APPENDIX G

Evaluation of Gold Wire Activation Data for the Water-Reflected Core LEU-1

The purpose of this appendix is to illustrate the comparison of wire activation data with corresponding analytical calculations. Section 4.2.1 describes the experimental procedures used to obtain the wire activation data while Section 6.1 outlines the data analysis methods. Results of measurements and calculations are compared in Section 7.2. For this illustration gold wire activation data, obtained from the water-reflected LEU- I core with fresh fuel (see Fig. 19, p. 8 1), will be used.

Table G.1 shows the gold wire activation data where the count rates have been corrected for background, dead time losses, and radioactive decay. A 0.010-inch diameter gold wire was activated near the center of water channel 9 (see Fig. 6, p. 20) for each of the 14 fuel elements in the core. The average count rates shown in Table G.1 were obtained by integrating the activities over the height of the fuel column and dividing the result by that height (23.625 in.). Fig. GA shows some plots of the axial distributions of gold activities. Each wire was a few inches longer than the height of the fuel column so these graphs clearly show the effects of flux peaking in the axial reflectors. Distances are measured from the top end of the wire.

Beginning with cross sections generated by EPRI-CELL, axial gold activity distributions were calculated using the three-dimensional mesh-centered flux file obtained from the DIF3D calculation for die LEU-1 core. Normally, a 4-by-4 array of axial gold reaction rate distributions are calculated for each fuel element. A two-dimensional interpolation scheme is used to determine the gold activity on each axial mesh plane at the location of the wire. This interpolated axial activity distribution is numerically integrated between the upper and lower reflector valleys (see Fig. G.1) to determine the axially-averaged calculated activity. For consistency, the experimental distributions were integrated over the same range. To compare calculated results with measured ones, the normalization procedure described in Section 6.1 was used.

Table G.2 shows the measured and calculated average activities for each of the gold wires used in the core LEU-1, the normalization factor, and the C/E ratios. The integrated average activities for the measured data are different in Table G.2 from those shown in Table G. I because of the differences in the integration limits. Fig. G.2 shows the C/E ratio for each fuel element. This figure is somewhat different from Fig. 24 in the text (p. 88) because these more recent results are based on improved gold cross sections.

Table G.1 Measured 198Au Axial Activity Distributions in Core LEU- I
(At Center of Channel 9)

	Loc. C4	Loc. C5	Loc.C6
Position Inches	Count Rate cps/inch	Count Rate cps/inch	Count Rate cps/inch
.4506	136.0279	152.1005	131.5691
.7137	129.1007	142.6686	131.4744
.9768	121.164	131.897	130.6221
1.2399	103.6692	123.9393	117.7331
1.503	87.19326	113.5821	94.48301
1.7661	86.19506	100.8985	86.57008
2.0292	82.55255	94.61724	76.17261
2.2923	89.04619	90.60995	78.16679
2.5554	88.20095	94.70754	82.82965
3.6078	114.5727	123.6261	100.6025
4.6602	146.4011	152.039	131.1156
5.7126	173.7011	184.3991	157.247
6.765	213.2033	226.1644	189.1361
7.8174	256.1111	285.6468	227.6123
8.869799	300.3921	328.3887	264.0069
9.9222	362.8949	376.7271	328.2395
10.9746	420.3366	477.3449	387.2395
12.027	495.5952	518.1622	444.0094
13.0794	581.9508	635.8171	516.5423
14.1318	640.5455	689.7934	575.6787
15.1842	696.7547	736.6861	635.7945
16.2366	725.062	789.7278	663.6095
17.289	740.655	828.3354	688.5331
18.3414	758.3626	824.9381	688.174
19.3938	735.6703	842.8748	684.9378
20.4462	690.8091	833.2643	652.5964
21.4986	629.6835	735.2521	605.1145
22.551	562.8238	642.7045	530.7995
23.6034	523.9747	609.0311	464.333
23.8665	547.9393	625.2325	463.4639
24.1296	601.4153	663.5674	485.4275
24.3927	723.1155	756.9358	530.944
24.6558	861.6812	901.0685	610.888
24.9189	988.7185	1063.627	724.4374
25.182	1055.808	1160.459	820.0115
25.4451	1093.465	1214.809	889.5954
25.7082	1102.292	1253.139	917.3002
Int. Ave. over Fuel:	468.1986	518.0801	423.3268

