low and high alarm setpoints for the three TRIGA facility ARMs (TS 5.4) were 0.1 and 1.0 millirem per hour (mr/hr), respectively. The NRC inspectors determined during the approach to criticality checkout of the TRIGA reactor on February 19, 1988, that the actual alarm setpoints for the ARMs were 1.0 and 10 mr/hr, respectively. Neither the licensee's calibration nor operational procedures address the required setpoints of the detectors. This condition has existed for an indeterminate length of time. The failure to maintain facility ARM setpoints is considered a deviation from commitments made to the NRC in TRIGA licensing documentation dated November 29, 1984. (407/8801-09)

The NRC inspectors determined, during the review of operational logs, that during the approach to criticality on January 4, 1988, the SRO noted that the reactor became critical prematurely while withdrawing the regulating rod with the safety rod already withdrawn and latched. The SRO expected the reactor to only become critical following full withdrawal of the regulating rod and subsequent partial withdrawal of the shim rod. The RSO manually tripped the reactor and conducted an investigation into the occurrence. The investigation was documented in the maintenance log and master operations log. The investigation revealed that the trapezoidal heavy water (D_2O) reflector tank (see Section 10.1.4 of the SER) was improperly reassembled and replaced into the core following biennial reactor core preventative

maintenance. The improperly reassembled tank resulted in an air space being replaced by heavy water which caused additional neutron moderation and reflection, thus causing a premature criticality. The improper reassembly and placement of the D_2O tank into the core following maintenance is discussed as an apparent violation in paragraph 10 of this report. The SRO's actions were considered appropriate and well documented. Operation was continued following removal of the D_2O tank from the core and correcting its configuration.

No other violations or deviations were identified.

9. Review and Audits (40750)

The licensee's review and audit program for the TRIGA and AGN-201 reactor facility was inspected to determine compliance with the requirements of AGN-201 TS 6.4.2 and 6.4.3 and TRIGA TS-6.5.4 and 6.5.5.

The NRC inspectors determined that the RSC audits were being performed in a detailed and thorough manner. Minutes of the RSC meetings for the period of 1986 through 1988 were reviewed. The NRC inspectors determined that the NEL staff's response to RSC audit findings were less than adequate and that, due to the failure to respond to RSC audit findings, there were several apparent violations and open items documented in this report. The Reactor Supervisor indicated that the increased RSC oversight has increased the operations staff's workload and that additional manpower resources were not available to both maintain the facility and correct all of the deficiencies promptly. The licensee's lack of adequate response to and followup on audit deficiencies is considered an open item pending licensee evaluation of the RSC audit process. (407/8801-16)

No violations or deviations were identified.

10. Logs and Records (40750)

The licensee's program for documentation of the TRIGA and AGN-201 reactor activities was reviewed for compliance with the requirements of AGN-201 TS 6.4.5 and 6.10 and TRIGA TS 4.3.5, 6.5.6, and 6.9.

The NRC inspectors reviewed the documentation of reactor operation for the TRIGA reactor for the period March 1985 to February 1988. The AGN-201 reactor was not operated during this period. The documents and records associated with maintenance, fuel movement, fuel inspection, personnel exposure, experiments, startup checklists, and instrument response checks were reviewed. The NRC inspectors determined that the licensee maintained legible operation and maintenance logs. However, many checkoff sheets for documentation of maintenance activities and periodic surveillance showed corrections that did not identify by whom and when the change/correction had been made. The NRC inspectors discussed with the licensee the standard industry practice of using a single line-out of an error, and the placing of the initials (legible) of the individual making the change and

the date of the correction near the item(s) corrected. This is considered an open item pending evaluation and action by the licensee. (407/8801-17)

No violations or deviations were identified.

11. Procedures (4075J)

The licensee's reactor operating procedures were reviewed for compliance with the requirements of TRIGA TS 6.8.

