Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

March 24, 1992

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 Units 2 and 3
Quad Cities Nuclear Power Station Units 1 and 2
LaSalle County Nuclear Power Station Units 1 and 2
Topical Report for Neutronics Methods for BWR Reload Design
NRC Docket Nos. 50-237/249, 50-254/265 and 50-373/374

Reference: P.L. Piet (CECo) letter to T.E. Murley (NRC), dated December 31, 1991, submitting CECo Topical Report NFSR-0091.

Dear Dr. Murley:

The referenced letter submitted for NRC Staff review and approval the licensing topical report titled "Commonwealth Edison Company Topical Report - Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods", NFSR-0091, Revision 0. The topical report summarized the nuclear analysis methods employed by Commonwealth Edison Company (CECo), based on Siemens Nuclear Power Corporation (SNP) approved methodology, in support of reload nuclear design for Dresden, Quad Cities, and LaSalle County Stations.

The referenced letter also indicated that a supplement to the topical report would be submitted to provide descriptions of the methods to be used for the licensing-related analyses of abnormal neutronic events, including comparisons to vendor results.

These comparisons are contained in the form of NFSR-0091 Supplement 1, which is enclosed as Attachment 1 for Staff review.

Also enclosed are Attachments 2 through 7 detailing comparisons to vendor results for cold and hot eigenvalues data, fuel pin and assembly gamma scan data, Traversing Incore Probe data, and cold rod worth data for Dresden Unit 2, Dresden Unit 3, and Quad Cities Unit 1.

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The referenced letter also indicated that after completion of the referenced Topical Report, CECo discovered a minor error in the MICROBURN code obtained from SNP. The impact of this error, which involves the manipulation of the samarium number density array to reflect fuel shuffling, occurs near beginning of cycle (BOC) only. The error has been assessed by SNP and has been shown to affect hot and cold eigenvalues by approximately 0.0005Δk or less. No correction for this error has been incorporated in the referenced Topical Report or Supplement 1 included herein as Attachment 1. However, the corrected version of MICROBURN has been received from SNP in March of 1992 and will be implemented by CECo after appropriate testing.

Because there is no impact on CECo comparisons to SNP results in the Attachment 1 Supplement 1 topical report (since both CECo and SNP results are equally affected) and because the impact on comparisons to plant data are very slight and well within the uncertainty of the calculations for both hot and cold conditions, CECo does not plan to repeat the entire benchmark. Sample cases, however, will be reperformed and provided by mid-May, 1992 to demonstrate the small impact consistent with SNP's assessment.

CECo plans to apply these NRC-approved SNP methods and computer codes to BWR reload licensing analyses beginning with Dresden Unit 3 Cycle 14, which has been rescheduled to startup in December 1993. To support this effort, CECo is requesting approval of the topical report and supplement by December 1992. Previous discussions with your staff have indicated CECo's schedule can be supported.

Please contact this office should further information be required.

Respectfully,

Peter L. Piet
Nuclear Licensing Administrator

Attachments: 1) CECo Topical Report "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods - Neutronic Licensing Analyses", NFSR-0091, Supplement 1, Revision 0

2) CECo vs SNP Cold Critical Eigenvalue Comparison
3) CECo vs SNP Hot Critical Eigenvalue Comparison
4) CECo vs SNP Quad Cities Pin Gamma Scan Local Peaking Comparison
5) CECo vs SNP Quad Cities Assembly Gamma Scan Comparison
6) CECO vs SNP Predicted vs Measured TIP Comparison
7) CECO vs SNP Cold Rod Worth Comparison

cc: A.B. Davis - Regional Administrator, Region III
B.L. Siegel - Dresden/LaSalle Project Manager, NRR
L.N. Olshan - Quad Cities Project Manager, NRR
R.C. Jones - Reactor Systems Branch Chief, NRR (w/2 copies of Att.)
W.G. Rogers - Senior Resident Inspector, Dresden
T. Taylor - Senior Resident Inspector, Quad Cities
D.E. Hills - Senior Resident Inspector, LaSalle County

