Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

September 21, 1990

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Document Control Desk

Subject: Dresden Nuclear Power Station Unit 2
Fuel Channel Evaluation for
Dresden Unit 2 Cycle 13
NRC Docket No. 50-237

References: (a) NRC Bulletin 90-02, Loss of Thermal Margin Caused by Channel Box Bow, dated March 20, 1990.

(b) M. Richter (CECo) letter to U.S. NRC, dated April 26, 1990.

(c) P. Eng (NRC) letter to T. Kovach (CECo), dated June 5, 1990.

(d) NRC (L. Phillips) and CECo (M. Richter) conference call on August 16, 1990.

Dr. Murley:

Reference (a) requested that all Boiling Water Reactor (BWR) licensees address the effect of fuel channel bow on thermal margins in BWRs, particularly the bow of channels that are being reused for a second bundle lifetime. Reference (b), which provided Commonwealth Edison Company's (CECo) response for Dresden, Quad Cities, and LaSalle County Stations, outlined CECo's current channel management practices and plans to account for the effect of high channel exposures on thermal margins for the current operating cycles and all future reloads. The NRC found these actions acceptable as detailed in Reference (c).

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Reference (b) indicated that previous channel management practices included the reuse of channels. Consequently, Dresden Unit 2 Cycle 13 (presently scheduled to begin on December 2, 1990) will have some fuel channels which were previously installed on another fuel bundle. In a recent teleconference with the NRR Reactor Systems Branch (Reference (d)), CECo was requested to provide additional information regarding the actions that are being taken to account for the impact of these reused channels during Cycle 13. Attachment 'A' to this letter presents the requested information.

Please direct any questions or comments on this letter to this office.

Respectfully,

Milton H. Richter

M. H. Richter
Nuclear Licensing Administrator

Attachment A - Effect of Channel Reuse on Thermal Margins - Dresden Unit 2 Cycle 13

B - Advanced Nuclear Fuels Corporation letter regarding Dresden Unit 2 Cycle 13

cc: A.B. Davis - Regional Administrator, Region III
B.L. Siegel - Project Manager, NRR
L.E. Phillips - Reactor Systems Branch, NRR
S. DuPont - Senior Resident Inspector, Dresden

MH:lmw
ZNLD256-9

ATTACHMENT A

Effect of Channel Reuse on Thermal Margins
Dresden Unit 2 Cycle 13

Background

NRC Bulletin 90-02 requested that all Boiling Water Reactor (BWR) licensees address the effect of channel bow on thermal margins in BWRs, particularly the bow of channels that are being reused for a second bundle lifetime. Commonwealth Edison's (Edison) response to NRC Bulletin 90-02 (Reference 1) outlined Edison's current channel management practices and plans to account for the effect of high channel exposures on thermal margins for the current operating cycles and all future reloads. Edison received NRC approval of the Bulletin 90-02 response via the letter in Reference 2.

As was discussed in the Reference 1 response, Dresden Unit 2 has reused channels resident in the core as a result of previous channel management practices. Dresden Unit 2 Cycle 12 has 303 fuel assemblies with reused channels; 183 of these fuel assemblies are scheduled for use in Dresden Unit 2 Cycle 13. Edison will be placing new channels on sixteen (16) of these 183 fuel assemblies during the Fall 1990 refueling outage (D2R12, scheduled to begin on September 23, 1990); therefore, there will be 167 assemblies with reused channels in Dresden Unit 2 Cycle 13. The 16 fuel assemblies which will receive new channels will be loaded into interior, relatively high power core locations. Replacement of these channels will minimize the effect of channel bow on thermal margins for Dresden Unit 2 Cycle 13 since all other assemblies with reused channels will be loaded into low power core locations, which are on or near the core periphery.

Technical Evaluation

All assemblies with reused channels will be located on or near the core periphery in Dresden Unit 2 Cycle 13. For the purpose of this discussion, peripheral channels are those located within three rows of the periphery. This distinction is based on the low assembly power and resulting large degree of Minimum Critical Power Ratio (MCPR) operating limit margin in these core locations.

