71-9248

FRAMATOME ANP

An AREVA and Siemens company

FRAMATOME ANP, Inc.

November 6, 2003
JKD:03:067

Mr. John D. Monninger
Chief, Licensing Section
Spent Fuel Project Office – NMSS
U.S. Nuclear Regulatory Commission
One White Flint North
1155 Rockville Pike
Rockville, MD 20852-2738

Dear Mr. Monninger:

Supplement to the Request for Amendment to Certificate of Compliance No. 71-9248 for the Model No. SP-1, SP-2 and SP-3 Packages (EMF-1563 Revision 12A)

Ref.: 1. Letter, Framatome ANP to NRC, Mr. Monninger, September 5, 2003, "Request for Amendment to the Certificate of Compliance No. 71-9248 for the Model SP-1, SP-2 and SP-3 Packages", JKD:03:053.

Ref.: 2. Letter, Framatome ANP to NRC, Mr. Monninger, September 24, 2003, "Certificate of Compliance No. 9248 for the Model No. 1 SP-1, SP-2 and SP-3 Packages", JKD:03:056.

Ref.: 3. Letter, Framatome ANP to NRC, Mr. Monninger, October 23, 2002, "Request for a Letter Amendment to the Certificate of Compliance No. 71-9248 for the SP-1 Shipping Package", EHSLR-02-038.

Attachment: EMF-1563 Revision 12A, "Consolidated License Application for Framatome ANP, Inc. Model SP-1, SP-2 and SP-3 Shipping Containers", November 2003.

Per Reference 1, Framatome ANP requested an amendment to Certificate of Compliance No. 71-9248. Reference 2 was a clarification to the amendment adding the request to extend the expiration date of the CoC for five years. The attached revision of EMF-1563 (Revision 12A) replaces Revision 12 submitted via Reference 1. EMF-1563 Revision 12 was revised to Revision 12A to permanently add the low enriched (2.3 max w/o U^{235}) and no gadolinia fuel category from the submittal in Reference 3 that was approved by the NRC for a one year period. Customer needs have shown that this fuel category needs to be used in the future after the current December 31, 2003 expiration date. Please retain the copies of the Appendices submitted with Revision 12 (Ref. 1) and place the Appendices after Section 8 of Revision 12A and before the new Appendix 6J.

EMF-1563 Revision 12A retains all of the changes made in Revision 12 and adds the changes required to permanently add the new fuel category (Category 10). The changes retained from Revision 12 and Reference 2 are:

- The company name has been changed throughout.

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- Extend the CoC expiration date for five years.

- The three inner packaging drawings [EMF-304,416 R/13 (SP-1), EMF-308,257 R/5 (SP-2), and EMF-309,818 R/0 (SP-3)] were consolidated into drawing EMF-304,416 R/14 (SP-1, -2, -3 Inner Shipping Container Assembly). The three inner packagings are almost identical and having three separate drawings for the minor differences made it difficult to keep the three consistent and to compare the differences between them. The drawing also has some other minor changes detailed on the nature of change page of the attachment. There is no adverse impact to the safety of the package as a result of these changes.

- The drawing for the outer packaging (EMF-306,272) was revised to Revision 10 to allow for counterboring of the top of the lid bolt holes. Counterboring the top of the lid bolt holes allows the top of the lid bolts to be below the surface of the lid so that the bolts do not contact the feet of another outer container that is stacked on top of it. The change does not affect the safety of the package.

The changes new to Revision 12A are:

- Updated Section 1.2 to summarize the changes in this application; this section was inadvertently not revised in Revision 12.

- Added Section 6.2.10 to describe the new Category 10 fuel which is the same description previously approved from Reference 3.

- Added Section 6.3.10 to summarize the criticality evaluation of the new Category 10 fuel; the evaluation is the same as previously approved from Reference 3.

- Added Appendix 6J for the detailed criticality analyses of the new Category 10 fuel; the analyses are the same as approved by the NRC from Reference 3.

Framatome ANP requests approval of the new certificate by February 2004, as the current Certificate expires on February 28, 2004. Please call me at (509) 375-8464 if any questions arise.

Very truly yours,

James K. Davis

James K. Davis
Principal Engineer
Environmental, Health, Safety and Licensing

cc: Stu Brown (U.S. NRC)

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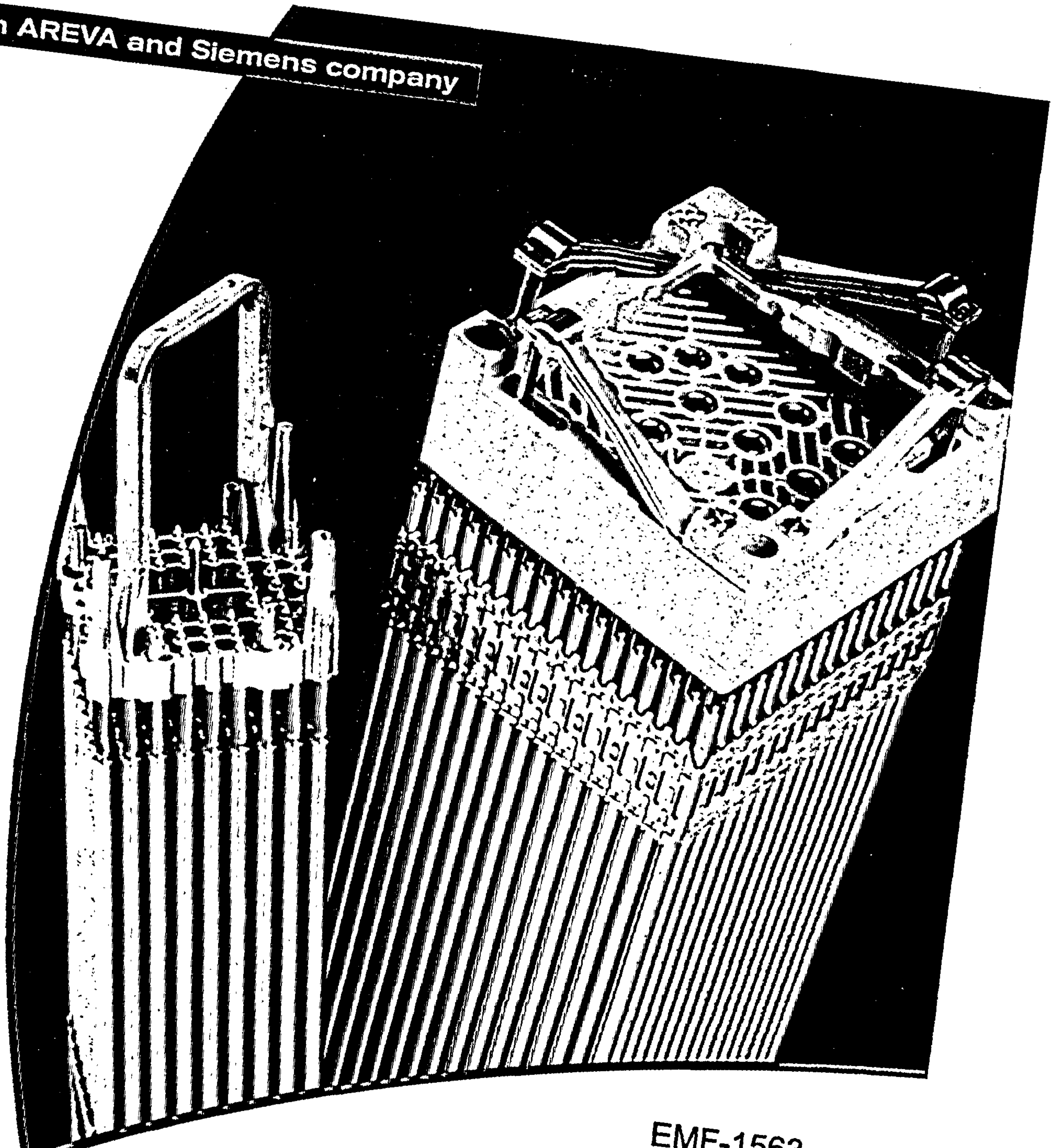

EMF-1563
Revision 12A

Consolidated License Application for Framatome ANP, Inc. Model SP-1, SP-2, and SP-3 Shipping Containers

November 2003

FRAMATOME ANP

Framatome ANP, Inc.

EMF-1563
Revision 12A

Consolidated License Application for Framatome ANP, Inc. Model SP-1, SP-2 and SP-3 Shipping Containers

Certificate of Compliance No. 9248
Docket No. 71-9248

Prepared: J. K. Davis — 11/04/03
J. K. Davis, Principal Engineer
Licensing & Compliance
Date

Approved: D. W. Parker — 11/04/03
D. W. Parker, Manager
Environmental, Health, Safety & Licensing
Date

Nature of Changes

Item	Paragraph or Page(s)	Description and Justification
1.	Throughout	Siemens Power Corporation and SPC changed to Framatome ANP and FANP, respectively. Justification: New company name.
2.	1.2	Changed Section 1.2 Justification: Changed to reflect this revision.
3.	1.6	Changed reference in third paragraph from Figure 1.4 to Figure 1.3. Justification: Drawings consolidated, gadolinia rod box drawing now Figure 1.3.
4.	Table 1.1 & Figure 1.1	Consolidated the three separate inner drawings EMF-304,416 R/13 (SP-1 inner); EMF-308,257 R/5 (SP-2 Inner) and EMF-309,818 R/0 (SP-3) into one drawing: EMF-304,416 R/14 (SP-1, -2, -3 Inner Shipping Container Assembly). Referring to the change block on the drawing: changes 14a, 14c, 14d, 14e, and 14f deal with consolidating the three inner containers into one drawing. Change 14b changed the maximum width of the CCP in Note 5 from 6 inches to 7 inches. Change 14g added the use of an optional lid screen in Zone B1. Change 14h updated washer quantities in Zones F14 and L14 to allow up to two per bolt. Change 14j added hollow or solid to gasket in Zones A5, F16, K11, and J1. Justification: For changes 14a, 14c, 14d, 14e, and 14f; the three inner containers are almost identical and having three separate drawings for the minor differences made it difficult to keep the three consistent and to compare the differences between them. Change 14b allows for the maximum widths of the inner channels. Change 14h allows the use of a washer under the bolt head and next to the nut which improves the effectiveness of the closure. Change 14j allows the flexibility to use either hollow or solid gaskets. The figure pictorially shows a hollow gasket. There is no adverse impact to the safety of the package as a result of these changes.
5.	Table 1.1 & Figure 1.2	Revised drawing EMF-306,272 for the outer wooden container to Revision 10 to allow counterbore of lid bolt holes. Figure renumbered from Figure 1.3 to Figure 1.2 due to Item 4 above. Justification: Counterboring certain lid bolt holes allows the top of the bolts to be below the surface of the lid so that they do not interfere with the feet of other outer containers when stacked. The change does not effect the safety of the package.

