71-6206

FRAMATOME ANP

An AREVA and Siemens Company

FRAMATOME ANP, Inc.

May 2, 2003

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

Subject: **Request for Amendment to the Certificate of Compliance No. 71-6206 for the Model Shipping Package**

Enclosure (I) List of effected pages

Attachment (I) Changed pages to SAR

Dear Mr. Monninger,

In response to conversations with Meraj Rahimi of your staff, Attachment I is being resubmitted by Framatome ANP in support of the request for an amendment to the Certificate of Compliance for the above referenced shipping package. In addition, Enclosure I is included to clarify the effected change pages.

Two copies of the change pages are provided as Attachment I. These pages should be used to replace the corresponding pages from the application as described in Enclosure I.

If you have any questions concerning this submittal, please call me at (434) 832-5268

Sincerely,

Robert S. Freeman
Site/Operations Manager

EHSL-03-44

NMSS01

Enclosure I
List of effected change pages

Section	Pages	Change
1.1	1	Statement was added for package description.
6.4	14 - 23	Additional information added outlining the nuclear criticality safety aspects associated with inclusion of the Special Absorber Rods.
7.0	24 - 25	Previous revision (6) pages 14 & 15. Section renumbered due to information added in Section 6.4.
8.0	26	Previous revision (6) page 16. Section page renumbered due to information added in Section 6.4.
Exhibit A	27	Previous revision (5) page 17. Page renumbered due to information added in Section 6.4.

Attachment I

Changed pages to the Safety Analysis Report

1.0 This section provides the safety demonstration of shipping design, construction, and contents as required by 10CFR71.

1.1 Package Description (71.33)

1.1.1 Gross weight loaded with two fuel assemblies and components, including Special Absorber Rods (SARs) will be 7600 lbs. maximum.

1.1.2 Model B.

1.1.3 The shipping container is constructed primarily of carbon steel as described in the drawings listed in Exhibit A.

1.1.3.1 The zircaloy or stainless steel cladding of the fuel rods is the containment vessel. The loaded fuel rods are arranged in a rigid configuration and having a volume of water to UO_2 ratio of not more than 2.0.

1.1.3.2 Two 3/16 inch thick full length borated stainless steel plates containing at least 1.5% by weight natural Boron are located between the two fuel assemblies as non fissile neutron absorbers.

1.1.3.3 The shell of the container is a cylindrical structure constructed of 0.089" thick carbon steel sheet with end domes of 0.125" thick carbon steel. Additional items to stiffen the outer shell to provide support to its basic structure are as follows:

* A series of two 90° angles which are rolled & welded circumferentially to the shell.
* The parting flanges on both the upper and lower sections of the container shell.
* The base structure of the container consists primarily of

Table 6.3.3. KENO-IV LRC Critical Results Using CSASN 27 Group Library For Worst Eight Core Configurations (Neutrons per Generation = 2000; Number of Active Generations = 847)

Spacing Between Arrays (in.)	Core Number	KENO-IV on IBM 6000 W/CSASN/27Gp (1σ Unc)	Measured (1σ Unc)	Calculated Minus Measured (1σ Unc)
None	I	0.98964 (0.00053)	1.0002 (0.0005)	-0.01056 (0.00073)
0.644	IV	0.98892 (0.00052)	0.9999 (0.0006)	-0.01098 (0.00079)
1.288	V	0.98797 (0.00052)	1.0000 (0.0007)	-0.01203 (0.00087)
	VI	0.99715 (0.00049)	1.0097 (0.0012)	-0.01255 (0.00130)
	XVI	0.98675 (0.00051)	1.0001 (0.0019)	-0.01335 (0.00197)
1.932	VII	0.98689 (0.00050)	0.9998 (0.0009)	-0.01291 (0.00103)
	XXI	0.98896 (0.00050)	0.9997 (0.0015)	-0.01074 (0.00158)
2.576	IX	0.99100 (0.00051)	1.0030 (0.0009)	-0.01200 (0.00103)

6.4 Evaluation of Special Absorber Rods

Although the Model B shipping package is authorized to allow burnable poison rods and assemblies to be shipped integral to the fuel assemblies, an evaluation of placing Special Absorber Rods (SAR) in the B&W Mk-BW 17x17 fuel assembly design (Design 4 in Table 1.2) is discussed below. The results of this evaluation indicate that the inclusion of the Special Absorber Rods will result in a net decrease in reactivity of the shipping packages and increase the margin to the criticality safety limit of 0.95 for the Model B container.

