71-6206

FRAMATOME COGEMA FUELS

February 7, 1996

William D. Travers, Director
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards, NMSS
US Nuclear Regulatory Commission
Washington, D. C. 20555-001

Dear Mr. Travers:

REFERENCE: Docket 71-6206, USA/6206/AF

On January 22, 1996, a Certificate of Compliance (C of C) was issued to increase the enrichment for Framatome Cogema Fuels (FCF) Model B fresh fuel shipping container. Because of the strict fuel design parameters specified in the C of C, the C of C was widely distributed to ensure the FCF would not violate the C of C conditions. During the review by Project Management, it was identified that the active fuel length for the MkBW 17 x 17, design 4, could exceed the maximum specified. The 144 inch value was provided as a nominal not a maximum number. The maximum guide tube ID for the Mk B assemblies, Designs 1, 2 &3, could also be exceeded but as demonstrated in Attachment I, the system reactivity is bounded by the C of C value.

Section 7.0 of Attachment I contains information that should be handled as propriety under the provisions of 10 CFR 2.790. In accordance with 10 CFR 2.790 (b)(1), this transmittal provides an affidavit and a separate copy of the response that does not contain the proprietary information.

The next scheduled ship date for the MkBW assemblies is March 1, 1996. Please, let me know as soon as possible if you can accommodate our schedule. I may be reached at (804) 832-5202.

Sincerely,

Framatome Cogema Fuels
Commercial Nuclear Fuel Plant

Kathryn S Knapp

Kathryn S. Knapp
Manager, Safety & Licensing

NT01

Change 1

FRAMATOME TECHNOLOGIES

Framatome Cogema Fuels
P.O. Box 11646, Lynchburg, VA 24506-1646
Telephone: 804-832-5000 Fax: 804-832-5167

AFFIDAVIT

State of Virginia
County of Campbell

Before the undersigned authority personally appeared C. W. Carr, who on oath says that he is Vice President, Manufacturing and Services of Framatome Cogema Fuels (FCF), a general partnership in Campbell County, Virginia.

Affiant further says that the documentation submitted to the NRC in support of the amendment request for the Model B fresh fuel shipping container that provides the minimum clad thickness for each assembly design and guide tube and instrument tube specifications for each assembly design (i.e., minimum tube thickness, minimum tube outer diameter, number of each type of tube) is proprietary to Framatome Cogema Fuels and should not be disclosed to the general public. FCF regards the dimensional data as proprietary fuel design information and should not be accessible to our competitor's.

Sworn to and subscribed before me this 1st day of December, 1995.

C. W. Carr, Vice President,
Manufacturing & Services,
Framatome Cogema Fuels

Kathleen A. Bennett
Notary Public

My Commission Expires August 31, 1999

ATTACHMENT I

1.0 Purpose

The purpose of this document is to evaluate minor deviations found in the recent Certificate of Compliance issued for the Model B Shipping Container[1]. The two deviations are a 'maximum' active fuel length of 144" for the Mk BW 17x17 assembly (144" is the nominal value) and the maximum guide tube ID for the Mk B assemblies.

2.0 Assumptions

No significant assumptions are made in this file other than the correctness of the original analysis[2].

3.0 Summary of Rssults

The KENOIV results for the Mk BW 17x17 assembly for various pellet stack lengths are listed in the following table. As is noted no significant increase in reactivity is noted for the additional stack heights. Results for about a 1.8" increase show no statistically significant difference relative to the base case with a 144" height.

KENOIV Results For Various Stack Lengths

Fiche	Stack Height cm/in	k_{eff}	$\pm\sigma$	k_{MAX}	Δk $k_x - k_{144}$
b24174	365.76/144 367.03/144.5	0.92334 0.92346	0.00058 0.00059	0.93855 0.93867	– 0.00012
b24179	366.3315/ 144.225	0.92438	0.00057	0.93958	0.00104
b24186	370.40/ 145.825	0.92253	0.00059	0.93774	-0.00081

The guide tube dimensions used in the calculations to support the license amendment provide the bounding reactivity results. Thus, while a larger guide tube ID is possible, the system reactivity is bounded by the C of C value.

4.0 List of Computer Codes and Fiche Accompanying File

The following computer program was used for this evaluation and contained a Full Certification Status:

KENOIV Version 2.0 RS.

