TABLE 22-DWPF. RADIOACTIVITY OF ACTIVATION PRODUCTS
IN DECAY OF SRP HLW: ELEMENTS

BASED ON ONE CANISTER, SLUDGE + SUPERNATE GLASS (3710 LB/CANISTER).

	CURIES							
ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
CO	1.699E+02	1.490E+02	4.560E+01	3.283E-04	0.0	0.0	0.0	0.0
NI	3.001E+00	2.978E+00	2.785E+00	1.425E+00	2.535E-02	2.198E-02	1.008E-02	4.137E-06
SUMTOT	1.729E+02	1.519E+02	4.838E+01	1.426E+00	2.535E-02	2.198E-02	1.008E-02	4.137E-06
TOTAL	1.729E+02	1.519E+02	4.838E+01	1.426E+00	2.535E-02	2.198E-02	1.008E-02	4.137E-06

ELEMENTS CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 23-DWPF. THERMAL POWER OF ACTIVATION PRODUCTS
IN DECAY OF SRP HLW: NUCLIDES

BASED ON ONE CANISTER, SLUDGE + SUPERNATE GLASS (3710 LB/CANISTER).

	WATTS							
NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
CO 60	2.619E+00	2.297E+00	7.030E-01	5.062E-06	0.0	0.0	0.0	0.0
NI 59	9.519E-07	9.518E-07	9.518E-07	9.510E-07	9.436E-07	8.728E-07	4.002E-07	1.643E-10
NI 63	3.000E-04	2.977E-04	2.782E-04	1.412E-04	1.603E-07	5.707E-37	0.0	0.0
SUMTOT	2.620E+00	2.297E+00	7.033E-01	1.472E-04	1.104E-06	8.728E-07	4.002E-07	1.643E-10
TOTAL	2.620E+00	2.297E+00	7.033E-01	1.472E-04	1.104E-06	8.728E-07	4.002E-07	1.643E-10

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 24-DWPF. THERMAL POWER OF ACTIVATION PRODUCTS
IN DECAY OF SRP HLW: ELEMENTS

BASED ON ONE CANISTER, SLUDGE + SUPERNATE GLASS (3710 LB/CANISTER).

	WATTS							
ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
CO	2.619E+00	2.297E+00	7.030E-01	5.062E-06	0.0	0.0	0.0	0.0
NI	3.009E-04	2.987E-04	2.791E-04	1.422E-04	1.104E-06	8.728E-07	4.002E-07	1.643E-10
SUMTOT	2.620E+00	2.297E+00	7.033E-01	1.472E-04	1.104E-06	8.728E-07	4.002E-07	1.643E-10
TOTAL	2.620E+00	2.297E+00	7.033E-01	1.472E-04	1.104E-06	8.728E-07	4.002E-07	1.643E-10

ELEMENTS CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 25-DWPF. PHOTON SPECTRUM OF ACTIVATION PRODUCTS IN DECAY OF SRP HLW

BASED ON ONE CANISTER, SLUDGE + SUPERNATE GLASS (3710 LB/CANISTER).

PHOTONS/SEC

EMEAN	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
18 GROUP PHOTON RELEASE RATES, PHOTONS/SECOND								
1.000E-02	3.337E+11	2.926E+11	8.996E+10	2.873E+08	3.254E+05	1.159E-24	0.0	0.0
2.500E-02	5.760E+10	5.051E+10	1.548E+10	1.758E+07	1.983E+04	7.060E-26	0.0	0.0
3.750E-02	3.287E+10	2.882E+10	8.828E+09	3.604E+06	4.019E+03	1.431E-26	0.0	0.0
5.750E-02	3.708E+10	3.251E+10	9.952E+09	4.298E+05	4.067E+02	1.448E-27	0.0	0.0
8.500E-02	1.458E+10	1.278E+10	3.913E+09	2.817E+04	0.0	0.0	0.0	0.0
1.250E-01	5.599E+09	4.909E+09	1.503E+09	1.082E+04	0.0	0.0	0.0	0.0
2.250E-01	1.841E+09	1.614E+09	4.942E+08	3.558E+03	0.0	0.0	0.0	0.0
3.750E-01	5.166E+08	4.529E+08	1.386E+08	9.983E+02	0.0	0.0	0.0	0.0
5.750E-01	2.966E+07	2.601E+07	7.961E+06	5.732E+01	0.0	0.0	0.0	0.0
8.500E-01	4.694E+08	4.116E+08	1.260E+08	9.072E+02	0.0	0.0	0.0	0.0
1.250E+00	1.257E+13	1.102E+13	3.373E+12	2.429E+07	0.0	0.0	0.0	0.0
1.750E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.250E+00	6.661E+07	5.840E+07	1.788E+07	1.287E+02	0.0	0.0	0.0	0.0
2.750E+00	2.061E+05	1.807E+05	5.532E+04	3.983E-01	0.0	0.0	0.0	0.0
3.500E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.000E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.500E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	1.305E+13	1.144E+13	3.504E+12	3.332E+08	3.497E+05	1.245E-24	0.0	0.0