The NRC inspectors determined that the licensee does not have a method of ensuring that only the most current RSC and/or NRC approved procedures, plans, TS, data sheets, and other forms are maintained available in the control room. This was evidenced by an SRO's confusion over what revision of the Emergency Plan was approved for use by both the RSC and the NRC. Three different revisions were available and approved by the RSC. The licensee did not have a formal document control and distribution program. This is considered an open item pending licensee actions to improve document control and distribution. (407/8801-18)

TRIGA TS 6.8 states, in part, that "Written operating procedures shall be adequate to ensure the safety of operation of the reactor . . . Operating procedures shall be in effect for the following items: . . .

(4) core changes and fuel movement . . .

(6) performing preventative maintenance . . . on the reactor and associated equipment"

During the biennial fuel and control rod inspection, the trapezoidal heavy water (D_2O) tank was removed from the core on December 29, 1987, for inspection and maintenance. No reference was made to the use of a procedure for this activity. The TRIGA reactor core was reassembled and the D_2O tank was replaced in its position at the outer periphery of the core on or about January 4, 1988. During the subsequent TRIGA reactor approach to criticality on January 4, 1988, the reactor prematurely went critical (see paragraph 7 for details). The ensuing investigation by the NEL staff determined that the D_2O tank had been installed without replacing the dry experiment tube in the tank center which caused the normal air space to be replaced with D_2O water, thus increasing neutron moderation and reflection. (Paragraph 4.1 and 10.1.4 of the SER addresses functional design considerations of the D_2O tanks.)

During a review of the maintenance log on February 18, 1988, the NRC inspectors could not verify that a procedure had been established and used for the removal, inspection, disassembly, and reassembly of the D_2O tank prior to placing it back into the TRIGA core tank. The NRC inspectors determined on February 19, 1988, that the failure to properly reassemble the D_2O tank was in part due to the lack of written procedure. The NRC inspector noted that a member of the RSC was reviewing the maintenance log entries on the same day as the NRC inspectors and that he also noted the

problem. The failure to develop and implement adequate procedures for core alterations and reactor maintenance operations is considered an apparent violation of TS 6.8(4) and (5). (407/8801-02)

The NRC inspectors reviewed the licensee's calibration of the fuel element temperature thermocouple (T/C). The licensee used a written procedure (Semiannual Thermocouple Calibration) for the T/C calibration. The calibration was performed using properly calibrated reference equipment and in-house laboratory prepared reference standards. The NRC inspectors noted that the stated calibration tolerances were considerably less than that which could be accurately determined from the fuel element temperature readout meter. The reactor console fuel element temperature readout is in increments of 5.0°C on the analog meter (0-500°C) and the calibration procedure requires that the fuel temperature alarm/trip point setting be within ±0.5°C of the actual setting. A limitation of one-half of the smallest scale division is normally taken as standard industry practice when interpreting analog meter readings. The licensee's use of 0.5°C as a tolerance is approximately 5 times greater than what can accurately be discerned from the fuel element temperature readout. Discussions with licensee personnel about the overly restrictive tolerance resulted in the reestablishing of the setpoint tolerance for this particular activity at ±5.0°C. The NRC inspectors noted that the licensee did not in all cases include TS limit values and, in most cases, setpoint/calibration tolerances on instrument calibration and checkout sheets. This is considered an open item pending the licensee's evaluation and review of current calibration and surveillance check sheets. (407/8801-19)

No violations or deviations were identified.

12. Experiments (40750)

The licensee's program for the control and conduct of experiments was inspected to determine compliance with the requirements of TRIGA TS 1.2, 3.2, 3.6, and 6.5.4(1); agreement with the recommendations of NRC Regulatory Guides (RG) 2.2 and 2.4; and agreement with industry standard ANS-15.6/N401-1974.