---

1 Certificate of Compliance, No. 6206, Rev. No. 20, USA/6206/AF, US. NRC, 01/22/96.

2 BWFC Doc. 32-1236517-00, "Criticality Analysis, Model B Cask," P. L. Holman, 6/95.

```
==> b24174 <==
  b24174 bw17x HASSLER LA 01/25/96 19:00:18 FCF frs3
   MODEL B Mk BW 17x17 fat with 144" & 144.5 stack height

==> b24179 <==
  b24179 bw17x1 HASSLER LA 01/25/96 21:00:13 FCF frs4
   MODEL B Mk BW 17x17 fat with 144.225" stack height

==> b24186 <==
  b24186 bw17x2 HASSLER LA 01/26/96 08:19:08 FCF frs7
   MODEL B Mk BW 17x17 fat with 145.6"  + 0.225 "stack height,
```

5.0 References

1. BWFC Doc. 32-1236517-00, "Criticality Analysis, Model B Cask," P. L. Holman, 6/95.
2. BWFC Dwg. 02-1207077D09, "Fuel Rod Assembly," 10/21/94.
3. BWFC Dwg. 02-1224242D05, "Fuel Rod Assembly,"8/26/95
4. BWFC Dwg. 02-1238301D00, "Fuel Rod Assembly," 3/10/95.
5 BWFC Dwg. 02-1224263D00, "Prototype Fuel Rod Assembly," 11/10/94.
6. BWFC Dwg. 02-1224045D01, "Fuel Rod Assembly," 3/22/91.
7. BWFC Dwg. 02-1224251D03, "Fuel Rod Assembly," 7/24/95.
8. Certificate of Compliance, No. 6206, Rev. No. 20, USA/6206/AF, US NRC, 01/22/96.

6.0 Mk BW 17x17 Evaluation

An evaluation of the Mk-BW 17x17 assembly with active fuel lengths above the nominal 144" is described in this section. This evaluation was made to ensure that there is no criticality safety concern related to lengths above the nominal. It is noted that previous analyses assumed a 97.5% pellet theoretical density with the maximum possible pellet diameter. This provided fuel loadings of ^{235}U at 5.05 wt% of 24.3108 Kgs. For actual BW 17x17 assemblies, the nominal loading is about 23.1 Kg for 5.05 wt% assemblies. Based on the allowable ^{235}U, the slight increase in stack height will have only an insignificant effect on the conservative bounding analysis previously made. However, to ensure this opinion, cases with increased stack length, and increased loadings, are made.

6.1 Background

The previous analyses, eg. 32-1236517[3], assumed a maximum pellet stack height of 144" for all BWFC fuel assemblies. This corresponded to the height listed on previous NRC Certificates of Compliance (C of C). The use of maximum versus nominal did not recognize that for the Mk BW 17x17 assembly, 144" represents a nominal dimension with a tolerance of ±0.225". Thus, the C of C

[3] BWFC Doc. 32-1236517-00, "Criticality Analysis Model B Cask," P.L. Holman, July 1995.

maximum height requirement for this assembly can be violated based upon allowable tolerances.

Due to this discrepancy, a review of the allowable stack heights for the current Framatome Cogema Fuels (FCF) fuel assemblies were reviewed. Table 1 provides the current specifications and possible stack heights for assemblies exceeding 144". As noted, the BW 17x17 assembly and a possible prototype will exceed the current C of C limit. Also, the Mk BW 15x15 assembly proposed for Virginia Power exceeded the limit. However, since there is currently no activity related to the BW15x15 assembly, a 144" height limit will be assumed. Thus for production assemblies only the Mk BW assemblies exceed the C of C stack height limit.

One prototype B-11 assembly had a stack height of 146.20". Two such test assemblies were fabricated. Both contained only natural uranium pellets to simulate the weight of a normal assembly. Thus, there was no safety concern related to the shipment of these assemblies.

Table 1. Current & Projected Stack Lengths

Assembly Type	Stack Height, in	Drawing No.	Comments
Mk-B9	140.595 ±0.253	02-1207077D09	
Mk-B10	140.595 ±0.253	02-1207077D09	
Mk-B10F	142.290 ±0.260	02-1224242D02	
Mk-B11	143.050 ±0.250 146.250 ±0.250	02-1238301D00 02-1224263D00	Current Design Prototype, Nat'l U, 2 Assys
Mk C 17x17	140.250 ±0.275	02-1224045D01	
Mk BW 17x17	144.000 ±0.225 145.600 ±0.225	02-1224251D03	Current Design Possible - Assumed Current Upper Limit
Mk BW 15x15	146?-Assume 144" max currently		Prop Value, No current design.