Item	Paragraph or Page(s)	Description and Justification
6.	Table 1.1 and Figure 1.3	As in Item 2 drawing EMF-309,141 R/1 was changed from Figure 1.4 to Figure 1.3. Justification: Drawings consolidated as stated above.
7.	6.2.10	Added description of new low enriched gadolinia free 10 x 10 fuel bundle type. Justification: Fuel type previously approved by the NRC in a letter amendment.
8.	6.3.10	Added criticality evaluation of new low enriched gadolinia free 10 x 10 fuel bundle type. Justification: See Item 7 above.
9.	Appendix 6J	Added criticality safety evaluation for low enriched gadolina free 10 x 10 fuel bundle type. Justification: The criticality safety evaluation is the same as approved by the NRC in the application dated October 23, 2002.

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Controlled Distribution

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1. Introduction

1.1 *History*

On April 7, 1992 the NRC notified Framatome ANP (FANP) that NRC Certificate of Compliance 4986 for the RA-2 and RA-3 shipping containers, under which FANP had been a registered user, was being revised for General Electric's use exclusively and that FANP should submit an interim application for a one-year certificate. The notice further stated that a consolidated application would have to be submitted by the expiration date of the one-year certificate. In response to that notice FANP submitted an abbreviated application for the SP-1 container on May 15, 1992. Subsequently, on December 15, 1992, FANP submitted an amendment application to add the SP-2 container. The SP-1 and SP-2 containers are virtually identical to the General Electric Company's RA-3 and RA-2 containers, respectively.

Revision 0 of Certificate of Compliance 9248 for the SP-1 container was issued June 17, 1992 with an expiration date of June 30, 1993. Subsequent revisions have added the SP-2 and SP-3 container.

1.2 *This Application*

The purpose of this amendment is to extend the certificate expiration date for an additional five years, consolidate the three inner packaging license drawings into one, update the company name throughout, and to permanently add the low enriched gadolinia free 10 x 10 fuel bundle category that was submitted in the application dated October 23, 2002 and approved by the NRC by a letter amendment dated December 24, 2002 for use until December 31, 2003. A new appendix (6J) was added to this Safety Analysis Report (SAR) EMF-1563 and provides the Criticality Safety Evaluation for the new fuel category and is essentially the same criticality technical justification from the October 23, 2002 submittal.

1.3 *General Package Description*

The SP-series package consists of a right rectangular metal inner container transported in a wooden outer container. The wooden outer container includes cushioning material. The inner metal container has two internal channel sections which may contain one fuel assembly each or group of unassembled rods each. Descriptions of the containers which comprise the SP-series package and the structural evaluations thereof are included in the subsequent chapters of this consolidated application.

The original GE-designed RA-1 inner container was modified to accommodate a longer bundle. This was accomplished by adding a larger end cap to the existing RA-1 body and identifying this design version as the RA-2 (FANP's SP-2) inner container. Subsequently, out of consideration for fabrication and handling, the longer bodied (short end cap) RA-3 (FANP's SP-1) was introduced. Currently in use are three models of the SP series inner containers, SP-1, SP-2 and SP-3. These models are presently being used with the SP-1 wooden outer container. In addition, loose rods containing gadolinia may be shipped in place of fuel assemblies if they are contained in the Gadolinia Rod Container or the five-inch, schedule 40 product container.

1.4 *Compliance*

This section generally describes the tests and evaluations carried out on the RA series of containers by General Electric. The results of such tests and evaluations are applicable also to the SP series of containers. The tests and evaluations are further described in Appendices 2A, 2B, 2C, 2D, and 2E.

The General Electric Model RA series fuel shipping container has been subjected to normal transport condition tests and evaluations specified in Appendix A of 10CFR71 and the hypothetical accident condition tests and evaluations, in the sequence specified in Appendix 2B.

It is concluded that the RA series packaging has successfully passed the acceptance criteria demonstrated as follows:

1.4.1 Normal Transport Condition Tests

1.4.1.1 Heat and Cold

None of the components of the fuel assemblies or the inner metal container on which containment integrity and nuclear safety depend are significantly affected by temperatures within the range of -40°F to 130°F.

1.4.1.2 Pressure

A breather valve opens automatically when the inner container is subjected to ± 0.5 psi pressure differential. Therefore, there is no effect on the packaging from an environmental difference of 0.5 atmosphere.

1.4.1.3 Vibration

A 3 inch thick layer of honeycomb cushioning material surrounds the inner metal container at the sides, top and bottom with an additional 9 inch thickness at the ends. Alternatively, there are 3 inches of honeycomb on top and bottom of the inner container and 2 inches on the sides. The inner container is not free to shift during transport since the ethafoam cushioning is slightly compressed during final closure, and the wooden outer container is bolted shut. Since the bolted assemblies in the metal container are held either by clips on the nuts or by lock washers, they cannot loosen during normal transport vibration or shock even if all vibration is not eliminated by the cushioning material.

1.4.1.4 Water Spray

Since the package is designed to remain subcritical assuming any degree of credible in-leakage, water inside the outer container would have no effect on criticality safety considerations. In addition, the effectiveness of the impact limiters and the wooden box structure was not substantially reduced as a result of the water spray test conducted on September 25, 1981. Results of the water spray test showed a maximum reduction of honeycomb compressive strength of 1-1/2% for one side, 3% for the other side, 5% for the bottom, and an undetectable amount for the ends since no wetting of the end honeycomb could be observed.

1.4.1.5 Drop Test

The complete package is designed to protect the fuel assemblies within the inner metal container from loss of containment integrity or change in nuclear safety reliability by virtue of thick cushioning material surrounding it. The shock absorption to the corners, edges and at all joints in the plywood, supplemented by the inherent elasticity of bolts and nails used in final closure of the outer package, constitute a more than adequate buffer against the subject tests. Additionally, the RA outer container provides added protection to the end cap and cover of the inner RA container during an accident.

1.4.1.6 Corner Drop

Test not required since the package weight exceeds 110 pounds.

1.4.1.7 Penetration

Tests were conducted in which the flat circular end of a vertical steel cylinder 1-1/4 inches in diameter weighing 13 pounds was dropped four feet onto the center of the ½ inch plywood outer container. No damage resulted after four drop tests.

1.4.1.8 Compression

Tests were conducted in which six loaded packages (15,750 lbs.) were stacked for 24 hours. There was no visible or measurable damage to the container on the bottom of the stack. The test weight was greater than either of the conditions specified in 10CFR71 Appendix A.

1.4.2 Hypothetical Accident Conditions

1.4.2.1 Free Drop

Four individual drop tests through a distance of 30 feet have been conducted on the RA containers in 1966, 1974, 1978, and 1980. The test packages contained two dummy fuel assemblies to simulate the actual weight of a loaded RA inner container (1,865 lbs.). In all tests, the cover and end caps remained intact. The inside angle spacers maintained the annulus required so that criticality safety considerations were not affected. The maximum annular reduction of approximately 1% was produced by the test in 1966.

There were no ruptured fuel rods in any of the tests. Therefore, the fuel pellets would remain contained inside the fuel rods.

1.4.2.2 Puncture

A puncture test on the inner metal container conducted in 1980 produced an indentation, but no puncture. There were no ruptured fuel rods, and even though the container was bowed approximately 2 inches, the angle spacers maintained the spacing required so that criticality safety considerations were not affected. This test was conducted on an inner container only, without the protection of the outer wooden box. It easily can be seen that the damage would be considerably less with both the outer and inner container packages. Furthermore, the inner package is designed to remain subcritical with water in-leakage such as that which could result from puncture.

1.4.2.3 Thermal

A thermal test was conducted in 1980 that produced a maximum temperature of 1640°F flame temperature. An actual gasoline fire test was selected to be most representative of the accident considered. The gasket and other combustible materials inside the container, including foamed polyethylene cushioning and plastic rod spacers, completely burned away during the thirty minute test.

Five hundred gallons of gasoline were consumed during the test, and no abnormal thermal distortion was observed. The pressure relief valve and the burnt gasket permitted the pressure inside to be vented away and prevented rupture of the container.

1.4.2.4 Water Immersion

After the fire test mentioned above, a water immersion test was performed. Water leaked into the container since the gasket was consumed during the fire. Residue and debris remaining did not restrict the free flow of water into and out of the container. The presence of water for 8 hours caused no damage to the fuel rods.

There was no significant deformation or distortion of the container that reduced the effectiveness of the annulus to flooding by water entering through the closure joints since the gasket had burnt away.

These conditions were considered in the criticality calculations which showed the reactivity of such an array when flooded to be subcritical.

1.5 *SP Series Shipping Packages*

1.5.1 SP-1 Inner Container

1.5.1.1 Description

The SP-1 inner container is a right rectangular metal box used inside an SP-1 outer wooden container for shipping fuel assemblies (maximum of two per inner container) or groups of fuel rods in specified containers.

The inner container consists of an outer shell and perforated inner basket separated by structural angle iron. The outer shell is formed of minimum 16-gauge carbon steel plate with an integral welded end of the same material. Four angle stiffeners made of 11-gauge carbon steel are welded on approximately four inch centers to the outer end surface of the container. Approximate dimensions of this inner container are 11-1/2 inches high, 18 inches wide, and 179 inches long.

The inner basket is constructed of 16-gauge carbon steel plate with 3/4 inch perforations on 1-3/4 inch centers. It is welded to the upper edge of the outer shell to form two U-shaped channels approximately 6-7/8 inch square in cross-section. The channels may be lined with low-density ethafoam cushioning cemented in place with perforations matching the size and location of those in the inner basket as described on Figure 1.1. To support the inner basket within the outer shell, four angle iron spacers made of 1/8 inch thick carbon steel are positioned longitudinally along the entire length of the body. Two similar angle iron spacers are positioned longitudinally in the cover.

The SP-1 inner metal container is designed with a longer body and shorter end cap than the SP-2 inner container. The SP-3 inner metal container, like the SP-1, is designed with a longer body and shorter end cap than the SP-2 inner container. The SP-1 and SP-2 inner containers are used interchangeably for shipping assemblies and rods while the SP-3 is limited to two types of assemblies. All may be used in the SP-1 wooden outer container.

The cover and end cap of the inner container are of similar construction to the box to provide an approximately two inch annulus around the fuel, except at the ends, when the box is closed. A gasket of approximately 1/2 inch thick hollow rubber (isoprene or neoprene) provides a completed seal with the cover in place. Closure of the box is effected by bolted assemblies.