The NRC inspectors reviewed the licensee's installation (as an experiment) of a computerized monitoring system for the monitoring of certain core parameters. The computer installation was reported to the NRC via the July 1, 1986, through June 30, 1987, "TRIGA Reactor Annual Operating Report." The licensee also included a 10 CFR Part 50.59(a) evaluation of the computer installation in the annual report. The NRC inspectors verified that the computer console was installed as depicted in the annual report. The licensee is treating the computer operation as a routine Class 2 type experiment TS 1.2(2). The NRC inspectors verified that the computer did not interfere with any reactor safety systems and had no affect on the reactor's automatic scram actions or engineered safety features. The computer monitors 11 reactor parameters. The licensee has had frequent software problems with the computer. Currently, the licensee

does not possess sufficient documentation for evaluation of the computer for permanent replacement of official core parameter monitoring circuitry. The licensee had also installed a new rack and pinion control rod drive mechanism (commonly used on TRIGA reactors) for replacement of the old drum and cable system (paragraph 4.1.2, 4.6.1, and 7.1.2 of the SER address the existing control rod drive mechanism) now employed. The licensee has connected the regulating control rod to the computer controlled rod drive mechanisms and classified it as an experiment. Due to the regulating rod's low reactivity worth (approximately $0.46), the reactor staff, through the RSC, determined that the use of the regulating rod in the experimental mode (with the rack and power system) would not cause an unreviewed safety question and approved its use in the computer system experiment. This change was also reported to the NRC in the same annual report.

No violations or deviations were identified.

13. Reactor Fuel Handling (40750)

The NRC inspectors reviewed the licensee's procedures and logs regarding the handling and storage of TRIGA reactor fuel for compliance with the requirements of TRIGA TS 4.4 and 5.5.

The licensee's biennial inspection of fuel for the period January 1985 through February 1988 were reviewed. The results of the 1985 fuel inspection and identification of excessive corrosion were reported to the NRC in the 1985-86 TRIGA Reactor Annual Report. The licensee's 1987 biennial fuel inspection did not identify any significant findings. An instrumented fuel element (fuel temperature thermocouples) was changed out due to failure of the thermocouples and excessive corrosion. The licensee had verified their suspicion that the core contained a leaking fuel element by finding positive indications of fission products in the TRIGA reactor core tank following a January 11, 1988, reactor run. Since that time, the licensee has only operated the reactor for purposes of trying to find the leaking fuel element following fuel shuffles. This is in accordance with the requirements of TS 4.4(3) which allows short-term operation of the reactor to aid in finding the leaking fuel element(s). This is an open item pending further review by the NRC during future inspections. (407/8801-20)

No violations or deviations were identified.

14. Transportation of Radioactive Materials (86721)

No transportation of radioactive materials has been made by the licensee since this area was last inspected in 1986.

No violations or deviations were identified.

15. Radiation Protection (40750)

The licensee's radiation protection program was inspected to determine compliance with the requirements of the TRIGA TS 3.7, 4.3.3, 5.4, and 10 CFR Part 20 and agreement with the recommendations of industry standard ANSI/ANS-15.11-1977.

The NRC inspectors reviewed current facility radiological surveys and reports to the NRC concerning comprehensive NEL surveys, performed independent confirmatory measurements of the loose surface contamination and radiation levels, and inspected portable and fixed radiation monitoring instrumentation within the NEL.

10 CFR Part 20.201(a) states, in part, that "As used in the regulations . . . 'Survey' means an evaluation of the radiation hazards incident to the . . . use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. When appropriate, such evaluations include a physical survey of the locations of materials . . . and measurements of levels of radiation . . . present." Part 20.201(b) requires, in part, that "Each licensee shall make or cause to be made such surveys as (1) may be necessary for the licensee to comply with regulations . . . (2) are reasonable under the circumstances to evaluate the extent of radiation hazards that may be present."