Based upon this stack height discrepancy for the BW 17x17 assembly, an evaluation of the reactivity effect of the actual or proposed heights was made.

6.2 Mk BW 17x17 Evaluation

The evaluation of the stack height reactivity effect is made with the KENOIV computer program using the same cross section information as in the previous analysis[4] and based upon the same input deck. The cross section library, 27gpbw17fat.lib, was copied from P.L Holman's file as was the input deck for the BW 17x17 assembly, 27gpbw17fat. This case was rerun to ensure that

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4 Ibid, page 33.

the correct base deck and cross section set were obtained for this evaluation. This base deck was modified for three additional cases. The first case considered a stack height of 144.5" to bound any current production design having a 144.0 ± 0.225" height. The second a case examined the upper tolerance on the stack height, 144.225", to assess the reactivity effect related to past shipments of this assembly. The last case examined the maximum proposed stack height of 145.6 ± 0.225". For all cases the base deck was modified to reflect the desired active length, i.e. changed from 365.76 to the desired length. In addition, as with the base design, the 8" (20.32 cm) top reflector was maintained. These were the only changes to the base deck for the evaluation.

The results for these four cases are listed in Table 2. The first case, b24174, contains both the rerun of the base deck and the case for 144.5". From Holman's file[5], a value of 0.92334 ± 0.00058 is expected and was obtained. This validates that the correct deck and cross section set were used for this evaluation. From Holman's file, the maximum k is obtained from:

$$k_{MAX} = k_{eff} + 0.01159 + [(1.763\sigma)^2 + 0.00347^2]^{0.5}$$

This was applied to the calculated k_{eff} to obtain the k_{MAX} value listed in the table. The three variation cases all show results within ±0.00104 of the base case. This is essentially within the uncertainty of the calculated results, i.e. 1.763(0.00057) = 0.00100, assuming the smallest sigma value. Thus, there may be a slight increase in reactivity, however, the effect of the increased length is essentially covered by the uncertainty of the KENOIV results. This conclusion is supported by the decrease in reactivity of the case with a active length of 145.825" - the assembly with the most fuel that should represent the most reactive configuration.

Table 2. Results For Various Stack Lengths

Fiche	Stack Height cm/in	k_{eff}	$\pm\sigma$	k_{MAX}	Δk $k_x - k_{144}$
b24174	365.76/144 367.03/144.5	0.92334 0.92346	0.00058 0.00059	0.93855 0.93867	- 0.00012
b24179	366.3315/ 144.225	0.92438	0.00057	0.93958	0.00104
b24186	370.40/ 145.825	0.92253	0.00059	0.93774	-0.00081

5 Ibid, page 33.

while a larger guide tube ID is possible, the system reactivity is bounded by the C of C value.

Based upon the discussion in this file, no safety implications are related to the noted deviations in the C of C.