Container Modeling Description

This evaluation employed the SCALE4.4a code system (Ref. 2) using the CSAS25 module with the 238 group LAW library. The dimensions for the Mk-BW fuel assembly were the same as those listed in Table 1.2. The container model has been transferred from the KENOIV of the previous analysis to KENOVa geometry specifications for this evaluation. Figure 6.4.1 provides a sketch of the model. The model represents one-half of a damaged container with reflected boundary conditions in the xy plane to represent an infinite array of containers in this plane. A 20 cm water reflector at the top and bottom of the active fuel region replaces the end fittings and container structures in the z direction of the model. In the transfer from KENOIV to KENOVa, the model dimensions and component positions within the container were duplicated exactly except for the polyethylene wrap around the fuel assembly. In the KENOIV model, the wrap extended around both the fuel assembly and the strongback due to geometry limitations in KENOIV. The KENOVa model placed the wrap against each surface of the fuel assembly. The material compositions were taken directly from the KENOIV model as listed in Table 6.4.1.

The Special Absorber Rods are comprised of lithium aluminate pellets within a stainless steel clad. Nickel-plated zirconium tubes are located between the pellets and the clad – see Figure 6.4.2. Table 6.4.2 lists the dimensions of the rod components and Figure 6.4.3 is a sketch of the absorber rod model in KENOVa. A smeared solid pellet represents the lithium pellet and a homogenized region replaces the clad and getter regions. The absorber region is axially centered on the active fuel region with voided stainless steel tubes modeled at either end of the absorber region. End caps, spacer sleeves, and springs have been ignored in the upper and lower regions. Table 6.4.3 lists the number densities for the two regions. The two lithium concentrations in Table 6.4.3 define the upper and lower concentrations for the range that can be used for the rods; however, generally only one concentration will be used in a particular assembly. Each Special Absorber assembly can contain from 4 to 24 rods suspended from a top hub similar to that used for a burnable poison rod assembly. Figure 6.4.1 illustrates the positioning of the 24 rods in the guide tubes of the assembly. For the 4 rod assembly, only the four outermost guide tubes on the diagonal of the fuel assembly contain the Special Absorber Rods.

In addition to the container model, a single, water reflected fuel assembly was also examined. For this model the fuel assembly was extracted from the container model and surrounded by 30 cm of water.

Evaluation Results

The bounding case for the Mk-BW fuel assembly is the damaged container array flooded with water. This configuration was modeled in the previous licensing calculations with KENOIV using the 27 group cross sections. To ensure that the KENOVa model adequately reflects the previous model and to provide a benchmark against the previous calculations, the KENOVa model was also executed with the 27-group cross section set and the same number of neutron histories. Table 6.4.4 shows the results from these two cases. The KENOVa case is slightly larger, but the results overlap at the $\pm 2\sigma$ level. Based upon these results, it is judged that the KENOVa model, methodology, and cross sections will provide equivalent results with those from the KENOIV system used previously. In addition, it is noted that the Mk-BW assembly is not the limiting assembly in the previous analysis. It is approximately 1% Δk less reactive that the bounding Mk-B11 assembly. Thus, any slight differences between KENOVa and KENOIV will not impact the criticality safety of the container. Table 6.4.4 also contains the results for the KENOVa case using the 238-group cross section set that is used for this evaluation. The k_{eff} value for this case is slightly less than that for the 27-group set but within one sigma of the 27-group set.

