DEPARTMENT OF MECHANICAL ENGINEERING
THE UNIVERSITY OF TEXAS AT AUSTIN

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Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

May 24, 1991

Subject: Letter of February 22, 1991
Request for additional information
Docket 50-602

Attn: Al Adams
Project Manager
Nonpower Reactor, Decommissioning and
Environmental Directorate

Four enclosures are submitted for the docket 50-602 license as per 10CFR part 50.4(b)2i and 50.4(b)6. These enclosures supplement the license request by revision of the Safety Analysis Report and response to the U. S. NRC questions (letter of 2/22/91). The enclosures are

1) The University of Texas Safety Analysis Report, Revision 1.01 (5/91).
2) Compilation of changes to the previous SAR submittal (11/89).
3) Specific response to letter 2/22/91.
4) List of material subject to license request.

A request to extend the CPRR-123 permit for an additional 4 months (expiration date 6/31/91) has been sent by separate letter.

Sincerely,

Thomas L. Bauer
Assistant Director
Nuclear Engineering
Teaching Laboratory

APPROVED:

Bernard W. Wehring
Bernard W. Wehring, Director
Nuclear Engineering Teaching Laboratory

cc: G. Fonken
H. Woodson
K. Diller
H. C. Lott
A. B. Beach, Region IV w/enclosures

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of	ξ	
The University of Texas at Austin	ξ	Docket No. 50-602
Balcones Research Center Nuclear Engineering Teaching Laboratory (NETL)	ξ	

AFFIDAVIT

Gerhard J. Fonken 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 corrections to The University of Texas Safety Analysis Report (Revision 1.01, May 1991) and supplemental material for docket 50-602 and Construction Permit CPRR-123; that he is familiar with the content thereof; and that the matters set forth therein are true and correct to the best of his knowledge and belief.

Gerhard J. Fonken
Executive Vice President and Provost

STATE of TEXAS ξ

Subscribed and sworn to before me, a Notary Public in and for the State of Texas, this 28th day of May, 19 91.

NOTARY PUBLIC in and for the State of Texas

Response to Questions
Letter 2/22/91

1. Chapter 3, section 3.4, page 3-12
Wording has been revised to remove the reference to the shield structure and storage pits as engineering safety features.

2. Chapter 4, section 4.1, page 4-1
Add reference (#34) to Simnad Report GA-117-833, and to page 4-76.

Section 4.1.1
The analysis of this section calculates the clad stresses of the standard element in the limiting operating conditions. Equation (2) demonstrates the relationship of the clad stress to the internal pressure. Section 4.1.2 extends the analysis to the evolution of gases by the diffusion of gases into and out of the fuel material. This analysis does not specifically reference the fuel follower control elements because the salient features of the analysis do not exceed any of the parameters for the standard fuel element. In fact, feature differences of the control rod design improve the margin of safety. The following conditions demonstrate this fact. (1) The dimension of the control element is slightly less (94%) than the standard element. Since the clad thickness remains the same the allowable clad stress actually increases. (2) Heat transfer and hydrogen diffusion rates improve with the larger surface to volume ratio. Both of these conditions improve the margin of safety. (3) The dehydride-rehydride process (section 4.1.2) and ultimately the stress on the clad is directly related to the air volume with the element. Assumptions for the amount of volume within the ends of a standard element and the amount of gas absorption available within the graphite end pieces are equally applicable to the control element. In the control elements, the proportionate space for expansion and absorption is substantially larger.

No change to the text of section 4.1.1 has been made since the design parameters of the control elements are within the parameters of the standard element as shown in Tables 4-10 and 4-11. Table 4-11 has been corrected to show the proper dimensions.

Section 4.2, page 4-47, Table 4-3
Table values previously listed at 1 MW have been recalculated for the license condition of 1.1 MW.