TABLE 1-HANF. CONCENTRATIONS OF ACTINIDES AND DAUGHTERS IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

GRAMS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
HE 4	0.0	8.083E-03	7.986E-02	7.437E-01	4.028E+00	5.354E+00	6.849E+00	2.632E+01
BI209	0.0	7.845E-15	9.053E-12	8.960E-09	1.020E-05	1.078E-02	3.234E+00	1.437E+02
U233	0.0	1.410E-04	1.447E-03	1.483E-02	1.877E-01	2.239E+00	1.867E+01	4.124E+01
U235	1.504E+02	1.504E+02	1.504E+02	1.506E+02	1.520E+02	1.648E+02	2.061E+02	2.093E+02
U238	1.749E+04	1.749E+04	1.749E+04	1.749E+04	1.749E+04	1.749E+04	1.749E+04	1.749E+04
NP237	4.425E+02	4.430E+02	4.472E+02	4.862E+02	6.783E+02	7.355E+02	7.144E+02	5.338E+02
PU239	5.789E+01	5.789E+01	5.788E+01	5.774E+01	5.644E+01	4.454E+01	3.425E+00	1.888E-11
AM241	3.000E+02	2.995E+02	2.954E+02	2.559E+02	6.042E+01	3.257E-05	0.0	0.0
SUMTOT	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04
TOTAL	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04

NUCLIDES CONTRIBUTING < 0.1000 % ARE OMITTED

TABLE 2-HANF. CONCENTRATIONS OF ACTINIDES AND DAUGHTERS IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

GRAMS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
HE	0.0	8.083E-03	7.986E-02	7.437E-01	4.028E+00	5.354E+00	6.849E+00	2.632E+01
PB	0.0	1.286E-14	1.340E-11	7.758E-09	1.376E-06	1.907E-04	2.268E-02	1.568E+00
BI	0.0	7.848E-15	9.054E-12	8.960E-09	1.020E-05	1.078E-02	3.234E+00	1.437E+02
TH	0.0	6.311E-07	4.076E-06	4.404E-05	9.099E-04	4.222E-02	8.636E-01	2.664E+00
U	1.765E+04	1.765E+04	1.765E+04	1.765E+04	1.766E+04	1.767E+04	1.773E+04	1.776E+04
NP	4.425E+02	4.430E+02	4.472E+02	4.862E+02	6.783E+02	7.355E+02	7.144E+02	5.338E+02
PU	6.347E+01	6.346E+01	6.332E+01	6.293E+01	6.113E+01	4.636E+01	3.448E+00	4.598E-03
AM	3.023E+02	3.018E+02	2.976E+02	2.581E+02	6.245E+01	8.706E-01	1.858E-04	3.620E-41
SUMTOT	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04
TOTAL	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04	1.846E+04

