COLLEGE OF ENGINEERING

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

NUCLEAR REACTOR LABORATORY

January 11, 1983

Mr. R. C. Lewis, Director
Division of Project and Resident Programs
U. S. Nuclear Regulatory Commission, Region II
101 Marietta Street, N.W.
Atlanta, GA 30303

Dear Sir:

In response to your letter of December 15, 1982 (Report No. 50-124/82-01), we acknowledge the two violations cited in Appendix A.

With respect to Item A, while the required annual audits were partially carried out, we admit that our documentation of the audits was unsatisfactory. The reason for this violation was the lack of a formal procedure for carrying out the audits. In order to prevent a recurrence of the violation, we propose to initiate a procedure for reactor audit and review. The proposed procedure is included as Attachment I. We believe that this corrective action will prevent a recurrence of the violation. The proposed procedure will be presented to the Reactor Safety Committee on January 31, 1983, so we should be in full compliance after that date.

In regard to Item B, while the Radiation Safety Committee has reviewed the fact that we were manually withdrawing control rods for drop time measurement testing of control rods, we admit we do not have documentation for a safety analysis being performed on manual withdrawal of a control rod. The reason for the error was the fact that without the moderator in the core (procedure requirement), we have a negative reactivity of 30% $\Delta K/K$ inserted in the core. The maximum reactivity any one control rod will insert when pulled is 0.77% $\Delta K/K$. This fact was apparently taken to meet the safety analysis requirements. We now realize we are in violation and propose to correct this by submitting to the Radiation Safety Committee a Safety Analysis Report covering a manual rod withdrawal with moderator out of the core. The proposed Safety Analysis Report is included in Attachment II. We believe this corrective action will prevent any recurrence of the violation. The proposed Safety Analysis Report will go before the Reactor Safety Committee for approval at the 31 January 1983 meeting and we should be in full compliance after that time.

Sincerely yours,

Thomas F. Parkinson

Thomas F. Parkinson, Director
Nuclear Reactor Laboratory

smw
attachments
cc: R. A. Teekell
P. D. H

APPROVED/REVIEWED ____________________
Date

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Chairman, Reactor Safety Committee

III.3 Reactor Audit and Review (annual)

In accordance with the Radiation Safety Manual, annual audits must be conducted in the following areas: Reactor Operations, Security, Special Nuclear Material Inventory and Safeguards. Accordingly, all procedures, Technical Specification operating logs and other documentation pertaining to the safe operation and of the VPI&SU Nuclear Reactor Laboratory shall be audited annually by three (3) members of the Reactor Safety Committee (R.S.C.) not directly associated with reactor operations. These members shall be designated at the general R.S.C. meeting just prior to the quarter in which the audit is to be performed.

All Special Nuclear Material (S.N.M.) shall be inventoried by:

1. The Reactor Supervisor
2. The University Reactor Radiation Safety Officer
3. One of the three members designated by the R.S.C. to take part in the annual audit.

As for the rest of the areas of the audit, the three members designated to perform the audit will perform the audit with only assistance from the reactor staff.

1. The Audit will consist of a review of the following:

   A. Reactor Operations

      i. Reactor Operating logs
      ii. Reactor Procedures
      iii. Reactor Operation/R.S.C. Meeting Minutes
      iv. Requalification procedures/documents
      v. Equipment calibration/maintenance data

   B. Security

      i. Security Procedures/documents

   C. Special Nuclear Material

      i. All S.N.M. stored with the VPI&SU Nuclear Reactor Laboratory or assigned to the Nuclear Laboratory Personnel.

   D. Safeguards

      i. Experiment Procedure/documentation
      ii. Annual Report
      iii. Technical Specifications
      iv. Safety Analysis Report

2. The Audit shall be documented by completing the attached report, with the exception of the S.N.M. inventory, which will documented on the S.N.M. report (NRC 742).

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Chairman, Reactor Safety Committee

III.3 (continued)

3. The S.N.M. inventory shall consist of actual "sighting" of all Special Nuclear Material listed in the previous S.N.M. report. (NRC 742) inventory, with adjustments made for any transfers since the previous inventory. Irradiated fuel sighting shall consist of inspection of fuel transfer logs, reactor core inventory, and confirmation of storage of the appropriate number of "hot" fuel plates as recorded in fuel storage logs.