The SP-1 inner container may be welded, riveted and/or screwed, or all welded construction. In the welded, riveted and/or screwed inner container, the cover liner is removable and the cavity is of riveted and welded construction.

1.5.1.2 Containment Vessel Penetrations

A standard breather relief valve installed on the outer shell of the end cap is set to re-seat at a 0.5 psi pressure difference between the inside and outside of the inner container and is capable of airflow adequate for surface or air transport.

1.5.1.3 Safety

The SP-1 inner container's safety was demonstrated to be acceptable based on a hypothetical accident condition test conducted in 1980 in accordance with criteria for compliance with 1OCFR71.36. See Appendix 2B for the Test Report.

1.5.2 SP-2 Inner Container

1.5.2.1 Description

The SP-2 inner container is a right rectangular metal box used inside an SP-1 outer wooden container for shipping fuel assemblies (maximum of two per inner) or groups of fuel rods strapped together (sometimes referred to as bundles).

The inner container consists of an outer shell and perforated inner basket separated by structural angle iron. The outer shell is formed of minimum 16-gauge carbon steel plate with an integral welded end of the same material. Four angle stiffeners made of 11-gauge carbon steel are welded on approximately four inch centers to the outer end surface of the container. Approximate dimensions of this inner container are 11-1/2 inches high, 18 inches wide, and 179 inches long.

The inner basket is constructed of 16-gauge carbon steel plate with 3/4 inch perforations on 1-3/4 inch centers. It is welded or riveted to the upper edge of the outer shell to form two U-shaped channels approximately 6-7/8 inch square in cross-section. The channels may be lined with low-density ethafoam cushioning cemented in place with perforations matching the size and locations of those in the inner basket. To support the inner basket within the outer shell, four angle iron spacers made of 1/8 inch thick carbon steel are positioned longitudinally along the entire length of the body. Two similar angle iron spacers are positioned longitudinally in the cover.

The cover and end cap of the inner container are constructed similar to the body to provide an approximately two inch annulus around the fuel, except at the ends, when the body is closed. The end cap of the SP-2 container is approximately seven inches long. A gasket of approximately 1/2 inch thick hollow rubber (isoprene or neoprene) provides a completed seal with the cover in place. Closure of the box is effected by bolted assemblies.

The SP-3 inner metal container, like the SP-1, is designed with a longer body and shorter end cap than the SP-2 inner container. The SP-1 and SP-2 inner containers are used interchangeably for shipping assemblies and rods while the SP-3 is limited to two types of assemblies. All may be used in the SP-1 wooden outer container.

1.5.2.2 <u>Containment Vessel Penetrations</u>

A standard breather relief valve installed on the outer shell of the end cap is set to re-seat at a 0.5 psi pressure difference between the inside and outside of the inner container and is capable of airflow adequate for surface or air transport.

1.5.2.3 <u>Safety</u>

The SP-2 inner container's safety was demonstrated to be acceptable based on tests performed on the GE RA-1 inner container as described in Appendix 2 and according to the current engineering evaluation performed on the RA series containers as discussed in Appendix 2A.

1.5.3 <u>SP-3 Inner Container</u>

1.5.3.1 <u>Description</u>

The SP-3 inner container is a right rectangular metal box used inside an SP-1 outer wooden container for shipping fuel assemblies (maximum of two per inner container) or groups of fuel rods in specified containers.

The inner container consists of an outer shell and perforated inner basket separated by structural angle iron. The outer shell is formed of minimum 16-gauge carbon steel plate with an integral welded end of the same material. Four angle stiffeners made of 11-gauge carbon steel are welded on approximately four inch centers to the outer end surface of the container. Approximate dimensions of this inner container are 11-1/2 inches high, 18 inches wide, and 179 inches long.

The inner basket is constructed of 16-gauge carbon steel plate with 3/4 inch perforations on 1-3/4 inch centers. It is welded to the upper edge of the outer shell to form two U-shaped

channels approximately 6-7/8 inch square in cross-section. The channels may be lined with low-density ethafoam cushioning cemented in place with perforations matching the size and location of those in the inner basket as described on Figure 1.1. To support the inner basket within the outer shell, four angle iron spacers made of 1/8 inch thick carbon steel are positioned longitudinally along the entire length of the body. Two similar angle iron spacers are positioned longitudinally in the cover. The body and cover angle iron spacers create a minimum spacing of 1-5/8 inches between the inner basket and the outer shell compared to 1-15/16 in the SP-1 and SP-2 containers. This is the only difference between the SP-1 and SP-3.

The SP-3 inner metal container, like the SP-1, is designed with a longer body and shorter end cap than the SP-2 inner container. The SP-1 and SP-2 inner containers are used interchangeably for shipping assemblies and rods while the SP-3 is limited to two types of assemblies. All may be used in the SP-1 wooden outer container.

The cover and end cap of the inner container are of similar construction to the box to provide an approximately 1-5/8 inch annulus around the fuel, except at the ends, when the box is closed. A gasket of approximately 1/2 inch thick hollow rubber (isoprene or neoprene) provides a completed seal with the cover in place. Closure of the box is effected by bolted assemblies.

The SP-3 inner container may be welded, riveted and/or screwed, or all welded construction. In the welded, riveted and/or screwed inner container, the cover liner is removable and the cavity is of riveted and welded construction.

1.5.3.2 Containment Vessel Penetrations

A standard breather relief valve installed on the outer shell of the end cap is set to re-seat at a 0.5 psi pressure difference between the inside and outside of the inner container and is capable of airflow adequate for surface or air transport.

1.5.3.3 Safety

The SP-3 inner container's safety was demonstrated to be acceptable based on a hypothetical accident condition test conducted in 1980 in accordance with criteria for compliance with 10CFR71.36. See Appendix 2B for the Test Report.

1.5.4 SP-1 Outer Container

1.5.4.1 Description

The all-wood outer container is a right rectangular box with nominal dimensions of between 31 inches and 33 inches high, 30 inches and 32 inches wide, and up to 207 inches long. It is fabricated of 1/2 inch plywood, cleated with nominal 2 inch x 4 inch studs, and mounted on a 30 to 32 inch wide platform constructed of nominal 2 inch x 10 inch planks and with bolted-on skids of nominal 4 inch x 4 inch wood.

Internal cushioning consists of kraft fiber honeycomb impregnated with phenolic resin. Cushioning nominally 8-1/2 inches to 9 inches thick is used to line the inside of the box at the ends, while one layer of between 2 inches and 3 inches thick material is used for the top, bottom, and sides.

Additional cushioning consists of pads of expanded polyethylene material. Five pads 3 inches thick x 18 inches x 20-1/2 inches are located over the transverse skids at the bottom and at the top, while five pads of material 1/2 inch thick x 18 inches x 12 inches are located at related positions on each side of the box. The RA-3 outer container has a 1/2 inch plywood sheet faced with 1/8 inch steel sheet at each end of the box.

The box has no attached lifting or tiedown devices.

The SP-1 outer container is used primarily to reduce shocks and vibrations to the packaged fuel assemblies which are encountered in normal material handling, warehousing, and transportation. The SP-1 outer container also provides a degree of impact reduction capability for protecting the packaged assemblies against damage in rough material handling, dropping while loading or unloading and in impacts due to low speed accidents. In addition, the outer container provides added protection to the end cap and cover of the SP-1, SP-2 and SP-3 inner containers during an accident.

1.5.4.2 Safety

The SP-1 outer container's safety has been determined as the result of a drop test to be acceptable for the purpose it was designed. See Appendix 2A of this section for the Test Report.

1.6 *Contents of Shipping Containers*

The contents allowed to be shipped in the SP-1, SP-2 and SP-3 containers include BWR fuel assemblies with a maximum enrichment of 5 wt% U-235 and individual fuel rods enriched to a maximum of 5.0 wt% U-235 and containing a minimum gadolinia content of 1.0 wt%. The payload of the SP-3 is limited to category 8 and 9 fuel assemblies as discussed in Chapter 6 and Appendices 6H and 6I.

Each fuel assembly is enclosed in an unsealed polyethylene sheath. The ends of the sheath are neither taped nor folded in any manner that would prevent the flow of liquids into or out of the ends of sheathed fuel assemblies.

Individual rods are shipped either in a product container or the gadolinia rod shipping container. The product container consists of a five-inch schedule 40 stainless steel pipe fitted with either a screw type or flanged closure. The gadolinia rod shipping container is shown in Figure 1.3.

Specific descriptions of fuel assemblies and rods to be shipped in the SP-1, SP-2 and SP-3 containers are given in Chapter 6.

TABLE 1.1	
Summary Listing of Applicable Licensing Drawings	
Reference Figure No.	**Drawing No. and Description**
1.1	EMF-304, 416, Rev. 14 SP-1, 2, & 3 Inner Shipping Container Assembly
1.2	EMF-306, 272, Sh. 1, Rev. 10 SP-1 Outer Shipping Container
1.3	EMF-309, 141, Rev. 1 Gadolinia Rod Shipping Container

FIGURE WITHHELD UNDER 10 CFR 2.390

Framatome ANP

SCALE 1:1/6

12b

SP-1, -2, & -3 INNER SHIPPING CONTAINER

14g ASSEMBLY

	05-12-81	MOD
	06-10-81	BCH
	06-16-81	AR
	06-11-81	RE
	06-16-81	CJB

EMF-304,416 R-14

1

1

FIGURE WITHHELD UNDER 10 CFR 2.390

Framatome ANP

SP-1 OUTER
SHIPPING CONTAINER

EMF-306,272 R-10

FIGURE WITHHELD UNDER 10 CFR 2.390

Siemens Power Corporation			
SCALE: .15" = 1"			1b
	DATE	NAME	TITLE: GADOLINIA ROD SHIPPING CONTAINER
DRAWN BY	5-11-95	DLP	
CHECKED BY	5-12-95	TCH	
APPROVED	5-15-95	JCC	
APPROVED	5-15-95	JBE	
APPROVED	5-19-95	TMH	
			DRAWING NO. EMF-309,141 R-1
			SH. NO. 1
			SHEETS 1

2. Structural Evaluation

The structural evaluations of the SP-1, SP-2 and SP-3 containers under normal transport and hypothetical accident conditions are described in Appendices 2A,2B,2C,2D, and 2E. These appendices are comprised of the appendices of Section 2 of General Electric's March 17, 1992 Consolidated Application for the RA-Series Shipping Package. The SP-1 and SP-2 are virtually identical to the RA-3 and RA-2, respectively. The SP-3 is identical to the SP-1 except for the spacing differences described in 1.5.3.1. Appendices 2A,2B,2C,2D and 2E cover structural, thermal, and containment evaluations of these containers.

