50-607

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SACRAMENTO AIR LOGISTICS CENTER (AFMC)
McCLELLAN AIR FORCE BASE, CALIFORNIA

8 July 1997

SM-ALC/CC
3237 Peacekeeper Way, Suite 1
McClellan AFB CA 95652-1044

U. S. Nuclear Regulatory Commission
Mr. Warren J. Eresian
Washington DC 20555-0001

Dear Mr. Eresian

Per your 7 May 97 letter, Subject: Request for Additional Information (TAC NO. M96343), we have provided the additional information you requested.

If you have any questions regarding these responses, please contact Dr. Wade Richards, (916)643-1024.

Sincerely

EUGENE L. TATTINI
Major General, USAF
Commander

Attachment:
Questions/Responses

State of California County of Sacramento

After being duly sworn, the person known to be Major General Eugene L. Tattini, Commander of the Sacramento Air Logistics Center, signed the above document this 8th day of July 1997 at McClellan Air Force Base, California

A020

Rita C. Larson
Notary Public

MGC 1
RITA C. LARSON
Comm. #1071545
NOTARY PUBLIC CALIFORNIA
SACRAMENTO COUNTY
Comm. Exp. Sept. 10, 1999
MGC 1

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Question 1

SAR, page 4-14: Since control rod speed is important to the control of power during "steady-state" operation and is important with regard to a reactivity insertion accident, please provide a detailed description of how you determine the rod drive speed to be used. In addition, please provide a description of the procedures that must be followed if you decide to increase control rod drive speed to faster than 24 inches per minute.

Answer

As the memo from Dan Sheddy to Wade Richards, "Rod Speed," 21 May 97, states, the maximum rod withdraw speed is 42 inches/min. The normal rod speed (withdrawal or insertion) is 21 inches/min. This rod speed was chosen for operator convenience. At this rod speed, changes in reactivity are made slowly and well within the operators ability to control. Clearly from the analysis done in the SAR, Chapter 13, pages 13-8 and 13-9, control rods withdrawal rates up to the maximum of 42 inches/min can be tolerated without resulting fuel-element damage.

The process for changing the control rod drive speed is controlled by administrative procedures and controlled access to the control rod drive areas.

As the analysis of Chapter 13 demonstrates, changing the control rod drive speeds to their maximum does not result in fuel damage. However, the change could result in actuating a high-power scram. Therefore, changes to systems important to safety require review and approval of, at a minimum, a senior reactor operator. Access to the control rod drives is restricted to authorized personnel. The reactor room is locked and accessible to authorized personnel only.

Question 2

SAR, page 9-1: Please provide the seismic design parameters for the "in-tank" fuel-storage racks. Specifically, are they designed to retain stored fuel elements in the event of your design seismic event.

Answer

General Atomics does not have seismic information for their fuel storage racks. Therefore, it is unknown whether the fuel-storage racks would survive a design basis earthquake.

Assuming the racks did fail, approximately 19 fuel elements (maximum capacity of the fuel racks) would fall a distance of approximately 15 feet to the bottom of the reactor tank. Analysis shows that even under the worst conditions of element free fall, the fuel element would not rupture. Therefore, 19 fuel elements would be lying in a random pattern on the tank bottom. There is no possibility that 19 elements distributed randomly present a criticality problem.

In summary, the racks could fail under a design basis earthquake, but the resultant fuel configuration would not present any increased danger to the health and safety of the public.

Question 3

SAR, page 9-8: Please provide the basis for your statement that the "heat generation" in fuel stored in the fuel storage pits will be increased by a factor of 2, given that the power is increased by a factor of 10 (200 kW to 2 MW).

Answer

This condition will be satisfied by administrative controls that will allow fuel to be transferred to the fuel storage pits only after it has cooled for at least 14 days, thereby assuring the heat generation will not increase by more than a factor of 2 from the analysis done at 200 kW.

Question 4

SAR, page 9-13: Please provide an analysis to show that your fuel element transfer cask will withstand an accidental drop of approximately 30 feet (preparation room access to the top of a shipping cask). An alternate approach would be to provide your calculations to show that off-site doses from a fuel element transfer cask drop would be less than those calculated for your "Maximum Hypothetical Accident."

