71-6078

Westinghouse

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Our ref: UAM-NRC-05-014
Your Ref:

Mr. Lewis:

September 27, 2005

Subject: Docket # 71-6078: Renewal Request for Certificate of Compliance USA/6078/AF, Model Numbers 927A1 and 927C1 – Corrected Pages to Previous Submittal

Westinghouse Electric Co. hereby submits corrected pages to our earlier submittal (UAM-NRC-05-011), our request for renewal of Certificate of Compliance No. 6078 for the Model No. 927A1 and 927C1 packages. The replacement pages are provided to correct minor administrative and typographical inconsistencies that were identified by your staff. Westinghouse intends to continue using the CE927 package under timely renewal while the application is under NRC review.

As stated earlier, there are no design changes to the package associated with this renewal request. However, the License Application, or Safety Analysis Report (SAR), is being issued as Revision 5 to incorporate the following administrative changes to the document:

- List of Effective Pages added (page vi)
- Table of contents revised to show page number format consistent with section page numbering (pages i–v).
- Correction to the page number designation of Revision 4 pages 6-26 through 6-31 to be consistent with page numbering of other appendices. Numbering changed to 6A-1 through 6A-6.

The SAR is otherwise identical to the version referenced in Revision 30 of the Certificate of Compliance. It is requested that NRC make appropriate page changes to the copies of the SAR that were submitted in the previous application, and discard the CD. This document should constitute the only supplement to the application.

Please direct any questions to me at (803) 647-3552.

Sincerely,

WESTINGHOUSE ELECTRIC COMPANY, LLC

Norman A. Kent

Norman A. Kent
Manager Transport Licensing and Regulatory Compliance
Uranium Asset Management

Enclosure: change pages to previous SAR

NMSS-01

WESTINGHOUSE ELECTRIC COMPANY LLC
NUCLEAR FUEL

APPLICATION FOR APPROVAL OF PACKAGING OF FISSILE RADIOACTIVE MATERIAL (Models #927A1 and 927C1)

PACKAGE IDENTIFICATION NUMBER
USA/6078/AF

Submitted: September 27, 2005
Expiration: October 1, 2008

U. S. NUCLEAR REGULATORY COMMISSION

DOCKET 71-6078

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927a1/927c1 SAFETY ANALYSIS REPORT
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APPENDIX 6A

Justification

Assumptions and conclusions from Section 6 are not changed. Section 6.4.2 concludes that the 16x16 fuel assembly configuration corresponding to CoC paragraph 5.(1)(b)(v) is the most reactive. Table 6.4-2 gives KENO-IV keff+2σ results for this FA configuration.

Calculations were made for each fuel type being modified. The contents were inserted into the 927A1/C1 packaging under hypothetical accident conditions and evaluated as individual packages and 2x4x1 package array. (Figure 6.3-3 shows the KENO Model for Damaged Containers). Results are given in Table 6A-1. Note that the fuel in items (iii) and (v) are identical with the exception of fuel length. The longer fuel is modeled at both 0.325" and 0.3255" pellet diameters.

Table 6A-1 Hypothetical Accident Condition Calculations for 927A1/C1 with Revised Fuel Assembly Types, 10.96 g/cc pellet density and 12-Inch Annular Pellet Zones Top and Bottom

Run No.	CoC Para 5.(b)(1)	Assembly Type	k_{eff}	σ	k_{eff} + 2σ
Individual Package in Isolation - SCALE Version 4.4 / CSAS25 / 44GROUPNDF5					
48	(ii)	14X14	0.9083	0.0013	0.9109
46	(iii) and (v)	16X16 (0.325")	0.9071	0.0012	0.9095
47	(iii) and (v)	16X16 (0.3255")	0.9057	0.0013	0.9083
65	New (vii)	16X16 (0.3225")	0.9169	0.0014	0.9197
Package Array - SCALE Version 4.4 / CSAS25 / 44GROUPNDF5					
51	(ii)	14X14	0.9304	0.0012	0.9328
49	(iii) and (v)	16X16 (0.325")	0.9270	0.0013	0.9296
50	(iii) and (v)	16X16 (0.3255")	0.9255	0.0012	0.9279
66	New (vii)	16X16 (0.3225")	0.9333	0.0012	0.9357

It is important to note that the 0.325" pellet diameter for the 16x16 fuel type was actually approved in previous revisions of the CoC. Prior to December 1992 the pellet diameter for the 16x16 fuel was 0.325". It was increased to 0.330" in Revision 17. Hence, in the case of reducing pellet diameter for paragraphs (iii) and (v), Westinghouse is returning to a fuel type that had already been approved, albeit at a lower pellet density.

