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TEXAS INSTRUMENTS
INCORPORATED
MATERIALS & ELECTRICAL PRODUCTS GROUP

May 1, 1979

Leland C. Rouse, Chief
Fuel Processing & Fabrication Branch
Div. of Fuel Cycle & Material Safety
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Reference: SNM-23, Docket 70-33

Gentlemen:

It is requested that USNRC License No. SNM-23, Docket No. 70-33, Amendment No. 8, dated July 28, 1978, be amended to:

> Permit the use of a newly developed borated phenolic foam insulated shipping container for storage and transfer of HFBR, NBSR, ORR, or other box type fuel elements within the HFIR Facility (with no greater ^{235}U content than HFBR fuel elements, approximately 351 g ^{235}U). As presented in the enclosures, designer and independent calculations demonstrate that the newly developed container meets Fissile Class I package requirements of 10 CFR Part 71. Therefore, the storage of box type fuel elements within the newly developed container will not affect the nuclear criticality safety of fuel storage at TI. Use of the newly developed shipping containers are limited to available shipping container storage space within location numbers (30), (31), (41), (51), and (57) as permitted by Table 1, Appendix 1, of Amendment No. 8.

Enclosures I and II provide information and form the justification of this request, and Enclosure III provides an update of Table 1 of Appendix 1 in accordance with past correspondence between TI and your staff. All changes to Table 1 are itemized in the enclosure.

Also enclosed is a check to cover the administrative amendment fees associated with this request.

Sincerely,

Calvin M. Hopper

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Calvin M. Hopper
Manager Nuclear Safety

/ck

Enclosures I, II, III, Check for Administrative Amendment.
Check #077082

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ENCLOSURE I

Justification for Use of Borated Phenolic Foam Seven Element Container (Reference ORNL/CSD/TM-77 and Enclosure II)

Analyses:

ORNL/CSD/TM-77 provides the primary nuclear criticality safety demonstration for the seven element shipping container loaded with approximately 351 g ^{235}U HFBR box type fuel elements. The primary demonstration justifies the use of the container as a Fissile Class I package.

Enclosure II provides the fabrication engineering drawings as a reference of geometry and material descriptions.

An independent nuclear criticality safety review of ORNL/CSD/TM-77 results was accomplished utilizing the same KENO IV code and cross-section sets. The code and cross-sections have been demonstrated to be adequate for calculations involving materials and geometries consistent with those encountered in the package analyses.[1,2,3,4,5,6]

To provide an independent calculational approach to the review, HFBR fuel elements were assumed to be homogenized throughout the fueled regions rather than using discrete geometries. Comparisons of the discrete geometry calculational results presented in Table 4 of ORNL/CSD/TM-58 and this review are shown in Table 1.

TABLE 1

Comparison of Discrete Versus Homogenized Geometry Calculational Results for HFBR Fuel Elements, Close Packed, Submerged in Water

Number of Fuel Elements	Element Arrangement	k_{eff} TM-58 (Discrete)	k_{eff} This Review (Homogenized)
16	XXXX XXXX XXXX XXXX	1.132 ± 0.008	1.137 ± 0.006
12	XXXX XXXX XXXX	1.054 ± 0.010	1.059 ± 0.006
10	XX XXXX XXXX	1.007 ± 0.007	———
9	XXX XXX XXX	———	1.004 ± 0.005

Results shown in Table 1 demonstrate the validity of utilizing homogenized descriptions of HFBR fuel elements in calculations.

Independent calculations of the third, fifth, and sixth results presented in Table 4 of ORNL/CSD/TM-77 were made with the HFBR fuel elements homogenized within the proposed container. Comparisons of the discrete geometry calculational results presented in Table 4 of ORNL/CSD/TM-77 and this review are shown in Table 2.

TABLE 2

Comparison of Discrete versus Homogenized Geometry Calculational Results for 9 HFBR Fuel Elements within the Damaged Proposed Borated Phenolic Foam Seven Element Shipping Container.

Number of Packages	Conditions	k_{eff} TM-77 (Discrete)	k_{eff} This Review (Homogenized)
Single	Water in fuel region package closely reflected by water	0.688 ± 0.009	0.729 ± 0.005
Infinite Array	Water in fuel region	0.739 ± 0.008	0.857 ± 0.005
Infinite Array	Water in fuel region water filling void between packages	0.682 ± 0.007	0.778 ± 0.006

The effects of 0.05 g/cm^3 density borated phenolic foam were examined also. Calculational results presented in Table 2 utilized 0.2 g/cm^3 borated phenolic foam. Comparative results of homogenized fuel elements are presented in Table 3.