Section 4.2.2., page 4-52

The pulse data of table 4-7 represent nominal values of $3 and $5 pulses and are for comparative purposes to relate the results of two pulse magnitudes. The data represent the result of measurements and in the case of a 3 dollar pulse the results are similar to that expected for the University of Texas TRIGA. The values of Table 4-7 represent typical results at TRIGA installations similar to the University of Texas facility. However, the actual peak power is strongly dependent on the number of fuel elements within a reactor core configuration. The fuel temperature which is a safety limit is a function of the reactivity insertion and other fuel parameters but not the peak power. For these reasons Table 4-7 represents measurements that demonstrate the pulse results for two reactivity insertions ($3, and $5), one case is a typical pulse, the other case exceeds the limiting design conditions. Calculations with a specific core configuration (i.e. 90 elements) for a $3.14 (2.2% $\Delta k/k$) pulse project a peak power of about 1700 MW. Note that the peak pulse power dependence is roughly proportional to the number of fuel elements. Thus the assumption of core configuration (core burnup) can substantially change the projected peak power. For example, a 25% change in peak power occurs in a 100 element versus an 80 element core. The fuel temperature does not vary substantially with the core configuration. Section 11.1 of the Safety Analysis Report considers pulse values up to $4, (the limiting transient rod design condition) to demonstrate that fuel element temperatures will not exceed design values or safety limits.

Section 4.3.1, page 4-53

The values of Table 4-8 are nominal values not maximum values. Analysis conditions for design limits demonstrate that acceptable conditions in excess of 1.5 MW are possible, page 4-44, although limits on the time at power and availability of cooling may be necessary. At the normal operating conditions, 1100 kW, the data of Table 4-8 represent the typical conditions of operation. An increase of the power by 10% to the license limit of 1100 kW does not cause any parameter within the table to approach a significant limit.

Section 4.4., pages 4-55, 4-56, 4-58

The Figures 4-25, 26 and 27 have been replaced to show as built conditions and correct readability.

Section 4.4.8.4, page 4-73
Maximum worth of transient rod is 2.8% $\Delta k/k$, maximum transient condition is 2.2% $\Delta k/k$. Wording of section 4.4.8.4 has been revised to distinguish the maximum design limit and the maximum insertion limit.

3. Chapter 5, section 5.3, page 5-14, Table 5-2
Flow areas and units corrected to show "squares".

4. Chapter 6, section 6.1.4 page 6-12
Revisions have been made to the text to be consistent with the figure and as-built conditions.

Section 6.1.4, page 6-12
Reference to automatic control rod and use of bank rods has been revised. The regulating control rod is the only automatic control rod.

5. Chapter 7 (page numbering has been revised)

Sections 7.4.1, 7.4.2 and 7.4.3 (pages 15-28) have been revised and relabeled

Section 7.4.2, page 7-25
The calculations of this section, see 7.4.3, have been revised. Results demonstrate that the factor of 10 is not necessary (see page 7-28) and that the release conditions are within the release limits.

Section 7, page 29 (references)
The list of references has been corrected.

6. Chapter 9
Several section of chapter have been revised to identify key detector locations. A new section 9.5 has been added to evaluate a typical detector type and identify detection criteria.

7. Chapter 11
Section 11.1.1, page 11-1
The rupture pressure of 1800 psi represents the internal gas pressure not the yield stress limit for the clad. The clad stress is related to the internal stress by equation (32) page 11-18. At 1800 psi the clad stress is 66000 psi, which compares to the rupture strength of 304 stainless steel at 400°C of 63000 psi (Fig. 11-4). At lower temperatures the ultimate tensile strength increases slightly. In reference [2] of chapter 11 page 4-2 the rupture pressure at 138°C is 68000 psi.