The new fuel type becomes the more limiting fuel but calculations demonstrate that keff for all types remains below the upper subcritical limit (USL) which is 0.9377.

The parameters important to criticality safety for the new 16x16 fuel design are given in Table 6A-2.

Table 6A-2 Parameters Important to Criticality Safety for New 16x16 Fuel Type	
Parameter	
Geometry	16x16
Wt.%U235	5.0
Nominal pellet density	10.96 g/cc
No. fuel rods	236
Active fuel length	150.0
Nominal clad OD	0.374
Nominal clad thickness	0.0225
Nominal pellet diameter	0.3225
Annular inner pellet diameter	0.155
Fuel rod lattice pitch	0.5065
Unit cell V_{H2O}/V_{UO2}	1.789
G U235/cm fuel assembly	56.7
Kg U235/Assembly	21.6
Kg U/Assembly	431

Acceptance Criteria

The SCALE 4.4 code package was used for all criticality calculations performed herein. Final calculations utilized the CSAS25 or CSAS2X sequence along with the 44 group ENDF/BV cross section library.

The arbitrary margin to ensure the subcriticality of ks, called Δkm, shall be no less than 0.05, where ks is the calculated allowable maximum multiplication factor, keff.

The equation for ks is given as:

$ks \leq kc - \Delta ks - \Delta kc - \Delta km$,

where

kc is the keff from the calculation of benchmark criticality experiments,

Δks is uncertainty in the value of ks, and

Δkc is uncertainty in the value of kc and identical to the uncertainty in the bias (i.e. $\Delta kc = \Delta\beta$).

Δkm =additional administrative margin to ensure subcriticality (i.e. Δkm= 0.05)

The calculation bias, β, is defined as $\beta = kc - 1$, therefore

$ks \leq \beta + 1 - \Delta ks - \Delta\beta - \Delta km$, or
$ks + \Delta ks - (\beta - \Delta\beta) \leq 1 - \Delta km$
$ks + \Delta ks - (\beta - \Delta\beta) \leq 1 - 0.05$
$ks + \Delta ks - (\beta - \Delta\beta) \leq 0.95$

For these calculations, ks is the average keff and Δks is two times the minimum standard deviation (σ) of the system that are listed at the top of the plot of average k-effective by generation skipped in the KENO-Va output, and a negative value of 0.0123 is assigned for the bias and uncertainty in the bias (β-$\Delta\beta$) associated with using SCALE 4.4 and the 44-group cross-section library. This is consistent with the Columbia Plant methodology for determining the upper subcritical limit (USL) in accordance with ANS/ANSI-8.1 guidance. The upper subcritical limit is 0.9377 and,

$USL = 1 - \Delta km + (\beta - \Delta\beta)$
$ks + \Delta ks \leq USL$
$keff + 2\sigma \leq 0.9377$

Table 6A-3 Input Deck for New 16x16 Fuel Assembly HAC Package Array

```
=CSAS25
   EXPLICIT MODELLING OF THE 927 SHIPPING CONTAINER
   44GROUPNDF5          LATTICECELL
   UO2        1  DEN=10.96 1.0 293 92235 5 92238 95 END
   ZIRC4       2  1.0 293 END
   H2O        3  1.00 293 END
   SS304       4  1.0 293 END
   CARBONSTEEL   5  1.0 293 END
   H2O        6  1.00 293 END
   H2O        7  1.0 293 END
   UO2        9  DEN=10.96 1.0 293 92235 5 92238 95 END
   ZIRC4      10  1.0 293 END
   H2O       11  1.00 293 END
   END COMP
   SQUAREPITCH 1.28651 0.81915 1  3  0.94996  2 0.83566 0  END
   MORE DATA  RES=9 CYLINDER 0.409575 0.19685
   DAN(9)=0.48795876
   RES=10 CYLINDER 0.47498 0.41783
   DAN(10)=0.44792306 END MORE
   KENO DESCRIPTION OF THE 927 CONTAINER 1.5 INCHES ABOVE STRONGBACK
   READ PARM GEN=210 GEN=410 NPG=1000 RND=756564767891 RUN=YES
   END PARM
   READ GEOM
   UNIT  1
   CYLINDER   1  1  0.409575  320.04  0.0
   CYLINDER   0  1  0.41783  320.04  0.0
   CYLINDER   2  1  0.47498  320.04  0.0
   CUBOID    3  1  0.64326 -0.64326  0.64326 -0.64326 320.04 0.0
   UNIT  2
   ARRAY  1  3*0.0
   CUBOID    6  1  20.58432 -2.91068 26.035 -3.810  320.04  0.0
   CUBOID    5  1  20.58432 -3.54568 26.035 -4.445  320.04  0.0
   UNIT  3
   ARRAY  1  3*0.0
   CUBOID    6  1  23.81250  0.0    26.035 -3.810  320.04  0.0
   CUBOID    5  1  24.44750  0.0    26.035 -4.445  320.04  0.0
   UNIT  4
   CUBOID    6  1  7.140580 -7.140580  19.36750  0.0    320.04 0.0
   CUBOID    5  1  7.620000 -7.620000  19.84375 -0.47625 320.04 0.0
   CUBOID    5  1  7.620000 -7.620000  19.84375 -1.11125 320.04 0.0
   CUBOID    6  1  7.620000 -7.620000  29.36875 -1.11125 320.04 0.0
   UNIT  5
   CUBOID    3  1  0.64326 -0.64326  0.64326 -0.64326 320.04 0.0
   UNIT 11
   CYLINDER  0 1 0.19685 30.48  0.0
   CYLINDER  9 1 0.409575  30.48  0.0
   CYLINDER  0 1 0.41783  30.48  0.0
   CYLINDER 10 1 0.47498  30.48  0.0
   CUBOID 3 11  4P0.643255  30.48  0.0
   UNIT  21
   ARRAY  11  3*0.0
   CUBOID    6  1  20.58432 -2.91068 26.035 -3.810  30.48  0.0
   CUBOID    5  1  20.58432 -3.54568 26.035 -4.445  30.48  0.0
```