TABLE 3

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Results of Varying Borated Phenolic Foam Density

Number of Packages	Conditions	k_{eff} 0.2 g/cm^3	k_{eff} 0.05 g/cm^3
Single	Water in fuel region package closely reflected by water	0.729 ± 0.005	0.715 ± 0.005
Infinite Array	Water in fuel region	0.857 ± 0.005	0.889 ± 0.006

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TABLE 3

(Continued)

Results of Varying Borated Phenolic Foam Density

Number of Packages	Conditions	k_{eff} 0.2 g/cm^3	k_{eff} 0.05 g/cm^3
Infinite Array	Water in fuel region water filling void between packages	0.778 ± 0.006	0.794 ± 0.007

An independent review of the physical characteristics of the container (geometries, materials, densities) was accomplished. This review indicated that:

1. The basic elemental composition of the borated phenolic foam as calculated in ORNL/CSD/TM-77 and this review are within the specifications for borated phenolic foam[7,8,9,10] as presented within ORNL/CSD/TM-77.

2. The basic calculational geometries and materials descriptions conform to the expected results of thermal tests described in references 7 and 8.

It is concluded that the designer's nuclear criticality safety assessment[3] of the described borated phenolic foam seven element shipping container is adequate to demonstrate the safe use of the container within the HFIR Project Facility and will not affect the nuclear criticality safety of fuel storage at TI.

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10. Personal communication with J.T. Thomas (1979).

ENCLOSURE II

The attached Engineering Drawings for the borated phenolic foam insulated seven element shipping container form the bases for calculational mock-ups.

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ENCLOSURE III

The following Table 1 of Appendix 1 of SNM-23 License Amendment No. 8, is attached to update the table to conform to this amendment request and previous corrections prior to NRC approval of Amendment No. 8.

Changes indicated on the following sheet revisions were documented by letters as follows:

Letter to NRC from T.I. dated:	Work Location No. Wording Change
April 13, 1978	(21), (68)
May 5, 1978	(22), (23), (24), (32), (33), (48), (54), (55), (59), (67), (79)
This request	(30) to eliminate reference to four elements

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TABLE 1

	LOCATION NO.	LOCATION NAME	MSQ	OPERATION
		GENERAL MFG. AREA CLEANING ROOM		
	(20)	Pickling & Rinse tanks	$\leq$ lot fuel plates, each lot of plates $\leq$ 468 gm ^{235}U	Pickle fuel plates
*	(21)	Degreaser	1 lot fuel plates each lot of plates $\leq$ 468 gm ^{235}U $\leq$ 12 fuel plates in the degreaser at one time.	Degrease fuel plates
*	(22)	Rinse tanks (deionized water)	1 HFIR outer element or 1 HFIR inner element or 10 HFBR or similar elements with $\leq$ 235 U content (a cart of 10 HFBR or similar elements may be in the work area)	Rinse elements one HFIR element at a time or up to five box-type elements at a time (remainder of box-elements to be inside storage cart)
*	(23)	Deburr & clean	1 HFIR outer element or 1 HFIR inner element or 10 HFBR or similar elements with $\leq$ ^{235}U content (a cart of 10 HFBR or similar elements may be in the work area) maximum no. of elements being deburred & cleaned at a time - 2.	Remove burrs and chips and wipe clean
		Element Assy. Room		
*	(24)	Assembly stand	1 HFIR outer element or 1 HFIR inner element + 23 fuel plates in box, the box of plates at lease 6" from the element.	Assemble element
	(25)	Storage array	$\leq$ 20 storage positions $\leq$ one lot of fuel plates per position each lot of plates $\leq$ 468 gm ^{235}U or 24 plates.	Store fuel plate in preparation for assembly into elements.
	(26)	Bench	$\leq$ one lot of fuel plates each lot of plates $\leq$ 468 gm ^{235}U or 24 plates.	Inspect and deburr fuel plates