Input File Listing - 145.825"/370.46 cm Active Length

```
MODB-mk-bw fat pel 0.975 den, 5.05 WT% dia +0.0007"
   4000   850 2000 3   27   27   34 13 34   37 8   18   18   1   -34
     1   0   2000   00   1   0   0   0   0 00   00   0   0
  -1.0 -1.0 -1.0 -1 0   0.0 0.0
          1     -92235     1.21875E-03
          1      92238     2.26254E-02
          1       8016     4.76883E-02
          2      40302     4.25156E-02
          3     308016     3.33757E-02
          3       1001     6.67514E-02
          4     440302     4.25156E-02
          5     508016     3.33757E-02
          5     501001     6.67514E-02
          6     640302     4.25156E-02
          7     708016     3.33757E-02
          7     701001     6.67514E-02
          8     808016     3.33757E-02
          8     801001     6.67514E-02
          9       5010     8.99740E-04
          9       5011     4.00706E-03
          9       6012     1.17770E-04
          9      25055     1.47630E-03
          9      14000     1.09130E-03
          9      24000     1.68220E-02
          9      28000     1.09910E-02
          9      26000     5.39270E-02
         10    1026000     8.40110E-02
         10    1006012     3.92590E-04
         10    1025055     3.43320E-04
         11    1105010     1.49885E-02
         11    1105011     6.67525E-02
         11    1106012     2.72470E-02
         12    1201001     4.18200E-02
         12    1205010     6.63638E-05
         12    12C5011     2.95556E-04
         12    1206012     3.34600E-02
         13    1306012     3.95670E-02
         13    1301001     7.91340E-02
BOX TYPE   1
CYLINDER   1  0.410464                                        370.40   0.0   123Z
CYLINDER   0  0.420370                                        370.40   0.0   123Z
CYLINDER   2  0.472440                                        370.40   0.0   123Z
CUBOID     3  0.629920 -0.629920   0.629920 -0.629920 370.40   0.0   123Z
BOX TYPE   2
CYLINDER   3  0.574040                                        370.40   0.0   123Z
CYLINDER   4  0.609600                                        370.40   0.0   123Z
CUBOID     3  0.629920 -0.629920   0.629920 -0.629920 370.40   0.0   123Z
BOX TYPE   3
CYLINDER   3  0.574040                                        370.40   0.0   123Z
CYLINDER   4  0.609600                                        370.40   0.0   123Z
CUBOID     3  0.629920 -0.629920   0.629920 -0.629920 370.40   0.0   123Z
BOX TYPE   4
CUBOID     8  2.936875     0.0     1.259840     0.0     370.40   0.0   123Z
CUBOID     9  3.413125     0.0     1.259840     0.0     370.40   0.0   123Z
CUBOID    12  3.571875     0.0     1.259840     0.0     370.40   0.0   123Z
CUBOID    13  3.592195     0.0     1.259840     0.0     370.40   0.0   123Z
BOX TYPE   5
CUBOID    11  0.793750     0.0     1.259840     0.0     370.40   0.0   123Z
CUBOID     8  2.936875     0.0     1.259840     0.0     370.40   0.0   123Z
CUBOID     9  3.413125     0.0     1.259840     0.0     370.40   0.0   123Z
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BOX TYPE    6
CUBOID       8  3.592195     0.0     1.611376     0.0     370.40  0.0   123Z
CUBOID       8  3.592195     0.0     3.043682     0.0     370.40  0.0   123Z
CUBOID      10  3.592195     0.0     3.519932     0.0     370.40  0.0   123Z
CUBOID       8  3.592195     0.0     3.678682     0.0     370.40  0.0   123Z
CUBOID       8  3.592195     0.0     3.699002     0.0     370.40  0.0   123Z
BOX TYPE    7
CUBOID       8  1.259840     0.0     1.611376     0.0     370.40  0.0   123Z
CUBOID       8  1.259840     0.0     3.043682     0.0     370.40  0.0   123Z
CUBOID      10  1.259840     0.0     3.519932     0.0     370.40  0.0   123Z
CUBOID      12  1.259840     0.0     3.678682     0.0     370.40  0.0   123Z
CUBOID      13  1.259840     0.0     3.699002     0.0     370.40  0.0   123Z
BOX TYPE    8
CUBOID       8  1.259840     0.0     1.611376     0.0     370.40  0.0   123Z
CUBOID       8  1.259840     0.0     3.043682     0.0     370.40  0.0   123Z
CUBOID      10  1.259840     0.0     3.519932     0.0     370.40  0.0   123Z
CUBOID      12  1.259840     0.0     3.678682     0.0     370.40  0.0   123Z
CUBOID      13  1.259840     0.0     3.699002     0.0     370.40  0.0   123Z
CORE BDY     0 25.009475     0.0    25.116282     0.0     370.40  0.0   123Z
CUBOID      13 25.029795     0.0    25.136602     0.0     370.40  0.0   123Z
CUBOID     8 34.794825     0.0   33.81070  -18.93240  370.40  0.0   123Z
CUBOID    10 35.023425     0.0   34.03930  -19.16100  370.40  0.0   123Z
CUBOID     8 35.023425     0.0   34.03930  -19.16100  390.72 -20.32 123Z