a. During the independent radiation surveys on February 17, 1988, the NRC inspectors found that a part of the TRIGA reactor pneumatic sample transfer system (rabbit terminus) stored on the floor in the AGN and TRIGA reactor room (1205-E, which is posted as a radiation area) had gamma radiation levels at contact near one end of approximately 120 mr/hr and approximately 10 mr/hr at 1 foot. Licensee documentation showed that on February 1, 1988, the rabbit terminus was removed from the reactor core and surveyed by an SRO. The SRO determined that the rabbit terminus had gamma radiation levels of 18 mr/hr on contact and approximately 10 mr/hr at 1 foot. The SRO tagged the rabbit terminus with a "Caution Radioactive Material" tag and annotated it with the contact dose reading. The NRC inspectors determined that the rabbit terminus was improperly surveyed and the posting failed to properly warn personnel of the radiation hazards associated with handling the material. The licensee on February 17, 1988, verified the NRC inspector's survey results with their own surveys and posted the rabbit terminus with a "Caution Radiation Area" sign. This is similar to the inspection findings referenced in NRC Inspection Report 50-407/86-01.

b. The NRC inspectors determined on February 17, 1988, during loose surface contamination surveys (smear surveys), that the NEL exhaust ventilation system (an engineered safety feature, paragraph 6.1 of the SER) was contaminated internally to a level of approximately 3,000 disintegrations per minute per 100 square centimeters. This contamination was found on the downstream side of the system's filters and system radiation monitors (four). The licensee confirmed

on February 17, 1988, by gamma spectrometry, that the contamination was primarily composed of cobalt-60. The licensee had never performed smear surveys of the interior of the ventilation ducting. However, the licensee had known of the presence of cobalt-60 contamination in the facility since initial core loading (1977). Routine NEL area smear surveys have detected the presence of cobalt-60 contamination throughout the facility on several previous occasions. The contamination had resulted from the reactor fuel being shipped to the licensee in fuel containers that were contaminated with cobalt-60.

The NRC inspectors discussed with the licensee the need to reevaluate the reactor facility's airborne effluent safety analysis in view of the above findings and report the results in the next TRIGA annual report.

The failure to adequately survey the rabbit terminus and the ventilation system internals is considered an apparent violation of 10 CFR Part 20.201(b). (407/8801-03)

TRIGA TS 5.0, "Design Features," and TS 5.4, "Radiation Monitoring System," state, in part, "This specification describes the functions and essential components of the . . . system for continuously monitoring airborne radioactivity . . . (2) Function of Continuous Air Radiation (CAM) Monitor (beta-, gamma-sensitive detector with particulate collection capability): Monitor concentration of radioactive particulate activity in the pool room, alarm and readout at control console."

The NRC inspectors determined on February 18, 1988, that the airborne monitors did not have the capability to collect or monitor qualitatively or quantitatively particulate radioactivity. This item was also addressed in an RSC audit performed by the UofU Radiation Safety Officer on June 6, 1987. The RSO recommended installation of a CAM in the facility, but no action had been taken to resolve the audit finding.

The failure to have installed and operating a continuous airborne monitoring with particulate collection capabilities is considered an apparent violation of TS 5.4(2). (407/8801-04)

No other violations or deviations were identified.

16. Emergency Planning and Preparedness (40750)

The licensee's implementation of the NRC approved UofU Emergency Plan (E-Plan) for the AGN-201 and TRIGA reactors was reviewed for compliance with the requirements of 10 CFR Part 50.54(q) and (r) and agreement with the recommendations of NRC RG 2.6 and industry standard ANSI/ANS-15.16-1982.

The licensee has not conducted an exercise of the E-Plan since June 12, 1986. NRC Inspection Report 50-407/86-01 addresses NRC observations and

concerns identified by the inspectors during the 1986 exercise. The licensee has tentatively scheduled an E-Plan exercise before June 1, 1988. The licensee is currently conducting training of staff and offsite support services on the requirements of the E-Plan.