ELEMENTS CONTRIBUTING < 0.0001 % ARE OMITTED

TABLE 3-HANF. RADIOACTIVITY OF ACTINIDES AND DAUGHTERS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL207	0.0	1.081E-10	9.871E-09	4.796E-07	6.828E-06	6.506E-05	3.743E-04	4.513E-04
TL209	0.0	1.392E-12	1.454E-10	1.442E-08	1.686E-06	1.636E-04	3.565E-03	8.676E-03
PB209	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
PB210	0.0	3.514E-16	3.890E-13	5.893E-10	5.273E-07	3.633E-05	7.685E-04	5.419E-03
PB211	0.0	1.084E-10	9.899E-09	4.810E-07	6.847E-06	6.524E-05	3.753E-04	4.525E-04
PB214	0.0	3.492E-14	4.268E-12	1.199E-09	5.274E-07	3.634E-05	7.687E-04	5.420E-03
BI210	0.0	3.514E-16	3.890E-13	5.893E-10	5.273E-07	3.633E-05	7.685E-04	5.419E-03
BI211	0.0	1.084E-10	9.899E-09	4.810E-07	6.847E-06	6.524E-05	3.753E-04	4.525E-04
BI213	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
BI214	0.0	3.492E-14	4.268E-12	1.199E-09	5.274E-07	3.634E-05	7.687E-04	5.420E-03
PO210	0.0	1.136E-16	3.890E-13	5.893E-10	5.273E-07	3.633E-05	7.685E-04	5.419E-03
PO213	0.0	6.307E-11	6.588E-09	6.532E-07	7.638E-05	7.410E-03	1.615E-01	3.930E-01
PO214	0.0	3.491E-14	4.267E-12	1.199E-09	5.273E-07	3.633E-05	7.685E-04	5.419E-03
PO215	0.0	1.084E-10	9.899E-09	4.810E-07	6.847E-06	6.524E-05	3.753E-04	4.525E-04
PO218	0.0	3.492E-14	4.269E-12	1.200E-09	5.275E-07	3.635E-05	7.688E-04	5.421E-03
AT217	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
RN219	0.0	1.084E-10	9.899E-09	4.810E-07	6.847E-06	6.524E-05	3.753E-04	4.525E-04
RN222	0.0	3.492E-14	4.269E-12	1.200E-09	5.275E-07	3.635E-05	7.688E-04	5.421E-03
FR221	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
RA223	0.0	1.084E-10	9.899E-09	4.810E-07	6.847E-06	6.524E-05	3.753E-04	4.525E-04
RA225	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
RA226	0.0	3.492E-14	4.268E-12	1.200E-09	5.275E-07	3.635E-05	7.688E-04	5.421E-03
AC225	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
AC227	0.0	1.084E-10	9.894E-09	4.809E-07	6.847E-06	6.524E-05	3.753E-04	4.525E-04
TH227	0.0	1.069E-10	9.763E-09	4.743E-07	6.753E-06	6.434E-05	3.701E-04	4.463E-04
TH229	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
TH230	0.0	1.631E-10	2.176E-09	7.581E-08	3.373E-06	4.814E-05	7.645E-04	5.420E-03
TH231	0.0	3.252E-04	3.253E-04	3.256E-04	3.287E-04	3.565E-04	4.457E-04	4.525E-04
TH234	0.0	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.881E-03
PA231	0.0	6.880E-09	6.888E-08	6.879E-07	6.845E-06	6.522E-05	3.753E-04	4.525E-04
PA233	0.0	3.124E-01	3.154E-01	3.429E-01	4.783E-01	5.187E-01	5.038E-01	3.764E-01
PA234M	0.0	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.881E-03
U233	0.0	1.365E-06	1.401E-05	1.436E-04	1.818E-03	2.169E-02	1.808E-01	3.994E-01
U234	1.750E-05	1.877E-05	3.096E-05	1.487E-04	5.024E-04	6.452E-04	1.825E-03	5.565E-03
U235	3.252E-04	3.252E-04	3.253E-04	3.256E-04	3.287E-04	3.565E-04	4.457E-04	4.525E-04
U236	8.188E-04	8.188E-04	8.191E-04	8.222E-04	8.519E-04	1.034E-03	1.146E-03	1.116E-03
U238	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.881E-03
NP237	3.121E-01	3.124E-01	3.154E-01	3.429E-01	4.783E-01	5.187E-01	5.038E-01	3.764E-01
NP239	0.0	4.441E-01	4.437E-01	4.400E-01	4.043E-01	1.736E-01	3.704E-05	7.220E-42
PU238	4.110E-01	4.588E-01	4.724E-01	4.242E-01	1.196E-02	1.840E-20	0.0	0.0
PU239	3.600E+00	3.600E+00	3.599E+00	3.591E+00	3.510E+00	2.769E+00	2.130E-01	1.174E-12

