A-13

May 28, 1982

NOTE TO: Homer Lowenberg

FROM: Paul S. Check

SUBJECT: CRBR FUEL CYCLE - REVIEW OF DRAFT MATERIAL FOR FES UPDATE

We have reviewed the material you provided with a memorandum dated May 21, 1982, and herewith return it with our suggestions indicated on individual pages. Most of our notations are editorial. There are two items we wish to call to your attention. In Section 7.2, we suggest the addition of a brief discussion on uranium hexafluoride. On page D.14, the efficiency of HEPA filters needs further attention (see attached Proceedings of Fourteenth ERDA Air Cleaning Conference.)

In general, the draft material is prepared well and it appears appropriate for our purpose. We appreciate the good efforts that have gone into it and look forward to receiving the final version.

P S Check

Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation

cc: H. Denton
C. Thomas
P. Leech
B. Morris
J. Swift

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TABLE 12.1-32

ISOTOPIC CURIE CONTENT - EQUILIBRIUM CORE-EOC

CO2 72 2.984E+0	NI2 72 4.894E+02	CU2 72 2.607E+03	ZN2 72 4.207E+03	GA2 72 4.245E+03	CO2 73 7.212E-02
NI2 73 2.783E+01	CU2 73 9.889+02	ZN2 73 4.940E+03	GA2 73 5.645E+03	GE1 73 5.669E+03	CO2 74 1.339E-1
NI2 74 5.263E+01	CU2 74 1.224+03	ZN2 74 9.817E+03	GA2 74 1.141E+04	CO2 75 3.389E-02	NI2 75 1.544+01
CU2 75 7.692E+02	ZN2 75 1.212E+04	GA2 75 1.813E+04	NI2 76 4.798E+00	CU2 76 3.184+02	ZN2 76 1.481+04
GA2 76 3.394E+04	AS2 76 8.747E+02	NI2 77 1.529E+00	CU2 77 1.879E+02	ZN2 77 1.192E+04	GA2 77 5.780E+04
GE1 77 6.581E+04	GE2 77 3.483E+04	AS2 77 8.750+04	SE1 77 2.651E+02	NI2 78 2.607E-01	CU2 78 7.504E+01
ZN2 78 8.095E+03	GA2 78 6.008E+04	GE2 78 1.467E+05	AS2 78 1.524E+05	CU2 79 1.694E+01	ZN2 79 2.538E+03
GA2 79 4.868E+04	GE2 79 2.489E+05	AS2 79 2.875E+05	SE1 79 2.899E+05	SE2 79 4.678E+00	BR1 79 3.245E-01
CU2 80 4.742E+00	ZN2 80 1.962+03	GA2 80 3.772E+04	GE2 80 3.208E+05	AS2 80 4.433+05	BR1 80 1.121E+01

TABLE 12.1-32 (Continued)

BR2 80 2.272E+01	CU2 81 5.134E-01	ZN2 81 5.110E+02	GA2 81 2.289E+04	GE2 81 3.513E+05	AS2 81 6.476E+05
SE1 81 3.133E+04	SE2 81 7.175E+05	KR1 81 2.961E-01	KR2 81 2.273E-06	ZN2 82 9.049+01	GA2 82 8.798E+03
GE2 82 3.377E+05	AS1 82 2.934E+05	AS2 82 6.587+05	BR1 82 9.033E+03	BR2 82 1.781E+04	ZN2 83 8.255E+00
GA2 83 2.565E+03	GE2 83 2.253E+05	AS2 83 1.329E+06	SE1 83 1.567E+06	SE2 83 1.175E+06	BR2 83 2.823E+06
KR1 83 2.823E+06	GA2 84 5.228E+02	GE2 84 1.051E+05	AS2 84 1.052E+06	SE2 84 3.947E+06	BR1 84 2.532E+05
BR2 84 4.206E+06	GA2 85 1.002E-08	GE2 85 1.299E+04	AS2 85 4.030E+05	SE1 85 1.455+06	SE2 85 1.949E+06
BR2 85 4.884E+06	KR1 85 4.957E+06	KR2 85 1.034E+05	GE2 86 2.875E+03	AS2 86 1.733E+05	SE2 86 3.090E+06
BR1 86 3.031E+06	BR2 86 3.138E+06	RB1 86 1.700E+04	RB2 86 1.382E+05	GE2 87 3.251E+02	AS2 87 4.210E+04
SE2 87 1.726E+06	BR2 87 5.565E+06	KR2 87 8.056E+06	RB2 87 2.092E-04	SR1 87 8.554E+02	GE2 88 2.543E+01