3. Thermal Evaluation

The thermal evaluations of the SP-1, SP-2 and SP-3 containers under normal transport and hypothetical accident conditions are described in Appendices 2A,2B,2C,2D, and 2E. These appendices are comprised of the appendices of Section 2 of General Electric's March 17, 1992 Consolidated Application for the RA-Series Shipping Package. The SP-1 and SP-2 are virtually identical to the RA-3 and RA-2, respectively. The SP-3 is identical to the SP-1 except for the spacing differences described in 1.5.3.1. Appendices 2A,2B,2C,2D, and 2E cover structural, thermal, and containment evaluations of these containers.

4. Containment Evaluation

The evaluations of containment of contents under normal transport and hypothetical accident conditions of the SP-1, SP-2 and SP-3 containers are described in Appendices 2A,2B,2C,2D, and 2E. These appendices are comprised of the appendices of Section 2 of General Electric's March 17, 1992 Consolidated Application for the RA-Series Shipping Package. The SP-1 and SP-2 are virtually identical to the RA-3 and RA-2, respectively. The SP-3 is identical to the SP-1 except for the spacing differences described in 1.5.3.1. Appendices 2A,2B,2C,2D, and 2E cover structural, thermal, and containment evaluations of these containers.

5. Shielding Evaluation

Because the SP-1, SP-2 and SP-3 shipping containers are designed to carry low enriched unirradiated fuel, there is no need for shielding to reduce radiation. Typical dose rates at the outer surface of a loaded container are 0.05-0.1 mSv/hr (5-10 mr/hr).

6. Criticality Evaluation

6.1 *Introduction*

The evaluations of the SP-1, SP-2 and SP-3 containers to retain their contents under both normal transport and hypothetical accident conditions are documented in Appendices 2A-2E.

6.2 *Description of Contents*

There are eight fuel assembly types, plus fuel rods outside of assemblies which constitute the contents to be shipped under this application. They are described below.

6.2.1 Type G1 (Category 1) Fuel Assemblies

UO_2 fuel assemblies in a 7 x 7, an 8 x 8, or a 9 x 9 square array with a maximum fuel cross-section area of 25 square inches, maximum fuel length of 174 inches and maximum average enrichment of 3.3 wt% U-235. Minimum zircaloy clad thickness is 0.025 inches; maximum pellet diameter is 0.555 inches. Any number of water rods in any arrangement are permitted.

6.2.2 Type G2 (Category 2) Fuel Assemblies

UO_2 fuel assemblies in a 7 x 7, an 8 x 8, or a 9 x 9 square array with a maximum fuel length of 174 inches, and a maximum average enrichment between 3.3 wt% to 4.0 wt% U-235. Pellet and cladding dimensions and nuclear poison specifications are to be in accordance with the limits specified in Appendix 6A.

6.2.3 10 x 10 (Category 3) Fuel

UO_2 fuel assemblies with a maximum enrichment of 5.0 wt% U-235, and a maximum average enrichment of 4.0 wt% U-235. Each fuel assembly is made up of fuel rods in a 10 x 10 square array, with a maximum fuel cross section of 5.022 inches square, a nominal pitch of 0.511 inch, and a maximum fuel length of 174 inches. The maximum pellet diameter is 0.3356 inch, the minimum clad thickness is 0.0225 inch, and the maximum U-235 enrichment in any edge rod is 4.0 percent by weight. Each assembly contains at least 6 rods with minimum nominal 2 weight percent Gd_2O_3, which are symmetric about the diagonal, and each assembly contains at least 4 water rods in the 4 central rod positions.

6.2.4 Fuel Rods (Category 4)

UO_2 fuel rods with a maximum U-235 enrichment of 5.0 wt.% and a minimum gadolinia content of 1.0 wt%. The maximum pellet diameter is 0.5 inch and the maximum rod length is 169 inches. The rods may be clad with zircaloy, steel, or aluminum. Rods meeting the above requirements may be placed into the "Gadolinia Rod Container" or the five-inch schedule 40 stainless steel pipe product container and shipped in the SP-1, SP-2 or SP-3 in lieu of one or two fuel assemblies.

6.2.5 10x10 (Category 5) ATRIUM Fuel Assemblies

UO_2 fuel assemblies with maximum U-235 enrichment (wt.%) constraints as follows: perimeter rods: 4.0%; UO_2-Gd_2O_3 ("gadolinia") Rods: 5.0%; All other interior rods: 4.0% average and no rod shall exceed 5.0%. Each assembly is composed of a 10x10 array of fuel rods and water rods. A water channel is required in the central 3x3 rod positions. Any number of additional water rods in any arrangement is permitted including part length rods. The maximum fuel dimensions are 5.0 inches by 5.0 inches by 174 inches. The maximum pellet diameter is 0.35 inches and the minimum clad thickness is 0.018 inches. Each assembly shall include at least twelve rods with at least 2.0 wt.% gadolinia in all axial regions with enriched pellets in a pattern symmetric about one of the assembly diagonals. At least eight of the twelve gadolinia rods shall be located in rows 2 and 9 and columns 2 and 9. The nominal diameter of the gadolinia pellets shall be not less than that of the UO_2 (non-gadolinia) pellets.

6.2.6 Additional 10x10 (Category 6) ATRIUM Fuel Assemblies

UO_2 fuel assemblies with a maximum U-235 enrichment of 5.0 wt.%. Each assembly is composed of a 10x10 array of fuel rods with a water channel or water rods located in a central 3x3 array of rods location. Any number of additional water rods or water channels in any arrangement is permitted including part length rods. The maximum fuel dimensions are 5.0 inches by 5.0 inches by 174 inches. The maximum pellet diameter is 0.35 inches and the minimum clad thickness is 0.018 inches. Each assembly shall contain at least eight rods with at least 2.0 wt.% gadolinia in all axial regions with enriched pellets. Additional gadolinia rod specifications are given in Appendix 6G.

6.2.7 9x9 (Category 7) ATRIUM Fuel Assemblies

UO_2 fuel assemblies with a maximum U-235 enrichment of 5.0 wt.%. Each assembly is composed of a 9x9 array of fuel rods with a water channel or water rods in the center 3x3 rod locations. Any number of additional water rods or water channels in any arrangement is permitted. The maximum fuel dimensions are 5.0 inches by 5.0 inches by 174 inches. The maximum pellet diameter is 0.40 inches and the minimum clad thickness is 0.015 inches. Each assembly shall contain at least eight rods with at least 2.0 wt.% gadolinia in all axial regions with enriched pellets. Additional gadolinia rod specifications are given in Appendix 6G.

6.2.8 Additional 9x9 (Category 8) ATRIUM Fuel Assemblies

UO_2 fuel assemblies in a 9x9 square array with a maximum fuel cross-section of 25 square inches, maximum fuel length of 174 inches, and a maximum average enrichment of 4.0 w/o U-235. The nominal pellet diameter is 0.370 inch. At least the center 3x3 rod locations shall be a water channel. Each assembly must include at least eight rods with a minimum nominal gadolinia (Gd_2O_3) content of 2.0 w/o in all axial regions with enriched pellets. Additional gadolinia rod specifications are given in Appendix 6H.

6.2.9 Additional 10x10 (Category 9) ATRIUM Fuel Assemblies

UO_2 fuel assemblies in a 10x10 square array with a maximum fuel cross section of 5.0 inches square and a maximum fuel length of 174 inches. The maximum U-235 enrichment is 5.0 weight percent, the maximum U-235 enrichment for all edge rods is 4.75 weight percent, the maximum enrichment for the four corner edge rods is 3.05 weight percent, and the maximum U-

235 enrichment for the eight edge rods immediately adjacent to the four corner edge rods is 3.55 weight percent. The pellet diameter is between 0.30 and 0.3957 inch and a nominal pitch of 0.510 inch. Each assembly must have a water channel in a central 3x3 position. Each assembly must include at least ten rods with a minimum nominal content of 2.0 weight percent gadolinia (Gd_2O_3) in all axial regions with enriched pellets and in a pattern symmetric about one of the assembly diagonals. Polyethylene shipping shims may be inserted between the fuel rods and between the upper tie plate and the fueled region. Additional gadolinia rod specifications are given in Appendix 6I.

6.2.10 Low Enriched Gadolinia Free 10x10 (Category 10) ATRIUM Fuel Assemblies

UO_2 fuel assemblies composed of fuel rods in a 10x10 square array with a maximum fuel cross section of 5.0 inches square and a maximum fuel length of 174 inches. The maximum U^{235} enrichment is 2.3 weight percent. The pellet diameter is between 0.30 and 0.3957 inch. Each assembly must have a water channel in a central 3x3 position. Any number of additional water rods in any arrangement is permitted, including part length rods. Polyethylene shipping shims may be inserted between the fuel rods. An additional upper tie plate (UTP) shipping shim may be added between the UTP and the fueled region. This UTP shim may consist of a maximum of 345 g plastic or plastic composite.

6.3 *Criticality Evaluation of Individual Fuel Types*

6.3.1 Type G1 (Category 1) Fuel Assemblies

Parameter	Value
Assembly size	5.0 inch x 5.0 inch (maximum)
Assembly array	7 x 7, 8 x 8, 9 x 9
Average water/fuel volume ratio (Vw/Vf)	1.0 (minimum)
Pellet to clad radial gap	0.003 inch (minimum)
Clad thickness	0.025 inch (minimum)
Pellet diameter	0.555 inch (maximum)
Water rods	Any number/any arrangement
Assembly-average enrichment[1]	3.3 wt% U-235 (maximum)
Gd_2O_3 requirement	None

Appendix 6A, as modified by 6F, describes the criticality analyses of the type G1 fuel assembly to be shipped in SP-1 or SP-2 containers.

6.3.2 Type G2 (Category 2) Fuel Assemblies

Parameter	Value
Assembly size	5.0 inch x 5.0 inch (maximum)
Assembly array	7 x 7, 8 x 8, 9 x 9

[1] UO_2 rods and UO_2-Gd_2O_3 rods may contain several inches of natural enrichment UO_2 pellets at either or both ends of the pellet stack. The assembly-average enrichment limits are for the enriched zone only; i.e., the assembly-average enrichment does not include the natural uranium at the ends of the pellet stack.

Average water/fuel volume ratio (Vw/Vf)	1.0 (minimum)
Pellet to clad radial gap	0.003 inch (minimum)
Clad thickness	0.025 inch (minimum)
Pellet diameter	0.555 inch (maximum)
Water rods	Any number/any arrangement
Assembly-average enrichment[1]	3.3-4.0 wt% U-235 (maximum)
Gd_2O_3 requirement	None

- Minimum number of UO_2-Gd_2O_3 rods is four in non-perimeter locations symmetric about the assembly diagonal.
- UO_2-Gd_2O_3 rods may contain various Gd_2O_3 concentrations in the enriched fuel zone but the minimum Gd_2O_3 concentration in the enriched zone to qualify as one of the four UO_2-Gd_2O_3 rods is 2.0 wt%.
- The nominal length of the UO_2-Gd_2O_3 region shall be equal to or greater than the nominal length of the enriched region in the UO_2 fuel rods.
- Gd_2O_3 is not required in the end regions with natural uranium.