The effect of inserting the Special Absorber Rods in the fuel assembly are listed in Table 6.4.5. The first case is the base model of the flooded, damaged container with the Mk-BW assembly without the SARs (k_{eff} = 0.92412). The second case examines the case with 24-SARs at 0.0317 g Li-6/in, the maximum SAR assembly loading (k_{eff} = 0.79376). The third case models the lightest SAR loading, i.e., 4 rods at 0.029 g Li-6/in with a k_{eff} = 0.92412. These cases illustrate that shipping the SARs in the container will reduce the reactivity of the container by a minimum of ~2 and up to ~13% Δk for the bounding accident condition.

An estimate of the effect for the normal condition can be obtained by looking at the damaged array with water replaced by void. Cases 4 and 5 in Table 6.4.5 provide the results for this case without and with 24-0.0317 g Li-6/in SARs. The lack of a moderator significantly reduces the effectiveness of the SARs to < 2%. However, the k_{eff} of the dry containers themselves are also significantly lower. A final set of cases examined a single assembly in water without and with the SARs. The results of these cases are listed in Table 6 as cases 6 and 7. Again a Δk of about 13% is shown, so that the effectiveness of the SARs are essentially independent of the absorber plate and materials of the container.

Conclusion

Based upon the information provided in Table 6.4.4, the current evaluation provides results consistent with those supporting the current CoC. Table 6.4.5 indicates that the addition of the SARs to the fuel assemblies in the container will reduce the k_{eff} of the container. The lithium loadings proposed for use with the TPBARS can range from 0.029 g/in to 0.0317 g/in. The number of SARs per assembly can range from 4 to 24 depending upon the fuel cycle design. The k_{eff} reduction ranges from a minimum of about 2% Δk for 4-0.029 g/in SARs to ~13% Δk for an absorber assembly with 24-0.0317 g/in SARs, the highest lithium loading. Thus, the presence of the SARs will increase the margin of safety of the Model B container.

Reference:

2. "SCALE, A Modular Code System for Performing Standardized Computer Analysis for Licensing Evaluation," NUREG/CR-0200, Revision 6.

Table 6.4.1. Component Number Densities Extracted From Previous Evaluation

Component Number Densities			
Fresh Fuel, 5.05 wt%, 0.975 TD		**Borated Stainless Steel**	
U-235	1.21875E-03	O	3.33757E-02
U-238	2.26254E-02	H	6.67514E-02
O	4.76883E-02	B-10	8.99740E-04
Zirconium Clad, GT, & IT		B-11	4.00706E-03
Zr	4.25156E-02	C	1.17770E-04
Polyethylene		Mn	1.47630E-03
C	3.95670E-02	Si	1.09130E-03
H	7.91340E-02	Cr	1.68220E-02
Neoprene		Ni	1.09910E-02
H	4.18200E-02	Fe	5.39270E-02
B-10	6.63638E-05	**Carbon Steel**	
B-11	2.95556E-04	Fe	8.40110E-02
C	3.34600E-02	C	3.92590E-04
		Mn	3.43320E-04

Table 6.4.2. SAR Dimensions

Item	Dimensions
Cladding OD, in	0.381
Cladding ID, in. (before coating)	0.336
Rod OD tolerance, in.	0.0005
Rod length, in.	151.700
Pellet OD, in.	0.303
Pellet ID, in.	0.223
^{6}Li loading, g/in. (enriched pellets)	0.029 & 0.032
^{6}Li enrichment, % (enriched pellets)	24.46 & 26.99
Enriched pellet stack length (cold), in.	132
Pellet stack off-set down from centerline, in.	0.0 (cold)

Table 6.4.3. SAR Material Data

Element	Wt%	Number Density
0.0317 g Li-6/in Pellet Material Smeared[a] Composite Density =1.116479 g/cm^3		
Li-6	2.40288	2.68590E-03
Li-7	7.67952	7.35946E-03
Al	41.13427	1.02504E-02
O	48.78333	2.05007E-02
0.029 g Li-6/in Pellet Material Smeared[a] Composite Density = 1.116866 g/cm^3		
Li-6	2.19746	2.45713E-03
Li-7	7.91556	7.58828E-03
Al	41.12027	1.02504E-02
O	48.76672	2.05008E-02
Clad/Getter Region SS316L (note Ag replaces Mo)[a]		
Cr	9.41881	8.29340E-03
Fe	34.94887	2.86510E-02
Ni	35.13289	2.74020E-02
Ag	0.05949	2.52490E-05
Mn	0.80732	6.72790E-04
Zr	19.63263	9.85630E-03

a) Model from core evaluation retained for this evaluation.

