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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 4 TO FACILITY OPERATING LICENSE NO. R-106

DOCKET NO. 50-243

OREGON STATE UNIVERSITY

I. Introduction

By letter dated April 16, 1979, supplemented by letters dated July 11, August 17 and October 10, 1979, the Oregon State University (OSU or the licensee) requested amendment to Facility Operating License No. R-106 for the OSU TRIGA Reactor (OSTR). The amendment would provide sixteen (16) changes to the Technical Specifications (TS) grouped as follows:

(A) Proposed Changes Nos. 1 through 4 relate to a proposed upgrading of the reactor control console.

(B) Proposed Changes Nos. 5 through 12 relate to proposed new limits on core configuration for an operational core, a proposed increase in allowable reactivity insertion for pulsing, and a proposed increase in reactivity worth of any single experiment.

(C) Proposed Changes Nos. 13 and 14 are proposed changes to the Administrative Section of the TS which would reflect a change in the licensee's organization.

(D) Proposed Change No. 15 would change the calibration frequency of the fuel temperature channels from semiannual to an annual basis.

(E) Proposed Change No. 16 would extend the time period for submitting the annual report from 60 days to 75 days following the 30th of June of each year.

II. Discussion and Evaluation

Each of the above items are discussed and evaluated separately below.

(A) Proposed Changes Nos. 1 through 4 relating to upgrading the reactor control console

Discussion

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The present OSTR console was installed in 1967 and contains many printed circuit boards which are no longer available. The licensee does not have a complete set of spare boards and is concerned that the reactor may be shutdown for an unreasonable length of time if problems with the console elec-

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tronics are experienced. Therefore, the licensee has decided to purchase from General Atomic, the console manufacturer, new electronic packages to upgrade their TRIGA console. These packages are standard instrumentation on new TRIGA consoles.

The proposed TS changes to Sections 3.5.2, "Reactor Control System" and 3.5.3, "Reactor Safety System" are needed to reflect the addition of this new instrumentation. The new instrumentation, which utilizes all solid state modular construction with integrated circuitry, would provide increased reliability over the existing instrumentation and, therefore, upgrade the console electronics.

The proposed new instrumentation package includes:

(a) A 9.5 - decade multirange linear channel (Model NML-2)
(b) A 10 - decade log power channel (Model NLW-2)
(c) A period circuit (Model NR-4)
(d) A linear safety channel (Model NP-5)
(e) A preamplifier (Model PA-5)
(f) Pulsing logic
(g) Calibration circuits for linear and log power and period, and
(h) Power supplies, including a high voltage supply (Model HV-6).

The relationship between the present instrumentation and the new instrumentation is shown in Figure 1.

Evaluation

The proposed modifications to the console instrumentation consist of:

(1) Replacing the present multirange linear channel using an ion chamber with the new 9.5 decade linear channel driven by a fission chamber. This same fission chamber is also used to drive the new 10-decade log channel. We view this arrangement as a single "linear-log" channel, as failure of the single detector (fission chamber) means the loss of both linear and log information to the operator.

Since this new fission chamber is physically larger than the existing detector, it cannot be located in the same position. The new fission chamber would be placed into the existing log ion chamber shroud, which would accept the physical size of the new chamber. We have reviewed this arrangement and find that the new location would basically provide the same source-fuel-detector geometry as the existing detector, and would not constitute a problem with detector shadowing. We find this change in detector location acceptable.

The present linear channel performs both safety (scram) and control functions. The linear portion of the new "linear-log" channel would provide a signal to the servo system for automatic power level adjustment. The new safety power level channel would provide the scram function.

(2) Replacing the present multirange log channel with a period circuit using an ion chamber with a new 10-decade log channel, also with a period circuit, driven by a fission chamber. This new instrumentation is considered to be the log portion of the new "linear-log" channel. This channel would provide the startup interlock function (preventing control rod withdrawal at a count rate of less than 2 cps) currently performed by the count-rate (startup) channel. The count rate channel would be no longer required.

The new calibration circuits for the log and linear power and period circuits are similar to the existing calibration circuits in that they generate test signals to the channel electronics for checking proper circuit alignment. Six different calibration signals are provided for calibration of both of the log and linear circuits. Two separate period calibration signals are used. The new calibrate switch (period/log test switch) is not spring-loaded as are the existing switches. To preclude leaving the calibrate switch in a calibrate position, the switch would be connected to the source and 1Kw interlocks. We find this arrangement to be acceptable.