TABLE 1

	LOCATION NO.	LOCATION NAME	MSQ	OPERATION
		GENERAL MFG. AREA		
	(27)	Fuel plate assy.	$\leq$ 468 gm ^{235}U or $\leq$ 24 compacts or 12 assemblies	Assemble compacts, frames & covers. One assy. has 2 compacts
	(28)	Vacuum storage array	8 storage positions $\leq$ 468 gm ^{235}U or $\leq$ 12 assemblies per position	Store 'as welded' fuel plate assemblies. One assy. has 2 compacts
	(29)	Element storage array (near auxiliary generator)	3 element carts or 3 6M containers 6M containers to have $\leq$ 9.6 Kg ^{235}U per container	Store 'in process' elements or 'as received' U_3O_8
*	(30)	Storage array (near overhead door)	10 shipping containers, 5 inner HFIR elements and 5 outer HFIR elements with one element per container; or 10 containers with HFBR or similar elements with $\leq$ ^{235}U content per element or 10 6M containers $\leq$ 9.6 Kg ^{235}U per container; or a total of 10 of any of the above containers	Store completed elements or 'as received' U_3O_8
	(31)	Shear	$\leq$ 468 gm ^{235}U $\leq$ 24 fuel plates or 5 6M containers $\leq$ 9.6 Kg ^{235}U per container	Trim edges and/or ends of fuel plates or temporarily store as received U_3O_8
*	(32)	Weld Milling machine shop	1 element cart; maximum number of elements being worked on in work station at a time - 2.	Weld fittings or store elements
*	(33)	Miller, Kearney and Trecher	1 element cart; maximum number of elements being worked on in work station at a time - 2.	Mill or store elements
	(34)	Drill press	1 HFBR or similar element	Drill holes in elements as required.

LOCATION NO.	LOCATION NAME	MSQ	OPERATION
(46)	Monarch lathe	$\leq$ one inner or one outer HFIR element	Machine HFIR elements
(47)	Storage array	4 element carts	Store 'in process elements.
	General Mfg. Area		
* (48)	Hot bond mill & Grieves Hendry oven.	$\leq$ 936 gm ^{235}U 24 fuel plates and 12 bonding assys; 12 bonding assemblies are to be at least 6" from the nearest fuel plate and remain on work bench until oven is empty.	Hot roll bond and load degreasing rack.
(49)	Trent furnace	$\leq$ 468 gm ^{235}U 24 fuel plates	Anneal fuel plates
(50)	Hevi-Duty furnace	$\leq$ 2.808 Kg ^{235}U or 144 fuel plates	Anneal fuel plates
(51)	Storage array	5 HFBR shipping containers or similar shipping containers for box-type fuel elements (4 elements maximum per container)	Store completed elements
(52)	Sciaky welder	one inner or one outer HFIR element	Weld, assy. or remove rings, remove spacers, HFIR elements
(53)	Dispatch oven	one inner or one outer HFIR element	Assemble or remove spacers HFIR elements
* (54)	Roll swage BNL	one HFBR or similar element plus 48 fuel plates. Fuel plates in boxes to be placed in designated areas on work bench. Boxes separated by 6" min. spacing. No element to be placed on work bench. Work bench to be used with one roll swage at a time.	Assemble & roll swage elements
* (55)	Roll swage ORR	one HFBR or similar element plus 48 fuel plates. Fuel plates in boxes to be placed in designated (cont)	Assemble & roll swage elements

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LOCATION #	LOCATION NAME	MSQ	OPERATION
* (55)	continued	areas on work bench. Boxes separated by 6" minimum spacing. No element to be placed on work bench. Work bench to be used with one roll swage at a time.	
(56)	Cold roll mill	$\leq$ 468 gm ^{235}U or 24 fuel plates	Cold roll fuel plates and load degreasing rack Check single plates at fluoroscope
(57)	Work place under crane	1 element cart and/or shipping container	Store 'in process' or completed element or perform misc. operations on element Load shipping containers
(58)	Storage array	48 storage positions $\leq$ one lot of fuel plates or one HFBR or box-type element Each lot of plates $\leq$ 468 gm ^{235}U 24 plates	Store 'in process' or completed fuel plates, or HFBR and/or ORR elements
* (59)	Press Brake	$\leq$ 936 gm ^{235}U or 48 plates; up to 25 plates may be in temporary assembly, w/no more than 24 plates outside temporary element assembly.	Blank, form fuel plates or load degreasing rack
(60)	Storage array	$\leq$10 waste or material discard (laundry) drums Any drum to contain $\leq$ 24 gms ^{235}U & 6 6M containers with $\leq$ 50 fuel plates or equivalent with $\leq$ 975 gms ^{235}U each container.	Store sealed waste material discard drums and load, seal and store 6M containers
	Inspection		
(61)	Storage array	52 storage positions $\leq$ one lot of fuel plates per position Each lot of plates $\leq$ 468 gm ^{235}U 24 plates	Store 'in process' or completed fuel plates