   Confirmation of fuel plate serial numbers shall be by inspection of individual serial numbers from not less than two (2) storage locations chosen at random by the consultant member of the S.N.M. inventory team. (for non-irradiated fuel only.)

   A. The formula used for burnup of U^{235} shall be 4.356×10^{-2} grams/Mw-hr. The formula for burnup + transmutation of U^{235} shall be 4.356×10^{-2} grams/Mw-hr. $\times \frac{98+580}{580}$.

      The figures reported on any completed NRC-732 forms shall be checked by the consulting member of the S.N.M. inventory team.

4. Any significant discrepancies (any excess or missing Items in the S.N.M. inventory) shall be reported immediately to the chairman of the Radiation Safety Committee. Should the S.N.M. discrepancy not be readily resolved, the discrepancy shall be reported to the Nuclear Regulatory Commission within 24 hours.

5. The report results (report sheet and NRC-732) shall be presented at the next general R.S.C. meeting along with recommendations for correction of any discrepancies found.

6. A copy of the results of the audit plus corrections performed for any discrepancies found shall be included in the annual report.

APPROVED/REVIEWED ____________
Date

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Chairman, Reactor Safety Committee

III.3 Reactor Audit and Review Report Sheet

Areas listed below are to be audited annually and will include the subjects listed in Procedure III.3. Any comments will be placed in the space provided and may be continued as necessary. All areas must be filled in. Special Nuclear Material will use NRC-742.

A. Reactor Operations:

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B. Security:

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Date

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Chairman, Reactor Safety Committee

III.3 Reactor Audit and Review Report Sheet (continued)

C. Safeguards:

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Continued /__/

D. Audit completed by:

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Reviewed: ______________________________
Chairman, Reactor Safety Committee

ATTACHMENT II

COLLEGE OF ENGINEERING

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

NUCLEAR REACTOR LABORATORY

January 11, 1983

TECHNICAL SPECIFICATION CHANGE PROPOSAL

RE: License No. R-62, Docket No. 50-124
Safety Analysis Report, Manual Withdrawal of a Control Rod
Drop Time Measurements and Analysis for Technical Specifications

SUBJECT: Change in Technical Specifications 6.2.2
Maximum Reactivity Input Rate of Safety and Shim Rods

TYPE: Nuclear

PROPOSAL:

Original wording:

6.2.2 The two safety rods and the shim rod shall each have a reactivity worth of approximately 0.55% $\Delta K/K$. The safety rods must be withdrawn sequentially prior to withdrawal of the shim or regulating rods. The maximum reactivity input rate of the safety and shim rods shall not exceed 0.02% $\Delta K/K$/sec. The maximum time for insertion of the shim and safety rods following initiation of a SCRAM signal shall not exceed 0.8 seconds.

New wording:

6.2.2 The two safety rods and the shim rod shall each have a reactivity worth of approximately 0.55% $\Delta K/K$. The safety rods must be withdrawn sequentially prior to withdrawal of the shim or regulating rods. The maximum time for insertion of the safety and shim rods following initiation of a SCRAM signal shall not exceed 0.8 seconds. The maximum reactivity input rate of the safety and shim rods shall not exceed 0.02% $\Delta K/K$/sec. This reactivity input rate (0.02% ΔK/Ksec) is not applicable when the core is devoid of water moderator.

EFFECTS: See Attached Safety Analysis Report

SUMMARY: See Attached Safety Analysis Report

COLLEGE OF ENGINEERING

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NUCLEAR REACTOR LABORATORY

January 11, 1983

SAFEY ANALYSIS REPORT

RE: License No. R-62, Docket No. 50-124

SUBJECT: Manual Withdrawal of a Control Rod for Control Rod Drop Time Measurements and Analysis for Technical Specifications

TYPE: Mechanical/Nuclear

PROPOSAL We propose that the manual withdrawal of a single control rod under the following conditions:

(1) Reactor Shutdown/Control Rods inserted
(2) Core devoid of water moderator
(3) Dump Valve Interlock enabled and activated;

will not cause a Reactivity Addition Accident,
will not impede or hinder the Reactor Safety Systems,
will not exceed Safety System limiting settings,
will not cause an uncontrolled radioactive release and
that the reactivity input rate of 0.02% ΔK/K/sec.
is not applicable when the the core is devoid of water moderator,

Therefore, this proposed manual withdrawal of a single control rod should be allowed in the Control Rod Droptime Measurement Procedure (IV.15) in order to expedite trouble shooting time prior to dismantling the core.