(3) Adding a new "safety power level" channel, with scram capability, driven by an ion chamber. This channel would be identical (except for new electronics) to the present percent power channel.

The two channels would use separate ion chambers. This safety power level channel would provide scram capability. This channel, however, would trip only at 110% of full power (i.e., 1.1 MW) whereas the present linear power channel trips at 110% of each range. Block diagrams of the present and proposed design are shown in Figure 1.

The use of the proposed wide-range "log-linear" channel with the automatic servo presents a different situation regarding the separation of safety and control instrumentation.

The existing instrumentation cannot cause the loss of both automatic power level adjustment and period protection via a single detector failure. Upon loss of the control signal to the servo system, period protection is still provided for a reactor trip, in addition to the fuel element temperature trip and a 100% neutron level trip. However, a period-limiting circuit in the existing design limits the regulating rod speed so that the period never gets shorter than about 12-15 seconds, thus period scram protection (period <3 sec.) is not utilized when in the

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automatic mode. The licensee has stated that the maximum increase in fuel temperature, before scram via a level trip, would be about 240°C from ambient or about 260°C. This temperature is well below the limiting safety system setting (LSSS) for fuel temperature (510°C), which in itself incorporates a large safety margin before the fuel temperature safety limit (1150°C) is reached.

Failure of the fission chamber detector in the proposed system causes the loss of both period protection and the control signal to the servo system for automatic power level adjustment. Protection would still be provided by two neutron level trips at 110% of full power and a fuel element temperature trip at 510°C. The licensee has stated that the maximum increase in fuel temperature resulting from this detector failure before a reactor trip (via one of the two level trips) would be about 40°C from ambient, or approximately 60°C.

Therefore, even though period protection would be lost due to failure of the fission chamber in the new design, the increase in fuel temperature would actually be less than that for a similar detector failure in the present system. In addition, the reactivity insertion rates postulated above are not nearly as rapid as during a routine pulse for which an acceptable safety analysis has been documented.

For the above reasons, we find the deletion of level trips at 100% of each range and the period/control circuitry configurations to be acceptable,

(4) Removing the count-rate (startup) channel. Its interlock function, which is to prevent control rod withdrawal at count rates less than 2 cps, will be taken over by the new "linear-log" channel.

The licensee has determined that overpower conditions will not produce saturation or fold-over in any of the proposed new instrumentation channels. All minimum reactor safety channel functions, interlock functions, and operable measuring channels required by the current TS will remain unchanged.

We have reviewed the proposed modifications to the OSTR console instrumentation described above, and find these equipment and design modifications acceptable and would not reduce the margin of safety. We have also reviewed the other console electronics included in the proposed package (i.e., pulsing logic, calibration circuits, preamplifier, and power supplies), and have found this instrumentation to be acceptable.

(5) Technical Specification (TS) changes

The following proposed changes to the OSTR TS are associated with the modifications to the console electronics:

1. In Section 3.5.2 (Reactor Control System), in the table listed in the Specification:

   Add "Safety Power Level" as a measuring channel, effective in the steady-state (s.s.) and square-wave (s.w.) modes.

2. In Section 3.5.3 (Reactor Safety System), Table I:

   Change "Log Power Level" in column 1 to read "Wide-Range Log Power Level."

3. In Section 3.5.3 (Reactor Safety System), Table I:

   Change "Linear Power Level" in column 1 to read "Safety Power Level."

4. In Section 3.5.3 (Reactor Safety System), Table II:

   Change "Count-rate Channel" in column 1 to read "Wide-Range Log Power Level Channel."

We find these proposed modifications to Sections 3.5.2 and 3.5.3 of the TS adequately reflect the proposed changes in console electronics for the OSTR and are correct, and, therefore, are acceptable.

In summary, based on our review of the licensee's submittal, we conclude that the proposed modifications to the OSTR console electronics and the associated TS changes are acceptable, would not reduce the margin of safety, and would not increase the probability or consequences of an accident.

(B) Proposed Changes Nos. 5 through 12 relating to limits on the core configuration, the reactivity insertion for pulsing, and the reactivity worth of any single experiment

Discussion

The present limits on the core configuration and operation were initially supported by the licensee's Safety Analysis Report (SAR) dated April 3, 1975, as revised September 11, 1975. The operating limits were established on the limiting core configuration by the SAR such that pulsing would produce pulse transients with maximum fuel temperatures no greater than 950°C in the FLIP fuel and 800°C in the standard fuel; i.e., a safety margin of 200°C with respect to the safety limits of the fuel.