ZNLD/1554/10

ATTACHMENT 1

COMMONWEALTH EDISON COMPANY TOPICAL REPORT

BENCHMARK OF CASMO/MICROBURN BWR NUCLEAR DESIGN METHODS

NEUTRONIC LICENSING ANALYSES

(NFSR-0091, SUPPLEMENT 1, REVISION 0)

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Attachment 2

CECo vs SNP Cold Critical Eigenvalue Comparison

Unit/Cycle	Cycle Exposure (MWD/MT)	CECo Eigenvalue	SNP Eigenvalue
D2 C12	0	1.0083	1.0080
D2 C13	0	1.0084	1.0083
	0	1.0089	1.0089
	16	1.0091	1.0089
D3 C11	0	1.0069	1.0063
	5202	1.0060	1.0053
	5202	1.0060	1.0055
D3 C12	0	1.0076	1.0078
	0	1.0078	1.0078
	0	1.0092	1.0089
	0	1.0086	1.0080
	2389	1.0069	1.0068
Average	-	1.0078	1.0076

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Attachment 3

CECo vs SNP Hot Critical Eigenvalue Comparison

Unit/Cycle	CECo Values		SNP Values	
	Mean	Standard Deviation ΔK	Mean	Standard Deviation ΔK
D2 C10	1.0053	0.0008	1.0039	0.0005
D2 C11	1.0046	0.0014	1.0037	0.0010
D3 C10	1.0049	0.0016	1.0045	0.0014
D3 C11	1.0070	0.0015	1.0065	0.0014

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Attachment 4

CECo vs SNP Quad Cities Pin Gamma Scan Local Peaking Comparison

Assembly	Axial[1] Height	CECo[2] STD	SNP[2] STD
GEH02	15	2.10	2.10
	21	2.08	2.16
	51	2.23	2.19
	56	2.17	2.58
	87	2.43	2.63
	93	2.56	2.79
	123	1.71	1.82
	129	1.91	2.08
CX214	15	3.42	3.33
	21	4.46	4.48
	51	2.42	2.82
	56	2.83	3.39
	87	2.64	3.77
	93	3.21	4.06
	123	3.16	3.88
	129	2.69	3.31

[1] Distance from bottom of active fuel (inches)

[2] STD = Standard Deviation of differences between predicted (P) and measured (M) pin powers = $\frac{P-M}{M} \times 100$

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Attachment 4 (continued)

CECo vs SNP Quad Cities Pin Gamma Scan Local Peaking Comparison

Assembly	Axial[1] Height	CECo[2] STD	SNP[2] STD
CX672	15	4.30	4.24
	21	4.29	4.31
	51	2.64	2.41
	56	2.89	2.93
	87	2.57	2.60
	93	2.53	2.58
	123	2.67	2.44
	129	2.89	2.72
L2593	15	5.14	5.21
	21	4.77	4.88
	51	1.92	2.17
	56	2.10	2.32
	87	2.19	2.38
	93	2.46	2.55
	123	2.23	2.32
	129	2.24	2.28

[1] Distance from bottom of active fuel (inches)

[2] STD = Standard Deviation of differences between predicted (P) and measured (M) pin powers = $\frac{P-M}{M} \times 100$

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Attachment 4 (continued)

CECo vs SNP Quad Cities Pin Gamma Scan Local Peaking Comparison

Assembly	Axial[1] Height	CECo[2] STD	SNP[2] STD
L2532	15	2.67	2.73
	21	2.69	2.71
	51	2.04	2.07
	56	2.01	2.05
	87	1.91	1.92
	93	2.11	2.14
	123	1.93	1.89
	129	2.04	1.98
GEH06	15	3.09	3.07
	21	2.95	2.95
	51	2.50	2.51
	56	2.29	2.29
	87	2.05	2.03
	93	2.24	2.20
	123	1.62	1.59
	129	1.87	1.84

[1] Distance from bottom of active fuel (inches)

[2] STD = Standard Deviation of differences between predicted (P) and measured (M) pin powers = $\frac{P-M}{M} \times 100$

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Attachment 4 (continued)