 1  2 18  1  2 18  1  1 1 1  0
 2  7 13  3  4 16  3  1 1 1  0
 2  5 15 10  5 15 10  1 1 1  0
 2  4 16 12  7 13  3  1 1 1  0
 3 10 10  1 10 10  1  1 1 1  0
 4  1  1  1  2 18  1  1 1 1  0
 6  1  1  1  1  1  1  1 1 1  0
 7  2 18  1  1  1  1  1 1 1  0
 8  5 15  1  1  1  1  1 1 1  1
END KENO
/EOR
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Document Control

FRAMATOME COGEMA FUELS

February 7, 1996

William D. Travers, Director
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards, NMSS
US Nuclear Regulatory Commission
Washington, D. C. 20555-001

Dear Mr. Travers:

REFERENCE: Docket 71-6206, USA/6206/AF

On January 22, 1996, a Certificate of Compliance (C of C) was issued to increase the enrichment for Framatome Cogema Fuels (FCF) Model B fresh fuel shipping container. Because of the strict fuel design parameters specified in the C of C, the C of C was widely distributed to ensure the FCF would not violate the C of C conditions. During the review by Project Management, it was identified that the active fuel length for the MkBW 17 x 17, design 4, could exceed the maximum specified. The 144 inch value was provided as a nominal not a maximum number. The maximum guide tube ID for the Mk B assemblies, Designs 1, 2 &3, could also be exceeded but as demonstrated in Attachment I, the system reactivity is bounded by the C of C value.

Section 7.0 of Attachment I contains information that should be handled as propriety under the provisions of 10 CFR 2.790. In accordance with 10 CFR 2.790 (b)(1), this transmittal provides an affidavit and a separate copy of the response that does not contain the proprietary information.

The next scheduled ship date for the MkBW assemblies is March 1, 1996. Please, let me know as soon as possible if you can accommodate our schedule. I may be reached at (804) 832-5202.

Sincerely,

Framatome Cogema Fuels
Commercial Nuclear Fuel Plant

Kathryn S Knapp

Kathryn S. Knapp
Manager, Safety & Licensing

FRAMATOME
TECHNOLOGIES

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AFFIDAVIT

State of Virginia
County of Campbell

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Affiant further says that the documentation submitted to the NRC in support of the amendment request for the Model B fresh fuel shipping container that provides the minimum clad thickness for each assembly design and guide tube and instrument tube specifications for each assembly design (i.e., minimum tube thickness, minimum tube outer diameter, number of each type of tube) is proprietary to Framatome Cogema Fuels and should not be disclosed to the general public. FCF regards the dimensional data as proprietary fuel design information and should not be accessible to our competitor's.

Sworn to and subscribed before me this 1st day of December, 1995.

C. W. Carr

C. W. Carr, Vice President,
Manufacturing & Services,
Framatome Cogema Fuels

Kathleen A. Bennett

Notary Public

My Commission Expires August 31, 1999

ATTACHMENT I

1.0 Purpose

The purpose of this document is to evaluate minor deviations found in the recent Certificate of Compliance issued for the Model B Shipping Container[1]. The two deviations are a 'maximum' active fuel length of 144" for the Mk BW 17x17 assembly (144" is the nominal value) and the maximum guide tube ID for the Mk B assemblies.

2.0 Assumptions

No significant assumptions are made in this file other than the correctness of the original analysis[2].

3.0 Summary of Rssults

The KENOIV results for the Mk BW 17x17 assembly for various pellet stack lengths are listed in the following table. As is noted no significant increase in reactivity is noted for the additional stack heights. Results for about a 1.8" increase show no statistically significant difference relative to the base case with a 144" height.

KENOIV Results For Various Stack Lengths

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The guide tube dimensions used in the calculations to support the license amendment provide the bounding reactivity results. Thus, while a larger guide tube ID is possible, the system reactivity is bounded by the C of C value.

4.0 List of Computer Codes and Fiche Accompanying File

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1 Certificate of Compliance, No. 6206, Rev. No. 20, USA/6206/AF, US. NRC, 01/22/96.

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```
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   MODEL B Mk BW 17x17 fat with 144.225" stack height

==> b24186 <==
  b24186 bw17x2 HASSLER LA 01/26/96 08:19:08 FCF frs7
   MODEL B Mk BW 17x17 fat with 145.6"  + 0.225 "stack height,
```