Answer

To conclude the fuel element cask would drop is in the category of an unlikely accident for the following reasons:

a. The cask-lifting lugs have been designed using the ASME code for analysis guidelines. This analysis (ref. SAR 9-6), shows that the maximum load on the lifting lug to cask weld is less than 1000 lbs/in. of weld when the entire weight of the cask is on one lug. The allowable load for this weld is 6360 lbs/in. of weld, a margin of greater than six even with the conservative assumption that all weight is on one lug. The cask lugs have been load tested in accordance with NE F8-6T. The cask welds will be nondestructively tested to ensure structural integrity before use. The cask can be supported by one lifting lug. For both lifting lugs to fail is unlikely.

b. The crane in the equipment room is a 10-ton crane. The crane is inspected yearly. The transfer cask weighs approximately 5000 pounds. Therefore there is a safety factor of 2. The crane fails in a safe mode (i.e., brakes lock).

c. All slings and shackles have been tested and certified for use These items receive yearly recertification and are clearly tagged.

d. As the SAR states, even if one sling should fail, the cask can be supported by one sling as each sling is rated for 6000 pounds. For both slings to fail would be unlikely.

For the above reasons and the defense in depth built into the handling system, it is felt that this item has been addressed adequately in the SAR.

Question 5

SAR, page 11-14: Please provide a new Figure 11.1 that also defines the boundaries for the core, tank wall, and outer surface of the biological shield.

Answer

Drawing was revised as requested.