CECo vs SNP Quad Cities Pin Gamma Scan Local Peaking Comparison

Assembly	Axial[1] Height	CECo[2] STD	SNP[2] STD
L2635	15	2.54	2.59
	21	2.49	2.62
	51	2.23	2.17
	56	2.23	2.27
	89	2.48	2.36
	93	2.75	2.61
	123	2.77	2.73
	129	2.71	2.66

[1] Distance from bottom of active fuel (inches)

[2] STD = Standard Deviation of differences between predicted (P) and measured (M) pin powers = $\frac{P-M}{M} \times 100$

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Attachment 5

CECo vs SNP Quad Cities Assembly Gamma Scan Comparison

SNP predicted vs. measured assembly integrated gamma scan results for Quad Cities Unit 1 Cycles 2 and 4 have been extracted from the SNP Topical Report XN-NF-80-19(P) Volume 1 Supplement 3 - Benchmark Results for the CASMO-3G/MICROBURN-B Calculation Methodology. Figures 5.3.5-1 and 5.3.5-2 from that SNP topical follow.

The CECo predicted vs measured assembly integrated gamma scan results for Quad Cities Unit 1 Cycles 2 and 4 follow as Figures Att 5-1 and Att 5-2. The CECo results are based on the same measured assemblies as the SNP results, and the same definition of the percent difference between predicted and measured results. (It should be noted that the database in the CECo Topical Report NFSR-0091 includes peripheral assemblies which were measured but excluded from the SNP figures 5.3.5-1 and 5.3.5-2).

Using the databases in the previously mentioned figures, the SNP assembly integrated standard deviations for Cycles 2 and 4 are 1.98% and 2.00%, respectively. The CECo assembly integrated standard deviations are 1.43% and 1.75%, respectively.

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				-----	0.609	0.757							
				-----	0.619	0.775							
				-----	1.605	2.527							
			-----	0.577	0.738	-----	1.172						
			-----	0.586	0.767	-----	1.177						
			-----	1.418	3.863	-----	0.420						
			-----	0.673	0.817	-----	1.015	1.055	Measured				
			-----	0.695	0.852	-----	1.052	1.082	Calculated				
			-----	3.245	4.290	-----	3.729	2.618	Pct. Difference (c-m)/m * 100				
			-----	-----	-----	0.999	1.287	-----	1.270				
			-----	-----	-----	1.025	1.289	-----	1.338				
			-----	-----	-----	2.604	0.150	-----	5.334				
		-----	-----	0.829	0.949	-----	-----	1.091	1.117	1.090			
		-----	-----	0.834	0.973	-----	-----	1.108	1.128	1.105			
		-----	-----	0.578	2.559	-----	-----	1.550	0.957	1.356			
-----	0.574	-----	0.890	1.213	1.068	1.057	1.062	1.141	-----	1.231			
-----	0.566	-----	0.884	1.181	1.047	1.057	1.083	1.160	-----	1.254			
-----	-1.267	-----	-0.655	-2.625	-1.990	0.014	2.020	1.667	-----	1.902			
-----	-----	0.808	-----	1.040	-----	1.047	1.062	-----	1.058	-----	1.025		
-----	-----	0.804	-----	1.028	-----	1.061	1.060	-----	1.055	-----	1.024		
-----	-----	-0.504	-----	-1.205	-----	1.337	-0.240	-----	-0.278	-----	-0.104		
-----	0.681	0.840	-----	1.270	1.071	1.282	1.078	1.266	1.058	1.040	-----	1.220	
-----	0.687	0.845	-----	1.222	1.070	1.268	1.075	1.262	1.061	1.038	-----	1.206	
-----	0.936	0.555	-----	-3.844	-0.018	-1.068	-0.244	-0.304	0.229	-0.245	-----	-1.192	
-----	-----	-----	-----	0.943	1.015	-----	1.050	1.065	1.053	-----	-----	1.026	1.035	1.038
-----	-----	-----	-----	0.943	1.010	-----	1.039	1.042	1.052	-----	-----	1.010	1.015	1.011
-----	-----	-----	-----	-0.021	-0.431	-----	-0.999	-2.121	-0.034	-----	-----	-1.511	-1.887	-2.584
-----	0.705	0.832	0.905	0.972	1.010	1.015	1.041	1.043	1.025	1.005	1.002	1.029	1.066
-----	0.707	0.838	0.918	0.973	0.935	1.007	1.028	1.019	1.008	0.985	0.981	0.935	1.020
-----	0.345	0.700	1.411	0.037	-1.498	-0.755	-1.227	-2.304	-1.719	-1.960	-2.117	-3.257	-4.297