Summary of Revisions
Version 1.01 - 5/91
Safety Analysis Report
The University of Texas at Austin

I. Summary of Changes

Page	Correction
Chapter 1	
Chapter 2	
pg. 6, par. 3, line 2	add sentence: Estimates of the 1990 census project the 1990 Austin population to be 465,600.
pg. 6, par. 3, line 10	change to ...0.2 persons per 1000 square meters
pg. 6, par. 3, line 12	change to ...densit 0.2 to 0.3 persons per 1000 squa. .iles
pg. 20	revise site location on figure 2-12 to 12.5mm northeast
Chapter 3	
pg. 12, par. 5, line 6-8	revise wording to identify only one engineering safety feature
pg. 13, par. 7, line 2	create new paragraph, add sentence: Control pathways for ...
pg. 15, par. 2, line 10	create new paragraph revise wording and add additional sentence
Chapter 4	
pg. 1, par. 3, line 8,	add sentence to provide reference to GA report by Simnad
pg. 47, table 3	revise temperature references to 1.1MW
pg. 47, table 4	revise table reference to control rods shim1, shim2, regulating
pg. 51, par. 3,	revise paragraph
pg. 52, par. 1, line 3	revise 1000kW to 1100kW
pg. 55,	revise Figure 4-25
pg. 56,	revise Figure 4-26
pg. 58,	revise Figure 4-27
pg. 56, par. 1, line 3	revise 1000kW to 1100kW
pg. 58, par. 1, line 3	revise 1000kW to 1100kW
pg. 61,	revise location of section 4.4.5.1 <2
pg. 62,	revise location of section 4.4.5.2 <1
pg. 64, section 4.4.8	revise control rods to shim1, shim2...
pg. 64, par. 5, line 1	revise wording to ...regulating and shim rods...
pg. 65, par. 1, line 1	revise wordi to ...regulating and shim rods...
pg. 65, table 11	delete refere e to safety rod in table
pg. 67, par. 2, line 3	change motion for rod from 11 to 18
pg. 67, par. 2,	revise par. break and wording to delete previous refe ence to safety rod

Page	Correction
Chapter 4 cont.	
pg. 73, par. 3, line 3	revise (a) to clarify. (a) and (b)
Chapter 5	
pg. 1, par. 2, line 3	revise wording of part (b)
pg. 6 par. 1, line 3	correct eq. number to 19
pg. 13, table 5-2	move to page 5-12. revise units several places
Chapter 6	
pg. 12, par. 2, line 4	change CONT/ON to AIR-MAGNET
pg. 12, par. 2, line 5	change ON indicator to on indication
pg. 12, par. 3, line 11	change the word AUTOMATIC to AUTO
pg. 12, par. 4, line 2	change the word AUTOMATIC to AUTO
pg. 12, par. 5, line 9	revise by deleting sentence
pg. 13, par. 1, line 2	change the word steady-state to MANUAL
pg. 13, par. 1, line 5	change the word MODE SELECTOR switch to MODE selection switches
pg. 13, par. 2, line 3	change the word steady-state to manual
pg. 13, par. 3, line 4	add NM1000, and NPP1000
pg. 13, par. 3, line 5	add NP1000, and NPP1000
pg. 13, par. 3, line 10	add ... (for experiments)
pg. 13, par. 3, line 11	move clarification in (h) and paragraph 4 to page 6-14, revise words
pg. 13, par. 3, line 12	add section (i) for watchdog timers
pg. 13, par. 5,	add paragraph for digital processing description
pg. 14, par. 2, line 3	remove the word ...level power
pg. 15, Figure 6-7	revise details of figure
pg. 16, par. 2, line 2	change 1000°C to 600°C
pg. 16, par. 5	reword paragraph
pg. 17, par. 1, line 10	change translator to control signal module
pg. 17, par. 2,	add description for enclosure 4.
pg. 17, par. 3, line 1	add references [6,7,8]
pg. 18, par.	add references 6,7,8
Chapter 7	
pg. 5, par. 5,	add one sentence for Figure 7-5
pg. 14, par. 3, line 1	Insert ...ambient atmospheric pressure
pg. 14, par. 3, line 2	insert ...building is a negative pressure difference. The differential ....
pg. 15, section 7.4.1.1	renumber and relocate from 7.4.1.2
pg. 19 section 7.4.1.2	revise section as per amendment letter to previous questions, includes correction to the original submittal
pg. 25, section 7.4.1.3	revise calculations
pg. 26, section 7.4.1.3	revise table 7-2
pg. 27, section 7.4.2	revise conclusion for analysis in 7.4.1.3