Table 6.4.4. KENOVa/KENOIV Comparison Results

No.	Case Description	k_{eff}	1 σ	Δk(Va-IV)	1 σ
1	Base Model 27 gp KENOIV	0.92334	0.00058	-	-
2	Base Model 27 gp KENOVa	0.92571	0.00073	0.00237	0.00093
3	Base Model 238 gp KENOVa	0.92412	0.00062	0.00078	0.00085

Table 6.4.5 KENOVa SARs Evaluation Results

No.	Case Description	k_{eff}	1 σ	Δk[a]	1 σ
1	Base Model –Damaged Flooded Container	0.92412	0.00062	-	-
2	Base Model w 24-SARs @ 0.0317 g Li-6/in.	0.79376	0.00074	0.13036	0.00097
3	Base Model w 4-SARs @ 0.029 g Li-6/in.	0.90600	0.00064	0.01812	0.00089
4	Base Model – Damaged Dry Container	0.55106	0.00036	-	-
5	Base Model w SARs – Damgd Dry Cont	0.53474	0.00038	0.01632	0.00052
6	Single Assembly in Water	0.93910	0.00072	-	-
7	Single Assembly in Water with 24-SARs @ 0.0317 g Li-6/in	0.81214	0.00068	0.12696	0.00099

a) k_{eff} without SARs minus keff with SARs.