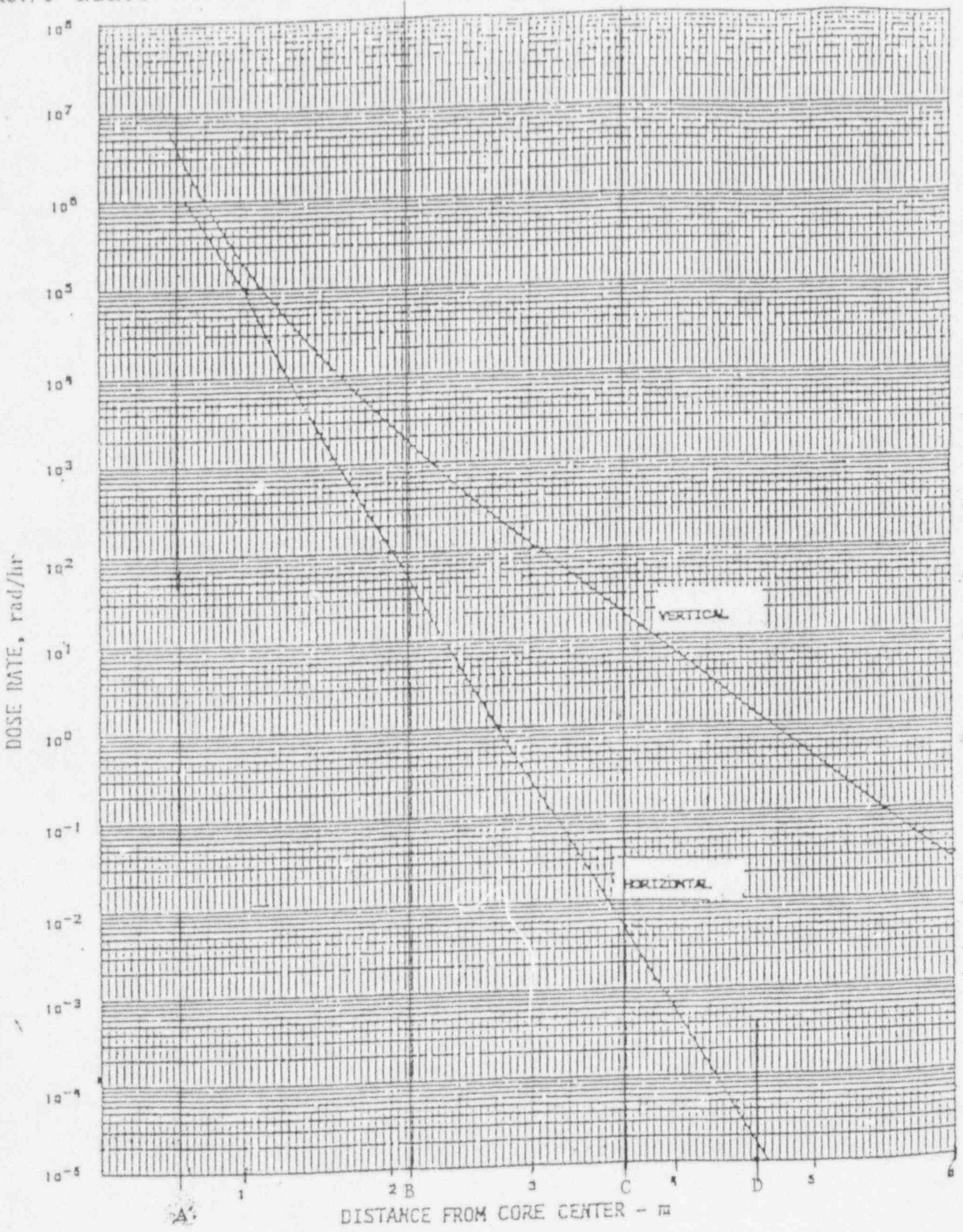


Figure 11.1 Reactor Bulk Shield Direct Dose Rate - 1 MW Operation

A: Core Boundary
B: Tank Boundary
C&D: Biological Shield

Question 6

SAR, pages 13-8 and 13-9: Please provide your calculation of the "Uncontrolled Withdrawal of a Control Rod" using the proposed Technical Specifications limits for:

a. maximum withdrawal speed;

b. maximum rod worth;

c. high power scram point;

d. 0.5 second (or more realistic value) from scram signal to actual rod release; and

e. rod fall time of 2 seconds.

Of particular interest will be the value of the "maximum positive reactivity insertion" (is this at any time greater than $2.12?)

Answer

Analysis as follows:

Calculation of the "Uncontrolled Withdrawal of a Control Rod" Using Proposed Technical Specification limits

The request for additional information (Docket NO. 50-607), item 6; Please provide your calculation of the "Uncontrolled Withdrawal of a Control Rod" using the proposed Technical Specification Limits for:

a. maximum withdrawal speed;
b. maximum rod worth;
c. high power scram point;
d. 0.5 second (or more realistic value) from scram signal to actual rod release; and
e. Rod fall time of 2 seconds.

Of particular interest will be the value of the "maximum positive reactivity insertion." (Is this at any time greater than $2.12?)

Assumptions used in the calculations for each item listed above are listed below.

Item

a. Maximum withdrawal speed. Letter from Dan Sheddy to Wade Richards, "Rod Speed," May 21, 1997; states that the V/F converters have the capability to pulse at a maximum rate of 500 pulse/s. Using numbers provided in this letter and converting 500 pulse/s to a rod velocity, yields a maximum withdrawal speed of 42 inches/min. This will be the maximum speed for a control rod being driving using a rack and pinion drive.

b. Maximum rod worth. Current Technical Specifications has no limit for maximum control rod worth. The current version of the SAR used $2.75 for this transient calculation which is less than measured rod worth values. Need to increase the $2.75 to something greater that the measured values. Suggest a value of $3.5 be used in the Technical Specifications and the SAR transient calculation.

c. High power scram point. Normal trip setpoint is 2.2 MW (110 % power), worst case setpoint of 2.3 MW (115 % power) should be used for the SAR calculations.

d. 0.5 second (or more realistic value) from scram signal to actual rod release. The 0.5 s delay for the type of power level trip channels use on the reactor is very conservative. Suggest checking with manufacture of the channel to verify the following assumptions for a realistic power level channel delay. Level-channel electronics response time to a step change would have a time constant of ~0.020 s (0 - 63 %). Relay delay of 0.015 s and electromagnet decay of 0.020 s before rods begin to move are assumed. A total delay time (0.020 + 0.015 + 0.020) of 0.055 s will be used to represent a realistic power channel response for the transient calculation.

e. Rod fall time of 2 seconds. The Technical Specifications limit for rod fall time includes the power channel delay time. Total time of actual rod movement is: rod fall time of 2 s minus the total channel delay time. Time of actual rod movement and the amount of shutdown reactivity available in the control rods at the time of scram will determine the rate of reactivity removal from the reactor.

