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November 11, 1995

Document Control Desk
US Nuclear Regulatory Commission
Washington DC. 20555

Subject: Response to Questions
NRC letter Aug 4, 1994
Docket 50-602

Dear Sir:

The following information is in response to the Request for Additional Information letter dated 8/2/94 and the original amendment request dated 25/1/95. The amendment request and response to questions correct language in the original Technical Specification. No change to the reactor operating conditions is being proposed.

Sincerely,

Thomas L. Bauer

T.L. Bauer
Assistant Director/Reactor Supervisor
Nuclear Engineering Teaching Laboratory

Enclosures: Affidavit
Response to Questions
TS amendment pages 14, 15, 44

cc: R. Charbeneau B.W. Wehring
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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of	&	
	&	
The University of Texas	&	
at Austin	&	Docket No. 50-602
	&	
J.J. Pickle Research Campus	&	
	&	
Nuclear Engineering Teaching	&	
Laboratory	&	

AFFIDAVIT

Mark G. Yudof being duly sworn, hereby deposes and says that he is Executive Vice President and Provost, The University of Texas at Austin; that he is duly authorized to sign and file with the Nuclear Regulatory Commission the enclosed Response to Questions (NRC letter 8/2/94) regarding Technical Specification 3.2.2, for docket 50-602; that he is familiar with the content thereof; and the matters set forth therein are true and correct to the best of his knowledge and belief.

Mark G. Yudof
Executive Vice President and Provost

Subscribed and sworn to before me, a Notary Public in and for the State of Texas, thi 3RD day of November, 1995

Sharon H. Young
NOTARY PUBLIC in and for the State of Texas

SHARON H. YOUNG
NOTARY PUBLIC
State of Texas
Comm. Exp. 05-12-97

Response to Questions

Docket 50-602

Amendment Request 25/1/93

1. The amendment request of 5/1/93 is being made pursuant to 10CFR50.90 as noted in the US NRC Request for Additional Information 8/2/94. The reference to 10CFR50.56 (letter 5/1/93), should be changed to 10CFR50.90.

2. Clarification of TS 3.2.2 regarding automatic mode interlocks is the purpose of this amendment request. Operation of the automatic mode is not a Technical Specification reportable occurrence, therefore reporting according to TS 6.6.2.2 is not a requirement. A reference to TS 6.6.2.2(b) was made to acknowledge the fact that some automatic mode operation of the reactor did occur prior to a determination by the licensee that the terminology of the Limiting Condition for Operation in TS 3.2.2 was not consistent with the system design and operation. As noted in the licensee's amendment request, no automatic mode (or square wave) operation will occur until a correction is made to the terminology in the Technical Specifications. No change is being made to the control system design.

3. The SAR describes the reactor operating modes in section 6.1.4. A general description of the automatic mode is presented on page 6 - 12. Detailed information about of the control rod system design, including operating characteristics, configuration and calibration, are found in the ICS System Operation and Maintenance Manual, Control Console Operator's Manual and notes in the ICS System files. Servo calculations that control the regulating rod in the automatic (and square wave) modes are done by a control system digital algorithm. All other rods remain in manual control mode during the automatic control of the regulating rod. Configuration of the servo

calculation control algorithm provides limits on the control signal magnitude, limits on the reactor period and a scale limit for the regulating rod drive speed. Output of the servo calculation has a full scale digital limit of ±32768 (±5 volts). This signal scale limit applies to both manual and automatic mode operation. The scale limit represents the maximum rod speed and is the same as the manual insertion and withdrawal rate of the regulating control rod drive. The automatic control cannot exceed this value but will in general be less than the scale limit. Digital constants further define the other two maximum limiting conditions of the automatic mode.

The following data summarizes current operating data for the regulating control rod.