Page	Correction
Chapter 8	
pg. 7, section 8.1.5	add new section for experment materials
pg. 10, section 8.2	add sections 8.2.2.1 and 8.2.2.2 for analysis of cobalt-60 irradiator
Chapter 9	
pg. 9, section 9.5	add new section to present evaluation of radiation monitors
Chapter 10	
pg. 10 section 10.2	add section operator requalification plan replaces previous sections 10.2.1-10.2.4 delete previous section 10.2.5, information is in section 10.3.5
pg. 10 section 10.1.5.3	revise paragraph wording
pg. 18, par. 2 and 5	change ...Reactor Committee to Nuclear Reactor Committee
pg. 10 section 10.1.5.3	revise paragraph wording
Chapter 11	
pg. 1, par. 5, line 10	move 5 lines from 2 and split paragraph
pg. 2, par. 1, line 1	add sentence to start of paragraph
pg. 5, par. 1, eq. 4	change C_1 to C_1T

II. Summary of Typographical and Editorial Changes

Page	Correction
Chapter 1	
pages 1-5	revise paragraph indentations
pg. 1, par. 1, line 1	capitalize The
pg. 1, par. 1, line 4,5	delete in and insert between 1963 and 1988
pg. 1, par. 1, line 8	delete Safe capitalize Operation
pg. 1, par. 1, line 9	capitalize The
pg. 1, par. 4, line 2	add hyphen to steady_state
pg. 2, line 5	add (design 1.5MW)
pg. 2, line 8	add delete (a)
pg. 2, line 23	change to follower
pg. 2, line 24	change to follower
pg. 2, line 23,24	swap lines 23 and 24
pg. 2, line 26,27	delete blank line
pg. 3, par. 9, line 1	add a fuel...
Chapter 2	
pages 1-28	revise paragraph indentations
pg. 1, par. 1, line 1,2	revise wording
pg. 1, par. 1, line 6	revise site to facility
pg. 1, par. 5,	add 2 lines from page 6
pg. 6, par. 3, line 1	change area to region
pg. 6, par. 3, line 9	change to ...6.4 persons per 1000 square meters
pg. 10, par. 2, line 11,12	revise wording
pg. 13, par. 5, line 4	change to drainage_ways
pg. 19,23	change paragraph break point
pg. 22	change location of figure 2-14 to page 22
pg. 23	revise table 2.4 format
pg. 24	revise format of table 2.5
pg. 24	change location of page from page 26
pg. 25-27	changes page locations of figures 15-16
Chapter 3	
pages 1-22	revise paragraph indentations
pg. 1, par. 5,	move 2 lines to page 3-3
pg. 3, par. 4, line 5	add the word of standard...
pg. 3, par. 1, line 11,12	revise sentence wording
pg. 3, par. 1, line 3	change reference to [2,3,4,5]
pg. 3, par. 3, line 3	delete the word the
pg. 3, par. 5, line 9	change year to yr
pg. 4, par. 5, line 11	change block to blocks
pg 7, par. 1, line 4	delete the word the
pg. 7, par. 1, line 7	delete the word a
	revise entryway to entry_way
pg. 7, par. 1, line 8	change Entryway to Entry_way
pg. 7, par. 1, line 10	delete the word general
pg. 7, par. 5, line 2	change roughly to about
pg. 12, par. 7, line 4	add the word the