TABLE 3-HANF. RADIOACTIVITY OF ACTINIDES AND DAUGHTERS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
PU240	1.180E+00	1.180E+00	1.180E+00	1.170E+00	1.064E+00	4.097E-01	2.939E-05	0.0
PU241	3.741E+01	3.565E+01	2.312E+01	3.037E-01	4.646E-20	0.0	0.0	0.0
PU242	6.501E-05	6.519E-05	6.681E-05	7.976E-05	1.047E-04	1.035E-04	8.806E-05	1.756E-05
AM241	1.030E+03	1.028E+03	1.014E+03	8.785E+02	2.075E+02	1.118E-04	0.0	0.0
AM242M	5.961E-01	5.934E-01	5.695E-01	3.778E-01	6.237E-03	9.368E-21	0.0	0.0
AM242	0.0	5.904E-01	5.667E-01	3.759E-01	6.205E-03	9.321E-21	0.0	0.0
AM243	4.441E-01	4.441E-01	4.437E-01	4.400E-01	4.043E-01	1.736E-01	3.704E-05	7.220E-42
CM242	1.230E+01	2.992E+00	4.688E-01	3.109E-01	5.132E-03	7.731E-21	0.0	0.0
CM244	9.696E-01	9.332E-01	6.613E-01	2.110E-02	2.310E-17	0.0	0.0	0.0
SUMTOT	1.087E+03	1.076E+03	1.046E+03	8.867E+02	2.138E+02	4.667E+00	2.754E+00	4.449E+00
TOTAL	1.087E+03	1.076E+03	1.046E+03	8.867E+02	2.138E+02	4.667E+00	2.754E+00	4.449E+00

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 4-HANF. RADIOACTIVITY OF ACTINIDES AND DAUGHTERS
IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL	0.0	1.095E-10	1.002E-08	4.940E-07	8.515E-06	2.286E-04	3.939E-03	9.128E-03
PB	0.0	1.729E-10	1.664E-08	1.150E-06	8.597E-05	7.711E-03	1.670E-01	4.130E-01
BI	0.0	1.729E-10	1.664E-08	1.150E-06	8.597E-05	7.711E-03	1.670E-01	4.130E-01
PC	0.0	1.718E-10	1.652E-08	1.139E-06	8.483E-05	7.584E-03	1.642E-01	4.097E-01
AT	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
RN	0.0	1.084E-10	9.903E-09	4.822E-07	7.375E-06	1.016E-04	1.144E-03	5.874E-03
FR	0.0	6.596E-11	6.870E-09	6.743E-07	7.816E-05	7.574E-03	1.650E-01	4.017E-01
RA	0.0	1.729E-10	1.664E-08	1.150E-06	8.544E-05	7.675E-03	1.662E-01	4.076E-01
AC	0.0	1.728E-10	1.663E-08	1.149E-06	8.492E-05	7.639E-03	1.654E-01	4.021E-01
TH	0.0	6.208E-03	6.208E-03	6.209E-03	6.299E-03	1.392E-02	1.725E-01	4.139E-01
PA	0.0	3.183E-01	3.213E-01	3.488E-01	4.842E-01	5.247E-01	5.101E-01	3.827E-01
U	7.044E-03	7.921E-03	7.639E-03	7.330E-03	9.383E-03	2.960E-02	1.901E-01	4.124E-01
NP	3.121E-01	7.594E-01	7.619E-01	7.848E-01	8.827E-01	6.923E-01	5.038E-01	3.764E-01
PU	4.260E+01	4.089E+01	2.837E+01	5.489E+00	4.586E+00	3.179E+00	2.131E-01	1.756E-05
AM	1.031E+03	1.030E+03	1.016E+03	8.797E+02	2.079E+02	1.737E-01	3.704E-05	7.220E-42
CM	1.327E+01	3.925E+00	1.130E+00	3.320E-01	5.132E-03	7.731E-21	0.0	0.0
SUMTOT	1.087E+03	1.076E+03	1.046E+03	8.867E+02	2.138E+02	4.667E+00	2.754E+00	4.449E+00
TOTAL	1.087E+03	1.076E+03	1.046E+03	8.867E+02	2.138E+02	4.667E+00	2.754E+00	4.449E+00