TABLE 12.1-32 (Continued)

AS2 88 9.865E+03	SE2 88 8.761E+05	BR2 88 5.111+06	KR2 88 1.141E+07	RB2 88 1.193+07	AS2 89 1.110E+03
SE2 89 2.170E+05	BR2 89 3.087E+06	KR2 89 1.244E+07	RB2 89 * 1.558E+07	Y1 89 3.000E+01	AS2 90 3.812E-08
SE2 90 5.248E+04	BR2 90 1.339E+06	KR2 90 1.183E+07	RB1 90 4.718E+06	RB2 90 1.308E+07	SR2 90 6.791E+05
Y1 90 9.232E+02	Y2 90 7.108+05	ZR1 90 2.437E-01	SE2 91 6.532E+03	BR2 91 3.994E+05	KR2 91 8.030+06
RB2 91 1.799E+07	SR2 91 2.102E+07	Y1 91 1.212E+07	Y2 91 2.042E+07	SE2 92 8.293E+02	BR2 92 1.093E+05
KR2 92 4.188E+06	RB2 92 1.506E+07	SR2 92 2.459E+07	Y2 92 2.492E+07	SE2 93 7.106E-08	BR2 93 1.966E+04
KR2 93 1.670E+06	RB2 93 1.152E+07	SR2 93 2.921E+07	Y1 93 1.159E+02	Y2 93 3.065E+07	ZR2 93 3.419E+01
NB1 93 1.856E+00	BR2 94 2.024E+03	KR2 94 3.099E+05	RB2 94 5.461E+06	SR2 94 2.864E+07	Y2 94 3.326E+07
NB1 94 7.821E+01	NB2 94 8.026E-03	BR2 95 1.481E+02	KR2 95 8.760+04	RB2 95 1.626E+06	SR2 95 2.525E+07

*SR2 89
1.60+07

TABLE 12.1-32 (Continued)

Y2 95	ZR2 95	NB1 95	NB2 95	BR2 96	KR2 96
3.657E+07	3.624E+07	4.353E+05	3.476E+07	1.018E+01	1.578E+04
RB2 96	SR2 96	Y2 96	NB2 96	KR2 97	RB2 97
5.848E+05	1.489E+07	3.397E+07	1.381E+05	4.564E+02	6.197E+04
SR2 97	Y2 97	ZR2 97	NB1 97	NB2 97	KR2 98
4.154E+06	2.203E+07	4.092E+07	3.542E+07	4.124E+07	1.455E+02
RB2 98	SR2 98	Y2 98	ZR2 98	NB1 98	NB2 98
3.975E+04	2.656E+06	1.150E+07	4.145E+07	4.257E+07	6.661E+05
RB2 99	SR2 99	Y2 99	ZR2 99	NB1 99	NB2 99
4.399E+03	3.685E+05	8.174E+06	3.667E+07	2.466E+06	4.327E+07
MO2 99	TC1 99	RB2 100	SR2 100	Y2 100	ZR2 100
4.664E+07	4.025E+07	5.381E+02	2.518E+05	3.797E+06	3.509E+07
NB1 100	NB2 100	TC2 100	RB2 101	SR2 101	Y2 101
2.368E+07	2.367E+07	4.477E+06	3.386E-08	2.923E+04	1.389E+07
ZR2 101	NB2 101	MO2 101	TC2 101	SR2 102	Y2 102
1.988E+07	4.129E+07	5.136E+07	5.139E+07	3.200E+03	2.883E+05
ZR2 102	NB2 102	MO2 102	TC1 102	TC2 102	SR2 103
1.346E+07	3.673E+07	5.141E+07	1.009E+05	5.151+07	9.053E+01

TABLE 12.1-32 (Continued)