Relative standard deviation 1.98
Bundle correlation coefficient 0.563
Planar correlation coefficient 0.695

FIGURE 5.3.5-1 QUAD CITIES 1 EOC 2 ASSEMBLY GAMMA SCAN RESULTS
COMPARISON OF MEASURED AND CALCULATED BA-140 DISTRIBUTION

-----	-----	-----	-----	-----						
-----	-----	-----	-----	-----						
-----	-----	-----	-----	-----						
0.605	0.557	0.562	0.483	0.376	-----					
0.612	0.572	0.561	0.475	0.372	-----					
1.175	2.574	-0.103	-1.735	-1.208	-----					
0.772	1.037	0.789	-----	0.596	0.475	-----	-----	-----		
0.772	1.028	0.785	-----	0.609	0.488	-----	-----	-----		
0.057	-0.874	-0.515	-----	2.135	2.776	-----	-----	-----		
1.099	1.111	-----	-----	-----	0.753	-----	0.513	0.405	-----	
1.061	1.091	-----	-----	-----	0.766	-----	0.523	0.409	-----	
-3.456	-1.781	-----	-----	-----	1.745	-----	2.022	1.052	-----	
0.900	-----	1.064	-----	0.918	-----	0.778	-----	0.547	0.414	-----
0.908	-----	1.075	-----	0.915	-----	0.789	-----	0.569	0.430	-----
0.823	-----	1.086	-----	-0.369	-----	1.422	-----	3.906	3.969	-----
1.174	1.000	-----	1.251	1.278	1.190	-----	0.914	0.923	0.640	
1.155	1.039	-----	1.249	1.236	1.169	-----	0.921	0.908	0.662	
-1.639	3.842	-----	-0.178	-3.274	-1.754	-----	0.826	-1.614	3.347	
0.938	1.356	1.022	1.397	1.069	1.375	0.970	-----	0.820		
0.951	1.323	1.044	1.415	1.058	1.345	0.978	-----	0.841		
1.359	-2.456	2.094	1.218	-1.034	-2.172	0.784	-----	2.542		
1.233	1.095	-----	1.319	-----	1.121	1.287	1.201			
1.203	1.117	-----	1.331	-----	1.142	1.266	1.212			
-2.445	2.009	-----	0.894	-----	1.838	-1.605	0.903			
1.016	-----	1.044	-----	1.129	-----	1.044				
1.010	-----	1.067	-----	1.166	-----	1.046				
-0.546	-----	2.232	-----	3.260	-----	0.166				
1.276	1.278	-----	1.156	1.382	1.334	Measured				
1.250	1.289	-----	1.182	1.355	1.319	Calculated				
-2.061	0.893	-----	2.262	-1.983	-1.138	Pct. Difference (c-m)/m * 100				
1.051	1.411	1.124	-----	1.125						
1.045	1.404	1.132	-----	1.163						
-0.626	-0.457	0.773	-----	3.336						
1.279	1.144	-----	1.158							
1.269	1.159	-----	1.148							
-0.769	1.365	-----	-0.867							
1.035	-----	1.042								
1.038	-----	1.038								
0.307	-----	-0.419								
1.317	1.326	-----								
1.249	1.297	-----								
-5.200	-2.115	-----								

Relative Standard Deviation = 2.00
Bundle Correlation Coefficient = 0.181
Planar Correlation Coefficient = 0.680