ELEMENTS CONTRIBUTING < 0.0001 % ARE OMITTED

TABLE 5-HANF. THERMAL POWER OF ACTINIDES AND DAUGHTERS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL207	0.0	3.173E-13	2.899E-11	1.408E-09	2.005E-08	1.911E-07	1.099E-06	1.325E-06
TL209	0.0	2.314E-14	2.416E-12	2.396E-10	2.802E-08	2.718E-06	5.923E-05	1.442E-04
PB209	0.0	7.413E-14	7.743E-12	7.678E-10	8.977E-08	8.709E-06	1.898E-04	4.619E-04
PB210	0.0	8.140E-20	9.011E-17	1.365E-13	1.222E-10	8.417E-09	1.780E-07	1.255E-06
PB211	0.0	3.247E-13	2.966E-11	1.441E-09	2.052E-08	1.955E-07	1.125E-06	1.356E-06
PB214	0.0	1.114E-16	1.361E-14	3.825E-12	1.682E-09	1.159E-07	2.451E-06	1.729E-05
BI210	0.0	8.103E-19	8.970E-16	1.359E-12	1.216E-09	8.378E-08	1.772E-06	1.250E-05
BI211	0.0	4.322E-12	3.948E-10	1.918E-08	2.731E-07	2.602E-06	1.497E-05	1.805E-05
BI213	0.0	2.710E-13	2.831E-11	2.807E-09	3.282E-07	3.184E-05	6.938E-04	1.689E-03
BI214	0.0	4.475E-16	5.469E-14	1.537E-11	6.759E-09	4.657E-07	9.851E-06	6.946E-05
PO210	0.0	3.640E-18	1.247E-14	1.889E-11	1.690E-08	1.165E-06	2.464E-05	1.737E-04
PO213	0.0	3.192E-12	3.334E-10	3.306E-08	3.865E-06	3.750E-04	8.171E-03	1.989E-02
PO214	0.0	1.621E-15	1.981E-13	5.568E-11	2.448E-08	1.687E-06	3.568E-05	2.516E-04
PO215	0.0	4.837E-12	4.419E-10	2.147E-08	3.057E-07	2.913E-06	1.675E-05	2.020E-05
PO218	0.0	1.265E-15	1.547E-13	4.347E-11	1.912E-08	1.317E-06	2.786E-05	1.964E-04
AT217	0.0	2.751E-12	2.873E-10	2.849E-08	3.331E-06	3.232E-04	7.043E-03	1.714E-02
RN219	0.0	4.496E-12	4.107E-10	1.996E-08	2.841E-07	2.707E-06	1.557E-05	1.878E-05
RN222	0.0	1.157E-15	1.414E-13	3.975E-11	1.748E-08	1.204E-06	2.547E-05	1.796E-04
FR221	0.0	2.488E-12	2.599E-10	2.577E-08	3.013E-06	2.923E-04	6.370E-03	1.550E-02
RA223	0.0	3.859E-12	3.525E-10	1.713E-08	2.438E-07	2.323E-06	1.336E-05	1.611E-05