EFFECTS: The Argonaut Research Reactor at VPI & SU has a shutdown condition defined as: all rods inserted, the water moderator "dumped" to the dump tank and the console key removed. By "dumping" the moderator, we void the core region of coolant/moderator and achieve a negative 30.0% ΔK/K reactivity. The control rods then add an additional 2.16% ΔK/K of negative reactivity. When using Procedure IV.15, the reactor is not technically shutdown; however, as specified in procedure IV.15, the Dump Valve Interlock must be activated and this condition prevents filling the core tanks.

A Reactivity Addition Accident cannot occur because with the moderator "dumped" the core reactivity is negative by 30.0% ΔK/K. Thus with manual withdrawal of a single rod (maximum reactivity of any rod is 0.77% ΔK/K) a shutdown reactivity of -29.24% ΔK/K is maintained.

$$(-30.0\%\ \Delta K/K + 0.77\%\ \Delta K/K = -29.24\%\ \Delta K/K)$$

EFFECTS: (continued)

Therefore, even with a single complete rod ejection the minimum shutdown margin of 0.5% ΔK/K will not be exceeded and a manual rod withdrawal will have no adverse effects on the core.

A manual rod withdrawal with core devoid of water moderator will not impede or hinder any Reactor Safety System owing to the fact that the safety system will be energized, operable and in compliance with any specific provisions listed in Technical Specifications for the VPI & SU Reactor, while the manual withdrawal is taking place.

As shown in the following analysis; no Safety System limiting settings will be exceeded:

(1) Neutron Countrate; not applicable, core devoid of water moderator

(2) Coolant/moderator;

A) Temperature not applicable, core devoid of water moderator

B) Flow

C) Operating level

(3) Reactor Room Ventilation; No effect - fans remain on

(4) Safety Rods 1 & 2 fully withdrawn;

has bypass provision - only withdrawn singly

(5) Reactor period/power set points;

never reached due to -29.24% ΔK/K reactivity in core with core devoid of water moderator

(6) Automatic cóntroller servo set point;

never effected,reactor not operating

(7) Regulating Rod at upper or lower limit;

rod not moved past upper or lower limits - also manual stops present

(8) Activation of manual SCRAM switch (remote/manual);

not applicable - core not operating (-29.24% ΔK/K)

(9) Shield tank level;

not applicable,core not operating

(10) Earthquake SCRAM;

not applicable core not operating

EFFECTS: (continued)

(11) Radiation levels; operable - with core not operating levels will not change

(12) Radiation level fission products monitor;

not applicable - core devoid of water moderator, no flow to detector.

SUMMARY: As mentioned in the previous statements, the reliability or safety of our facility will not be degraded nor will a a safety hazard be posed by manually withdrawing a single rod when the core is devoid of water moderator. By not exceeding the Safety System limiting settings we are protected against an uncontrolled radioactive release and therefore the requirements set forth in the proposal are met. We propose that the manual rod withdrawal be included in the Control Rod Droptime Procedure (IV.15) and that a reactivity input rate of 0.02% ΔK/K/sec. not be applicable when the core is devoid of water moderator.

APPROVED/REVIEWED ______ ______
Date

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Chairman, Radiation Safety
Committee

IV.15 Measurement of Total Control Rod Drop Time

A. Initial Conditions

1. Two individuals with the following minimum qualifications are available:

Rev. 7

   (a) nuclear senior operator
   (b) reactor operator

2. The reactor control console switch key is installed, the console is on and manned by a reactor operator.

3. The dump valve disable interlock is activated and all control rods are fully inserted.

4. Log any jumpers installed or removed from reactor instrumentation in the jumper log.

5. The graphite stack, core tanks and surrounding core region are at thermal equilibrium at $\geq$ 130°F.

Rev. 7

6. A Tektronix oscilloscope model 2213 or equivalent is available.

7. If this is performed subsequent to a reactor run shutdown checks have been performed without removing the console key.

   CAUTION: Do not leave the console unattended with the key inserted.