Y2 103 5.192E+04	ZR2 103 4.267E+06	NB2 103 2.587E+07	MO2 103 5.014E+07	TC2 103 5.144E+07	RU2 103 5.260E+07
RH1 103 5.260+07	SR2 104 3.966E+00	Y2 104 4.130E+03	ZR2 104 1.115E+06	NB2 104 9.915E+06	MO2 104 4.414E+07
TC2 104 4.892E+07	RH1 104 2.552E+05	RH2 104 3.567E+06	Y2 105 2.120E+02	ZR2 105 1.030E+05	NB2 105 3.097E+06
MO2 105 2.784E+07	TC2 105 3.712E+07	RU2 105 3.851E+07	RH1 105 9.935E+06	RH2 105 3.850E+07	Y2 106 2.280E-08
ZR2 106 9.031E+03	NB2 106 5.245E+05	MO2 106 1.513E+07	TC2 106 3.000E+07	RU2 106 1.957E+07	RH1 106 1.206E+04
RH2 106 1.958E+07	Y2 107 8.634E-02	ZR2 107 2.996E+02	NB2 107 5.869E+04	MO2 107 4.308E+06	TC2 107 1.572E+07
RU2 107 2.228E+07	RH2 107 2.238E+07	PD1 107 1.867E+05	PD2 107 3.361E+00	ZR2 108 1.445E+02	NB2 108 1.576E+04
MO2 108 9.097E+05	TC2 108 6.679E+06	RU2 108 1.489E+07	RH1 108 2.056E+05	RH2 108 1.510E+07	AG2 108 3.464E-01
ZR2 109 1.195E+01	NB2 109 3.857E+03	MO2 109 4.258E+05	TC2 109 4.718E+06	RU2 109 1.081E+07	RH1 109 5.613E+06

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TABLE 12.1-32 (Continued)

RH2 109 1.123E+07	PD1 109 5.622E+06	PD2 109 1.159E+07	AG1 109 1.159E+07	CD2 109 3.468E-03	NB2 110 1.121E+02
MO2 110 3.152E+04	TC2 110 5.001E+05	RU2 110 3.766E+06	RH1 110 3.168E+05	RH2 110 4.187E+06	AG1 110 4.327E+04
AG2 110 6.042E+05	NB2 111 1.045E+01	MO2 111 2.782E+03	TC2 111 1.122E+05	RU2 111 1.615E+06	RH2 111 2.[illegible]18E+06
PD1 111 6.111E+04	PD2 111 2.575E+06	AG1 111 2.566E+06	AG2 111 2.609E+06	CD1 111 1.963E+02	NB2 112 9.922E-10
MO2 112 2.445E[illegible]02	TC2 112 1.255E+04	RU2 112 3.241E+05	RH2 112 1.173E+06	PD2 112 1.360E+06	AG2 112 1.363E+06
MO2 113 2.584E+01	TC2 113 3.356E+03	RU2 113 1.563E+05	RH2 113 5.042E+05	PD2 113 9.061E+05	AG1 113 9.309E+05
AG2 113 8.193E+05	CD1 113 1.914E+03	IN1 113 2.350E-04	MO2 114 1.543E+00	TC2 114 3.877E+02	RU2 114 4.533E+04
RH2 114 2.661E+05	PD2 114 6.535E+05	AG2 114 6.714E+05	IN1 114 2.007E+01	IN2 114 3.226E+01	MO2 115 8.050E-02
TC2 115 6.701E+01	RU2 115 8.954E+03	RH2 115 1.325E+05	PD2 115 5.015E+05	AG1 115 1.650E+05	AG2 115 3.991E+05

TABLE 12.1-32 (Continued)

CD1 115	CD2 115	IN1 115	IN2 115	TC2 116	RU2 116
3.545E+04	5.462E+05	5.461E+05	1.107E-09	5.069E+00	2.249E+03
RH2 116	PD2 116	AG1 116	AG2 116	IN1 116	IN2 116
3.526E+04	3.315E+05	2.184E+05	2.248E+05	3.233E+04	8.907E+03
TC2 117	RU2 117	RH2 117	PD2 117	AG1 117	AG2 117
2.474E-01	2.264E+02	1.406E+04	2.239E+05	2.027E+05	2.084E+05
CD1 117	CD2 117	IN1 117	IN2 117	SN1 117	TC2 118
6.490E+04	3.991E+05	3.712E+05	2.674E+05	2.463E+02	1.992E-11
RU2 118	RH2 118	PD2 118	AG1 118	AG2 118	CD2 118
1.708E+03	1.184E+04	1.257E+05	1.713E+05	2.019E+05	4.458E+05
IN1 118	IN2 118	RU2 119	RH2 119	PD2 119	AG2 119
5.170E+02	4.464E+05	6.936E-07	6.082E+03	1.927E+05	4.020E+05
CD1 119	CD2 119	IN1 119	IN2 119	SN1 119	RU2 120
2.206E+05	2.206E+05	2.207E+05	2.317E+05	9.973E+03	3.864E-01
RH2 120	PD2 120	AG2 120	CD2 120	IN1 120	IN2 120
1.472E+02	1.923E+04	1.277E+05	4.162E+05	2.193E+05	2.206E+05
RH2 121	PD2 121	AG2 121	CD2 121	IN1 121	IN2 121
2.759E+01	4.928E+03	7.996E+05	3.984E+05	1.055E+05	3.656E+05