5.0 References

1. BWFC Doc. 32-1236517-00, "Criticality Analysis, Model B Cask," P. L. Holman, 6/95.
2. BWFC Dwg. 02-1207077D09, "Fuel Rod Assembly," 10/21/94.
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7. BWFC Dwg. 02-1224251D03, "Fuel Rod Assembly," 7/24/95.
8. Certificate of Compliance, No. 6206, Rev. No. 20, USA/6206/AF, US NRC, 01/22/96.

6.0 Mk BW 17x17 Evaluation

An evaluation of the Mk-BW 17x17 assembly with active fuel lengths above the nominal 144" is described in this section. This evaluation was made to ensure that there is no criticality safety concern related to lengths above the nominal. It is noted that previous analyses assumed a 97.5% pellet theoretical density with the maximum possible pellet diameter. This provided fuel loadings of ^{235}U at 5.05 wt% of 24.3108 Kgs. For actual BW 17x17 assemblies, the nominal loading is about 23.1 Kg for 5.05 wt% assemblies. Based on the allowable ^{235}U, the slight increase in stack height will have only an insignificant effect on the conservative bounding analysis previously made. However, to ensure this opinion, cases with increased stack length, and increased loadings, are made.

6.1 Background

The previous analyses, eg. 32-1236517[3], assumed a maximum pellet stack height of 144" for all BWFC fuel assemblies. This corresponded to the height listed on previous NRC Certificates of Compliance (C of C). The use of maximum versus nominal did not recognize that for the Mk BW 17x17 assembly, 144" represents a nominal dimension with a tolerance of ±0.225". Thus, the C of C

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3 BWFC Doc. 32-1236517-00, "Criticality Analysis Model B Cask," P.L. Holman, July 1995.

maximum height requirement for this assembly can be violated based upon allowable tolerances.

Due to this discrepancy, a review of the allowable stack heights for the current Framatome Cogema Fuels (FCF) fuel assemblies were reviewed. Table 1 provides the current specifications and possible stack heights for assemblies exceeding 144". As noted, the BW 17x17 assembly and a possible prototype will exceed the current C of C limit. Also, the Mk BW 15x15 assembly proposed for Virginia Power exceeded the limit. However, since there is currently no activity related to the BW15x15 assembly, a 144" height limit will be assumed. Thus for production assemblies only the Mk BW assemblies exceed the C of C stack height limit.

One prototype B-11 assembly had a stack height of 146.20". Two such test assemblies were fabricated. Both contained only natural uranium pellets to simulate the weight of a normal assembly. Thus, there was no safety concern related to the shipment of these assemblies.

Table 1. Current & Projected Stack Lengths

Assembly Type	Stack Height, in	Drawing No.	Comments
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Mk-B10	140.595 ±0.253	02-1207077D09	
Mk-B10F	142.290 ±0.260	02-1224242D02	
Mk-B11	143.050 ±0.250 146.250 ±0.250	02-1238301D00 02-1224263D00	Current Design Prototype, Nat'l U, 2 Assys
Mk C 17x17	140.250 ±0.275	02-1224045D01	
Mk BW 17x17	144.000 ±0.225 145.600 ±0.225	02-1224251D03	Current Design Possible - Assumed Current Upper Limit
Mk BW 15x15	146?-Assume 144" max currently		Prop Value, No current design.

Based upon this stack height discrepancy for the BW 17x17 assembly, an evaluation of the reactivity effect of the actual or proposed heights was made.

6.2 Mk BW 17x17 Evaluation

The evaluation of the stack height reactivity effect is made with the KENOIV computer program using the same cross section information as in the previous analysis[4] and based upon the same input deck. The cross section library, 27gpbw17fat.lib, was copied from P.L Holman's file as was the input deck for the BW 17x17 assembly, 27gpbw17fat. This case was rerun to ensure that

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4 Ibid, page 33.

the correct base deck and cross section set were obtained for this evaluation. This base deck was modified for three additional cases. The first case considered a stack height of 144.5" to bound any current production design having a 144.0 ± 0.225" height. The second a case examined the upper tolerance on the stack height, 144.225", to assess the reactivity effect related to past shipments of this assembly. The last case examined the maximum proposed stack height of 145.6 ± 0.225". For all cases the base deck was modified to reflect the desired active length, i.e. changed from 365.76 to the desired length. In addition, as with the base design, the 8" (20.32 cm) top reflector was maintained. These were the only changes to the base deck for the evaluation.

The results for these four cases are listed in Table 2. The first case, b24174, contains both the rerun of the base deck and the case for 144.5". From Holman's file[5], a value of 0.92334 ± 0.00058 is expected and was obtained. This validates that the correct deck and cross section set were used for this evaluation. From Holman's file, the maximum k is obtained from:

$$k_{MAX} = k_{eff} + 0.01159 + [(1.763\sigma)^2 + 0.00347^2]^{0.5}$$

This was applied to the calculated k_{eff} to obtain the k_{MAX} value listed in the table. The three variation cases all show results within ±0.00104 of the base case. This is essentially within the uncertainty of the calculated results, i.e. 1.763(0.00057) = 0.00100, assuming the smallest sigma value. Thus, there may be a slight increase in reactivity, however, the effect of the increased length is essentially covered by the uncertainty of the KENOIV results. This conclusion is supported by the decrease in reactivity of the case with a active length of 145.825" - the assembly with the most fuel that should represent the most reactive configuration.