Table G.1 Measured 198Au Axial Activity Distributions in Core LEU-1
(At Center of Channel 9 - Continued)

	Loc. D3	Loc. D5	Loc.D7
Position Inches	Count Rate cps/inch	Count Rate cps/inch	Count Rate cps/inch
.4506	142.7661	163.9593	123.8042
.7137	115.1595	153.4077	120.6003
.9768	104.9329	142.2677	118.7481
1.2399	88.21987	125.9313	105.3831
1.503	81.89888	111.9852	93.31827
1.7661	75.61558	103.6564	85.36227
2.0292	74.47979	106.7676	76.19821
2.2923	77.30055	109.7699	77.7713
2.5554	80.52009	110.0747	78.97065
3.6078	102.739	144.7723	96.9936
4.6602	123.4951	181.2104	127.2414
5.7126	147.6215	225.183	154.1873
6.765	184.7376	274.8034	183.8068
7.8174	212.9719	330.8248	226.3216
8.869799	260.6638	395.7546	268.85
9.9222	308.7681	470.6575	321.9383
10.9746	381.2429	576.8055	376.8017
12.027	460.4113	717.4415	448.7271
13.0794	547.5856	853.7805	518.1748
14.1318	637.8149	953.7936	576.4283
15.1842	677.7925	1047.928	639.5887
16.2366	717.6953	1112.788	658.5902
17.289	739.6591	1169.362	686.742
18.3414	752.3984	1189.527	687.1465
19.3938	737.766	1170.342	677.9015
20.4462	741.2188	1123.233	645.4058
21.4986	661.6968	1036.308	589.2608
22.551	586.3971	938.7328	519.6222
23.6034	552.6236	840.7815	493.714
23.8665	581.9388	866.734	523.5024
24.1296	619.6496	931.1507	577.2239
24.3927	709.696	1004.986	688.9706
24.6558	839.8229	1183.342	829.9192
24.9189	944.4441	1443.452	955.1095
25.182	1031.125	1646.345	985.8726
25.4451	1102.867	1769.486	1008.282
25.7082	1121.174	1806.893	1009.097
Int. Ave. over Fuel:	456.5588	702.5913	428.1905

Table G.1 Measured ^{198}Au Axial Activity Distributions in Core LEU- I
(At Center of Channel 9 - Continued)

Position Inches	Loc. E3 Count Rate cps / inch	Loc. E4 Count Rate cps/inch.	Loc.E5 Count Rate cps/inch
.4506	142.9693	179.9031	220.369
.7137	135.6389	167.664	206.54
.9768	126.8781	154.0194	197.8328
1.2399	116.6232	132.5168	167.9068
1.503	93.97246	120.9888	150.0877
1.7661	86.59134	111.6142	140.833
2.0292	84.16572	112.9994	137.1741
2.2923	87.50938	116.9799	137.8954
2.5554	91.32055	120.5314	147.326
3.6078	112.9367	147.7198	168.8363
4.6602	150.6176	197.5292	215.8845
5.7126	193.8843	242.7067	290.5608
6.765	220.074	285.1771	336.8468
7.8174	272.0938	337.221	391.8756
8.869799	313.8024	412.7348	482.9081
9.9222	380.4428	495.274	599.752
10.9746	454.332	592.6463	685.7021
12.027	529.8228	752.3163	835.0072
13.0794	597.3532	846.7002	965.2068
14.1318	680.9815	976.9059	1068.148
15.1842	735.8491	1091.419	1188.816
16.2366	810.4269	1168.069	1305.774
17.289	913.3879	1236.21	1364.584
18.3414	941.6344	1237.153	1321.623
19.3938	920.7533	1240.144	1316.159
20.4462	867.9662	1171.849	1321.531
21.4986	811.0818	1089.083	1232.67
22.551	685.5395	1007.423	1073.13
23.6034	644.2986	913.9365	1022.375
23.8665	669.3943	944.5731	1028.891
24.1296	758.688	967.0354	1138.673
24.3927	902.4241	1022.34	1337.889
24.6558	1123.846	1156.516	1636.897
24.9189	1236.418	1436.692	1853.797
25.182	1373.253	1695.582	1995.024
25.4451	1415.039	1835.083	2101.353
25.7082	1413.793	1907.758	2183.063
Int. Ave. over Fuel:	541.7231	733.7438	825.5951