The licensee established, in August 1976, an operational core consisting of 85 FLIP fuel elements (a full FLIP core). The "Startup Report for the Full FLIP Fuel Loading" dated May 30, 1977, provided data that not only conservatively confirmed the analyses of the SAR, but also verified that pulsing could be increased to 2.60 dollars on a full FLIP core, and the pulsing would produce pulse transients with maximum fuel temperatures no greater than 950°C in FLIP fuel and 800°C in standard fuel if it were in the outer region of the core.

The licensee's request would: (1) increase the minimum number of FLIP elements from 56 to 80 in a contiguous block in the central region of the core, (2) increase the allowable reactivity insertion for pulsing from 2.35 to 2.55 dollars, and (3) increase the allowable reactivity worth for a single experiment from 2.35 to 2.55 dollars.

The licensee has indicated that such a proposed core configuration would behave essentially as a full FLIP core in operation. The licensee based this upon the analysis in the SAR which concluded that the maximum power per fuel element in a core with 55 FLIP fuel elements in a contiguous block in the central region of the core would differ little from the maximum power per fuel element in a full FLIP core. Therefore, the difference in maximum power per element between the proposed core configuration and a full FLIP core is not significant. Hence, the proposed core configuration would behave essentially as full FLIP core and an increase in reactivity insertion to 2.55 dollars would produce pulse transients with maximum fuel temperatures no greater than 950°C for FLIP fuel elements and 800°C for standard fuel elements.

The licensee's basis for the proposed change of the reactivity worth of a single experiment to 2.55 is that it can be the same as the pulsing limit on reactivity.

TRIGA Standard and TRIGA FLIP fuel have distinctive markings on the upper tip of each fuel element. Fuel loading procedures use these markings to assure the proper positioning of each fuel element in the core a . therefore assure that a standard element would only be placed in the outer region of the core where power levels are the lowest.

Evaluation

We agree with the licensee that the proposed operational core would behave essentially as a full FLIP core. Based on the data of the Startup Report dated May 30, 1977, we agree that the proposed operational core would produce pulse transients with maximum fuel temperatures no greater than 950°C in the FLIP fuel and 800°C in the standard fuel when pulsed with reactivity insertion no greater than 2.55 dollars. This would maintain a safety margin of 200°C with respect to the safety limit of the fuel. We agree with the licensee that the limit on reactivity worth of a single experiment can be the same as the limit on reactivity insertion for pulsing. Therefore, we find the licensee's proposed operational core configuration, proposed limit on reactivity insertion for pulsing and proposed reactivity worth of a single experiment to be acceptable and would not reduce the margin of safety and would not increase the probability or consequences of an accident.

(C) Proposed Changes Nos. 13 and 14 relating to changes in the licensee's organization

Discussion

This proposed changes reflect a change of title of one of the licensee's principal officers. The office of the former Dean of Administration has been changed to Vice President for Administration. The Reactor Administrator would be responsible to this Vice President for the safe operation and maintenance of the reactor.

Evaluation

We have reviewed the licensee's proposed changes and find them to be administrative in nature, acceptable and would have no affect on reactor safety.

(D) Proposed Change No. 15 relating to calibration frequecy of fuel temperature channels

We have discussed with the licensee their proposed change in calibration frequency of the fuel temperature channels from a semiannual to an annual basis. As a result of our discussions, the licensee has agreed to withdraw the requested change in calibration frequency and to continue with the current requirements of the TS.

(E) Proposed Change No. 16 relating to a change in the time for submitting the annual report

Discussion

The licensee has requested an additional 15 days in which to submit the annual report. The change would provide approximately one month to prepare the report after all the data are available.

Evaluation

We have reviewed the licensee's request and have determined that extending the time for submitting the annual report by 15 days is not significant and therefore is acceptable.