Figure A-1 shows the assembly serial numbers and the projected end of Cycle 13 channel exposures for those locations with reused channels in Cycle 13. The maximum projected end of Cycle 13 channel exposure is 53.8 GWd/MTU at Position (10,28) in Figure A-1.

Figure A-1 also illustrates control blade locations to indicate in which direction the channels will tend to bow. It should be noted that those channels with a water face will tend to bow away from the water face due to the flux gradients across the channel. Therefore, unrestricted bow is not likely.

Bowing of a channel causes an increase in the wide-wide water gap between assemblies which are adjacent to one another on either side of a control blade. For this reason, the assemblies most affected by channel bow are; the assembly with the channel having the high exposure, and the adjacent assemblies across the wide-wide water gap. For Cycle 13, the assemblies with the reused channels are not limiting due to their low power, as these assemblies are located near the core periphery and are typically on their fourth cycle of irradiation.

Assemblies loaded adjacent to reused channels were evaluated to determine the most limiting location. This evaluation showed that assemblies loaded at Position (13,4) and the octant symmetric partners of this location are the most limiting of all assemblies affected by the peripheral reused channels. These assemblies are once-burned and are located closest to the core center (relative to all other assemblies which are loaded adjacent to assemblies with reused channels).

The MCPR margin on the most limiting assemblies which would be affected by the peripheral reused channels shows a minimum of 27% margin to the operating limit. This minimum occurs during the middle of the cycle at peak reactivity. For Dresden Unit 2 Cycle 12, an analysis was performed by Advanced Nuclear Fuels (ANF), the fuel vendor for Dresden, to quantify the CPR effect caused by large magnitudes of channel bowing. For this analysis, a cell configuration which contained three (3) highly exposed channels and a new assembly was utilized in order to provide a bounding condition. The Unit 2 Cycle 12 analysis determined that when closure of the narrow-narrow gap is assumed, a net MCPR penalty of 0.06 occurs. This corresponds to approximately 4% loss in MCPR margin. The MCPR penalty credited the conservatism of the XN-3 MCPR correlation, which will be used for Dresden Unit 2 Cycle 13, relative to ANFB, the fuel vendor's most recently approved correlation. This conservatism was discussed in Edison's response to NRC Bulletin 90-02, Reference 1. Details of ANF's evaluation of the conservatism of XN-3 relative to ANFB were transmitted to the NRC by ANF in Reference 3.

Therefore, the reuse of channels on or near the periphery will not have a MCPR safety margin impact because the degree of margin to the operating limit these areas exhibit, a minimum of 27%, is significantly greater than the maximum degradation of margin due to extreme channel bow, which is approximately 4%. ANF has concurred with this analysis, as indicated in Attachment B.

Summary and Conclusions

Edison has evaluated the impact on thermal margin resulting from bowing of reused channels for Dresden Unit 2 Cycle 13 and has concluded that the degradation in CPR which results from the high channel exposures on the periphery is small relative to the degree of margin inherent in these cells. These cells cannot become limiting even for the maximum amount of channel bow possible.

The steps taken to account for the effects of channel bow are adequate and conservative; therefore, there is no impact on fuel rod integrity or safe plant operation.

References

1. Letter, M.H. Richter (CECo) to U.S. Nuclear Regulatory Commission, "Dresden Station Units 2 and 3; Quad Cities Station Units 1 and 2; LaSalle County Station Units 1 and 2; Response to NRC Bulletin 90-02; NRC Docket Nos. 50-237/249, 50-254/265, and 50-373/374", dated April 26, 1990.

2. Letter, P.L. Eng (U.S. NRC) to T.J. Kovach (CECo), "Commonwealth Edison Response to NRC Bulletin 90-02, Loss of Thermal Margin Caused by Channel Box Bow", dated June 5, 1990.

3. Letter RAC:030:90, R.A. Copeland (ANF) to R.C. Jones (U.S. NRC), "Loss of Thermal Margin Caused by Channel Box Bow", dated April 9, 1990.