Table 2. Results For Various Stack Lengths

Fiche	Stack Height cm/in	k_{eff}	$\pm\sigma$	k_{MAX}	Δk $k_x - k_{144}$
b24174	365.76/144 367.03/144.5	0.92334 0.92346	0.00058 0.00059	0.93855 0.93867	- 0.00012
b24179	366.3315/ 144.225	0.92438	0.00057	0.93958	0.00104
b24186	370.40/ 145.825	0.92253	0.00059	0.93774	-0.00081

5 Ibid, page 33.

7.0 Guide Tube Dimension

The current C of C[6] reference is made to tables provided with the license amendment submittal. This table specifies guide tube dimensions in addition to other parameters that must be satisfied for use of the container. One guide tube dimension does not appear to agree with the referenced drawing and requirements of the C of C. This section provides a brief discussion on this dimension.

The guide tube dimension in question is that for Designs 1, 2 and 3, i.e. the Mk B9, B10, and B11 fuel assemblies. The maximum guide tube ID is specified as x.xxx" and the minimum OD as x.xxx". Reference to the drawing shows the following specifications: Nominal OD x.xxx ± x.xxx" with a wall thickness of x.xxx ± x.xxxx". The analysis used the minimum OD, x.xxx" and the minimum wall thickness to determine the maximum ID, x.xxx - x(x.xxxx) = x.xxxx" = x.xxx". The minimum ID was rounded to x.xxx which is more conservative. Based upon these dimensions, the cross sectional area of Zr in the guide tube is 0.02261 square inches. If the maximum OD is used with the minimum wall thickness, then the maximum ID would be x.xxx -x(x.xxxx) = x.xxxx". This violates the maximum ID specified in the C of C by x.xxxx". However, the cross sectional area of this tube is 0.023416 square inches which is larger, about 3%, than the case analyzed. Since the larger cross sectional area replaces water with zirconium in an already under moderated system, it is less reactive than the case used for the analysis. Thus the values specified will provide reactivities that bound the non-conforming values and the container retains it safety margin.

Rather than specifying the ID and OD, it would have been better to specify the minimum OD and the minimum wall thickness. However, since some eccentricity is allowed in the tube specification, the OD and ID specifications were used to circumvent the allowable eccentricity. An amendment to the C of C to replace the OD/ID specification with and OD/wall thickness specification should be pursued to circumvent this non-safety related discrepancy.

8.0 Conclusion

The KENOIV results for the Mk BW 17x17 assembly for various pellet stack lengths show no significant increase in reactivity for stack heights up to 145.8". Results for about a 1.8" increase show a statistically insignificant difference from the base case with a 144" height.

The guide tube dimensions used in the calculations to support the license amendment provide the bounding reactivity results. Thus,

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6 Certificate of Compliance, No. 6206, Rev. No. 20, USA/6206/AF, US. NRC, 01/22/96.

while a larger guide tube ID is possible, the system reactivity is bounded by the C of C value.

Based upon the discussion in this file, no safety implications are related to the noted deviations in the C of C.