FIGURE WITHHELD UNDER 10 CFR 2.390

FIGURE WITHHELD UNDER 10 CFR 2.390

Attachment A. KENOVa Input File for 24-SARs Case

The following is a listing of the KENOVa input file for the damaged Model B container with a Mk-BW fuel assembly containing 24-0.0317 g Li-6/in SARs. Note that additional material data are included that were not used in the modeling. These were in the KENOIV input file and were retained here for traceability to this previous file.

```
=csas25                parm=size=400000
Mk BW17 5.05 wt% assembly in water 0.975 TD
238g lat
'2345678901234567890123456789012345678901234567890123456789012345678901
'fresh fuel 5.05 wt%
  u-235        1  0.0      1.21875E-03 end
  u-238        1  0.0      2.26254E-02 end
  o            1  0.0      4.76883E-02 end
'clad
  zr           2  0.0      4.25156E-02 end
'moderator 1
  o            3  0.0      3.33757E-02 end
  h            3  0.0      6.67514E-02 end
'zircalloy 1
  zr           4  0.0      4.25156E-02 end
'moderator 2
  o            5  0.0      3.33757E-02 end
  h            5  0.0      6.67514E-02 end
'zircalloy 2
  zr           6  0.0      4.25156E-02 end
'moderator 3
  o            7  0.0      3.33757E-02 end
  h            7  0.0      6.67514E-02 end
'moderator 4
  o            8  0.0      3.33757E-02 end
  h            8  0.0      6.67514E-02 end
'bss absorber plate
  b-10         9  0.0      8.99740E-04 end
  b-11         9  0.0      4.00706E-03 end
  c            9  0.0      1.17770E-04 end
  mn           9  0.0      1.47630E-03 end
  si           9  0.0      1.09130E-03 end
  cr           9  0.0      1.68220E-02 end
  ni           9  0.0      1.09910E-02 end
  fe           9  0.0      5.39270E-02 end
' carbon steel
  fe          10  0.0      8.40110E-02 end
  c           10  0.0      3.92590E-04 end
  mn          10  0.0      3.43320E-04 end
' poly
  c           13  0.0      3.95670E-02 end
  h           13  0.0      7.91340E-02 end
'b4c  ???? (not used here)
  b-10        11  0.0      1.49885E-02 end
  b-11        11  0.0      6.67525E-02 end
  c           11  0.0      2.72470E-02 end
'neoprene
  h           12  0.0      4.18200E-02 end
  b-10        12  0.0      6.63638E-05 end
  b-11        12  0.0      2.95556E-04 end
  c           12  0.0      3.34600E-02 end
```

```
' poly
  c          13  0.0     3.95670E-02 end
  h          13  0.0     7.91340E-02 end
'tpbar pellet - 0.032 g/cc
  li-6       14  0.0     2.68590E-03 end
  li-7       14  0.0     7.35946E-03 end
  al         14  0.0     1.02504E-02 end
  o          14  0.0     2.05007E-02 end
'tpbar clad - ss318 with Ag for Mo
  cr         15  0.0     8.29340E-03 end
  fe         15  0.0     2.86510E-02 end
  ni         15  0.0     2.74020E-02 end
  ag         15  0.0     2.52490E-05 end
  mn         15  0.0     6.72794E-04 end
  zr         15  0.0     9.85360E-03 end
  ss316      16  1.0                 end
end comp
'
'pitch data based on fuel pins
'           pitch   pel OD   fuelid modid cladOD cladid#  gapOD   gapid#
squarepitch 1.25984 0.820928    1     3    0.94488  2     0.84074 0 end
KENO
read parm  tme=3000  gen=850  npg=2000 nsk=3 plt=yes run=yes end parm
read geom
'fuel cell
unit 1
   cylinder  1  1  0.410464   365.76  0.0
   cylinder  0  1  0.42037    365.76  0.0
   cylinder  2  1  0.47244    365.76  0.0
   cuboid    3  1  4p0.62992  365.76  0.0
'GT cell w. TP Bar and upper/lower plenum
unit 21
   cylinder  14 1 0.38481     350.52 15.24
   cylinder  15 1 0.48387     350.52 15.24
   cylinder  3 1 0.57404      350.52 15.24
   cylinder  4 1 0.60960      350.52 15.24
   cuboid    3 1 4p0.62992    350.52 15.24
unit 22
   cylinder  0  1 0.42672     15.24  0.0
   cylinder  16 1 0.48387     15.24  0.0
   cylinder  3 1 0.57404      15.24  0.0
   cylinder  4 1 0.60960      15.24  0.0
   cuboid    3 1 4p0.62992    15.24  0.0
unit  2
   array 5   0  0  0
'IT cell
unit 3
   cylinder  3 1 0.57404      365.76  0.0
   cylinder  4 1 0.60960      365.76  0.0
   cuboid    3 1 4p0.62992    365.76  0.0
' assembly  in strongback
global
unit 4
   array 4   0  0  0
   replicate 13 1 4*0.02023                       2*0.0 1
   replicate 12 1 0.0 0.15875  0.0 0.15875        2*0.0 1
   replicate  9 1 0.0 0.47625  2*0.0              2*0.0 1
   replicate  8 1 0.0 2.936875 8.674098 0.0       2*0.0 1
   replicate 10 1 2*0.0        0.0 0.47625        2*0.0 1
   replicate  8 1 9.76503 0.0   0.0 18.9324        2*0.0 1
   replicate 10 1 0.2286  0.0   2*0.2286           2*0.0 1
   replicate  8 1 2*0.0        2*0.0              2*20.32 1
```

```
end geom
read array
'fresh fuel assembly
   ara=4    nux=17    nuy=17    nuz=1
   fill     1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 2 1 1 2 1 1 2 1 1 1 1 1
            1 1 1 2 1 1 1 1 1 1 1 1 1 2 1 1 1
            1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
            1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1
            1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
            1 1 2 1 1 2 1 1 3 1 1 2 1 1 2 1 1
            1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
            1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1
            1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
            1 1 1 2 1 1 1 1 1 1 1 1 1 2 1 1 1
            1 1 1 1 1 2 1 1 2 1 1 2 1 1 1 1 1
            1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   end fill
'TP Bar Rod
   ara=5    nux=1    nuy=1    nuz=3
   fill     22 21 22
   end fill
end array
read bounds
   xyf=mirror
   zfc=vacuum
end bounds
read plot
ttl='x-y slice of  at z=50'
xul=-5        yul=33.0   zul=50
xlr=33.0   ylr=-22     zlr=50
uax=1 vdn=-1 nax=260   end
ttl='x-y slice of  at z=50'
xul=-0.5      yul=22.0   zul=50
xlr=22.      ylr=-1      zlr=50
uax=1 vdn=-1 nax=260   end
ttl='x-y slice of  at z=10'
xul=-0.5      yul=11.0   zul=10
xlr=11.      ylr=-1      zlr=10
uax=1 vdn=-1 nax=260   end
ttl='x-y slice of  at x=10.71'
xul=10.71      yul=11.0   zul=-25
xlr=10.71      ylr=-1      zlr=25
vax=1 wdn=-1 nax=260   end
ttl='x-y slice of  at x=10.71'
xul=10.71      yul=11.0   zul=345
xlr=10.71      ylr=-1      zlr=387
vax=1 wdn=-1 nax=260   end
end plot
end data
end
```