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Figure A-1

Assemblies with Reused Channels and the Projected EOC13 Channel Exposures (GWD/MTU)

```
        1      2      3      4      5      6      7      8      9    10     11     12     13     14     15

 1                                                                      X2B014 X2B038 X2B105 X2B168 X2A009
                                                                         51.5   51.2   44.8   51.3   40.2
                                                                              +             +             +
 2                                                               X2B041 X2B013 X2B121 X2B152
                                                                  52.3   51.8   40.5   46.3
                                           +-------------+             +-------------+             +-------
 3                                         |X2B142 X2B110|X2B153 X2B048|X2B101       |X2B137       |
                                           | 46.4   41.5 | 41.7   53.6 | 40.3        |44.0         |
                                           |      +      |      +      |      +      |      +      |      +
 4                                   X2B009|       X2B112|X2B167       |             |             |
                                      51.8 |        42.6 | 52.5        |             |             |
                                           +-------------+             +-------------+             +-------
 5                            X2B001 X2B006 X2B154
                               51.9   50.8   43.0
                                     +            +             +             +             +             +
 6                     X2B172 X2B046 X2B035
                        52.6   51.2   51.9
                +-------------+            +-------------+             +-------------+             +-------
 7              |X2B169       |X2B132      |             |             |             |             |
                | 51.6        | 49.9       |             |             |             |             |
                |      +      |      +     |      +      |      +      |      +      |      +      |      +
 8              |X2B097 X2B099|            |             |             |             |             |
                | 50.8   41.2 |            |             |             |             |             |
                +-------------+            +-------------+             +-------------+             +-------
 9               X2B107 X2B010
                  44.6   52.1
                       +             +            +             +             +             +             +
10        X2B005 X2B008
           51.0   43.9
                +-------------+            +-------------+             +-------------+             +-------
11 X2B109 X2B047|X2B108       |            |             |             |             |             |
    38.0   52.8 | 40.9        |            |             |             |             |             |
         +      |      +      |      +     |      +      |      +      |      +      |      +      |      +
12 X2B034 X2B021|             |            |             |             |             |             |
    51.1   49.7 |             |            |             |             |             |             |
                +-------------+            +-------------+             +-------------+             +-------
13 X2B170 X2B157 X2B133
    51.4   43.6   51.4
                       +             +            +             +             +             +             +
14 X2B029
    50.8
                +-------------+            +-------------+             +-------------+             +-------
15 X2A188       |             |            |             |             |             |             |
    40.0        |             |            |             |             |             |             |
         +      |      +      |      +     |      +      |      +      |      +      |      +      |      +
```

Figure A-1, Continued

Assemblies with Reused Channels and the Projected EOC13 Channel Exposures (GWD/MTU)

```
       16     17     18     19     20     21     22     23     24     25     26     27     28     29     30

 1        X2B089 X2B085 X2B039 X2B027
           35.8   38.1   50.7   51.6
  +             +             +
 2               X2B151 X2B087 X2B185 X2B064
                  45.0   43.2   38.4   52.3
  -------+             +-------------+             +-------------+
 3       |       X2B176|       X2B135|X2B044 X2B159|X2B081 X2B163|
         |        52.4 |        44.0 | 51.9   42.8 | 43.7   45.1 |
  +      |      +      |      +      |      +      |      +      |
 4       |             |             |      X2B090|X2B156       |X2B032
         |             |             |       42.5 | 45.0        | 51.5
  -------+             +-------------+             +-------------+
 5                                                         X2B160 X2B171 X2B031
                                                            42.2   42.8   50.7
  +             +             +             +             +             +
 6                                                                X2B042 X2B026 X2B033
                                                                   52.5   51.6   51.8
  -------+             +-------------+             +-------------+             +-------------+
 7       |             |             |             |             |      X2B139|      X2B075|
         |             |             |             |             |       41.2 |       41.3 |
  +      |      +      |      +      |      +      |      +      |      +      |      +      |
 8       |             |             |             |             |             |X2B100 X2B093|
         |             |             |             |             |             | 42.7   40.9 |
  -------+             +-------------+             +-------------+             +-------------+
 9                                                                                X2B192 X2B145
                                                                                   43.0   51.8
  +             +             +             +             +             +             +
10                                                                                       X2B079 X2B017
                                                                                          36.8   52.5
  -------+             +-------------+             +-------------+             +-------------+
11       |             |             |             |             |             |      X2B146|X2B053 X2B084
         |             |             |             |             |             |       51.6 | 52.0   38.3
  +      |      +      |      +      |      +      |      +      |      +      |      +      |      +
12       |             |             |             |             |             |             |X2B007 X2B043
         |             |             |             |             |             |             | 49.5   52.0
  -------+             +-------------+             +-------------+             +-------------+
13                                                                                       X2B140 X2B177 X2B076
                                                                                          45.7   52.8   44.7
  +             +             +             +             +             +             +             +
14                                                                                                     X2B020
                                                                                                        52.0
  -------+             +-------------+             +-------------+             +-------------+
15       |             |             |             |             |             |             |       X2A199
         |             |             |             |             |             |             |        40.3
  +      |      +      |      +      |      +      |      +      |      +      |      +      |      +
```