TABLE 12.1-32 (Continued)

SN1 121 1.941E+01	SN2 121 4.747E+05	RH2 122 4.007E+00	PD2 122 1.870E+03	AG2 122 2.311E+04	CD2 122 3.339E+05
IN1 122 5.355E+04	IN2 122 4.179E+05	SB1 122 4.222E+02	SB2 122 4.110E+04	RH2 123 5.249E-01	PD2 123 3.835E+02
AG2 123 1.662E+04	CD2 123 3.118E+05	IN1 123 1.959E+05	IN2 123 3.646E+05	SN1 123 2.041E+05	SN2 123 3.615E+05
TE1 123 1.695E+02	TE2 123 2.219E-11	PD2 124 1.214E+02	AG2 124 5.920E+03	CD2 124 2.604E+05	IN2 124 6.125E+05
SB2 124 2.498E+04	PD2 125 4.483E-08	AG2 125 2.903E+03	CD2 125 1.816E+05	IN1 125 3.917E+05	IN2 125 4.415E+05
SN1 125 5.836E+05	SN2 125 7.583E+05	SB2 125 3.964E+05	TE1 125 7.878E+04	PD2 126 3.681E+00	AG2 126 8.480E+02
CD2 126 1.093E+05	IN2 126 7.273E+05	SN2 126 1.947E+00	SB2 126 6.887+04	AG2 127 8.151E-08	CD2 127 4.680E+04
IN1 127 4.104E+05	IN2 127 3.841E+05	SN1 127 1.266E+06	SN2 127 2.165E+06	SB2 127 3.762E+06	TE1 127 5.399E+05
TE2 127 3.690E+06	AG2 128 1.225E+02	CD2 128 4.099E+04	IN2 128 6.840E+05	SN2 128 4.626E+06	SB1 128 5.225E+06

TABLE 12.1-32 (Continued)

SB2 128	I2 128	CD2 129	IN2 129	SN1 129	SN2 129
6.054E+05	2.573E+05	9.224E+03	4.333E+05	3.347E+06	3.352E+06
SB2 129	TE1 129	TE2 129	I2 129	XE1 129	CD2 130
1.029E+07	2.651E+06	9.706E+06	6.730E-01	2.071E+03	2.092E+04
IN2 130	SN2 130	SB1 130	SB2 130	I1 130	I2 130
5.655E+05	1.003E+07	1.226E+07	4.224E+06	3.288E+05	6.079E+05
CD2 131	IN2 131	SN2 131	SB2 131	TE1 131	TE2 131
3.291E+03	2.360E+05	9.170E+06	2.447E+07	4.454E+06	2.633E+07
I2 131	XE1 131	CD2 132	IN2 132	SN2 132	SB1 132
3.004E+07	2.121E+05	3.220E+02	6.328E+04	4.786E+06	8.503E+06
SB2 132	TE2 132	I2 132	IN2 133	SN2 133	SB2 133
1.332E+07	3.998E+07	4.080E+07	9.661E+03	1.435E+06	1.361E+07
TE1 133	TE2 133	I1 133	I2 133	XE1 133	XE2 133
1.683E+07	3.204E+07	2.349E+06	5.150E+07	1.62E+06	5.226E+07
IN2 134	SN2 134	SB1 134	SB2 134	TE2 134	I1 134
6.657E+02	2.828E+05	2.691E+06	2.343E+06	4.032E+07	7.157E+06
I2 134	XE1 134	CS1 134	CS2 134	SN2 135	SB2 135
5.465E+07	2.889E+05	2.652E+05	6.603E+05	2.819E+04	1.515E+06