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LOCATION #	LOCATION NAME	MSQ	OPERATION
(62)	Surface plate	1 HFIR inner or outer fuel element	Inspect element
(63)	Inspection Table #1	$\leq$ 468 gm ^{235}U or 24 fuel plates	Inspect fuel plates
(64)	Inspection Table #2	$\leq$ 468 gm ^{235}U or 24 fuel plates	Inspect fuel plates
(65)	X-ray homogeneity scanner #1	$\leq$ 468 gm ^{235}U or 24 fuel plates	Inspect fuel plates
(66)	X-ray homogeneity scanner #2	$\leq$ 468 gm ^{235}U or 24 fuel plates	Inspect fuel plates
* (67)	Ultrasonic test	$\leq$ 585 gms ^{235}U or $\leq$ 30 fuel plates with up to 6 plates immersed in water. All fuel plates not being processed are to be in boxes. Boxes of fuel plates are to be separated from other boxes of fuel plates by at least 6".	Inspect fuel plates
* (68)	Storage array	18 storage positions 16 positions for $\leq$ one lot of fuel plates per position, each lot of plates $\leq$ 468 gms ^{235}U or 24 plates and 2 element carts.	Store "in process" or completed fuel plates Store "in process" or completed elements
(69)	Inspection Table #3	$\leq$ 468 gm ^{235}U or 24 fuel plates	Inspect fuel plates
(70)	Inspection Table #4	$\leq$ 468 gm ^{235}U or 24 fuel plates	Inspect fuel plates
(71)	Inspection Table #5	$\leq$ 468 gm ^{235}U or 24 fuel plates	Inspect fuel plates
(72)	Inspection Table #6	$\leq$ 468 gm ^{235}U or 24 fuel plates	Inspect fuel plates
(73)	Inspection Table #7	$\leq$ 468 gm ^{235}U or 24 fuel plates	Inspect fuel plates
(74)	Element channel probe	one element HFIR or box-type	Probe element channels

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TABLE 1

LOCATION NO.	LOCATION NAME	MSQ	OPERATION
(75)	Storage array	40 storage positions $\leq$ one lot of fuel plates per position Each lot of plates $\leq$ 468 gm ^{235}U 24 plates	Store 'in process' or completed fuel plates
(76)	Fluoroscope room	$\leq$ 468 gm ^{235}U or 24 fuel plates	Fluoroscope and punch or fluoroscope inspect fuel plates
(77)	Radiography room	one (1) inner or outer HFIR element or one (1) cart of HFBR or ORR elements or 1 lot of fuel plates $\leq$ 468 gm ^{235}U or 24 fuel plates	Radiograph elements or fuel plates
(78)	Storage array	20 storage positions $\leq$ one lot of fuel plates per position Each lot of plates $\leq$ 468 gm ^{235}U or 24 fuel plates	Store 'in process' or completed fuel plates
* (79)	Gamma count and Alpha count	$\leq$ 585 gm ^{235}U or $\leq$ 30 fuel plates (includes 6 standard plates). All fuel plates not being processed are to be in boxes. Boxes of fuel plates are to be separated from other boxes of fuel plates by at least 6".	Gamma count and alpha count ^{235}U content of fuel plates
(80)	Storage array	4 standard 30 gal. waste drums with 3,7, 12, & 24 gms ^{235}U	Store standards for waste drum counting
(81)	Storage array	1 element cart	Store 'in process' elements
(82)	Degreasing rack cart (two)	$\leq$ 468 gm ^{235}U or 24 fuel plates or $\leq$ 3.3 Kg ^{235}U $\leq$ one bottle of U_3O_8 per cart.	Move one lot of fuel plates in two degreasing racks or one bottle of U_3O_8