Figure A-1, Continued

Assemblies with Reused Channels and the Projected EOC13 Channel Exposures (GWD/MTU)

```
        1      2      3      4      5      6      7      8      9     10     11     12     13     14     15
         +      |      +      |      +      |      +      |      +      |      +      |      +      |      +
16 X2A159       |             |             |             |             |             |             |
   41.0         |             |             |             |             |             |             |
                +-------------+             +-------------+             +-------------+             +-------
17 X2B070
    40.5
         +             +             +             +             +             +             +             +
18 X2B183 X2B158 QC1001
    42.1   41.9   52.0
                +-------------+             +-------------+             +-------------+             +-------
19 X2B059 X2B069|             |             |             |             |             |             |
    51.4   38.9 |             |             |             |             |             |             |
                |      +      |             |      +      |             |      +      |             |      +
20 X2B128 X2B050|X2B103       |             |             |             |             |             |
    41.0   51.6 | 43.4        |             |             |             |             |             |
                +-------------+             +-------------+             +-------------+             +-------
21        X2B067 X2B037
           45.4   52.8
                       +             +             +             +             +             +             +
22               X2B104 X2B191
                  38.1   46.7
                +-------------+             +-------------+             +-------------+             +-------
23              |X2B182 X2B126|             |             |             |             |             |
                | 43.0   41.5 |             |             |             |             |             |
                |      +      |      +      |      +      |      +      |      +      |      +      |      +
24              |X2B174       |QC1002       |             |             |             |             |
                | 42.7        | 51.3        |             |             |             |             |
                +-------------+             +-------------+             +-------------+             +-------
25                      X2B071 X2B055 X2B060
                         42.8   51.8   52.9
                                     +             +             +             +             +             +
26                             X2B004 X2B072 QC1004
                                51.7   42.2   44.8
                                            +-------------+             +-------------+             +-------
27                                    X2B184|       X2B120|X2B173       |             |             |
                                       43.4 |        38.5 | 43.6        |             |             |
                                            |      +      |      +      |      +      |      +      |      +
28                                          |X2B148 X2B125|QC1003 X2B049|X2B124       |X2B130       |
                                            | 44.8   42.5 | 42.7   53.8 | 41.9        | 42.8        |
                                            +-------------+             +-------------+             +-------
29                                                                X2B051 X2B016 X2B122 X2B179
                                                                   53.1   51.9   41.2   44.9
                                                                               +             +             +
30                                                                       X2B015 X2B061 X2B116 X2B080 X2A218
                                                                          51.6   51.1   44.9   37.7   40.0
```