Time of rod movement:

Conservative Case	2.0 - 0.5 = 1.5 s
Realistic Case	2.0 - 0.055 = 1.945 s

Rate of shutdown reactivity removal = Total shutdown reactivity / Time of rod movement

Additional Assumptions

The amount of shutdown reactivity at the time of scram is based on the following: Four control rods are capable of providing a total of \$0.5 of shutdown reactivity (conservative assumption) and the rod that is adding reactivity for the "uncontrolled withdrawal of a control rod" is available as shutdown reactivity. Thus the total shutdown reactivity is \$0.5 plus reactivity of moving rod at time of scram.

Measured rod worth profile used to calculate the inserted reactivity as a function of time. The initial rod position for the transient calculations assumes either 0 % and 32 % insertion points. The 32 % initial position for the control rod is the region of maximum slope. Attached is the control rod worth profiles as a function time using 42 inches/min insertion velocity and a second plot as a function of position.

Initial reactor power either 100 W or 2.0 MW and reactivity feedback is included in the calculations.

The Dynamic Simulator for Nuclear Power Plants (DSNP) is used to solve the one group point kinetics equation. The reactivity feedback coefficient was assumed to be

$$\alpha\ (T) = 4.689 \times 10^{-6} + 1.3 \times 10^{-7} - 7.436 \text{ X } 10^{-11} T^2 \quad \Delta k/k/°C.$$

The heat capacity of the core was assumed to be

$$C_p = 7.54 \times 10^4 + 151.0T \quad \text{watt-second/°C.}$$

Calculated Results

Initial Power 100 W

Power Channel Delay	0.055 s	0.055 s	0.5 s	0.5 s
Initial Power	100 W	100 W	100 W	100 W
Initial Average Fuel Temperature	35 °C	35 °C	35 °C	35 °C
Initial Control Rod Position	0%	32 %	0%	32 %
Trip Point	2.3 MW	2.3 MW	2.3 MW	2.3 MW
Time to Trip Point	7.2475 s	4.2625 s	7.2475 s	4.2625 s
Time Rods begin to Move	7.3025 s	4.3175 s	7.7475 s	4.7625 s
Shutdown Reactivity	1.557 $	2.525 $	1.663 $	2.635 $
Inserted Reactivity	1.057 $	1.071 $	1.163 $	1.181 $
Peak Power	5.8213 MW	6.6258 MW	10.127 MW	12.470 MW
Average Fuel Temperature at 10 s	68.8 °C	63.3 °C	114 °C	118 °C