TABLE 12.1-32 (Continued)

TE2 135	I2 135	XE1 135	XE2 135	CS1 135	CD2 135
2.459E+07	5.039E+07	1.109E+07	5.648E+07	2.758E+04	2.549E+01
BA1 135	SN2 136	SB2 136	TE2 136	I1 136	I2 136
2.318E+02	3.145E+03	2.441E+05	1.073E+07	1.254E+07	2.349E+07
CS2 136	BA1 136	SB2 137	TE2 137	I2 137	XE2 137
2.654E+06	4.247E+05	5.553E+04	3.948E+06	2.134E+07	4.569E+07
CS2 137	BA1 137	SB2 138	TE2 138	I2 138	XE2 138
1.702E+06	1.617E+06	7.528E+03	1.060E+06	1.075E+07	3.643E+07
CS1 138	CS2 138	XE2 138	LA2 138	SB2 139	TE2 139
2.542+06	4.649E+07	3.643E+07	6.734E-10	6.001E+02	2.014E+05
I2 139	XE2 139	CS2 139	BA2 139	TE2 140	I2 140
4.354E+06	3.334E+07	4.444E+07	4.529E+07	3.452E+04	1.181E+06
XE2 140	CS2 140	BA2 140	LA2 140	TE2 141	I2 141
1.955E+07	3.823E+07	4.190E+07	4.218E+07	1.312E+03	2.028E+05
XE2 141	CS2 141	BA2 141	LA2 141	CE2 14	TE2 142
7.600E+06	1.495E+07	4.265E+07	4.290E+07	4.287E+07	1.954E+02
I2 142	XE2 142	CS2 142	BA2 142	LA2 142	CE2 142
4.102E+04	2.711E+06	1.495E+07	3.655E+07	3.770E+07	3.806E-04

TABLE 12.1-32 (Continued)

PR1 142	PR2 142	I2 143	XE2 143	CS2 143	BA2 143
2.570E+05	5.130E+05	3.377E+03	3.726E+05	6.734E+06	3.046E+07
LA2 143	CE2 143	PR2 143	I2 144	XE2 144	CS2 144
3.455E+07	3.481E+07	3.478E+07	2.823E+02	1.192E+05	2.448E+06
BA2 144	LA2 144	CE2 144	PR1 144	PR2 144	ND2 144
2.120E+07	2.894E+07	2.016E+07	2.552E+05	2.019E+07	7.649E-09
I2 145	XE2 145	CS2 145	BA2 145	LA2 145	CE2 145
1.427E-08	1.710E+04	5.590E+05	1.148E+07	2.237E+07	2.501E+07
PR2 145	XE2 146	CS2 146	BA2 146	LA2 146	CE2 146
2.503E+07	1.143E+03	8.232E+04	4.536E+06	1.495E+07	2.060E+07
PR2 146	XE2 147	CS2 147	BA2 147	LA2 147	CE2 147
2.070E+07	8.668E+01	2.758E+04	1.376E+06	7.677E+06	1.620E+07
PR2 147	ND2 147	PM2 147	SM2 147	CS2 148	BA2 148
1.676E+07	1.703E+07	5.021E+06	3.044E-05	1.597E+03	3.829E+05
LA2 148	CE2 148	PR2 148	PM1 148	PM2 148	SM2 148
2.797E+06	1.218E+07	1.372E+07	7.387E+05	7.891E+05	1.157E-10
CS2 149	BA2 149	LA2 149	CE2 149	PR2 149	ND2 149
3.283E-07	4.344E+04	9.875E+05	5.986E+05	1.051E+07	1.110E+07

TABLE 12.1-32 (Continued)