RA225	0.0	4.520E-14	4.722E-12	4.682E-10	5.474E-08	5.311E-06	1.157E-04	2.817E-04
RA226	0.0	1.008E-15	1.232E-13	3.464E-11	1.523E-08	1.050E-06	2.220E-05	1.565E-04
AC225	0.0	2.252E-12	2.352E-10	2.332E-08	2.727E-06	2.646E-04	5.765E-03	1.403E-02
TH227	0.0	3.900E-12	3.563E-10	1.731E-08	2.465E-07	2.348E-06	1.351E-05	1.629E-05
TH229	0.0	1.972E-12	2.060E-10	2.043E-08	2.388E-06	2.317E-04	5.049E-03	1.229E-02
TH230	0.0	4.617E-12	6.158E-11	2.145E-09	9.546E-08	1.362E-06	2.163E-05	1.534E-04
TH234	0.0	2.385E-06	2.385E-06	2.385E-06	2.385E-06	2.385E-06	2.385E-06	2.385E-06
PA231	0.0	2.073E-10	2.076E-09	2.073E-08	2.062E-07	1.965E-06	1.131E-05	1.364E-05
PA233	0.0	7.090E-04	7.158E-04	7.783E-04	1.086E-03	1.177E-03	1.143E-03	8.543E-04
PA234M	0.0	2.907E-05	2.907E-05	2.907E-05	2.907E-05	2.907E-05	2.907E-05	2.907E-05
U233	0.0	3.969E-08	4.072E-07	4.175E-06	5.285E-05	6.304E-04	5.256E-03	1.161E-02
U234	5.041E-07	5.406E-07	8.916E-07	4.283E-06	1.447E-05	1.858E-05	5.255E-05	1.603E-04
U235	8.517E-06	8.517E-06	8.518E-06	8.527E-06	8.609E-06	9.335E-06	1.167E-05	1.185E-05
U236	2.218E-05	2.218E-05	2.219E-05	2.227E-05	2.308E-05	2.802E-05	3.104E-05	3.022E-05
U238	1.492E-04	1.492E-04	1.492E-04	1.492E-04	1.492E-04	1.492E-04	1.492E-04	1.492E-04
NP237	9.537E-03	9.547E-03	9.638E-03	1.048E-02	1.462E-02	1.585E-02	1.540E-02	1.150E-02
NP239	0.0	1.073E-03	1.073E-03	1.064E-03	9.773E-04	4.197E-04	8.955E-08	1.745E-44
PU238	1.362E-02	1.521E-02	1.565E-02	1.406E-02	3.963E-04	6.098E-22	0.0	0.0
PU239	1.109E-01	1.109E-01	1.109E-01	1.107E-01	1.082E-01	8.535E-02	6.564E-03	3.619E-14
PU240	3.675E-02	3.675E-02	3.673E-02	3.644E-02	3.313E-02	1.276E-02	9.151E-07	0.0
PU241	1.160E-03	1.105E-03	7.167E-04	9.414E-06	1.440E-24	0.0	0.0	0.0