Page	Correction
Chapter 3 cont.	
pg. 13, par. 1, line 3	revise entryway to entry_way
pg. 13, par. 4, line 6	change are as to include
pg. 16, par. 4, no. 4	add the word Amendments
Chapter 4	
pages 1-74	revise paragraph indentations
pages 1-74	revise page break points, several places
pages 1-74	revise equation formats, several places
pg. 1, par. 5, line 3	change designbases to design_bases
pg. 1, par. 6,	move par. and title from page 2
pg. 7, par. 5, line 4	separate heat_transfer
pg. 16, par. 3, line 2,10	correct Btu/hr-ft^2-°F
pg. 16, par. 5,	revise par. wording
pg. 16, par. 4, line 10	correct Btu/hr-ft^2-°F
pg. 21, par. 4, line 3	change symbol Z to ξ
pg. 21, par. 4, line 9	add missing symbolΛ εγξατιρν ^{3} εγξαω τρ ξ
pg. 37, par. 2, line 13	change fig. references, 3-20,21 to 4-20,21
pg. 40, equation 29	add missing ρ, 2 places
pg. 41, par. 7, line 3,4	add missing ρ, 2 places
pg. 43, equation 40	add missing ρ, 2 places
pg. 43, equation 43	add missing ρ, 1 place
pg. 44, par. 2, line 4	correct spelling of separate
pg. 47, table 3	revise table format
pg. 61,62	revise paragraphs and table locations
pg. 61,62	change refernces to table 4-9 to 4-10
pg. 65, table 11	revise table location to this page
pg. 67, section 4.4.8.2	change title Reg... to Regulating...
pg. 65, table 11	correct dimension 0.20 in. (0.051 cm)
pg. 67, par. 6,7	combine two paragraphs into one
pg. 73, par. 3, line 3	relabel (b) to (c)
Chapter 5	
pages 1-13	revise paragraph indentations
pg. 1, par. 3, line 4	change 2x3 to two by three
pg. 1, par. 7, line 4,5	move lines from page 5-2
pg. 2, par. 5, line 6,7	move lines from page 5-3
pg. 3,	capitalize W/m four places
pg. 3, par. 1, line 8	change units to -°C
pg. 3, par. 1, line 10	change units to -°C
pg. 3, par. 1, line 12	delete square in units of k
pg. 3, par. 2, line 6	add space after period in sentence
pg. 4, par. 1, line 11	capitalize Number
pg. 4, eq. 7,8,9,10,11	add commas and periods
pg. 5, par. 1, line 1	move line from previous page
pg. 5, par. 1, line 5-6	add commas and periods to several line
pg. 5, eq. 12,13,14,15	add commas and periods to equations
pg. 5, eq. 16,17,18	add commas and periods to equations
pg. 5, eq. 17,18	revise format of equation
pg. 6 par. 4, line 6	change Figure to Figures
pg. 9 par. 1, line 2	change room from 1.104 to 1.104b
pg. 9 table 5-1	change reference from 5_1 to 5-1