Regulating Rod

Calibration Data

year	control rod withdrawal time (1) (seconds)	control rod drive speed (2) (units/sec)	peak differential reactivity (3) (¢/unit)	maximum withdrawal rate (4) (%δk/k/sec)
1995	33.8	28.4	0.666	0.13
1994	34.8	27.8	0.660	0.12
1993	33.5	28.7	0.654	0.13
1992	34.5	27.8	0.657	0.13

(1) 0 - 960 units for full rod withdrawal

(2) speed in manual mode at control maximum

(3) function fit to rod calibration data

(4) 100¢ = 0.7% δk/k

a. Magnitude of the limiting period is 4 decades per minute or a factor of "e" each 6.5 seconds. In the servo algorithm an error limit of 20% of the demand power combines with a factor of 20 and the derivative constant of one to drive the control rod to a stop if the period is 4 decades per minute. A limit twice this rate, 8 decades per minute is used in the square wave mode for the first 300 cycles.

b. The limiting period is set by configuration parameters in the digital control system. Surveillance checks of the control system verify the automatic mode limiting period of ~6.5 seconds with a statistical accuracy 1 to 2 seconds.

c. Safety considerations for the limiting period in the servo calculations include two automatic control parameters, the control rod drive speed and the reactor rate of power change. Design of the servo calculations limits the controllable regulating rod speed in the automatic mode to rod speed values no greater than that available in manual mode operation. At this value the reactivity insertion rate does exceed 0.15% $\delta k/k/sec$ significantly less than the TS 3.2.1.c limit of 0.2% $\delta k/k/sec$. The limit on reactivity insertion rate (rod speed) in the manual mode is necessary to provide sufficient reaction time for manual control of the reactivity. Automatic mode control applies an additional limit on the reactor period to compensate for the fact that an operator will not be making the manual changes necessary to respond to the reactor rate of power change. A limiting period to control the reactor rate of power change assures that automatic control actions do not exceed those that can occur in the manual mode. Another consideration for the limiting period is the amount of reactivity insertion that can occur if one of the other control rods moves in the up direction. At the limiting period condition the regulating rod stops moving, therefore any increase in the reactor period will cause the regulating rod to move down maintaining the limiting period.

4. At the limiting condition, 4 decades per minute, the regulating rod stops, moving neither up or down. A reactivity insertion of .33% δk/k would create the equivalent stable reactor period. Pressing a shim rod control "up" button while the reactor power is being increased in the automatic mode at the limiting control rate will cause the following reactor response.

a. The shim control rod will move up. Approximating the reactor response as a prompt jump a change in reactor power of 40% would occur for a one second movement of the control rod if power coefficient is negligible and no action is made by the automatic mode control. At the peak rod worth a shim rod will insert about 0.1% δk/k in one second. A stable reactor period of ~ 3 seconds would occur after a one second movement of the shim rod without any response from the automatic control.

b. As the automatic control detects the period increase, exceeding the limiting value, a control output signal will go negative driving the regulating rod down. The change in the period combines with the difference between the current and demand power to control the down motion of the rod until the demand power condition is met. At the maximum drive down speed the reactivity change is roughly equivalent to that of the shim rod.

c. Automatic mode control will maintain the reactor period at the limiting period condition only if the error signal exceeds 20% of the demand signal. A progressively shorter period limit applies as the automatic mode approaches the setpoint for demand power until the period becomes infinite at the control point.

5. Pages 14 and 15 of the University of Texas Technical Specifications have been revised to clarify the application of the four modes of control in TS 3.2.2, TS 3.2.3 and TS 3.2.4. The effective mode column for manual control has been changed to show Manual (M), Automatic (A), and Square Wave (S) control. The effective mode column for Pulse (P) mode remains the same. A note at the bottom of each table defines the use of M, A, S and P. A note to the table in TS 3.2.2 removes the regulating rod from interlock requirements when in the automatic mode.

6. Amend section A.3.2.2 paragraph 5 (page 44) of the Technical Specification bases to read as follows:

Auto mode is a special condition of the manual mode with automatic control of the regulating rod. The simultaneous withdrawal interlock does not apply to the regulating rod in auto mode so that the up or down manual operation of rods other than the regulating rod can occur. The servo control calculations apply a limiting period (4 decades/minute) to assure that two rods moving in the up direction do not exceed a safe control condition. Square wave mode is also a special case of the manual mode with automatic control except that pulse logic applies to the initiation of the auto mode condition.

3.2 Reactor Control and Safety System

3.2.1 Control Assemblies

Specification(s)

The reactor shall not be operated unless the control rods are operable, and

a. Control rods shall not be operable if damage is apparent to the rod or drive assemblies.

b. The scram time measured from the instant a simulated signal reaches the value of a limiting safety system setting to the instant that the slowest scrammable control rod reaches its fully inserted position shall not exceed 1 second.

c. Maximum reactivity insertion rate of a standard control rod shall be less than 0.2% $\Delta k/k$ per second.