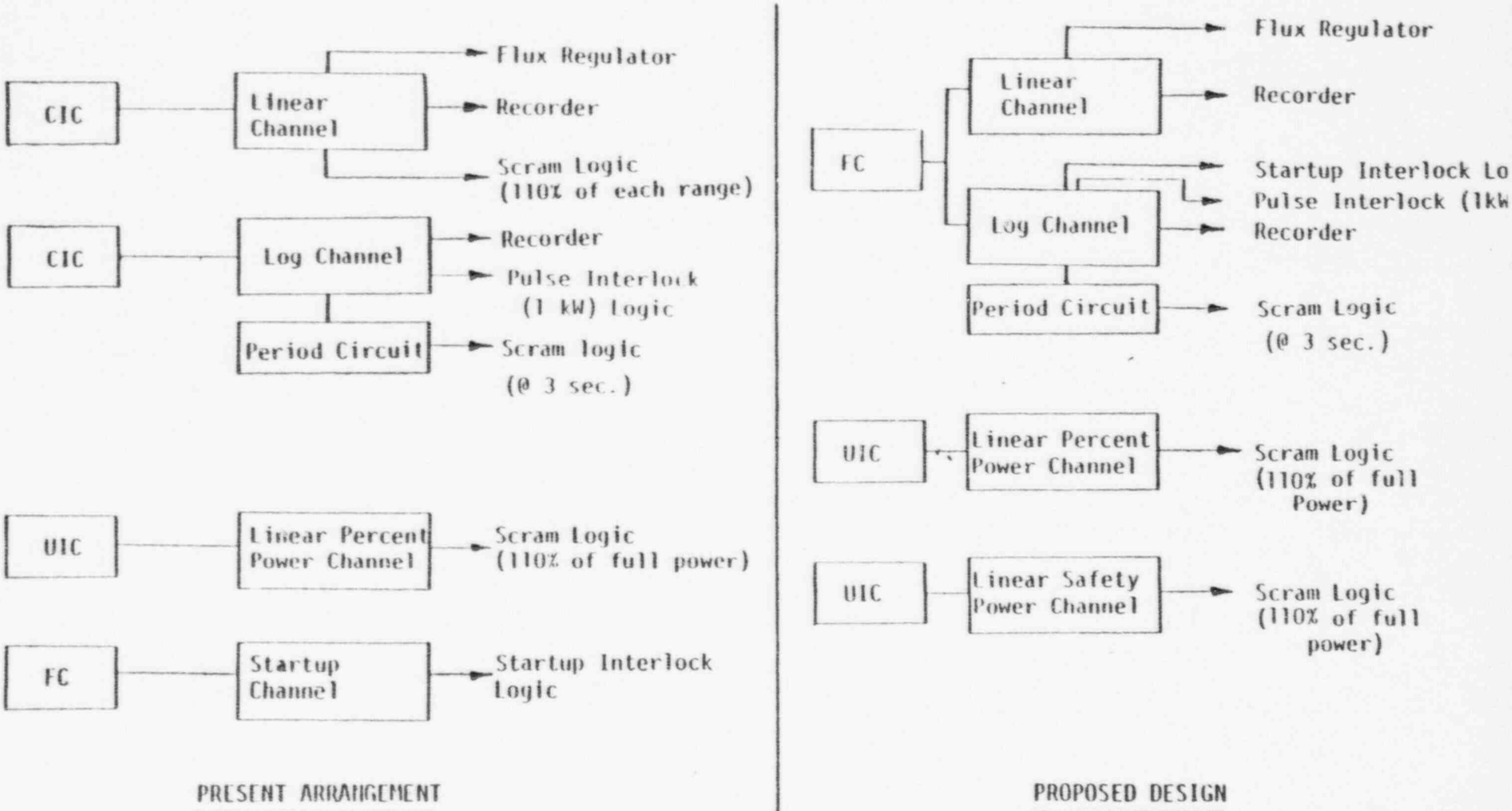
III. Environmental Consideration

We have determined that this amendment will not result in any significant environmental impact and that it does not constitute a major Commission action significantly affecting the quality of the human environment. We have also determined that this action is not one of those covered by 10 CFR § 51.5(a) or (b). Having made these determinations, we have further concluded that, pursuant to 10 CFR § 51.5(d)(4), an environmental impact statement or environmental impact appraisal and negative declaration need not be prepared in connection with issuance of this amendment.

IV. Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: December 18, 1979



CIC
Linear Channel
Flux Regulator
Recorder
Scram Logic (110% of each range)
CIC
Log Channel
Recorder
Pulse Interlock (1 kW) Logic
Period Circuit
Scram logic (@ 3 sec.)
UIC
Linear Percent Power Channel
Scram Logic (110% of full power)
FC
Startup Channel
Startup Interlock Logic
PRESENT ARRANGEMENT
FC
Linear Channel
Flux Regulator
Recorder
Log Channel
Startup Interlock Lo
Pulse Interlock (1kW
Recorder
Period Circuit
Scram Logic (@ 3 sec.)
UIC
Linear Percent Power Channel
Scram Logic (110% of full Power)
UIC
Linear Safety Power Channel
Scram Logic (110% of full power)
PROPOSED DESIGN

FIGURE 1