Table G. 1 Measured 198Au Axial Activity Distributions in Core LEU- I
(At Center of Channel 9 - Continued)

	Loc. E6	Loc. E7	Loc.F'3
Position Inches	Count Rate cps/inch	Count- Rate cps/inch	Count Rate cps/inch
.45506	204.21-94	699.8473	97.56349
.7137	178.1555	166.9983	95.66779
.9763	181.98	158.7289	89.13234
1.2399	182.1089	153.844	76.81811
1.503	166.1688	131.8312	69.54932
1.7661	149.6111	113.7225	64.01101
2.0292	1216.693	103.7255	60.17691
2.2923	114.8279	97.69638	62.90499
2.5554	118.806	100.8211	63.47204
3.60718	134.8985	127.4263	81.13682
4.6602	173.723	156.8722	103.5932
5.7126	209.0662	183.6702	127.3639
6.765	259.0948	222.5871	155.5278
7.8174	320.7621	274.8324	185.3771
8.869799	383.6151	325.1356	225.6777
9.9222	478.7024	370.4863	269.4977
10.9746	567.2878	443.9271	323.7399
12.027	669.8516	524.6011	387.0157
13.0794	829.2305	599.6801	495.0287
14.1318	934.3451	663.3361	573.0385
15.1842	1021.722	733.4361	620.29
16.2366	1142.252	793.9178	661.2992
17.289	1153.191	842.8876	636.4318
18.3414	1170.733	827.2599	691.276
19.3938	1157.619	866.3266	691.5161
20.4462	1166.354	827.2S62	655.9181
21.4986	1062.105	748.6159	629.539
22.551	1006.261	690.4675	558.163
23.6034	853.4289	630.3861	484.1725
23.8665	836.4231	615.5688	493.8174
24.1296	848.6607	662.132	509.5038
24.3927	895.9797	745.3055	559.7858
24.6558	989.4421	890.1323	657.4593
24.9189	1122.713	1040.033	771.8406
25.182.	1338.76	1212.095	901.7635
25.4451	1580.206	1325.671	985.0179
25.7082	1795.496	1386.573	1039.533
Int. Ave. over Fuel:	695.4896	518.6264	408.4063

Table G. 1 Measured 198Au Axial Activity Distributions in Core LEU- I
(At Center of Channel 9 - Continued)

	Loc. F5	Loc. F7
Position Inches	Count Rate cps/inch	Count Rate cps/inch
.4.506	117.3123	119.5044
. 7137	106.4369	111.7272
.9768	99.33302	94.68091
1.2399	87.37	85.42605
1.503	78.671263	72.35198
1.7661	74.76671	67.03659
2.0292	75.36137	64.02223
2. 2923	77.97291	64.99362
2. 5554	75.5609	71.24961
3.6078	100.8428	89.96247
4.6602	127.8729	105.7551
5.7126	155.6124	128.3726
6.765	189.111	157.7222
7.8174	229.0937	193.8606
8.869799	278.5275	231.8699
9.9222	330.7011	274.5933
10.9746	406.1546	323.1735
12.027	504.0735	388.3622
13.0794	600.4759	443.6434
14.1318	698.1096	501.6072
15.1842	770.3724	551.1395
16.2366	826.6775	582.0284
17.289	864.4247	593.4058
18.3414	881.9652	603.4778
19.3938	866.4815	602.0778
20.4462	838-589	587.9789
21.4986	799.4298	521.8882
22.551	708.3498	467.0313
23.6034	668.8453	436.3344
23.8665	693.9453	456.568
24.1296	748.6863	507.1826
24.3927	865.2592	581.2651
24.6558	1032.558	713.5565
24.9189	1221.853	800.5647
255.182	1375.899	871.3371
25.4451	1449.244	931.5334
25.7082	1490.705	943.0004
Int. Ave. over Fuel:	520.7812	373.6751