FIGURE 5.3.5-2 QUAD CITIES 1 EOC4 ASSEMBLY GAMMA SCAN RESULTS
COMPARISON OF MEASURED AND CALCULATED BA-140 DISTRIBUTION

Figure Att 5-1

Differences in CECo Predicted vs Measured Assembly Gamma Scan Results
for Quad Cities Unit 1 Cycle 2

```
+--------------------------------+                                    +-------------+-------------+-------*
|Mean Measured Value    =  1.0000|                                    |             |             |       *
|Standard Deviation     =  1.4312|                                    |      |      |      |      |      |*
|Number of Data Points  =      62|                                    |    --+--    |    --+--    |    --+*
+--------------------------------+                                    |      |      |      |      |      |*
                                                                      |             |             |       *
+-------------------+                     +-------------+-------------+-------------o-------------+-------*
|  Set 1  Cycle  2  |                     |             |             |             |             |       *
|   Radial Data     |                     |      |      |      |      |      |      |      |      |      |*
|    Total Input    |                     |    --+--    |    --+--    |    --+--    |    --+--    |    --+*
+-------------------+                     |      |      |      |      |      |      |      |      |      |*
                                          |             |             |             |             |       *
+-------------+             +-------------+-------------+-------------+-------------+-------------+-------*
|  Bundle ID  |             |             |             |             |             |             |       *
| 100(C-M)/M  |             |      |      |      |      |      |      |      |      |      |      |      |*
+-------------+             |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+*
                            |CX0719|CX0191|      |      |      |      |      |      |      |      |      |*
                            | -0.31  -0.21|             |             |             |             |       *
              +-------------o-------------+-------------o-------------+-------------o-------------+-------*
              |       CX0494|CX0286       |GEH008       |             |             |             |       *
              |      | -0.59|  1.98|      |  0.95|      |      |      |      |      |      |      |      |*
              |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+*
              |      |CX0174|CX0617|      |CX0100|CX0024|      |      |      |      |      |      |      |*
              |         0.86|  2.29       |  2.32   1.22|             |             |             |       *
              +-------------+-------------+-------------+-------------+-------------+-------------+-------*
              |             |       CX0332|GEH029       |GEB123       |             |             |       *
              |      |      |      |  1.32|  1.35|      |  4.46|      |      |      |      |      |      |*
              |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+*
              |      |CX0150|CX0440|      |      |CX0015|CX0378|CX0186|      |      |      |      |      |*
              |        -0.91|  1.90       |         0.91| -0.58  -0.80|             |             |       *
+-------------+-------------o-------------+-------------o-------------+-------------o-------------+-------*
|       CX0611|       CX0351|GEH023 CX0396|CX0093 CX0316|CX0723       |GEB149       |             |       *
|      | -1.91|      | -0.64|  0.17| -1.35| -0.05|  1.92|  0.67|      |  2.19|      |      |      |      |*
|    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+*
|      |      |CX0631|      |CX0399|      |CX0397|CX0231|      |CX0161|      |CX0297|      |      |      |*
|             | -1.32       |  0.49       |  1.61  -1.23|        -0.91|        -0.71|             |       *
+-------------+-------------+-------------+-------------+-------------+-------------+-------------+-------*
|       CX0523|CX0198       |GEH022 CX0393|GEH002 CX0672|GEB132 CX0585|CX0281       |GEB105       |       *
|      |  0.22| -0.18|      | -1.15|  0.36|  1.38| -0.81|  0.62| -0.76| -0.63|      |  0.38|      |      |*
|    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+*
|      |      |      |CX0044|CX0327|      |CX0362|CX0306|CX0660|      |      |CX0287|CX0498|CX0310|      |*
|             |         0.53|  0.07       | -0.04  -2.81| -0.80       |        -1.71| -1.46  -1.70|       *
+-------------+-------------o-------------+-------------o-------------+-------------o-------------+-------*
|       CX0520|CX0137 CX0420|CX0106 CX0394|CX0057 CX0052|CX0162 CX0717|CX0225 CX0453|CX0165 CX0482|       *
|      |  0.56|  0.15|  2.10|  1.10| -0.17|  0.30|  0.05| -1.94| -1.32| -2.09| -2.43| -2.19| -2.41|      |*
|    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+--    |    --+*
***********************************************************************************************************
```