The NRC inspectors discussed with the licensee the current status of the revised E-Plan (December 1, 1986) submitted to the NRC Office of Nuclear Regulation (NRR) for review and approval on or about May 21, 1987. The NRC inspectors verified that the old E-Plan (1984) was still the E-Plan being implemented.

The NRC inspectors inventoried the contents of the E-Plan required emergency supply kit located in the NEL. All items that are required were found to be in the emergency kit (duffel bag) or were accessible during an emergency.

The NRC inspectors determined on February 17, 1988, that the campus police department dispatcher's office contained an outdated NEL emergency response procedure (Appendix 5A, dated May 30, 1986). An RSC revision to Appendix 5A was issued/approved June 4, 1987. This is considered an open item pending licensee actions to ensure that nonNEL organizations which have emergency response responsibilities have and will continue to receive the latest revision to the emergency procedures. (407/8801-21)

No violations or deviations were identified.

17. Physical Security (81431)

The NRC inspectors verified the implementation of the Physical Security Plan (PSP) by review of logs, observation of equipment, and discussions with licensee representatives responsible for implementation of the PSP. An unannounced test of the UofU police department's response to an intrusion alarm was conducted. The current PSP approved for implementation by the licensee is addressed in Amendment No. 5 to the facility license (R-126). License Condition 2.C(3) of License R-126 states, in part, that "The licensee shall maintain and fully implement all provisions of the Commission-approved physical security plan, including amendment and changes made pursuant to the authority of 10 CFR 50.54(p). The approved physical security plan consists of documents . . . entitled "University of Utah Physical Security Plan for Protection of SNM of Low Strategic Significance under Licenses R-25 and R-126 . . . Revision 1 dated July 28, 1980 . . . ."

Chapter 3 of the PSP states, in part, "In every event of a violation of the UNEL (University Nuclear Engineering Laboratory, also known as the NEL) Intrusion Alarm System an armed campus police officer is dispatched to the UNEL to investigate the incident . . . Each campus police officer receives annual familiarization tours and instructions . . . and incident response procedures are given. The dispatcher's office is supplied with written instructions for sequential actions . . . ." Chapter 2 of the PSP

requires that the satisfactory operation of the entire intrusion alarm system be verified monthly.

Appendix 5A of the NEL Emergency Procedures, RSC-approved May 30, 1986, and June 7, 1987, titled "NEL Emergency Procedures for Non-NEL Organizations," requires that upon receipt of an intrusion (NR) alarm signal from the NEL the dispatcher (campus police) should immediately dispatch one or more officers to Merrill Engineering Building (MEB). The officer(s) responding to an alarm from the NEL shall first check the exterior perimeter of the facility for physical damage and/or breach of security. The entrances (old room No./new room No.) to be checked are:

- Exterior door to room 1001/1205 MEB
- Exterior door to room 1001-G/1205-G. Note: Access to this door is through the west end of room 1056/1156.
- Exterior windows (outdoors, west side of MEB)
- Roll-up garage door (west side of MEB)

NOTE: Room numbers were revised in 1986. Room and door identifiers are contained in Revision 1 to the PSP and Figure 4.1 of the SER. Furthermore, one radiochemistry room is mislabeled in these documents; 1001-E should be labeled 1001-G.

On February 17, 1988, an unannounced security drill was conducted and was initiated by tripping the intrusion alarm at room 1001-G/1205-G exterior door (enters into room 1156) to a radiochemistry room. An SRO and an NRC inspector were positioned at the open door. The campus police responded to the event within 4 minutes. However, the NRC inspectors determined that the responding police officer entered MEB room 1001/1205 prior to checking the perimeter of the facility. The responding officer then only checked on the status of the room 1205-G exterior door after some coaching from a supervising police officer in the dispatcher's office. Door 1001-G/1205-G was not discovered open until approximately 16 minutes after the police officer's arrival at the MEB/NEL. The officer's entry into the classroom of room 1001/1205 could have prevented the police officer's efforts to determine if an intrusion had been made and allowed the intruder to make an exit via room 1056/1156 of the MEB. The responding officer stated that he had been provided a familiarization tour of the NEL during the last 12 months.