B. Precautions and Limitations

1. This procedure will be coordinated and performed by a senior reactor operator.

2. Observe all appropriate electrical safety precautions.

3. Use a 2 to 3 way AC adapter on the AC input power, to the oscilloscope to insure the oscilloscope power cord is not grounded to earth ground.

4. The total control rod drop time is a Technical Specification limit (para. 6.2.2) and shall not exceed 0.8 seconds.

Rev. 7

5. If control rod drop times exceed .65 seconds, inform the Reactor Supervisor. Check the alignment between the drive mechanism and the shaft. Operate the mechanism and listen for any abnormal sounds which may indicate bad bearings and/or re-alignment of the mechanism. If this still does not correct the problem and the mechanism appears to be functioning properly disconnect it from the control rod shaft. Rotate the mechanism by hand to ascertain if it requires maintenance. If this is required, perform procedures III.2 and IV.16.

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Chairman, Radiation Safety Committee

IV.15 C. Procedure

1. Set the controls on the oscilloscope as follows:

   (a) Sync: ext.
   (b) Sweep: 100M.S./cm.
   (c) Stability: preset, adjust as necessary
   (d) Triggering level: + and near 0
   (e) Main Sweep: normal
   (f) Volts/Div.: 1 volt/cm sensitivity minimum

   NOTE: Connection from the trigger input to the reactor control console should be through a short length of shielded cable. Connection from the vertical amplifier input to the console may be through a 10X probe or a short length of shielded cable. The TB numbers refer to terminal connections on the rear of the console.

2. Make the following connections for each measurement:

   (a) oscilloscope probe grounded to TB9-80
   (b) trigger input TB9-3
   (c) vertical amplifier input thru a.01µF capacitor)

      1. safety rod No. 1 TB11-14
      2. safety rod No. 2 TB11-20
      3. shim rod TB11-26

   (d) Just prior to making the drop time test, the intensity control on the oscilloscope should be adjusted for a light trace. This will be a vertical line four or more centimeters high and should be located at the left calibration line on the CRT graticule. The triggering level control should be set on the positive side and as close to zero as is possible without accidental triggering due to noise. When the manual scram button is pushed the oscilloscope sweep circuit will be triggered and an intense trace will proceed from left to right across the screen of the CRT. The point at which the trace collapses to a central line is the end of the drop time.
   (e) NOTE: With the respective jumpers installed allowing rod withdrawal you must manually reset the scram to ensure scram bus continuity (clutch voltage applied).

3. Shim rod:

   (a) Insure safety rods and regulating rod are fully inserted.
   (b) Install a jumper between TB9-75 and TB9-16. This disables the start-up interlock on the safety rods allowing the shim and regulating rod to be withdrawn.
   (c) Insure the regulating rod is maintained fully inserted.
   (d) Withdraw the shim rod fully until both analog and digital indicators verify the rod is fully withdrawn.
   (e) Perform step 5, repeat as necessary.
   (f) Remove the jumper between TB9-75 and TB9-16.

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IV.15 C. (continued)

4. Safety rods:

(a) For safety rod 1 verify all other rods are fully inserted.
(b) Install a jumper between TB9-75 and TB9-11. This disables the respective start-up interlocks allowing withdrawal of safety rod 1.
(c) Withdraw safety rod 1 fully until the top light energizes and both analog and digital indicators verify the rod is fully withdrawn.
(d) Perform step 5, repeat as necessary.
(e) <u>Remove the jumper</u> between TB9-75 and TB9-11.
(f) For safety rod 2 verify all other rods are fully inserted.
(g) Install a jumper between TB9-75 and TB9-14. This disables the respective start-up interlocks allowing withdrawal of safety rod 2.
(h) Withdrawal safety rod 2 fully until the top light energizes and both analog and digital indicators verify the rod is fully withdrawn.
(i) Perform step 5, repeat as necessary.
(j) <u>Remove the jumper</u> between TB9-75 and TB9-14.

5. On command by the senior reactor operator, the reactor operator will scram the reactor. The senior reactor operator will note the drop time by deserving the oscilloscope.

D. <u>Final Conditions</u>

1. Disconnect the oscilloscope from the back of the reactor control console.

2. Remove the reactor control console key. Verify all rods are inserted and complete shutdown checklist.