PM2 149 1.110E+07	SM2 149 1.065E-09	CS2 150 1.593E+00	BA2 150 4.159E+03	LA2 150 1.722E+05	CE2 150 2.879E+06
PR2 150 7.327E+06	PM2 150 1.026E+04	BA2 151 1.152E-05	LA2 151 3.065E+04	CE2 151 1.043E+06	PR2 151 4.280E+06
ND2 151 6.637E+06	PM2 151 6.673E+06	SM2 151 6.838E+04	BA2 152 1.075E+01	LA2 152 3.215E+03	CE2 152 3.853E+05
PR2 152 2.259E+06	ND2 152 4.874E+06	PM2 152 4.949E+06	EU1 152 4.909E+03	EU2 152 3.072E+02	GD2 152 1.844E-11
LA2 153 4.127E+02	CE2 153 7.587E+04	PR2 153 8.321E+05	ND2 153 2.856E+06	PM2 153 3.178E+06	SM2 153 3.464E+06
GD2 153 5.706E+01	LA2 154 1.709E+01	CE2 154 1.181E+04	PR2 154 2.213E+05	ND2 154 1.830E+06	PM1 154 2.415E+05
PM2 154 2.095E+06	EU2 154 3.147E+04	LA2 155 5.061E-09	CE2 155 1.156E+03	PR2 155 6.465E+04	ND2 155 9.661E+05
PM2 155 1.518E+06	SM2 155 1.657E+06	EU2 155 2.834E+05	CE2 156 1.272E+02	PR2 156 1.022E+04	ND2 156 4.255E+05
PM2 156 8.852E+05	SM2 156 1.022E+06	EU2 156 1.339E+06	CE2 157 6.965E+00	PR2 157 1.555E+03	ND2 157 1.148E+05

TABLE 12.1-32 (Continued)

PM2 157	SM2 157	EU2 157	PR2 158	ND2 158	PM2 158
5.038E+05	7.415E+05	7.531E+05	9.092E+01	1.896E+04	1.679E+05
SM2 158	EU2 158	PR2 159	ND2 159	PM2 159	SM2 159
4.487E+05	4.682E+05	3.674E+00	1.621E+03	4.116E+04	2.302E+05
EU2 159	GD2 159	ND2 160	PM2 160	SM2 160	EU2 160
2.671E+05	2.954E+05	1.395E+02	6.625E+03	1.120E+05	1.624E+05
TB2 160	ND2 161	PM2 161	SM2 161	EU2 161	GD2 161
3.984E+04	7.062E+00	6.466E+02	2.282E+04	6.093E+04	9.125E+04
TB2 161	PM2 162	SM2 162	EU2 162	GD2 162	TB1 162
9.183E+04	8.563E+00	1.974E+03	1.799E+04	4.037E+04	1.592E+03
TB2 162	SM2 163	EU2 163	GD2 163	TB2 163	SM2 164
4.036E+04	1.318E+02	3.358E+03	1.587E+04	1.786E+04	1.052E+01
EU2 164	GD2 164	TB2 164	SM2 165	EU2 165	GD2 165
6.291E+02	8.073E+03	1.102E+04	3.951E-01	8.256E+01	2.744E+03
TB2 165	DY1 165	DY2 165	DY2 166	HO1 166	HO2 166
5.591E+03	4.335E+03	7.815E+03	1.131E+03	2.607E-01	1.731E+03
ER1 167					
1.894E+00					

Amend. 65
Feb. 1982

A-14

DISTRIBUTION
CENTRAL FILE
AEB R/F
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Plant File
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MAY 2 8 1982

MEMORANDUM FOR: Paul S. Check, Director
Clinch River Breeder Reactor Program Office, NRR

FROM: R. W. Houston, Assistant Director
for Radiation Protection
Division of Systems Integration

SUBJECT: EVALUATION OF CLASS 9 ACCIDENTS FOR THE CRBR ENVIRONMENTAL REVIEW

In response to your request to L. G. Hulman, dated 3/31/82, the Accident Evaluation Branch (AEB) has re-evaluated the risks resulting from a Class 9 accident at CRBR site.

Per your request, AEB has utilized as a basis the Class 9 accident scenario in the existing FES. The event chosen in the FES results in release into the outer containment of 100% of the noble gases, 10% of the volatiles including halogens, and 1% of the solid fission products and fuel (including plutonium). Radionuclides are assumed to be released to atmosphere as a result of the failure of the containment 24 hours after their release from the core. The accident probability of one chance in one hundred thousand per year provided in your request was used in the present analysis. Since our evaluation is based on the methodologies of the Reactor Safety Study and the related follow-on work on calculation of light water reactor (LWR) consequences, our methods at present do not account for the large quantities of sodium present in the CRBRP in place of the large quantities of water present in the LWRs.