3.2.2 Reactor Control System

Specification(s)

The reactor shall not be operable unless the minimum safety interlocks are operable. The following control system safety interlocks shall be operable:

Interlocks Rod Drive Control	Number Operable	Function	Effective Mode* M, A, S	P
a. Startup Withdrawal Standard control rods Transient control rod	4	prevent rod withdrawal for less than 2 counts per sec	X	
b. Simultaneous Withdrawal Standard control rods Transient control rod	4	prevent rod withdrawal for two or more rods	X	
c. Non pulse condition Transient control rod	1	prevent withdrawal for drive not down except square wave	X	
d. Pulse Withdrawal Standard control rods	3	prevent withdrawal of non pulse rods		X
e. Transient Withdrawal Transient control rod	1	prevent rod withdrawal for more than 1 kilowatt power		X

*Modes are: (M) Manual, (A) Auto, (S) Square Wave, and (P) Pulse
Note: Regulating rod has no simultaneous withdrawal interlock in the automatic mode.

3.2.3 Reactor Safety System

Specification(s)

The reactor shall not be operable unless the minimum safety channels are operable. The following control rod scram safety channels shall be operable.

Safety Channel	Number Operable	Function	Effective Mode* M, A, S	P
a. Fuel Temperature	2	Scram at ≤550°C	X	X
b. Power Level	2	Scram at ≤1.1 Mw	X	
Pulse Power	1	Scram at ≤2000Mw		X
c. High Voltage	2	Scram on loss	X	X
d. Magnet Current	1	Scram on loss	X	X
e. Manual Scram Console Button	1	Scram on demand	X	X
f. Watchdog Trip Microprocessor scan rate	2	Scram on loss of timer reset	X	X

*Modes are: (M) Manual, (A) Auto, (S) Square Wave, and (P) Pulse

3.2.4 Reactor Instrument System

Specification(s)

A minimum configuration of measuring channels shall be operable. The following minimum reactor parameter measuring channels shall be operable:

Measuring Channel	Number Operable	Effective Mode M, A, S	P
a. Fuel Temperature	2	X	X
b. Power Level	2	X	
c. Pulse Power	1		X
d. Pulse Energy	1		X

*Modes are: (M) Manual, (A) Auto, (S) Square Wave, and (P) Pulse

Two basic interlocks control rod movements for the pulse mode. The interlock to prevent withdrawal of the motor driven rods in the pulse mode is designed to prevent changing the critical state of the reactor prior to the pulse. A power level interlock controls potential fuel temperature changes by setting a limit of less than 1 kilowatt for initiation of any pulse.

Interlocks applicable to the transient rod determine the proper rod operation during manual mode and pulse mode operation. The non pulse condition interlock determines the allowable position of the rod drive for actuation of the FIRE switch. Actuation of the switch applies the air impulse for removal of the transient rod from the reactor core.

Auto mode is a special condition of the manual mode with automatic control of the regulating rod. The simultaneous withdrawal interlock does not apply to the regulating rod in auto mode so that the up or down manual operation of rods other than the regulating rod can occur. The servo control calculations apply a limiting period (4 decades/minute) to assure that two rods moving in the up direction do not exceed a safe control condition. Square wave mode is also a special case of the manual mode with automatic control except that pulse logic applies to the initiation of the auto mode condition.

A.3.2.3 Reactor Safety System

Applicability

These specifications apply to operation of the reactor safety system.

Objective

The objective is to determine the minimum safety system scrams operable for the operation of the reactor.

Bases

Safety system scram functions consist of three types. These scram types are the limiting safety system settings, operable system conditions, and the manual or program logic scrams. The scrams cause control rod insertion and reactor shutdown.

Scrams for limiting safety system settings consist of signal trip levels that monitor fuel temperature and power level. The trip levels are conservative by a significant margin relative to the fuel element temperature safety limit.

Operation without adequate control and safety system power supplies is prevented by scrams on neutron detector high voltage and control rod magnet current.

Manual action of the scram switch, key switch, or computer actuation of watchdog timers will initiate a protective action of the reactor safety system. Either of two watchdog circuits provide updating timers to terminate operation in the event that key digital processing routines fail, such as a display system. Each watchdog circuit with four resettable timers contains one trip relay and monitors one microcomputer.