Table 6A-3 Input Deck for New 16x16 Fuel Assembly HAC Package Array (cont.)

```
UNIT 31
ARRAY 11 3*0.0
CUBOID   6 1 23.81250 0.0   26.035 -3.810 30.48 0.0
CUBOID   5 1 24.44750 0.0   26.035 -4.445 30.48 0.0
UNIT 41
CUBOID   6 1 7.140580 -7.140580 19.36750 0.0   30.48 0.0
CUBOID   5 1 7.620000 -7.620000 19.84375 -0.47625 30.48 0.0
CUBOID   5 1 7.620000 -7.620000 19.84375 -1.11125 30.48 0.0
CUBOID   6 1 7.620000 -7.620000 29.36875 -1.11125 30.48 0.0
UNIT 51
CUBOID  11 1 0.64326 -0.64326 0.64326 -0.64326 30.48 0.0
UNIT 6
ARRAY 2 -32.0675 0.0 0.0
CUBOID   6 1 37.7825 -37.7825 35.5600 0.0000 381.0 0.0
CUBOID   5 1 38.0873 -38.0873 35.8648 -0.3048 381.0 0.0
GLOBAL
UNIT 7
ARRAY 3 3*0.0
REPLICATE 7 1 6r30.48 1
END GEOM
READ ARRAY
ARA=1 NUX=16 NUY=16 NUZ=1
COM=!THIS IS THE ARRAY CONFIGURATION OF THE STANDARD 16X16 CE ASSEMBLY!
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 1 1 1 1 1 1 1 1 1
1 1 1 5 5 1 1 1 1 1 1 5 5 1 1 1
1 1 1 5 5 1 1 1 1 1 1 5 5 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 1 1 1 5 5 1 1 1 1 1 1 1
1 1 1 1 1 1 1 5 5 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
1 1 1 5 5 1 1 1 1 1 1 5 5 1 1 1
1 1 1 5 5 1 1 1 1 1 1 5 5 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 1 1 1 1 1 1 1 1 1 1 1 1
END FILL
```

Table 6A-3 Input Deck for New 16x16 Fuel Assembly HAC Package Array (cont.)

```
   ARA=11 NUX=16 NUY=16 NUZ=1
   COM=!THIS IS THE ARRAY CONFIGURATION OF THE STANDARD 16X16 CE ASSEMBLY!
   FILL
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   11 11 11 51 51 11 11 11 11 11 11 11 51 51 11 11 11
   11 11 11 51 51 11 11 11 11 11 11 11 51 51 11 11 11
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   11 11 11 11 11 11 11 11 51 51 11 11 11 11 11 11 11 11
   11 11 11 11 11 11 11 11 51 51 11 11 11 11 11 11 11 11
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   11 11 11 51 51 11 11 11 11 11 11 11 51 51 11 11 11
   11 11 11 51 51 11 11 11 11 11 11 11 51 51 11 11 11
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11 11
   END FILL
   ARA=2 NUX=3 NUY=1 NUZ=3
   FILL 21 41 31
      2 4 3
     21 41 31 END FILL
   ARA=3 NUX=2  NUY=4  NUZ=1
   FILL  8R6 END FILL
   END ARRAY
read bnds
  +xb=vacuum
  -xb=vacuum
  +yb=vacuum
  -yb=vacuum
  +zb=vacuum
  -zb=vacuum
  end bnds
   END DATA
END
```