Appendix 6A, as modified by 6F, describes the criticality analyses of the type G2 fuel assembly to be shipped in SP-1 or SP-2 containers. Attached Appendix 6H describes the criticality analysis of the Category 2 fuel to be shipped in the SP-3 container.

6.3.3 10x10 (Category 3) Fuel Assemblies

Parameter	Value
Edge of outer square determined by peripheral fuel rods	5.022 inch (maximum)
Enrichment of any pellet in assembly	5.0 wt% U-235 (maximum)
Enrichment of any pellet in an edge rod	4.0 wt% U-235 (maximum)
Maximum average planar enrichment[2]	4.0 wt% U-235 (maximum)
Clad thickness	0.0225 inch (maximum)
Pellet diameter	0.3356 inch (maximum)
Fuel density	98.0% TD (maximum)
Rod pitch	0.511 inch (nominal)
UO_2-Gd_2O_3 rods	6 (minimum)
Gd_2O_3 content	2.0± 0.08 wt% (minimum)
Water rods	Center 4 rods (minimum)
Poison rod arrangement	Symmetrical across the diagonal
Fuel rod array in bundle	10 x 10

[2] Maximum average planar enrichment: The average enrichment at the axial location yielding the highest planar average.

Appendix 6B, as modified by 6F, describes the criticality analyses for 10 x 10 fuel assemblies to be shipped in SP-1 or SP-2 containers.

6.3.4 Fuel Rods (Category 4)

UO_2 fuel rods with a maximum U-235 enrichment of 5.0 wt.% and a minimum gadolinia content of 1.0 wt%. The maximum pellet diameter is 0.5 inch and the maximum rod length is 169 inches. The rods may be clad with zircaloy, steel, or aluminum. Rods meeting the above requirements may placed into the "Gadolinia Rod Container" or the five-inch schedule 40 stainless steel pipe product container and shipped in the SP-1 or SP-2 in lieu of one or two fuel assemblies.

Appendix 6C, as modified by 6F, describes the criticality analyses for gadolinia-bearing rods to be shipped in the gadolinia rod container in SP-1 and SP-2 containers.

6.3.5 10x10 (Category 5)ATRIUM Fuel Assemblies

Parameter	Value
Edge of outer square determined by peripheral fuel rods	5.0 inch (maximum)
Enrichment of any pellet in assembly	5.0 wt% U-235 (maximum)
Enrichment of any pellet in an edge rod	4.0 wt% U-235 (maximum)
Maximum average planar enrichment[2] excluding Gd rods and edge rods	4.0 wt% U-235 (maximum)
Clad thickness	0.018 inch (minimum)
Pellet diameter	0.35 inch (maximum)
Fuel density	98.0% TD (maximum)
Rod pitch	0.510 inch (nominal)
UO_2-Gd_2O_3 rods	12 (minimum)
Gd_2O_3 content	2.0± 0.08 wt% (minimum)
Water rods	Center 3 x 3 rods (minimum)
Poison rod arrangement	Symmetrical across the diagonal
Fuel rod array in bundle	10 x 10

Appendix 6D, as modified by 6F, describes the criticality analyses for 10 x 10 fuel assemblies to be shipped in SP-1 or SP-2 containers.

6.3.6 Additional 10x10 (Category 6) ATRIUM Fuel Assemblies

Parameter	Value
Edge of outer square determined by peripheral fuel rods	5.0 inch (maximum)
Enrichment of any pellet in assembly	5.0 wt% U-235 (maximum)
Clad thickness	0.018 inch (minimum)
Pellet diameter	0.35 inch (maximum)
Fuel density	98.0% TD (maximum)
Rod pitch	0.510 inch (nominal)
UO_2-Gd_2O_3 rods	8 (minimum)
Gd_2O_3 content	2.0± 0.08 wt% (minimum)
Water rods	Center 3 x 3 rods (minimum)
Fuel rod array in bundle	10 x 10

Appendix 6E, as modified by 6F, describes the criticality analyses for 10 x 10 fuel assemblies to be shipped in SP-1 or SP-2 containers.

6.3.7 9x9 (Category 7) ATRIUM Fuel Assemblies

Parameter	Value
Edge of outer square determined by peripheral fuel rods	5.0 inch (maximum)
Enrichment of any pellet in assembly	5.0 wt% U-235 (maximum)
Enrichment of any pellet in an edge rod	4.0 wt% U-235 (maximum)
Maximum average planar enrichment[3]	4.0 wt% U-235 (maximum)
Clad thickness	0.015 inch (minimum)
Pellet diameter	0.40 inch (maximum)
Fuel density	98.0% TD (maximum)
Rod pitch	0.569 inch (nominal)
UO_2-Gd_2O_3 rods	8 (minimum)
Gd_2O_3 content	2.0± 0.08 wt% (minimum)
Water rods	Center 3 x 3 rods (minimum)
Fuel rod array in bundle	9 x 9

Appendix 6E, as modified by 6F, describes the criticality analyses for 9 x 9 fuel assemblies to be shipped in SP-1 or SP-2 containers.

[3] Maximum average planar enrichment: The average enrichment at the axial location yielding the highest planar average.

6.3.8 Additional 9x9 (Category 8) ATRIUM Fuel Assemblies

Parameter	Value
Assembly size	5.0 inch x 5.0 inch (maximum)
Assembly array	9x9
Average water/fuel volume ratio (Vw/Vf)	1.0 (minimum)
Pellet to clad radial gap	0.003 inch (minimum)
Clad thickness	0.025 inch (minimum)
Pellet diameter	0.555 inch (maximum)
Water rods	Center 3x3 rods
Assembly-average enrichment	4.0 wt% U-235 (maximum)
Gd_2O_3 requirement	

- Minimum number of UO_2-Gd_2O_3 rods is four in non-perimeter locations symmetric about the assembly diagonal.
- UO_2-Gd_2O_3 rods may contain various Gd_2O_3 concentrations in the enriched fuel zone but the minimum Gd2O3 concentration in the enriched zone to qualify as one of the four UO_2-Gd_2O_3 rods is 2.0 wt%.
- The nominal length of the UO_2-Gd_2O_3 region shall be equal to or greater than the nominal length of the enriched region in the UO_2 fuel rods.
- Gd_2O_3 is not required in the end regions with natural uranium.

Attached Appendix 6H describes the criticality analysis of the Category 8 fuel to be shipped in the SP-1, SP-2 and SP-3 containers.

6.3.9 Additional 10x10 (Category 9) ATRIUM Fuel Assemblies

Parameter	Value
Assembly size	5.0 inch x 5.0 inch (maximum)
Fuel rod array in bundle	10x10
Fuel length	174 inches (maximum)
Enrichment of any pellet in the assembly	5.0 wt% U-235 (maximum)
Enrichment of any pellet in an edge rod	4.75 wt% U-235 (maximum)
Enrichment of any pellet in one of the four corner edge rods	3.05 wt% U-235 (maximum)
Enrichment of any pellet in one of the eight edge rods immediately adjacent to the four corner rods	3.55 wt% U-235 (maximum)
Clad thickness	Not restricted
Pellet diameter	0.30 inch (minimum); 0.3957 inch (maximum)

Rod pitch	0.510 inch (nominal)
Fuel density	98.0% TD (maximum)
UO_2 - Gd_2O_3 rods	10 (minimum)
Gd_2O_3 content	2.0 wt% nominal (minimum)
Water rods	Center 3x3 rods (minimum)

- Each assembly must include a minimum of 10 rods with a minimum 2.0 weight percent gadolinia (Gd_2O_3) in all axial regions with enriched pellets.
- The gadolinia rods must be in a pattern symmetric about one of the assembly diagonals.
- At least ten gadolinia rods must be located in rows 2 and 9 and in columns 2 and 9 of the assembly and cannot be immediately adjacent to another one of the ten gadolinia rods, however diagonally adjacent is permitted.
- Polyethylene shipping shims may be inserted between the fuel rods up to a maximum volume fraction of 0.14 averaged over the void volume of the assembly.
- An additional upper tie plate shipping shim may be added between the upper tie plate and the fueled region. This upper tie plate shim may consist of a maximum of 345 g plastic or plastic composite.

Appendix 6I describes the criticality analyses for Category 9, 10x10 fuel assemblies to be shipped in SP-1, SP-2 or SP-3 packagings.

6.3.10 Low Enriched Gadolinia Free 10x10 (Category 10) ATRIUM™ Fuel Assemblies

Parameter	Value
Assembly size	5.0 inch x 5.0 inch (maximum)
Fuel rod array in bundle	10x10
Fuel length	174 inches (maximum)
Enrichment of any pellet in the assembly	2.3 wt% U-235 (maximum)
Clad thickness	Not restricted
Pellet diameter	0.30 inch (minimum); 0.3957 inch (maximum)
Rod pitch	0.510 inch (nominal)
Fuel density	98.0% TD (maximum)
UO_2 - Gd_2O_3 rods	0 (minimum)
Gd_2O_3 content	0.0 wt% nominal (minimum)
Water rods	Center 3x3 rods (minimum)

- Polyethylene shipping shims may be inserted between the fuel rods up to a maximum volume fraction of 0.14 averaged over the void volume of the assembly.

- An additional upper tie plate shipping shim may be added between the upper tie plate and the fueled region. This upper tie plate shim may consist of a maximum of 345 g plastic or plastic composite.

Appendix 6J describes the criticality analyses for Category 10, 10x10 fuel assemblies to be shipped in SP-1, SP-2 or SP-3 packagings.

7. Operating Procedures for Loading and Unloading SP-1, SP-2 and SP-3 Containers

7.1 *Container Handling*

Fuel assemblies and individual fuel rods are loaded for shipment into the SP-1, SP-2 and SP-3 containers in the UO2 Building in accordance with standard operating procedures. The following describes the portions of the applicable procedures pertinent to safety.