Input File Listing - 145.825"/370.46 cm Active Length

```
MODB-mk-bw fat pel 0.975 den, 5.05 WT% dia +0.0007"
   4000  850 2000 3  27  27  34 13 34  37 8  18  18  1  -34
    1  0  2000  00  1  0  0  0  0 00  00  0  0
 -1.0 -1.0 -1.0 -1.0  0.0 0.0
           1      -92235     1.21875E-03
           1       92238     2.26254E-02
           1        8016     4.76883E-02
           2       40302     4.25156E-02
           3      308016     3.33757E-02
           3        1001     6.67514E-02
           4      440302     4.25156E-02
           5      508016     3.33757E-02
           5      501001     6.67514E-02
           6      640302     4.25156E-02
           7      708016     3.33757E-02
           7      701001     6.67514E-02
           8      808016     3.33757E-02
           8      801001     6.67514E-02
           9        5010     8.99740E-04
           9        5011     4.00706E-03
           9        6012     1.17770E-04
           9       25055     1.47630E-03
           9       14000     1.09130E-03
           9       24000     1.68220E-02
           9       28000     1.09910E-02
           9       26000     5.39270E-02
          10     1026000     8.40110E-02
          10     1006012     3.92590E-04
          10     1025055     3.43320E-04
          11     1105010     1.49885E-02
          11     1105011     6.67525E-02
          11     1106012     2.72470E-02
          12     1201001     4.18200E-02
          12     1205010     6.63638E-05
          12     1205011     2.95556E-04
          12     1206012     3.34600E-02
          13     1306012     3.95670E-02
          13     1301001     7.91340E-02
BOX TYPE    1
CYLINDER    1  0.410464                                        370.40   0.0   123Z
CYLINDER    0  0.420370                                        370.40   0.0   123Z
CYLINDER    2  0.472440                                        370.40   0.0   123Z
CUBOID      3  0.629920 -0.629920  0.629920 -0.629920 370.40   0.0   123Z
BOX TYPE    2
CYLINDER    3  0.574040                                        370.40   0.0   123Z
CYLINDER    4  0.609600                                        370.40   0.0   123Z
CUBOID      3  0.629920 -0.629920  0.629920 -0.629920 370.40   0.0   123Z
BOX TYPE    3
CYLINDER    3  0.574040                                        370.40   0.0   123Z
CYLINDER    4  0.609600                                        370.40   0.0   123Z
CUBOID      3  0.629920 -0.629920  0.629920 -0.629920 370.40   0.0   123Z
BOX TYPE    4
CUBOID      8  2.936875      0.0    1.259840      0.0    370.40   0.0   123Z
CUBOID      9  3.413125      0.0    1.259840      0.0    370.40   0.0   123Z
CUBOID     12  3.571875      0.0    1.259840      0.0    370.40   0.0   123Z
CUBOID     13  3.592195      0.0    1.259840      0.0    370.40   0.0   123Z
BOX TYPE    5
CUBOID     11  0.793750      0.0    1.259840      0.0    370.40   0.0   123Z
CUBOID      8  2.936875      0.0    1.259840      0.0    370.40   0.0   123Z
CUBOID      9  3.413125      0.0    1.259840      0.0    370.40   0.0   123Z
```

```
BOX TYPE     6
CUBOID        8   3.592195      0.0     1.611376     0.0     370.40   0.0    123Z
CUBOID        8   3.592195      0.0     3.043682     0.0     370.40   0.0    123Z
CUBOID       10   3.592195      0.0     3.519932     0.0     370.40   0.0    123Z
CUBOID        8   3.592195      0.0     3.678682     0.0     370.40   0.0    123Z
CUBOID        8   3.592195      0.0     3.699002     0.0     370.40   0.0    123Z
BOX TYPE     7
CUBOID        8   1.259840      0.0     1.611376     0.0     370.40   0.0    123Z
CUBOID        8   1.259840      0.0     3.043682     0.0     370.40   0.0    123Z
CUBOID       10   1.259840      0.0     3.519932     0.0     370.40   0.0    123Z
CUBOID       12   1.259840      0.0     3.678682     0.0     370.40   0.0    123Z
CUBOID       13   1.259840      0.0     3.699002     0.0     370.40   0.0    123Z
BOX TYPE     8
CUBOID        8   1.259840      0.0     1.611376     0.0     370.40   0.0    123Z
CUBOID        8   1.259840      0.0     3.043682     0.0     370.40   0.0    123Z
CUBOID       10   1.259840      0.0     3.519932     0.0     370.40   0.0    123Z
CUBOID       12   1.259840      0.0     3.678682     0.0     370.40   0.0    123Z
CUBOID       13   1.259840      0.0     3.699002     0.0     370.40   0.0    123Z
CORE BDY      0 25.009475       0.0    25.116282     0.0     370.40   0.0    123Z
CUBOID       13 25.029795       0.0    25.136602     0.0     370.40   0.0    123Z
CUBOID      8 34.794825      0.0    33.81070   -18.93240   370.40   0.0    123Z
CUBOID     10 35.023425      0.0    34.03930   -19.16100   370.40   0.0    123Z
CUBOID      8 35.023425      0.0    34.03930   -19.16100   390.72 -20.32  123Z
 1   2 18 1   2 18   1   1 1 1   0
 2   7 13 3   4 16   3   1 1 1   0
 2   5 15 10  5 15  10   1 1 1   0
 2   4 16 12  7 13   3   1 1 1   0
 3  10 10 1  10 10   1   1 1 1   0
 4   1  1 1   2 18   1   1 1 1   0
 6   1  1 1   1  1   1   1 1 1   0
 7   2 18 1   1  1   1   1 1 1   0
 8   5 15 1   1  1   1   1 1 1   1
END KENO
/EOR
```