Initial Power 2.0 MW

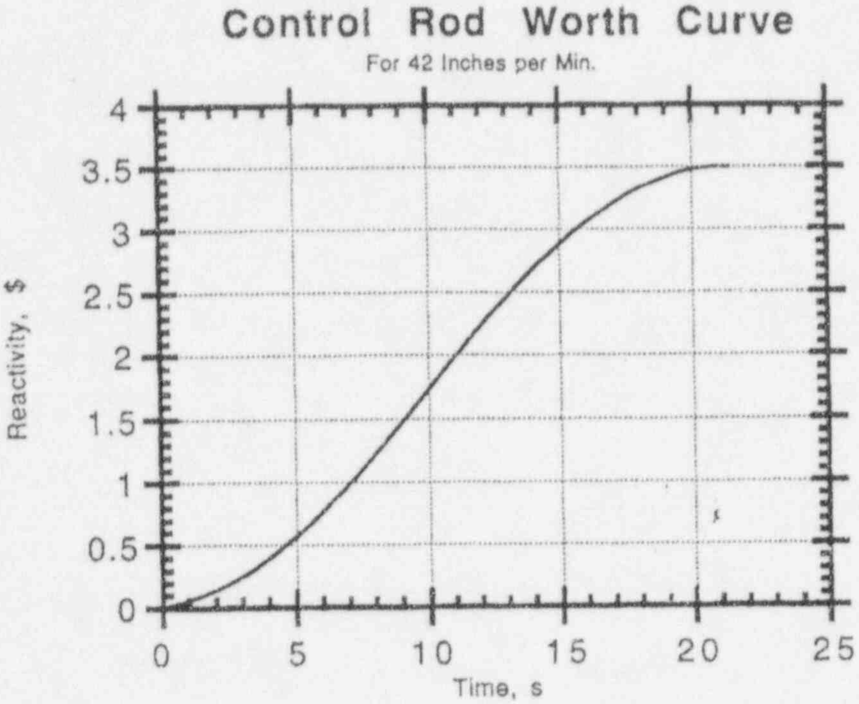
Power Channel Delay	0.055 s	0.5 s
Initial Power	2.0 MW	2.0 MW
Initial Average Fuel Temperature	257.2 °C	257.2 °C
Initial Control Rod Position	32 %	32 %
Trip Point	2.3 MW	2.3 MW
Time to Trip Point	0.554 s	0.554 s
Time Rods begin to Move	0.609 s	1.054 s
Inserted Reactivity	0.142 $	0.249 $
Peak Power	2.3374 MW	2.6723 MW
Average Fuel Temperature at 2 s	258.8 °C	261.9 °C

Summary

Changing the SAR control rod drive (Rack & Pinion Drive) maximum speed from 7.5 inches/s to 42 inches/min results in slower transients and yields more flexibility in setting technical specifications limits for control rod worth.

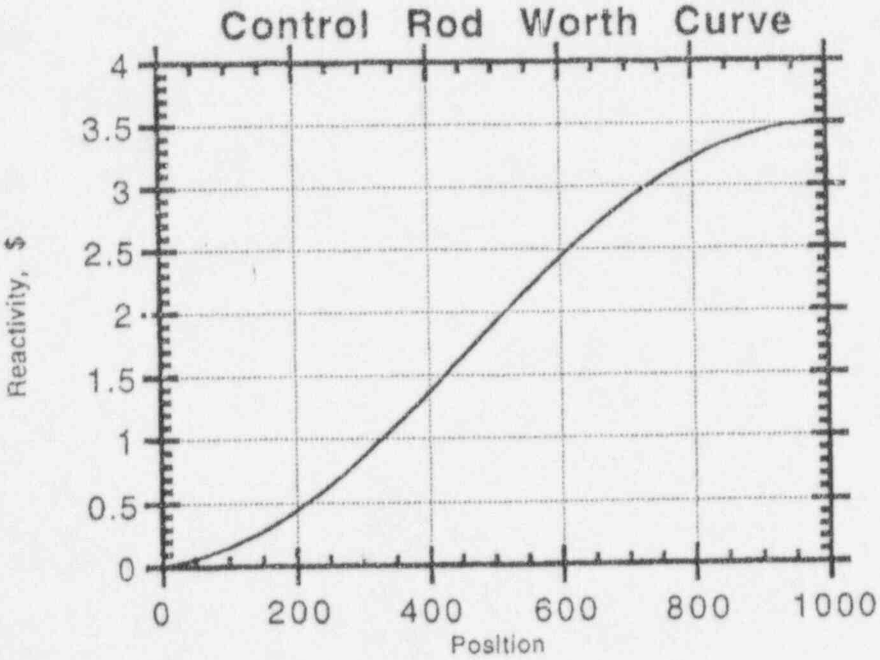
The conservative value for power_level channel delay time (0.5 s) used in the SAR dose not impact the outcome of the transient as it did with the faster insertion rate (7.5 inches/s) assumed in the SAR.

The maximum positive reactivity insertion for all the cases listed above are much less than the $2.12 maximum reactivity insertion that can be allowed under worst case conditions, SAR (Section 13.2.2.2.1).



Control Rod Worth Curve

For 42 Inches per Min.



Control Rod Worth Curve