The failure to follow the sequential requirements of the NEL emergency response procedures which implement the PSP is an apparent violation of the PSP. (407/8801-05)

The NRC inspectors determined during the inspection that an area radiation monitor (ARM) located just inside and over the entrance door to classroom 1001/1205 was not turned on for most of the time the NRC inspectors were present in the room. The ARM was turned on prior to the

conducting of the intrusion test on February 17, 1988, but was again noted by the NRC inspectors to be turned off on February 18-19, 1988.

Appendix 5A of the NEL Emergency Procedures requires, in part, that "the security personnel observe area radiation monitor readout for dose rate information when responding to an alarm. This is to be accomplished before entering the NEL interior but after inspection of the perimeter doors." The ARM to be used in this instance is located inside the NEL over the entrance door to room 1001/1205. The responding police officer did not know how to determine if the monitor was on or how to turn the monitor on. When in the off mode, the monitor's radiation level indicator reads zero (no radiation present). This could lead to a false assumption by the responding officer that no radiation is present. The area radiation monitor is not referenced in or required by the E-Plan.

This is considered to be an open item pending evaluating and action by the licensee. (407/8801-22)

The NRC inspector's review of the NEL Monthly Inspection Checklist log book found one monthly checklist missing (June 1987). The monthly checklist was present for all other months reviewed (1985-1988). Part of the monthly checklist concerns an intrusion alarm check. This security drill is required on a monthly basis by the PSP. Failure to perform the PSP-required monthly security drill is an apparent violation of the PSP. However, the licensee believes the security check was performed and they will conduct a search in order to locate the record. This is considered an unresolved item pending further NRC review. (407/8801-08)

A test of the emergency power system was performed on February 17, 1988. Emergency power (or back-up power) is supplied by a 12 Vdc battery to the radiation monitors and intrusion detectors on a loss of building AC power. To test the battery capacity, the trickle charge supply to the battery and AC power to the TRIGA console were disconnected. The emergency power system (batteries) dropped in voltage to 2-3 Vdc within 7 hours. At that time, an automatic trouble alarm was received by the UofU police department. The trouble alarm was responded to by the UofU maintenance department. Prior to the maintenance person correcting the problem, the SRO attempted to activate the intrusion alarm by opening alarmed door 1001-E/1205-E. The intrusion alarm circuitry failed to actuate due to the low voltage condition of the discharged battery. The NRC inspectors determined that the backup power system (batteries) failed to maintain the radiation and intrusion alarms circuits operable.

The test indicated the batteries would fail to perform their intended function over a period of time if a real loss of AC power emergency event had occurred. Additionally, a large crack was noted on one of the battery cells. The preventative maintenance program for the batteries appears to need more attention by the licensee. This is considered an open item pending evaluation and action by the licensee. (407/8801-23)

Chapter 1 of the PSP states that all Special Nuclear Material (SNM) for the AGN-201 nuclear reactor is located within the core assembly of the reactor. Access to this SNM requires the removal of approximately 25 tons of dense concrete block and three other mechanical barriers to gain access to the AGN fuel. Due to the time and heavy equipment needed to gain access to the AGN fuel, this is considered an adequate barrier to prevent unauthorized removal of the AGN fuel.

Further, the PSP states, in regard to the protection of TRIGA fuel, that fuel elements within the reactor core tank are covered by 24 feet of water and require a special tool (which is locked up when not in actual use) for removal of the fuel elements from the tank.