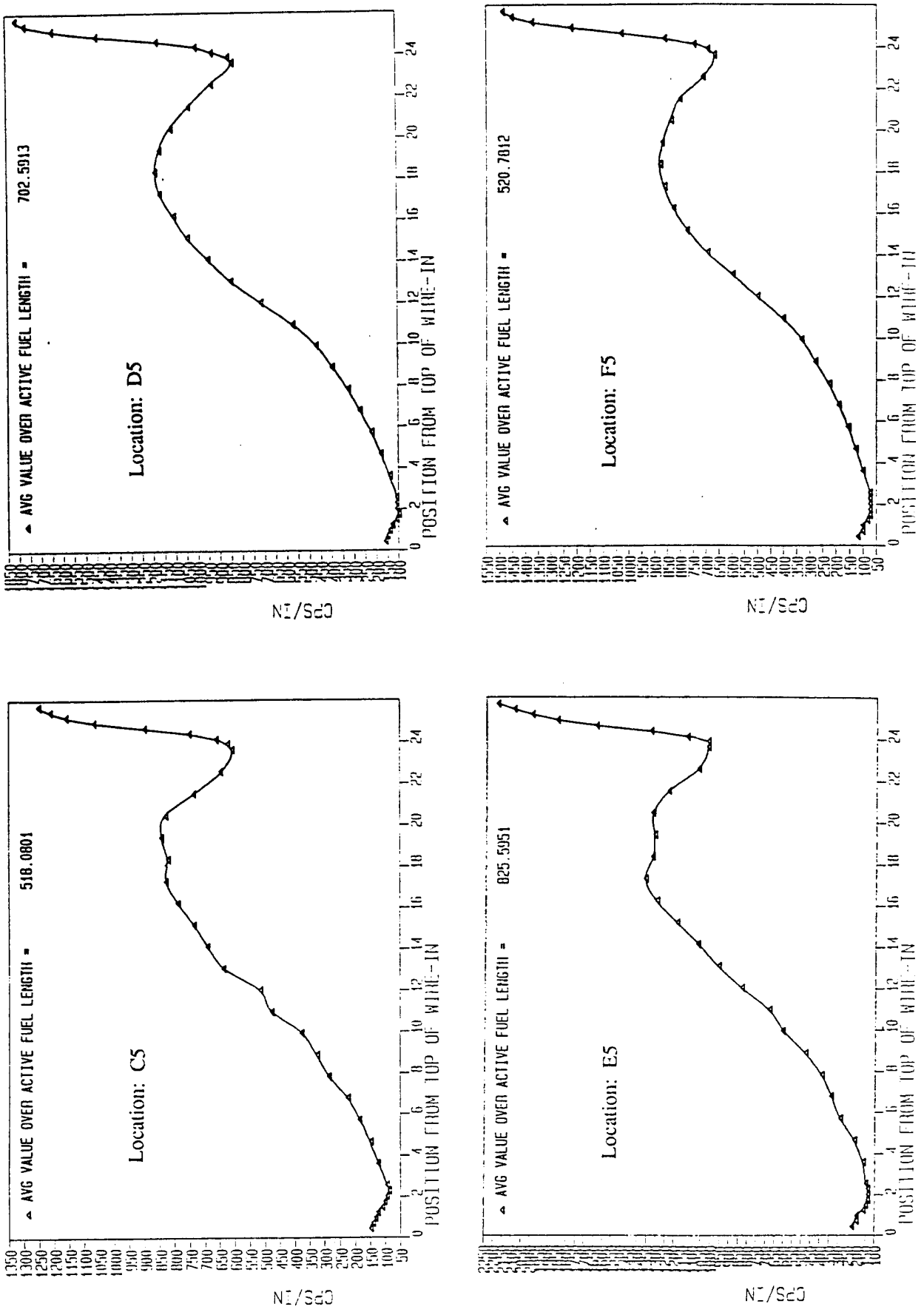

Fig. G.1 Gold Wire Activity Distributions in Core LEU-1

Table G.2 Evaluation of Gold Wire Activations for Core LEU-1

Grid	Meas. Act. Ave, cps(E)	Calc. Act.	N * x Calc. Act. UC	C/E
C4	467.79	1574.6	481.74	1.030
C5	522.68	1804.7	552.14	1.056
C6	428.14	1469.1	449.46	1.050
D3	456.16	1567.1	479.45	1.051
D5	697.07	2358.1	721.45	1.034
D7	427.34	1431.5	437.96	1.025
E3	539.56	1746.2	534.24	0.990
E4	729.31	2250.2	688.44	0.944
E5	823.36	2487.3	760.98	0.925
E6	708.69	2167.7	663.20	0.936
E7	528.32	1626.0	497.47	0.942
F3	409.02	1291.0	394.97	0.966
F5	513.93	1938.3	593.01	1.154
F7	373.13	1209.4	370.01	0.992
Total:	7624.50	24921.2		