- Verify that the fuel assemblies have been completed in compliance with applicable acceptance criteria.
- Inspect fuel assemblies for cleanliness.
- Assure that the polyethylene sheath which is placed over the assembly prior to loading into containers is open at both ends and is no longer than the assembly.
- If loose (not part of a fuel assembly) rods are to be shipped in an SP container, they must be prepared as described below.
  - Only rods containing at least 1.0 wt.% gadolinia, sheathed or unsheathed, may be shipped in the SP-1, SP-2 and SP-3 containers.
  - The rods may be shipped either in the gadolinia rod shipping container, shown in Figure 1-4 or in a product container consisting of a five-inch, schedule 40, stainless steel pipe with a screw type or flange closure. The product container must be vented if it contains material that decomposes at less than 1475 °F.
- Prior to placing fuel assemblies or fuel rods into the SP inner container, visually inspect SP inner container for overall condition including:
  - Proper container preparation (presence of a "release" sticker)
  - Handles and brackets
  - Exterior welds
  - Foam padding
  - Gasket condition
  - Cleanliness
- For fuel assemblies, raise the SP inner container to the vertical position and insert the fuel assembly with the lower tie plate inserted into the wooden thrust block to assure proper orientation. Lower the inner container to horizontal and add shimming to prevent fuel assembly movement.
- For fuel rods, the gadolinia rod shipping container and the product container are loaded into the SP inner container while it is in the horizontal position.

- Complete an inspection to assure compliance with loading procedures for the inner SP container.
- Bolt the end cap and lid of the inner container into place.
- Inspect the outer SP-1 container for structural integrity, cleanliness, and loose material.
- Load the inner container into the outer container and shim as necessary to prevent differential movement between the containers.
- Complete a second inspection to assure compliance with the procedures for loading the inner container into the outer SP container.
- Install and bolt the outer lid into place.
- Install tamper indicating seals at each end of the outer container.
- Radioactively survey for compliance with DOT regulations and release the loaded SP container for shipment.

7.2 *Shipment Procedures*

- Affix proper warning labels to each container.
- Overcheck fuel assembly or fuel rod parameters for compliance with the shipping container NRC Certificate of Compliance requirements.
- Load, tie down, and/or shore the SP containers onto a truck and radioactively survey the truck for compliance with DOT regulations.

8. Acceptance Tests and Maintenance Program

FANP's radioactive material shipping containers, including the SP-1, SP-2 and SP-3 containers, are covered by its NRC-approved quality assurance program for shipping containers. The scope of this QA program includes design, procurement, fabrication, assembly, maintenance, modification and repair of such shipping containers.

8.1 *Acceptance Tests*

FANP conducts quality inspections of SP-1 outer containers and SP inner containers prior to first use. The following steps are included in such inspections.

8.1.1 SP Inner Containers

Typical Characteristic Inspected	Typical Inspection Method
• Proper marking, general cleanliness, rust, cracks, and dents	Visual
• Cover and end pieces for fit and function	Visual
• Container dimensions	Measurements, based on approved drawings, to assure that minimum dimensions for criticality safety are met. Assure that overall length, width and height are within tolerance.
• Weld integrity, including closure lugs and lifting handle placement and attachment	Visual
• Gasket condition	Visual
• Pressure relief valve	Check for presence and proper operation
• Vendor's certificate of compliance	Review for completeness
• Vendor's facility and QC program	FANP QA representative inspection

8.1.2 SP-1 Outer Containers

Typical Characteristic Inspected	Typical Inspection Method
• Proper marking, general cleanliness	Visual
• Cover/base for fit and function	Visual
• Container dimensions	Measurements, based on approved drawings, to assure minimum thickness of honeycomb material.
• Shipping damage	Visual
• Cover drain holes	Probe to make sure holes are not plugged
• Fit of inner container in outer container	Visual
• Vendor's certificate of compliance	Review for completeness

8.2 *Maintenance Program*

The SP inner containers and SP-1 outer containers are maintained and repaired at FANP. The following steps are included in the maintenance and repair done at FANP.

8.2.1 SP Inner Containers

- Repair any holes.
- Replace parts or work out dents greater that ½ inch deep.
- Replace parts or do weld repair on broken welds, seams, damaged lugs, or damaged lifting handles.
- Replace pressure relief valves which don't pass test or have been damaged.
- Replace or repair gaskets which are damaged, brittle, or flat from overcompression.
- Replace ethafoam if greater that 10% of a piece is missing.
- Replace damaged or missing fasteners.
- Repaint if needed.
- Make sure container is clean and free of loose debris.

8.2.2 SP-1 Outer Container

- Replace structural members, 2x4's, 2x10's, and 2x12's, if cracks exceed 25% depth or width.
- Replace plywood with punctures, separating laminations, or more than a square foot of missing lamination.
- Replace damaged skids.

- Replace honeycomb if greater than 10% of a piece is missing or damaged.
- Replace damaged, rusted, or missing nuts, bolts, nails, and screws.
- Make sure interior is clean and dry.
- Repaint and remark as necessary.

Appendix 6J

FRAMATOME ANP SUPPLEMENTAL APPLICATION TO CERTIFICATE OF COMPLIANCE 9248 TO ADD THE CRITICALITY SAFETY ANALYSIS FOR ATRIUM™-10 FUEL ASSEMBLIES WITH 2.3 WEIGHT PERCENT U^{235} MAXIMUM ENRICHMENT AND NO GADOLINIA RODS TO THE SP-1/2/3 PACKAGES

Criticality Evaluation

1. Introduction

This Criticality Safety Evaluation (CSE) provides the criticality safety basis for shipping ATRIUM™-10 fuel assemblies with a maximum U^{235} enrichment with no gadolinia (Gd_2O_3) containing rods. The CSE is the same one that was submitted and approved by the NRC in the letter amendment submittal dated October 23, 2002 (Reference 3). That submittal was for a one time letter amendment for one particular customer. In the mean time other customers have demonstrated a need for the same type of low enriched, no poison fuel to replace multiple burned fuel assemblies due to fuel failures. Therefore FANP would like the fuel description analyzed in this appendix permanently to the certificate.

2. Evaluation

Previously burned fuel assemblies are significantly less reactive than fresh fuel, and as a result in order to match the necessary physics criteria of the operating core, replacement fuel must be comprised of lower maximum and assembly average enrichments. In addition, since the fuel assemblies are replacing previously burned fuel assemblies, gadolinia poison, typically used for reactivity hold down at the beginning of a cycle, is not necessary. The CSE shows that sufficient margin to safety exists for SP-1/2/3 packagings that contain fuel assemblies enriched to maximum of 2.3 w/o U^{235} but containing no gadolinia rods.

The following calculations will demonstrate that the reduction in fresh fuel enrichment is sufficient to offset the removal of the neutron poison gadolinia material. The analysis used in Appendix 6I was essentially repeated using the same general methodology to calculate the nuclear safety margin for the worst case conditions, using reduced enrichments and no burnable poison content. The evaluation considers a single undamaged flooded container with full water reflection, an array of undamaged reflected packages, and an array of damaged packages with various amounts of interspersed moderator and full water reflection. The previous revision of the SAR (EMF-1563 Revision 11) contains 9 categories of allowable contents. The new category 10 is essentially a modification of the category 9 ATRIUM™ 10X10 fuel design.

With the exception of the two parameters mentioned (enrichment and poison), the contents in this Appendix are the same as those in Appendix 6I and Section 5.(b)(1)(ix) of the C of C.:

> UO_2 fuel assemblies composed of fuel rods in a 10 x 10 square array, with a maximum fuel cross section of 5.0 inches square, and a maximum fuel length of 174 inches. The maximum U^{235} enrichment is 2.3 weight percent. The pellet diameter is between 0.30 and 0.3957 inch. Each assembly must have a water channel in a central 3 x 3 position. Any number of additional water rods in any arrangement is permitted, including part length rods. Polyethylene shipping shims may be inserted between the fuel rods. An additional upper tie plate (UTP) shipping shim may be added between the UTP and the fueled region. This UTP shim may consist of a maximum of 345 g plastic or plastic composite.

Reference 1 involved a transmittal to the NRC which updated Table 1 of the initial submittal (Reference 2) in accordance with concerns that were raised during the NRC review. Reference 1 also identified the most reactive isolated reflected undamaged package reactivity to be Keff = 0.75413 ± 0.00323. By maintaining all parameters the same and simply removing the gadolinia rods and making all fuel rods equal to the maximum rod enrichment of 2.3 w/o U^{235}, the reactivity decreased to Keff = 0.72278 ± 0.00335. The same calculation was repeated where enrichment in

each rod was set at 1.9 w/o which represents the assembly average. The resulting multiplication factor was calculated to be Keff = 0.68706 ± 0.00296.

The second set of calculations involved determination of the effect of the reduced enrichment(s) on an undamaged array of packages. Again the evaluation involved a comparison to the data previously approved and presented in Reference 1. The original reactivity listed in Table 1 of Reference 1 was Keff = 0.81454 ± 0.00248. The reductions in reactivity based on the changes in enrichment and the removal of burnable poisons were Keff = 0.77748 ± 0.00291 and Keff = 0.73442 ± 0.00260 for 2.3 w/0 and 1.9 w/o enrichments, respectively.

Again, referencing the transmittal listed in Reference 1, the accident mode of transportation was evaluated by examining the effects of reducing the enrichments to 2.3 w/o and again to 1.9 w/o and removing the burnable poison material from the previously determined worst case accident situation. The same methodology was employed as in the isolated and the undamaged array calculations. The reduction(s) in the enrichment and removal of poisons resulted in reductions in the maximum reactivity of Keff = 0.90901 ± 0.00279 and Keff = 0.85100 ± 0.00230 for each of the two lower enrichments. This is relative to the existing values of 0.93506 ± 0.00274. The revised input deck is provided in Figure 2.

In order to demonstrate that the conditions resulting in the maximum reactivity did not change due to the reduction in enrichment or exclusion of poison material, the worst case accident case was evaluated over the entire range of interspersed moderator, from 1% to a full flooded condition. Figure 1 demonstrates the system is well behaved as evidenced by the consistency in the curves. For comparisons to the previously transmitted values, Table 1 contains reactivity values for both the existing licensed conditions, and those proposed in this appendix.

Reference: 1 Letter, Framatome ANP to NRC, Mr. Hansen, March 21, 2001
"Certificate of Compliance Amendment Request (Framatome ANP Richland, Inc. Docket 71-9248; Revision 11 of EMF-1563", PCR:01:009.

Reference: 2 Letter, Framatome ANP to NRC, Mr. Hansen, November 17, 2000
"Certificate of Compliance Amendment Request (Framatome ANP Richland, Inc. Docket 71-9248; Revision 11 of EMF-1563", PCR:01:009.

Reference: 3 Letter, Framatome ANP to NRC, Mr. Monninger, October 23, 2002
"Request for a Letter Amendment to the Certificate of Compliance No. 71-9248 for the SP-1 Shipping Package", EHSLR-02-038.