The NRC inspectors determined on February 16, 1987, that the licensee removed the 25 tons of concrete block from over and around the AGN-201 reactor. The licensee had started this removal in August 1987 and had completed the removal about November 28, 1987. When questioned by the NRC inspectors on the removal of the concrete bricks, licensee representatives indicated that they thought of the concrete bricks only as a radiation shield and not a required physical barrier to prevent removal of the AGN fuel. The last review of the PSP by the RSC was conducted on or about May 21, 1987. Removal of the concrete physical barrier was not approved by the NRC. In addition, the NRC inspectors also determined that the licensee was storing the TRIGA fuel handling tool in an unlocked cabinet below the chemistry fume hood in room 1205-F (unlocked access door) adjacent to the TRIGA/AGN reactor room (1205-E). This condition had existed for an indeterminate amount of time. The NRC inspectors noted that RSC audits do not appear to include PSP components or requirements.

The failures to properly implement the PSP regarding protection of SNM is considered apparent violations of the PSP. (407/8801-06)

No other violations or deviations were identified.

18. Plans, Procedures, and Reviews (81401)

The licensee's control and maintenance of the PSP was reviewed to determine compliance with the requirements of 10 CFR Part 50.54(p).

The NRC inspectors reviewed the current PSP (December 1, 1986) and compared its contents against the previous PSP (July 28, 1980) to determine that changes to the PSP have not decreased the overall effectiveness of the plan and the implementing procedures are adequate to satisfy the performance objectives of the regulations.

License Condition 2.C(3) of License R-126 states, in part, that "The licensee shall maintain and fully implement all provisions of the Commission-approved physical security plan, including amendments and changes made pursuant to the authority of 10 CFR 50.54(p)."

10 CFR Part 50.54(p)(1) states that the licensee may make no change which would decrease the effectiveness of a security plan prepared pursuant to 50.54(c). Furthermore, Part 50.54(p)(2) states that a licensee may make changes to the plans referenced in Part 50.54(p)(1) without prior Commission approval if the changes do not decrease the safeguards effectiveness of the plan. When such changes are made, the licensee must submit, as specified in Part 50.4, a report containing a description of each change within 2 months after the change is made.

Revision 2 of the PSP (new plan) dated December 1, 1986, was reviewed and approved by the RSC. The revised PSP was sent to the NRC for review on or about May 21, 1987, some 5 months following its apparent implementation. The NRC inspectors determined on February 18, 1988, that Revision 2 to the PSP decreased the plan's effectiveness in at least five areas and thus decreased the overall effectiveness of the plan. NOTE: Room numbers were revised in 1986, but the old room numbers will be used in this discussion. Room and door identifiers are contained in Revision 1 to the PSP and Figure 4.1 of the SER. Furthermore, one radiochemistry room is mislabeled 1001-E in these documents and should be labeled 1001-G.

The five areas of decreased effectiveness are:

a. Old Plan - The two doors (4 and 5) leading to and between the two chemistry rooms (1001-F and G) from the adjoining TRIGA/AGN reactor room (1001-E) were both required to be secured by dead bolt lock. These two chemistry rooms share a common false ceiling.

   New Plan - Only requires that door 5 between rooms 1001-F and 1001-G be the only door required to be dead bolt locked.

   Discussion - Due to the existence of a common false ceiling (between rooms 1001-F and G) over door 5 and the lack of a requirement for dead bolting of door 4 (door leads directly into the TRIGA/AGN reactor room (1001-E)). This effectively decreases access control to room 1001-E.

b. Old Plan - States that door 3 (entrance to room 1001-E from 1001-D), door 4 (entrance from 1001-E to 1001-F), and door 5 (entrance from 1001-F to 1001-G) are treated the same for security purposes.

   New Plan - States that only doors 3 and 4 are treated the same for security purposes.

   Discussion - This is in line with the change made in paragraph 1 above. However, this does result in a lessening of the access control plan for the facility.

c. Old Plan - States that there are four physical barriers to prevent access and the removal of fuel from the AGN reactor. One of the specified barriers is 25 tons of concrete blocks stacked over and around the AGN reactor.

New Plan - Has eliminated reference to the 25 tons of concrete blocks from the plan.