7.0 Operating Procedures

Use and maintenance of the Model B fresh fuel shipping package is controlled by formal written procedures approved by appropriate plant management. These procedures specifically describe the sequence of operations for packaging, shipping, labeling, unloading, storing and maintaining the Model B shipping package to insure it meets the requirements set forth in its Certificate of Compliance.

7.1 Loading Procedure

During the loading process the package is visually inspected for defects in the overall package including key components subject to wear. Specific attention is given to inspection of the container shell, closure bolts and nuts, the strongback assembly, shock mounts and bow clamps to verify they are present and in acceptable condition.

The following general steps are performed as part of the fuel assembly loading process:

1) If applicable the container should be de-pressurized by either releasing the flange bolts, or releasing the pressure valve.
2) Using a crane hoist or lifting device the cover is removed.
3) Release the bolts to separate the shock mount frame from the strongback.
4) Rotate bolts to release clamp bows and open top end gate.
5) Raise strongback to vertical position.
6) Transfer fuel assembly(s) into container
7) Close all clamp bows – tighten the two end fitting clamp bows located at the top and lower end of the assembly(s)
8) Lower strongback
9) Fasten the strongback to the shock mount frame
10) Raise the upper end gate and secure in position
11) Tighten remaining clamp bow and adjust grid bow clamp side pressure pads
12) Retract frame interlocking toggle clamps releasing the strongback to shock mounts
13) Replace the container cover and tighten flange bolts

7.2 Unloading Procedure

The procedure for unloading of the shipping package is essentially the reverse of the loading procedure. Following initial visual inspection for external damage that may have occurred during transport or problems with the tamperseals, the package is unloaded. If applicable, the package is depressurized, the lid is removed, the majority of the bow clamps released and the strongback raised. The assemblies are then removed one at a time.

7.3 Records

Records pertaining to the Model B container shipments as required by 10CFR 71 are retained for a minimum of 3 years.

8.0 Maintenance

Maintenance operations are performed in accordance with criteria outlined in the applicable licensed drawings. Visual inspections shall be performed on all Model-B containers prior to their first use following routine maintenance to verify acceptable condition of welds and components, as identified by the licensing drawings.

Pressure and leak tests are not applicable to the testing of the Model-B containers. The containers are not subjected to internal pressure since only unirradiated clad fuel is shipped. Component testing is accomplished as part of the normal fuel loading process. Deficiencies or deviations are reported as required by the FCF shipping container Quality Program. Testing of rupture discs and fluid transport devices are not used in the Model B container design. Testing of gasketed surfaces is not required since gaskets are non-safety related and are only intended to maintain product quality. Tests for shielding integrity are not necessary since no shielding in incorporated into the Model B container design. There are no thermal acceptance tests required since there are no heat generating materials authorized for shipment in the Model B containers.

EXHIBIT A

MODEL B - FRESH FUEL SHIPPING CONTAINER DRAWING LIST

DRAWING NO.	DRAWING TITLE	PAGES
1215464 E	Shipping Container Strongback Assembly and Details	Sheets 1 - 4
1215465 E	Shipping Container Upper Weldment, Lower Weldment and Details	Sheets 1 - 2
1215466 E	Shipping Container Assembly and Components	Sheets 1 - 4