Table 1
Update to Table 1 in Ref.1
Comparative listing of Reactivity Changes

Description of Most Reactive Case	k_{eff}	σ	Bias	$k_{eff}+2\sigma+$ bias[1]
ATRIUM™-10 Fuel Assemblies with PE Shipping Shims (see detailed payload description listed in Section 1.2)				
Single SP-3 Inner Package, Assemblies Moved as Close as Physically Possible within Inner Packaging, Asymmetric Gd_2O_3 Rods in Assemblies are Toward Outside of Inner Packaging, 0.35" Diameter Pellets, 0.14 VF PE[2] as Shipping Shims, Fully Flooded, All Rods 5.0 wt% ^{235}U (see Section 3.1.2)	Base =0.75413 **2.3 w/o = 0.72278** **1.9 w/o = 0.68706**	0.00323	-0.00321[1]	0.76059
Undamaged Spacing, 256 SP-1/2/3 Inner/Outer Packages (16 Wide x 16 High), Assemblies as Far Apart as Physically Possible within Inner Packaging, Asymmetric Gd_2O_3 Rods in the Assemblies in Each Group of Two Vertically Adjacent Inner Packages Facing Towards the Inside of the Group, 0.3957" Diameter Pellets, 0.14 VF PE within Inner Packaging as Shipping Shims, 13 vol% Interspersed Moderator, 1 vol% PE between Inner and Outer Packages (see Section 3.1.3)	Base =0.81454 **2.3 w/o = 0.77748** **1.9 w/o = 0.73442**	0.00248	-0.00321[1]	0.81950
Damaged Spacing, 104 SP-3 Inner Packages (8 Wide x 13 High), Assemblies as Far Apart as Physically Possible within Inner Packaging, Asymmetric Gd_2O_3 Rods in the Assemblies in Each Group of Two Vertically Adjacent Inner Packages Facing Towards the Inside of the Group, 0.3957" Diameter Pellets, 0.14 VF PE[2] as Shipping Shims, 13 vol% Interspersed Moderator (see Section 3.1.4)	Base =0.93506 **2.3 w/o = 0.90901** **1.9 w/o = 0.85100**	0.00274	-0.00321[1]	0.94054

(1) Note that as discussed in Section2.4 the bias is negative (conservative), so it is not included in the results as presented in Table 1.

(2) Under severe accident conditions, the UTP shim may increase the PE VF between the fuel rods from 0.14 to 0.151. Calculations in Section 3 show that this increase in the PE VF within the void volume produces statistically identical results.

Figure 1

Comparison of Reactivity for Reduced Enrichment,
No Burnable Poison(s) vs. Base Case