Discussion - This decreases the physical security for the AGN fuel.

d. Old Plan - Stated that the NEL's intrusion alarm was tied into the UofU's Radiation Safety Office as well as the campus police department and provides a visual as well as an oral alarm.

New Plan - Deletes reference to this secondary alarm location.

Discussion - The licensee was previously issued a Notice of Violation (NRC Inspection Report 50-407/86-01) concerning the failure to maintain this alarm at the Radiation Safety Office. The deletion of the secondary alarm is considered a reduction in the PSP intrusion alarm capabilities.

e. Old Plan - Chapter 3 required that the police dispatch in every event of a violation of the NEL intrusion alarm system an armed campus police officer to the NEL to investigate the incident and to report to the dispatcher the officer's findings.

New Plan - Chapter 3 now states, "In every unresolved event of a violation of the . . . intrusion alarm . . ."

Discussion - This change indicates that the dispatcher now makes an evaluation of the alarm and decides on whether or not to dispatch an officer. No guidance has been given the dispatcher on how they are to accomplish this evaluation. The licensee indicated that the dispatcher would try and contact someone at the NEL to confirm the alarm as part of the evaluation. This reasoning does not provide for the possibility that the person being contacted is under duress (being forced to give a positive reply) and informing the dispatcher that the alarm was a false alarm. This also decreases the effectiveness of the PSP.

The NRC inspectors determined that the effectiveness of the PSP had been overall decreased by the combined changes in Revision 2 to the PSP. Even though some of the changes were warranted, the licensee and the RSC failed to provide adequate documentation as to why the changes were being made, and obtain NRC approval prior to making them.

The failure to submit the revised PSP to the NRC within 2 months after implementation and the failure to obtain NRC approval before implementing the revised PSP is considered an apparent violation of and 10 CFR Part 50.54. (407/8801-07)

No deviations or other findings were noted in this area.

19. Material Control and Accounting (85102)

The licensee's SNM control and accountability program was reviewed to determine compliance with 10 CFR Part 70.

The NRC inspected the licensee's NRC Forms 741 and 742 to determine compliance with inventory and reporting requirements. The licensee has been reporting a combined SNM inventory of 5,498 grams in the routine reports since 1985 to the NRC per 10 CFR Part 74.13.

The NRC inspectors performed a inventory of SNM including TRIGA fuel the licensee had on site. Inventory balance for the TRIGA fuel showed that based on SER values for SNM content of TRIGA fuel the licensee's reporting values are lower than those calculated by the NRC inspectors. The NRC inspectors did not consider burn up and only considered the inventoried fuel elements to contain the original quantities of SNM. The licensee's TRIGA fuel element inventory by serial number is over 8 years old. The NRC inspectors discussed the need to conduct a serial number inventory of each fuel element and source containing SNM on site, including the AGN fuel. The NRC inspectors determined the licensee had 5 spent TRIGA elements in the spent fuel storage wells (4 in the south well, none in the center well, and 1 in the north well) and 50 elements in 6 fuel storage racks inside the reactor tank, and 81 fuel elements in the TRIGA core. These values agree with the licensee inventory of 136 fuel elements.

This is considered an open item pending the licensee's review of the SNM accountability program. (407/8801-24)

No violations or deviations were identified.

20. Reports and Notifications

The NRC inspectors reviewed the licensee's submittal of reports and notification to the NRC to determine compliance with AGN-201 TS 6.9.1 and 6.9.2, and TRIGA TS 6.10 requirements.

The NRC inspectors reviewed reactor facility annual reports since 1980, 30-day notifications concerning self-identified TS deficiencies, and telephonic communications with NRC NRR and Regional staffs.

No violations or deviations were identified.

21. Exit Interview

The NRC inspectors met with the licensee's representatives identified in paragraph 1 of this report on February 19, 1988. The NRC inspectors summarized the scope and the results of the inspection. The NRC inspectors emphasized to the licensee that the numerous violations indicate a lack of management oversight and support.