TABLE 5-HANF. THERMAL POWER OF ACTINIDES AND DAUGHTERS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
PU242	1.920E-06	1.925E-06	1.973E-06	2.355E-06	3.093E-06	3.056E-06	2.601E-06	5.186E-07
AM241	3.422E+01	3.416E+01	3.369E+01	2.918E+01	6.891E+00	3.715E-06	0.0	0.0
AM242	0.0	6.702E-04	6.433E-04	4.267E-04	7.044E-06	1.058E-23	0.0	0.0
AM243	1.428E-02	1.428E-02	1.426E-02	1.414E-02	1.300E-02	5.581E-03	1.191E-06	2.321E-43
CM242	4.533E-01	1.102E-01	1.728E-02	1.146E-02	1.891E-04	2.849E-22	0.0	0.0
CM244	3.392E-02	3.264E-02	2.313E-02	7.382E-04	8.079E-19	0.0	0.0	0.0
SUMTOT	3.489E+01	3.450E+01	3.392E+01	2.938E+01	7.063E+00	1.236E-01	6.236E-02	1.071E-01
TOTAL	3.489E+01	3.450E+01	3.392E+01	2.938E+01	7.063E+00	1.236E-01	6.236E-02	1.071E-01

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 6-HANF. THERMAL POWER OF ACTINIDES AND DAUGHTERS
IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL	0.0	3.405E-13	3.141E-11	1.648E-09	4.807E-08	2.909E-06	6.033E-05	1.455E-04
PB	0.0	3.989E-13	3.742E-11	2.213E-09	1.121E-07	9.029E-06	1.935E-04	4.818E-04
BI	0.0	4.594E-12	4.232E-10	2.201E-08	6.093E-07	3.499E-05	7.204E-04	1.789E-03
PO	0.0	8.046E-12	7.769E-10	5.471E-08	4.232E-06	3.821E-04	8.276E-03	2.053E-02
AT	0.0	2.751E-12	2.873E-10	2.849E-08	3.331E-06	3.232E-04	7.043E-03	1.714E-02
RN	0.0	4.498E-12	4.109E-10	2.000E-08	3.016E-07	3.912E-06	4.105E-05	1.984E-04
FR	0.0	2.492E-12	2.602E-10	2.579E-08	3.013E-06	2.923E-04	6.370E-03	1.550E-02
RA	0.0	3.905E-12	3.573E-10	1.763E-08	3.138E-07	8.684E-06	1.513E-04	4.543E-04
AC	0.0	2.304E-12	2.400E-10	2.356E-08	2.730E-06	2.646E-04	5.765E-03	1.403E-02
TH	0.0	2.568E-06	2.568E-06	2.608E-06	5.300E-06	2.380E-04	5.087E-03	1.246E-02
PA	0.0	7.382E-04	7.450E-04	8.075E-04	1.115E-03	1.208E-03	1.184E-03	8.971E-04
U	1.804E-04	1.821E-04	1.823E-04	1.885E-04	2.482E-04	8.355E-04	5.500E-03	1.196E-02
NP	9.537E-03	1.064E-02	1.072E-02	1.155E-02	1.560E-02	1.627E-02	1.540E-02	1.150E-02
PU	1.625E-01	1.640E-01	1.640E-01	1.612E-01	1.417E-01	9.811E-02	6.568E-03	5.186E-07
AM	3.423E+01	3.418E+01	3.370E+01	2.920E+01	6.904E+00	5.585E-03	1.191E-06	2.321E-43
CM	4.872E-01	1.429E-01	4.041E-02	1.219E-02	1.891E-04	2.849E-22	0.0	0.0
SUMTOT	3.489E+01	3.450E+01	3.392E+01	2.938E+01	7.063E+00	1.236E-01	6.236E-02	1.071E-01
TOTAL	3.489E+01	3.450E+01	3.392E+01	2.938E+01	7.063E+00	1.236E-01	6.236E-02	1.071E-01