The results of the AEB analysis indicate that the calculated risks for the selected CRBR accident release are substantially below the risks that the staff has presented in the environmental statements of light water reactors which have been licensed since the issuance of the Comission's June, 1980 Statement of policy. Based on this analysis the AEB has revised its 12/18/81 transmittal to you by including the findings of the present analysis. The revised input is enclosed.

This evaluation was performed, and the attached input prepared by Mohan Thadani X28941. The addendum on the liquid pathway was prepared by R. Codell (HGEB), and reported in AEB transmittal to you dated 12/19/82.

Original signed by
R. Wayne Houston

R. Wayne Houston, Assistant Director
for Radiation Protection
Division of Systems Integration

8206080462

Enclosure: As stated

cc: H. Denton, E. Case, R. Mattson, P. Leech, J. Swift, W. Pasedag, M. Thadani, R. Codell, G. Lear

*See Previous Concurrence Sheet

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ACCIDENT EVALUATION BRANCH INPUT TO THE FINAL ENVIRONMENTAL STATEMENT UPDATE FOR CLINCH RIVER BREEDER REACTOR PLANT

Addendum to Section 7.1

7.1 PLANT ACCIDENTS INVOLVING RADIOACTIVE MATERIALS

The staff has examined the Clinch River Breeder Reactor Plant (CRBRP) Final Environmental Statement (FES) with a view to updating the FES reflecting any plant-site features or regulatory framework changes that have occurred since the FES was issued in February 1977. The staff finds that since the issuance of the FES no plant-site changes have occurred that would materially change the environmental impacts or risks of accidents as reported in the FES. Since the issuance of the FES, however, the Commission has issued a Statement of Interim Policy (June 13, 1980) that provides guidance on the considerations to be given to nuclear power plant accidents under NEPA. Among other things the Commission's statement indicated that "this change in policy is not to be construed as any lack of confidence in conclusions regarding the environmental risks of accidents expressed in any previously issued (Environmental Impact) statements, nor, absent a showing of --- special circumstances, as a basis for opening, reopening, or expanding any previous or ongoing proceeding."

The staff in its environmental review of the CRBRP application concluded that the CRBRP did constitute a special circumstance that warranted consideration of Class 9 accidents in the Environmental Statement. Since the CRBRP reactor was very different from the conventional light water reactor plants for which the safety experience base is much broader, the staff included in the CRBRP FES a discussion of the potential impacts and risks of such accidents. As noted in the Statement of Interim Policy, the fact that the staff had identified this case as a special circumstance was one of the considerations that led to the promulgation of the June 13, 1980 Statement.

In examining the CRBRP FES, as issued in 1977, the staff has considered the guidance of the Interim Policy Statement which was provided for "Future NEPA Reviews." We have concluded that the discussion of accidents as presented in the FES generally meets that guidance except for consideration of the risks due to liquid pathways. A discussion of the liquid pathway risks is included below.

The staff has also performed some new calculations to provide an additional perspective on the risk associated with the atmospheric release pathway for a hypothetical Class 9 accident at the CRBR, as discussed below:

A probabilistic risk analysis such as the Reactor Safety Study, WASH-1400, attempts to portray the complete spectrum of possible Class 9 event sequence. Such a probabilistic risk analysis has not been performed for the CRBR as currently designed. Therefore, for the purpose of estimating the risks of Class 9 events at the CRBR site comparable to the risks presented in environmental statements for LWRs, the staff has selected, as representative of the Class 9 event category, a specific release of radioactivity from the CRBR core with an associated estimate of a probability of its occurrence.

The event analyzed is that described in the FES (Table 7.2, f.n.11). Specifically, an accident is postulated which results in a core release of 100% of the noble gases and volatiles, 10% of the solid fission product inventory and 10% of the plutonium inventory.* In this scenario, the volatiles, including halogens, are reduced to 10% of the core inventory and the solid fission products and fuel are reduced to 1% of the core inventory during passage out of the reactor vessel and into the outer containment building. Containment leakage is taken as proportional to the square root of the pressure for 24 hours, at which time containment integrity is assumed to be lost and all airborne material released to the environment.