Figure A-1, Continued

Assemblies with Reused Channels and the Projected EOC13 Channel Exposures (GWD/MTU)

```
       16     17     18     19     20     21     22     23     24     25     26     27     28     29     30
  +      |      +      |      +      |      +      |      +      |      +      |      +      |      +
16       |             |             |             |             |             |             |       X2A174
         |             |             |             |             |             |             |        40.3
  -------+             +-------------+             +-------------+             +-------------+
17                                                                                                   X2B074
                                                                                                      44.8
  +             +             +             +             +             +             +             +
18                                                                                     X2B162 X2B178 X2B092
                                                                                        44.4   44.4   38.1
  -------+             +-------------+             +-------------+             +-------------+
19       |             |             |             |             |             |             |X2B073 X2B056
         |             |             |             |             |             |             | 43.8   51.3
  +      |      +      |      +      |      +      |      +      |      +      |      +      |      +
20       |             |             |             |             |             |      X2B131|X2B057 X2B117
         |             |             |             |             |                     41.4 | 52.3   40.9
  -------+             +-------------+             +-------------+             +-------------+
21                                                                                     X2B036 X2B065
                                                                                        51.7   42.5
  +             +             +             +             +             +             +
22                                                                              X2B011 X2B144
                                                                                 52.6   38.9
  -------+             +-------------+             +-------------+             +-------------+
23       |             |             |             |             |             |X2B127 X2B082|
         |             |             |             |             |             | 41.5   36.1 |
  +      |      +      |      +      |      +      |      +      |      +      |      +      |
24       |             |             |             |             |      X2B161|      X2B095|
         |             |             |             |             |       42.4 |       38.8 |
  -------+             +-------------+             +-------------+             +-------------+
25                                                                X2B019 X2B186 X2B078
                                                                   52.2   37.8   36.5
  +             +             +             +             +             +
26                                                         X2B188 X2B077 X2B030
                                                            42.1   42.2   53.1
  -------+             +-------------+             +-------------+
27       |             |             |      X2B096|X2B134       |X2B012
         |             |             |       42.1 | 46.3        | 51.8
  +      |      +      |      +      |      +      |      +      |
28       |      X2B166|      X2B143|X2B045 X2B187|X2B118 X2B189|
         |       45.7 |       41.9 | 51.8   41.7 | 45.7   44.3 |
  -------+             +-------------+             +-------------+
29              X2B180 X2B088 X2B022 X2B063
                 46.2   39.1   51.8   52.0
  +             +             +
30 X2A181 X2B091 X2B113 X2B062 X2B023
    40.5   43.3   44.9   51.3   52.0
```

ATTACHMENT B

ADVANCED NUCLEAR FUELS *CORPORATION*

155 108th AVENUE NE, PO BOX 90777, BELLEVUE, WA 98009-0777
(206) 453-4300

September 4, 1990
JMR:239:90

Mr. D. F. Kelter
Fuel Buyer
Commonwealth Edison Company
P. O. Box 767
Chicago, IL 60690

Dear Mr. Kelter:

Subject: Justification for Placing Used Fuel Channels on the Core Periphery of D2C13.

ANF has performed analyses to quantify the CPR effect caused by large magnitudes of channel bowing. These analyses consider geometries expected to bound all possible in-reactor channel configurations. The most limiting case considered for Dresden 2 is a full closure of the nominal narrow-narrow water gap (nominal gap is 374 mils) with an associated 374 mil increase in the wide-wide water gap, plus an additional 100 mil increase in the wide-wide gap. The result of calculations for this limiting case is that the CPR penalty is less than 0.15. This very conservative geometry is expected to bound any possible in-reactor configuration for Dresden 2, Cycle 13.

CPR monitoring for Dresden 2, Cycle 13 will be performed with the XN-3 correlation. Based on previous calculations, credit can be taken for 0.09 excess conservatism in CPR predictions with XN-3. The 0.15 penalty is then reduced to 0.06. This 0.06 CPR penalty can be neglected for peripheral assemblies in core monitoring because they are at very low relative power and will remain bounded by the limiting central region fuel assemblies.

Very truly yours,

J. M. Ross
Contract Administrator

sig

c: T. L. Krysinski
G. N. Ward