UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

OREGON STATE UNIVERSITY

DOCKET NO. 50-243

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 11
License No. R-106

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment to Facility Operating License No. R-106 filed by Oregon State University (the licensee), dated November 7, 1988, as supplemented on November 6, 1989, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations as set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the regulations of the Commission;

   C. There is reasonable assurance: (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied; and

   F. Prior notice of this amendment was not required by 10 CFR §2.105(a)(4) and publication of notice of this amendment is not required by 10 CFR §2.106(a)(2).

2. Accordingly, paragraph 2.C.(1) of License No. R-106 is hereby amended to read as follows:

   (1) Maximum Power Level

   The licensee may operate the facility at steady state power levels not in excess of 1100 kilowatts (thermal) and, in the pulse mode, with reactivity insertions not to exceed 2.55$.

3. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the enclosure to this license amendment, and paragraph 2.C.(2) of License No. R-106 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 11, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

4. This license amendment is effective as of its date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Seymour H. Weiss

Seymour H. Weiss, Director
Non-Power Reactor, Decommissioning and
Environmental Project Directorate
Division of Reactor Projects - III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

Enclosure:
Appendix A Technical
Specifications Changes

Date of Issuance: December 21, 1989

ENCLOSURE TO LICENSE AMENDMENT NO. 11

FACILITY OPERATING LICENSE NO. R-106

DOCKET NO. 50-243

Replace the following pages of the Appendix A Technical Specifications with the enclosed pages. The revised pages are identified by amendment number and contains vertical lines indicating the areas of change.

Remove	Insert
6	6
7	7
8	8
12	12
32	32
35	35

2. SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 SAFETY LIMIT-FUEL ELEMENT TEMPERATURE

Applicability. This specification applies to the temperature of the reactor fuel.

Objective. The objective is to define the maximum fuel element temperature that can be permitted with confidence that no damage to the fuel element cladding will result.

Specifications

a. The temperature in a TRIGA-FLIP fuel element shall not exceed 2100°F (1150°C) under any condition of operation.

b. The temperature in a standard TRIGA fuel element shall not exceed 1830°F (1000°C) under any condition of operation.

Bases. The important parameter for a TRIGA reactor is the fuel element temperature. This parameter is well suited as a single specification especially since it can be measured. A loss in the integrity of the fuel element cladding could arise from a build-up of excessive pressure between the fuel-moderator and the cladding if the fuel temperature exceeds the safety limit. The pressure is caused by the presence of air, fission product gases, and hydrogen from the dissociation of the hydrogen and zirconium in the fuel-moderator. The magnitude of this pressure is determined by the fuel-moderator temperature and the ratio of hydrogen to zirconium in the alloy.

The safety limit for the TRIGA-FLIP fuel element is based on data which indicate that the stress in the cladding due to the hydrogen pressure from the dissociation of zirconium hydride will remain below the ultimate stress provided the temperature of the fuel does not exceed 2100°F (1150°C) and the fuel cladding is water cooled. (SAR I)*

The safety limit for the standard TRIGA fuel is based on data including the large mass of experimental evidence obtained during high performance reactor tests on this fuel. These data indicate that the stress in the cladding due to hydrogen pressure from the dissociation of zirconium hydride will remain below the ultimate stress provided that the temperature of the fuel does not exceed 1830°F (1000°C) and the fuel cladding is water cooled. (SAR I)

---

* References to the Safety Analysis Report and its amendment will be abbreviated as:

SAR - Safety Analysis Report, August 1968

SAR I - Amendment No. 4 to SAR, September 11, 1975

2.2 LIMITING SAFETY SYSTEM SETTINGS

Applicability. This specification applies to the scram settings which prevent the safety limit from being reached.

Objective. The objective is to prevent the safety limits from being reached.

Specification. The limiting safety system setting shall be 510°C (950°F) as measured in an instrumented fuel element. The instrumented fuel element shall be located in the B-ring.

Bases. The limiting safety system setting is a temperature, which, if exceeded shall cause the reactor safety system to initiate a reactor scram. This setting applies to all modes of operation. In steady-state operation up to 1.1 megawatts ample margins exist between this setting and the safety limits of 1150°C and 1000°C for FLIP and standard fuel, respectively.

The highest fuel temperatures are experienced during pulse transients, initiated from low power. The fuel temperature scram, to which the limiting safety system setting applies, can prevent reaching the safety limit of the fuel by reducing the energy released in the "tail" of the pulse. A setting of 510°C is conservatively estimated to provide the largest permissible pulses. These estimates are obtained from calculations based on an adiabatic reactor kinetics model. This model when applied to existing cores yields characteristics which are in good agreement with measured values.

Input parameters to this model for predicting mixed and full FLIP cores are obtained from flux profiles and prompt reactivity coefficients calculated for these cores, and from information concerning cell parameters and prompt neutron life time, which have been established for similar cores elsewhere (Torrey-Pines, GA 9350, PRNC). The calculations leading to this value of the limiting safety system setting are outlined in detail in SAR I.

3. LIMITING CONDITIONS OF OPERATION

3.1 STEADY STATE OPERATION

Applicability. This specification applies to the energy generated in the reactor during steady state operation.

Objective. The objective is to assure that the fuel temperature safety limit will not be exceeded during steady state operation.

Specifications. The reactor power level shall not exceed 1.1 megawatts except for pulsing operations.

Basis. Thermal and hydraulic calculations indicate that TRIGA fuel may be safely operated up to power levels of at least 2.0 megawatts with natural convection cooling.

3.2 REACTIVITY LIMITATIONS

Applicability. These specifications apply to the reactivity condition of the reactor and the reactivity worths of control rods and experiments. They apply for all modes of operation.