*In addition to these elements, activation products of the primary coolant (i.e. radioactive isotopes of sodium) would be released to the containment in accidents involving the loss of primary coolant. Although it is recognized that these isotopes could be substantial contributors to the accident source term, the present analytical models used by the staff are not readily amenable to an explicit inclusion of these isotopes in the quantitative analysis described herein.

The probability of this representative event has been estimated to be not greater than one in one hundred thousand per reactor year. This probability was selected for the new calculations discussed here in consideration of the nature of the representative sequence, in comparison with the results of other probabilistic risk ansyses, and in consideration of the staff's objective that there be no greater than one chance in a million per year for potential consequences greater than 10 CFR Part 100 guidelines for an individual plant.

ATMOSPHERIC PATHWAYS

The potential atmospheric pathway radiological consequences of this release have been calculated by the consequence model used in the RSS (NUREG-0340) adapted and modified to the specific CRBRP site. The model used one year site meteorology data, projected population for the year 2010 extending throughout regions of 80-km (50-mi) radius and 56-km (350-mi) radius from the site, and habitable land fractions within the 563-km (350-mi) radius.

The results of the calculations are summarized in table 7-1A as expectation values, or averages of environmental risk per year of reactor operation. These averages are instructive as an aid to the comparison of radiological risks associated with CRBR accident releases and those associated with risks calculated for recently evaluated LWRs. The table shows the average risk associated with population dose, early fatalities, latent fatalities, and cost of evacuation and protective actions.

TABLE 7.1A
Average Values of Environmental Risks
due to Selected CRBR Accident

Environmental Risk (Per Reactor Year)	Average Value
Population exposure	
Person-rems within 80 km	8
Total person-rems	12
Early Fatalities	0.0000004
Latent cancer, fatalities	
All organs excluding thyroid	0.0007
Thyroid only	0.00005
Cost of protective actions and decontamination	$156*

*1980 dollars

It should be noted that these results do not fully account for the effects of the sodium coolant on the radioactive source term. For example, inclusion of the effects of sodium is expected to reduce the quantity of iodine available for leakage. The large mass of sodium aerosol also contributes to the agglomeration and settling of aerosols in the primary containment. On the other hand, the sodium activation products would be released together with the primary coolant, thereby adding to the amount of radioactive material released to the containment. On balance, it is expected that these effects would not be so large as to invalidate the conclusions of these calculations. Further consideration of this subject will be included in the staff's review of the Probabilistic Risk Assessment for this plant, and in the staff's Safety Evaluation Report.

The assessment of environmental risks of atmospheric pathways, assuming reasonable protective action, shows that they are significantly lower than similarly calculated values for light water reactors currently being licensed for operation. See, for example, FES for Calloway (NUREG-0813), DES for Seabrook Station (NUREG-0895), FES for Susquehanna Station (NUREG-0564), and DES for Skagit (NUREG-0894) for the environmental risks of light water reactors.

LIQUID PATHWAYS

Surface water hydrologic properties at CRBRP should be similar to those used for the Liquid Pathways Generic Study (LPGS) small river site which was based on the Clinch - Tennessee - Ohio - Mississippi rivers system, although the river uses and populations in the LPGS were based upon national averages and have not been directly compared to the CRBRP. The groundwater characteristics at Clinch River do not indicate any unusual adverse transport characteristics.

Additionally, the CRBRP is a considerably smaller plant than LPGS case (CRBRP is 1121 MWt vs. 3425 MWt assumed for LPGS), and contrary to the Light Water Reactors characteristics, CRBRP does not contain any large storage of water which could serve as a potential "prompt source" to to the environmental liquid pathways. Therefore, only the radioactive material leached from the core debris by the local groundwater is likely to be transported to the Clinch River. This source was found in the LPGS to be considerably smaller than the "prompt source". Therefore, based on the preliminary appraisal of the liquid pathways, the staff concludes that the liquid pathways impacts of CRBRP would be probably smaller than those for the LWRs analyzed in the LPGS "Small River" site case.

CONCLUSION

The foregoing sections have evaluated the environmental impacts of a severe accident including potential radiation exposure to the population as a whole, the risk of near - and long-term adverse health effects that such exposures could entail, and the potential economic and societal consequences of accidental contamination of the environment. The overall assessment of environmental risk of accidents, assuming reasonable protective action, shows that it is significantly lower than the risk from light water reactors currently being licensed for operation, and the conclusions reached in the FES remain unchanged by this evaluation.