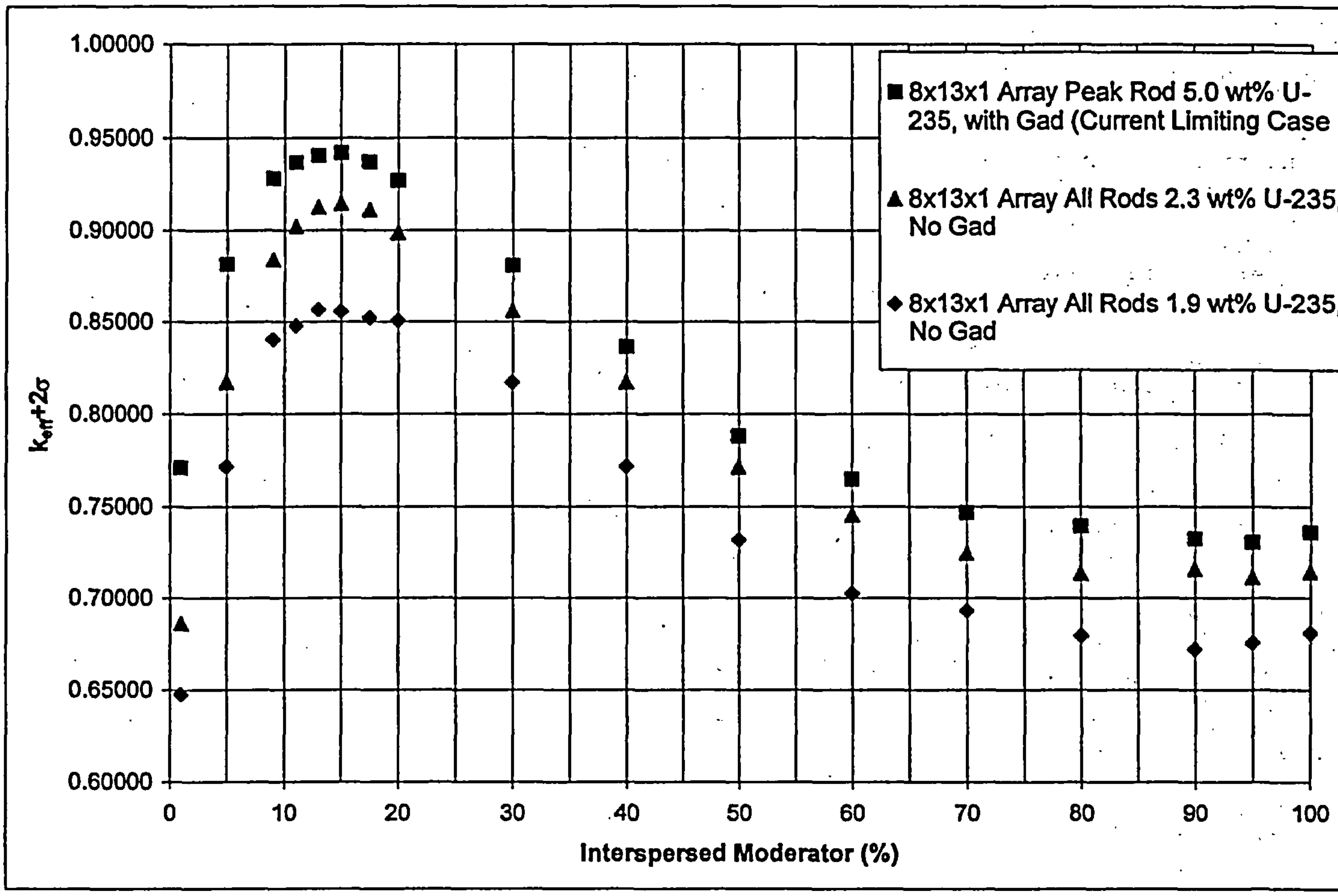

Figure 2
SCALE Input Deck
Accident Mode Array of Packages
(Changes to Ref 1 input are marked in Column)

```
=csas25
atrium-10 in sp1 shipping container
hans infhom

' mixture 1
'  interior rods not immed. adj. to water channel, no gd2o3, 2.3 wt% u235
uo2 1 0.98 293 92235 2.3 92238 97.7 end

' mixture 2
'  interior rods immed. adj. to water channel, no gd2o3, 2.3 wt% u235
uo2 2 0.98 293 92235 2.3 92238 97.7 end

' mixture 3
'  interior rods, 2.3 wt% u235

uo2 3 0.98 293 92235 2.3 92238 97.7 end

' mixture 4
'  corner rods facing other bundle, 2.30 wt% u235
uo2 4 0.98 293 92235 2.30 92238 97.70 end

' mixture 5 - not used
'  smeared zr clad
'  pod, cid, cod = 0.4221", 0.4281", 0.4781"
'  vol fract zr = 0.8988
'   at dens = 0.8988 * 4.2518-2 = 3.8215e-02
zircalloy 5 0.0 3.8215e-02 293 end

' mixture 6
'  interspersed moderator
h2o 6 0.13 293 end

' mixture 7
'  carbon steel, 100 vol%
c  7 0.0 3.921682e-03 293 end
fe 7 0.0 8.350009e-02 293 end

' mixture 8
'  carbon steel, 85.57 vol% smeared with 10 vol% h2o
c  8 0.0 3.355783e-03 293 end
fe 8 0.0 7.145103e-02 293 end
o  8 0.0 4.8167e-04 293 end
h  8 0.0 9.6335e-04 293 end

' mixture 9 - not used
'  carbon steel, 8.64 vol%
c  9 0.0 3.388333e-04 293 end
fe 9 0.0 7.214408e-03 293 end
o  9 0.0 3.0496e-03 293 end
h  9 0.0 6.0992e-03 293 end
```

```
' mixture 10
'  water for reflector
h2o 10 1.00 293 end

' mixture 11
'  pe and interspersed water
'   vf pe = 0.14
'   water at full density is (1-.14) = .86 g/cc
h2o 11 den=0.86 0.13 293 end
arbmepe  0.92 2  0  1 1 6012 1
                        1001 2 11 0.14 end

' mixture 12
'  corner rods not facing other bundle, 2.30 wt% u235
uo2 12 0.98 293 92235 2.30 92238 97.70 end

' mixture 13
'  rods immed. adj. to corner rod, facing other bundle, 2.30 wt% u235
uo2 13 0.98 293 92235 2.30 92238 97.70 end

' mixture 14
'  rods immed. adj. to corner rod, not facing other bundle, 2.30 wt% u235
uo2 14 0.98 293 92235 2.30 92238 97.70 end

' mixture 15
'  balance of edge rods facing other bundle, 2.30 wt% u235
uo2 15 0.98 293 92235 2.30 92238 97.70 end

' mixture 16
'  balance of edge rods not facing other bundle, 2.30 wt% u235
uo2 16 0.98 293 92235 2.30 92238 97.70 end

end comp
more data
 res=  1 cyli  3.9373E-01 dan(  1)= 7.1462E-01
 res=  2 cyli  4.9179E-01 dan(  2)= 6.3800E-01
 res=  3 cyli  3.7646E-01 dan(  3)= 7.1738E-01
 res=  4 cyli  5.4253E-01 dan(  4)= 3.2492E-01
 res= 12 cyli  5.7437E-01 dan( 12)= 2.9006E-01
 res= 13 cyli  4.9373E-01 dan( 13)= 4.7915E-01
 res= 14 cyli  5.1981E-01 dan( 14)= 4.6880E-01
 res= 15 cyli  5.6427E-01 dan( 15)= 4.9128E-01
 res= 16 cyli  5.6151E-01 dan( 16)= 4.7466E-01
end more
atrium-10 in spl shipping container
read parameters
   tme=90.0 gen=103 npg=500
   flx=yes  fdn=yes xs1=yes nub=yes pwt=yes
   run=yes  plt=yes
end parameters
read geometry

unit  5
com="  10x10 bundle in left basket (top inner)  "
array 1  -8.7381 -6.477 -225.58
cubo  6  1  4p8.7381  2p225.58
'  add 0.0598 inch of perforated steel
```

```
cubo  8  1  4p8.89  2p225.58

unit  6
com="  10x10 bundle in right basket (top inner) ."
array 2  -4.2151 -6.477 -225.58
cubo  6  1  4p8.7381  2p225.58
'  add 0.0598 inch of perforated steel
cubo  8  1  4p8.89  2p225.58

unit  7
com="  10x10 bundle in left basket (bottom inner)  "
array 5  -8.7381 -6.477 -225.58
cubo  6  1  4p8.7381  2p225.58
'  add 0.0598 inch of perforated steel
cubo  8  1  4p8.89  2p225.58

unit  8
com="  10x10 bundle in right basket (bottom inner)  "
array 6  -4.2151 -6.477 -225.58
cubo  6  1  4p8.7381  2p225.58
'  add 0.0598 inch of perforated steel
cubo  8  1  4p8.89  2p225.58

unit 9
com="1 5/8 x 1 5/8 inch moderation regions at corners  "
cubo  6  1  4p2.06375 2p225.58

unit 10
com="  1 inner container (top)  "
array  3  -21.9075 -13.97 -225.58
'  add 0.0598 inch walls
repl  7  1 6r0.1519  1

unit 11
com="array of 2 inners (top & bottom)  "
array 8 3r0.0
'repl 10 2 6r3.0  10

unit 12
com="  1 inner container (bottom)  "
array  7  -21.9075 -13.97 -225.58
'  add 0.0598 inch walls
repl  7  1 6r0.1519  1

unit 13
com="8x12 array of inners "
array 9 3r0.0

unit 14
com="8x1 array of inners "
array 10 3r0.0

global
unit 15
com="8x13 array of inners "
array 11 3r0.0
repl 10 2 6r3.0  10
```

```
hole 22  -3.96875 -3.81  0.0

unit 18
com=" angles & spacing beneath baskets  "
cubo  6 1  2p8.89 4.12750 0.0  2p225.58
hole 21  0.0  0.15875  0.0
hole 21 -0.3175  0.47625  0.0
hole 21  0.3175  0.47625  0.0
hole 21  0.635  0.79375  0.0
hole 21 -0.635  0.79375  0.0
hole 21  0.9525  1.11125  0.0
hole 21 -0.9525  1.11125  0.0
hole 21  1.27  1.42875  0.0
hole 21 -1.27  1.42875  0.0
hole 21  1.5875  1.74625  0.0
hole 21 -1.5875  1.74625  0.0
hole 21  1.905  2.06375  0.0
hole 21 -1.905  2.06375  0.0
hole 21  2.2225  2.38125  0.0
hole 21 -2.2225  2.38125  0.0
hole 21   2.54 2.69875 0.0
hole 21  -2.54 2.69875 0.0
hole 21  2.8575 3.01625  0.0
hole 21  -2.8575 3.01625 0.0
hole 21   3.175 3.33375 0.0
hole 21   -3.175 3.33375  0.0
hole 21    3.4925 3.65125 0.0
hole 21   -3.4925  3.65125 0.0
hole 21    3.81 3.96875 0.0
hole 21   -3.81 3.96875 0.0

unit 19
com="angles & spacing above baskets  "
cubo  6 1  2p8.89  0.0 -4.12750  2p225.58
hole 21  0.0  -0.15875  0.0
hole 21 -0.3175  -0.47625  0.0
hole 21  0.3175  -0.47625  0.0
hole 21  0.635  -0.79375  0.0
hole 21 -0.635  -0.79375  0.0
hole 21  0.9525  -1.11125  0.0
hole 21 -0.9525  -1.11125  0.0
hole 21  1.27  -1.42875  0.0
hole 21 -1.27  -1.42875  0.0
hole 21  1.5875  -1.74625  0.0
hole 21 -1.5875  -1.74625  0.0
hole 21  1.905  -2.06375  0.0
hole 21 -1.905  -2.06375  0.0
hole 21  2.2225  -2.38125  0.0
hole 21 -2.2225  -2.38125  0.0
hole 21   2.54 -2.69875 0.0
hole 21  -2.54 -2.69875 0.0
hole 21  2.8575 -3.01625  0.0
hole 21  -2.8575 -3.01625 0.0
hole 21   3.175 -3.33375 0.0
hole 21   -3.175 -3.33375  0.0
hole 21    3.4925 -3.65125 0.0
hole 21   -3.4925  -3.65125 0.0
```

```
hole 21    3.81 -3.96875 0.0
hole 21   -3.81 -3.96875 0.0

unit 21
com="part of steel angle in horiz sections of stringer"
'  0.1552" x 0.125"
cubo  7 1 2p0.197104 2p0.15874 2p225.58

unit 22
com="part of steel angle in vert sections of stringer"
'  0.125" x 0.1552"
cubo  7 1 2p0.15874 2p0.197104 2p225.58

unit 101
com=" interior rods not immed. adj. to water channel, no gd2o3, 5 wt% u235 "
cyli  1 1 0.50254  2p225.58
cubo 11 1 4p0.6447 2p225.58

unit 102
com=" interior rods immed. adj. to water channel, no gd2o3, 5 wt% u235 "
cyli  2 1 0.50254  2p225.58
cubo 11 1 4p0.6447 2p225.58

unit 103
com=" interior rods, 1.5 wt% gd2o3, 5 wt% u235 "
cyli  3 1 0.50254  2p225.58
cubo 11 1 4p0.6447 2p225.58

unit 104
com=" corner rods facing other bundle, 3.05 wt% u235 "
cyli  4 1 0.50254  2p225.58
cubo 11 1 4p0.6447 2p225.58

unit 105
com=" corner rods not facing other bundle, 3.05 wt% u235 "
cyli 12 1 0.50254  2p225.58
cubo 11 1 4p0.6447 2p225.58

unit 106
com=" rods immed adj. to corner rod, facing other bundle, 3.55 wt% u235 "
cyli 13 1 0.50254  2p225.58
cubo 11 1 4p0.6447 2p225.58

unit 107
com=" rods immed adj. to corner rod, not facing other bundle, 3.55 wt% u235 "
cyli 14 1 0.50254  2p225.58
cubo 11 1 4p0.6447 2p225.58

unit 108
com=" balance of edge rods facing other bundle, 4.75 wt% u235 "
cyli 15 1 0.50254  2p225.58
cubo 11 1 4p0.6447 2p225.58

unit 109
com=" balance of edge rods not facing other bundle, 4.75 wt% u235 "
cyli 16 1 0.50254  2p225.58
cubo 11 1 4p0.6447 2p225.58
```

```
unit 110
com=" water rod "
cubo  6 1 4p0.6447 2p225.58

end geometry

read array

' array 1 is bundle in left basket (top inner)
ara=1 nux=10 nuy=10 nuz=1
fill
105 107 109 109 109 109 109 109 107 104
107 101 103 101 103 101 101 103 101 106
109 103 101 101 101 101 101 101 103 108
109 101 101 102 102 102 101 101 101 108
109 103 102 110 110 110 102 101 101 108
109 101 102 110 110 110 102 101 103 108
109 101 102 110 110 110 102 101 101 108
109 101 101 102 102 102 101 101 103 108
107 101 101 101 101 103 101 103 101 106
105 107 109 109 109 109 109 109 107 104
end fill

' array 2 is bundle in right basket (top inner)
ara=2 nux=10 nuy=10 nuz=1
fill
104 107 109 109 109 109 109 109 107 105
106 101 103 101 101 103 101 103 101 107
108 103 101 101 101 101 101 101 103 109
108 101 101 101 102 102 102 101 101 109
108 101 101 102 110 110 110 102 103 109
108 103 101 102 110 110 110 102 101 109
108 101 101 102 110 110 110 102 101 109
108 103 101 101 102 102 102 101 101 109
106 101 103 101 103 101 101 101 101 107
104 107 109 109 109 109 109 109 107 105
end fill

' array 3 is 1 inner container (top inner)
ara=3 nux=4 nuy=3 nuz=1
fill
 9 18 18  9
16  5  6 17
 9 19 19  9
end fill

' array 4 is an array of inner containers
ara=4 nux=8 nuy=13 nuz=1
fill f10 end fill

' array 5 is bundle in left basket (bottom inner)
ara=5 nux=10 nuy=10 nuz=1
fill
105 107 109 109 109 109 109 109 107 104
107 101 101 101 101 103 101 103 101 106
109 101 101 102 102 102 101 101 103 108
```

```
109 101 102 110 110 110 102 101 101 108
109 101 102 110 110 110 102 101 103 108
109 103 102 110 110 110 102 101 101 108
109 101 101 102 102 102 101 101 101 108
109 103 101 101 101 101 101 101 103 108
107 101 103 101 103 101 101 103 101 106
105 107 109 109 109 109 109 109 107 104
end fill

' array 6 is bundle in right basket (bottom inner)
ara=6 nux=10 nuy=10 nuz=1
fill
104 107 109 109 109 109 109 109 107 105
106 101 103 101 103 101 101 101 101 107
108 103 101 101 102 102 102 101 101 109
108 101 101 102 110 110 110 102 101 109
108 103 101 102 110 110 110 102 101 109
108 101 101 102 110 110 110 102 103 109
108 101 101 101 102 102 102 101 101 109
108 103 101 101 101 101 101 101 103 109
106 101 103 101 101 103 101 103 101 107
104 107 109 109 109 109 109 109 107 105
end fill

' array 7 is 1 inner container (bottom inner)
ara=7 nux=4 nuy=3 nuz=1
fill
 9 18 18  9
16  7  8 17
 9 19 19  9
end fill

' array 8 is 2 inner containers (top & bottom)
ara=8 nux=1 nuy=2 nuz=1
fill 12 10 end fill

' array 9 is array of 96 (8x12x1) containers
ara=9 nux=8 nuy=6 nuz=1
fill f11 end fill

' array 10 is array of 8 (8x1x1) containers
ara=10 nux=8 nuy=1 nuz=1
fill f12 end fill

' array 11 is array of 104 (8x13x1) containers
ara=11 nux=1 nuy=2 nuz=1
fill 13 14 end fill

end array

read start
nst=1
end start

read bounds
all=vacuum
end bounds
```

```
read bias
  id=500 2  11
end bias

read plot
'
ttl=' xy section of two inner containers '
xul=0          yul=52.6776   zul=10
xlr=44.1188    ylr=0         zlr=10
uax=1          vdn=-1        nax=150   lpi=10   end
'
ttl=' xy section of entire array '
xul=-32        yul=401       zul=10
xlr=385        ylr=-32       zlr=10
uax=1          vdn=-1        nax=150   lpi=10   end
'
ttl=' xz section of one inner container '
xul=0          yul=7.1882    zul=0
xlr=44.1188    ylr=7.1882    zlr=452
uax=1          wdn=1         nax=150   lpi=10   end
'
ttl=' xz section of entire array '
xul=-32        yul=7.1882    zul=-32
xlr=385        ylr=7.1882    zlr=484
uax=1          wdn=1         nax=150   lpi=10   end
'
end plot

end data
end
```