Objective. The objective is to assure that the reactor can be shut down at all times and to assure that the fuel temperature safety limit will not be exceeded.

Specifications. The reactor shall not be operated unless the following conditions exist:

The shutdown margin provided by control rods shall be greater than $0.57 with:

1. experimental facilities and experiments in place and the highest worth non-secured experiment in its most reactive state,

2. the most reactive control rod fully withdrawn, and

3. the reactor in the cold condition without xenon.

Bases. The value of the shutdown margin assures that the reactor can be shut down from any operating condition even if the most reactive control rod should remain in the fully withdrawn position.

TABLE I

Minimum Reactor Safety Channels

Safety Channel	Function	Effective Mode		
		S.S.	Pulse	S.W.
Fuel Element Temperature	SCRAM @ 510°C	X	X	X
Safety Power Level	SCRAM @ 1100 kW(t) or less	X		X
Percent Power Level	SCRAM @ 1100 kW(t) or less	X		X
Console Scram Button	SCRAM	X	X	X
Wide-Range Log Power Level	SCRAM @ period no less than 3 sec.	X		
Preset Timer	Transient rod SCRAM @ 15 sec or less after pulse		X	
High Voltage	SCRAM @ 25% of nominal operating voltage	X	X	X

TABLE II

Minimum Interlocks

Interlock	Function	Effective Mode		
		S.S.	Pulse	S.W.
Wide-Range Log Power Level Channel	Prevents control rod withdrawal @ less than 2 cps	X		
Transient Rod Cylinder	Prevents application of air unless fully inserted	X		
1 kw Pulse Interlock	Prevents pulsing above 1 kw		X	
Shim, Safety, and Regulating Rod Drive Circuit	Prevents simultaneous withdrawal of two rods	X		X
Shim, Safety, and Regulating Rod Drive Circuit	Prevents movement of any rod except transient rod		X	
Transient Rod Cylinder Position	Prevents pulse insertion of reactivity greater than $2.55		X	X

2. Review and approval of all proposed changes to the facility, procedures, and Technical Specifications;

3. Determination of whether a proposed change, test, or experiment would constitute an unreviewed safety question or a change in the Technical Specifications;

4. Review of the operation and operational records of the facility;

5. Review of abnormal performance of plant equipment and operating anomalies;

6. Review of all events which are required by regulations or Technical Specifications to be reported to the NRC in writing within 24 hours; and

7. Approval of individuals for the supervision and operation of the reactor.

6.3 ACTION TO BE TAKEN IN THE EVENT A SAFETY LIMIT IS EXCEEDED

In the event a safety limit (fuel temperatures) is exceeded:

a. The reactor shall be shut down and reactor operation shall not be resumed until authorized by the NRC;

b. An immediate report of the occurrence shall be made to the Chairman, ROC, and reports shall be made to the NRC in accordance with Section 6.7 of these Specifications;

c. A report shall be prepared which shall include an analysis of the causes and extent of possible resultant damage, efficacy of corrective action, and recommendations for measures to prevent or reduce the probability of recurrence. This report shall be submitted to the ROC for review and then submitted to the NRC when authorization is sought to resume operation of the reactor.

6.4 ACTION TO BE TAKEN FOR REPORTABLE OCCURRENCES

For all events which are required by regulations or Technical Specifications to be reported to NRC in writing within 24 hours, the following action shall be taken:

a. The Reactor Administrator or his designated alternate shall be notified and corrective action taken prior to resumption of the operation involved.

b. A report shall be made which shall include an analysis of the cause of the occurrence, efficacy of corrective action and recommendations for measures to prevent or reduce the probability of reoccurrence. This report shall be submitted to the Reactor Operations Committee for review.

c. Where appropriate, a report shall be submitted to the NRC in accordance with Section 6.7 of these specifications.

2. Those events reported as required by Sections 6.7.a.2 through 6.7.a.8.

c. A report within 30 days in writing to the NRC, Document Control Desk, Washington, D.C., with a copy to the NRC, Region V.

1. Any significant variation of measured values from a corresponding predicted or previously measured value of safety-connected operating characteristics occurring during operation of the reactor;

2. Any significant change in the transient or accident analyses as described in the Safety Analysis Report;

3. Any changes in facility organization or personnel; and

4. Any observed inadequacies in the implementation of administrative or procedural controls such that the inadequacy causes or could have caused the existence or development of an unsafe condition with regard to reactor operations.

d. A report within 90 days after completion of starting testing of the reactor (in writing to the NRC, Document Control Desk, Washington, D.C. and a copy to NRC, Region V) upon receipt of a new facility license, or an amendment to the license authorizing an increase in reactor power level, describing the measured values of the operating conditions or characteristics of the reactor under the new conditions including:

1. An evaluation of facility performance to date in comparison with design predictions and specifications.

2. A reassessment of the safety analysis submitted with the license application in light of measured operating characteristics when such measurements indicate that there may be substantial variance from prior analysis.

e. An annual report by November 1 of each year (in writing to the NRC, Document Control Desk, Washington, D.C. and a copy to the NRC, Region V).

1. A brief summary of operating experience including experiments performed and changes in facility design, performance characteristics and operating procedures related to reactor safety occurring during the reporting period, and results of surveillance test and inspections.

2. A tabulation showing the energy generated by the reactor (in megawatt-hours), hours reactor was critical, and the cumulative total energy output since initial criticality.

3. The number of emergency shutdowns and inadvertent scrams, including reasons therefore.

4. Discussion of the major maintenance operations performed during the period, including the effect, if any, on the safety of the operation of the reactor and the reasons for any corrective maintenance required.