N (Normalization Factor) = 7624.50 / 24921.2 = 0.305944

ORR CORE LEU–1

AVERAGE C/E RATIOS FOR IRRADIATED WIRES

NEW AND (ORIGINAL) GOLD–197 CROSS SECTIONS

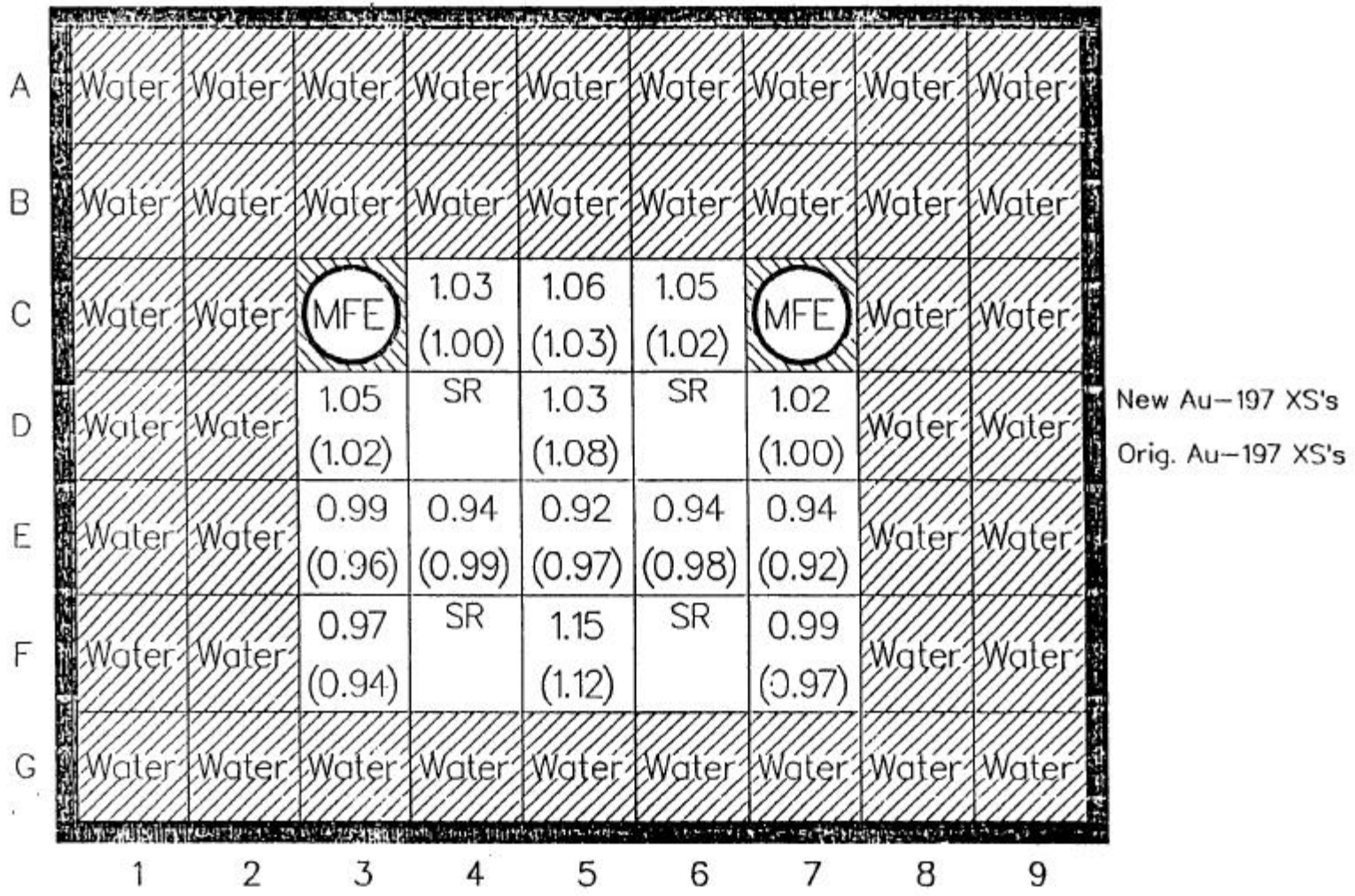

Fig. G.2 Average C/E Ratios for Irradiated Gold Wires in Core LEU-1