Figure Att 5-2

Differences in CECo Predicted vs Measured Assembly Gamma Scan Results

for Quad Cities Unit 1 Cycle 4

CX0657 0.86	CX0572 1.67	CX0640 -0.50	CX0166 -2.42	CX0690 -1.87				
CX0599 -0.71	LJ5747 0.99	CX0706 -1.80	CX0329 2.64	CX0183 1.66				
LJ2619 -1.45	LJ2532 0.10			CX0541 0.54		CX0208 1.29	CX0607 0.44	
CX0113 0.73	GEH023 2.53		CX0103 -1.09		CX0042 1.25		CX0393 4.25	CX0709 3.08
LJ2557 -0.14	CX0645 1.72		LJ2615 1.16	LJ2648 -1.59	LJ2596 -0.10		GEH011 2.04	LJ2640 0.74	CX0545 2.46
CX0550 -0.95	LJ5683 -1.59	CX0326 1.37	LJ5678 1.88	CX0347 -2.32	LJ5649 -1.32	CX0582 -1.10	CX0714 0.78		
LJ2558 -1.13	GEH030 2.78		LJ2543 2.00		GEB119 0.95	LJ2652 -0.45	LJ2582 2.19		
CX0547 -2.95	CX0052 1.17		CX0534 1.15		CX0219 -2.24				
LJ2590 -1.03	LJ2572 1.93		GEB109 1.07	LJ2642 -0.69	LJ2607 -0.07				
CX0270 -3.12	LJ5663 -0.06	CX0497 -1.77	CX0612 1.25						
LJ1756 -0.40	GEH024 1.22		GEH003 -0.18						
CX0146 -2.15	CX0097 -1.98								
LJ2539 -4.25	LJ2635 -0.99								

Mean Measured Value	= 1.0000
Standard Deviation	= 1.7466
Number of Data Points	= 63

Set 1 Cycle 4
Radial Data
Total Input

Bundle ID
100(C-M)/M

Attachment 6

CECo vs SNP Predicted vs Measured TIP Comparison

Unit/Cycle	Cycle Exposure (MWD/MT)	% Standard Deviation[1]			
		CECo		SNP	
		Radial	Nodal	Radial	Nodal
D2 C10	254	4.43	5.63	6.37	7.77
	4061	5.30	6.08	5.34	6.63
	6773	5.54	7.31	5.44	6.78
D2 C11	341	5.51	6.44	5.42	6.42
	3943	6.32	7.84	6.25	7.82
	6554	6.02	8.45	5.90	8.10
D2 C12	2191	7.60	9.63	7.26	9.01
D3 C9	346	6.90	7.72	7.39	8.46
	3579	6.86	8.18	6.77	8.46
	5098	7.78	9.19	7.68	9.15
D3 C10	1418	3.29	6.59	3.25	6.30
	5351	3.28	6.59	3.27	6.05
D3 C11	183	4.32	5.89	4.17	5.89
	3569	3.89	9.16	3.98	7.94
Average		5.50	7.48	5.61	7.48

[1] Standard Deviation of differences (d_i) between Predicted (P) and Measured (M) TIP values where $d_i = \frac{P-M}{M} \times 100$. Only central 20 nodes included.

ASP:cs
ZBRDLE:16:13

Attachment 7

CECo vs SNP Cold Rod Worth Comparison

Dresden Unit 3 Beginning of Cycle 13

Parameter*	CECo Value ΔK	SNP Value ΔK
1) Worth of Strongest Rod	.0357	.0361
2) Strongest Rod Fully Withdrawn - Worth of Diagonally Adjacent Rod	.0094	.0093
3) Worth of First Group of 24 In-Sequence Rods Withdrawn	.0417	.0421
4) Worth of Second Group of 20 In-Sequence Rods Withdrawn	.0145	.0146
5) Worth of Third Group of 24 In-Sequence Rods Withdrawn Position 00-04	.0009	.0009
6) Worth of Third Group of 24 In-Sequence Rods Withdrawn Position 04-08	.0068	.0069
7) Worth of Third Group of 24 In-Sequence Rods Withdrawn Position 08-12	.0070	.0071
8) Worth of Third Group of 24 In-Sequence Rods Withdrawn Position 12-48	.0059	.0059

* Position 00 = Fully Inserted
Position 48 = Fully Withdrawn

ASP:cs
ZBRDLE:16:14