Page	Correction
Chapter 5 cont.	
pg. 10, par. 2, line 6	change GPM to gpm
pg. 10, par. 4, line 1	change then to thru
pg. 10, par. 5, line 4	change Figure to Figures
pg. 12, par. 1, line 2	change probe to probes
pg. 12, par. 5, line 4,5,8	remove the word the
pg. 12, par. 6, line 7	remove the word used
Chapter 6	
pages 1-17	revise paragraph indentations
pg. 1, par. 1, line 8	add comma ...vendor, ...
pg. 2, par. 3, line 2	insert the word that deliver ...
pg. 2, par. 3, line 5	change Figure reference to 6-2
pg. 2, par. 5, line 10	insert semicolon ; in sentence
pg. 5, par. 1, line 2	change the word form to from
pg. 6, par. 2, line 1	insert quotation marks ..."nv"
pg. 6, par. 4, line 2	change the word of to for
pg. 8, par. 7,	move paragraph from page 6-12
Chapter 7	
pages 1-13	revise paragraph indentation
pg. 5, par. 4, line11	changes ports to parts
pg. 5, par. 4, line 4	remove apostrophe ' in it's
pg. 8, par. 3	move start of section 7.2.3 to page 10
pg. 10, par. 2, line 5	add ...inches wide
pg. 10, section 7.2.4	change demonstrate to demonstrates
pg. 11, par. 1, line 4	remove apostrophe ' in it's
pg. 11, par. 6, line 4	capitalize the word Material
pg. 12, par. 4, line 3	change comma to .
pg. 13, par. 4, line	
pg. 14, par. 1, line 3	delete the word... the
pg. 14, par. 1, line 4	delete the word ... and
pg. 14, par. 1, line 5	delete ... of the building
pg. 14, par. 1, line 9	delete the word the
pg. 14, par. 1, line 9	insert the words ... the reactor
pg. 14, par. 1, line 10	delete ... of the reactor
pg. 14, par. 3, line 2	change if to are
Chapter 8	
pages 1-13	revise paragraph indentations
pg. 4, par. 6, line 4-8	revise sentences for clarity
pg. 4, par. 6,	combine part (c) and (d) into (c)
pg. 6, par. 1, line 11	add sentence for graphite encasement
pg. 6, par. 4, line 14	revise paragraph split, revise first sentence of par. 5
Chapter 9	
pages 1-22	revise paragraph indentations

Page	Correction
Chapter 10	
pages 1-32	revise paragraph indentations
pages 1-32	revise paging breaks throughout chapter
pg. 1, par. 1, line 4	change as show by to of
pg. 1, par. 3, line 5	change Department of Mechanical Engineering to Mechanical Engineering Department
pg. 4, par. 5, line 1	remove section title (only) 10.1.2.1 revise numbers of following sections
pg. 6, par. 5, line 3	revise order of words
pg. 17, par. 5, line 2	add comma for clarity
Chapter 11	
pages 1-30	revise paragraph indentations
pg. 1, par. 2, line 2-4	add periods to each line
pg. 4, par. 2, line 14,17	capitalize W-sec.
pg. 5, par. 1, eq. 5	delete last)
pg. 5, par. 1, eq. 6	delete last)
pg. 5, par. 1, eq. 8	capitalize W-sec in 3 places
pg. 7, par. 2, eq. 22	change equation format
pg. 7, par. 3, eq. 23	change equation format
pg. 7, par. 4, eq. 24	change equation format
pg. 8, par. 4, line 3	revise last sentence into two...
pg. 10, par. 2, line 1	capitalize Chapter
pg. 10, par. 5, line 2	correct misplane to midplane
pg. 11, par. 3, line 2	change is to are
pg. 15, par. 1,	move to section (c) to page 11
pg. 15,	revise chapter pagination from page 15 on

Enclosure #4

List of Materials[1]
Docket 50-602 License

Part 70 type	enrichment	quantity	comments
uranium-235	<20%	5800 g.	fuel elements
uranium-235	all	20 g	detectors
Part 30			
americium-beryllium		2 Ci	reactor neutron source
polonium-beryllium		6 Ci	reactor neutron source
californium-252		1200 mg	neutron source for experiments[2]
Part 70			
uranium-233	-	10 mg	foils
uranium-235	-	50 mg	foils
plutonium-239	-	40 mg.	foils
plutonium-240	-	10 mg	foils
plutonium-241	-	10 mg	foils
Part 70			
uranium-235	-	10 g	reference materials
plutonium-239	-	1 g	reference materials
Part 40			
uranium-236	-	8 mg	foils material
uranium-238	-	150 g	foils material
Part 30			
cobalt-60		10,000 Ci	multiple source irradiator in reactor pool

(1) Foils and reference materials are for use with the reactor for measurement and experiment purposes.

(2) The californium-252 is for use as a reactor neutron source for experiment purposes. Licensing of the californium-252 is with the Texas agreement state license.

5/29/91