ELEMENTS CONTRIBUTING < 0.0001 % ARE OMITTED

TABLE 7-HANF. ALPHA RADIOACTIVITY OF ACTINIDES AND DAUGHTERS IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
BI211	0.0	1.081E-10	9.871E-09	4.796E-07	6.828E-06	6.506E-05	3.743E-04	4.513E-04
BI213	0.0	1.392E-12	1.454E-10	1.442E-08	1.686E-06	1.636E-04	3.565E-03	8.676E-03
PO210	0.0	1.136E-16	3.890E-13	5.893E-10	5.273E-07	3.633E-05	7.685E-04	5.419E-03
PO213	0.0	6.307E-11	6.588E-09	6.532E-07	7.638E-05	7.410E-03	1.615E-01	3.930E-01
PO214	0.0	3.491E-14	4.267E-12	1.199E-09	5.273E-07	3.633E-05	7.685E-04	5.419E-03
PO215	0.0	1.084E-10	9.899E-09	4.810E-07	6.847E-06	6.524E-05	3.753E-04	4.525E-04
PO218	0.0	3.492E-14	4.268E-12	1.199E-09	5.274E-07	3.634E-05	7.687E-04	5.420E-03
AT217	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
RN219	0.0	1.084E-10	9.899E-09	4.810E-07	6.847E-06	6.524E-05	3.753E-04	4.525E-04
RN222	0.0	3.492E-14	4.269E-12	1.200E-09	5.275E-07	3.635E-05	7.688E-04	5.421E-03
FR221	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
RA223	0.0	1.084E-10	9.899E-09	4.810E-07	6.847E-06	6.524E-05	3.753E-04	4.525E-04
RA226	0.0	3.492E-14	4.268E-12	1.200E-09	5.275E-07	3.635E-05	7.688E-04	5.421E-03
AC225	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
TH227	0.0	1.069E-10	9.763E-09	4.743E-07	6.753E-06	6.434E-05	3.701E-04	4.463E-04
TH229	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
TH230	0.0	1.631E-10	2.176E-09	7.581E-08	3.373E-06	4.814E-05	7.645E-04	5.420E-03
PA231	0.0	6.880E-09	6.888E-08	6.879E-07	6.845E-06	6.522E-05	3.753E-04	4.525E-04
U233	0.0	1.365E-06	1.401E-05	1.436E-04	1.818E-03	2.169E-02	1.808E-01	3.994E-01
U234	1.750E-05	1.877E-05	3.096E-05	1.487E-04	5.024E-04	6.452E-04	1.825E-03	5.565E-03
U235	3.252E-04	3.252E-04	3.253E-04	3.256E-04	3.287E-04	3.565E-04	4.457E-04	4.525E-04
U236	8.188E-04	8.188E-04	8.191E-04	8.222E-04	8.519E-04	1.034E-03	1.146E-03	1.116E-03
U238	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.882E-03	5.881E-03
NP237	3.121E-01	3.124E-01	3.154E-01	3.429E-01	4.783E-01	5.187E-01	5.038E-01	3.764E-01
PU238	4.110E-01	4.588E-01	4.724E-01	4.242E-01	1.196E-02	1.840E-20	0.0	0.0
PU239	3.600E+00	3.600E+00	3.599E+00	3.591E+00	3.510E+00	2.769E+00	2.130E-01	1.174E-12
PU240	1.180E+00	1.180E+00	1.180E+00	1.170E+00	1.064E+00	4.097E-01	2.939E-05	0.0
PU242	6.501E-05	6.519E-05	6.681E-05	7.976E-05	1.047E-04	1.035E-04	8.806E-05	1.756E-05
AM241	1.030E+03	1.028E+03	1.014E+03	8.785E+02	2.075E+02	1.118E-04	0.0	0.0
AM243	4.441E-01	4.441E-01	4.437E-01	4.400E-01	4.043E-01	1.736E-01	3.704E-05	7.220E-42
CM242	1.230E+01	2.992E+00	4.688E-01	3.109E-01	5.132E-03	7.731E-21	0.0	0.0
CM244	9.696E-01	9.332E-01	6.613E-01	2.110E-02	2.310E-17	0.0	0.0	0.0
SUMTOT	1.049E+03	1.038E+03	1.021E+03	8.848E+02	2.129E+02	3.940E+00	1.739E+00	2.833E+00
TOTAL	1.049E+03	1.038E+03	1.021E+03	8.848E+02	2.129E+02	3.940E+00	1.739E+00	2.833E+00

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 8-HANF. ALPHA RADIOACTIVITY OF ACTINIDES AND DAUGHTERS IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
BI	0.0	1.095E-10	1.002E-08	4.940E-07	8.515E-06	2.287E-04	3.939E-03	9.129E-03
PO	0.0	1.718E-10	1.652E-08	1.139E-06	8.483E-05	7.584E-03	1.642E-01	4.097E-01
AT	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
RN	0.0	1.084E-10	9.903E-09	4.822E-07	7.375E-06	1.016E-04	1.144E-03	5.874E-03
FR	0.0	6.446E-11	6.733E-09	6.677E-07	7.807E-05	7.573E-03	1.650E-01	4.017E-01
RA	0.0	1.084E-10	9.903E-09	4.822E-07	7.375E-06	1.016E-04	1.144E-03	5.874E-03
AC	0.0	6.596E-11	6.870E-09	6.743E-07	7.816E-05	7.574E-03	1.650E-01	4.017E-01
TH	0.0	3.345E-10	1.867E-08	1.218E-06	8.819E-05	7.686E-03	1.662E-01	4.075E-01
PA	0.0	6.880E-09	6.888E-08	6.879E-07	6.845E-06	6.522E-05	3.753E-04	4.525E-04
U	7.044E-03	7.047E-03	7.072E-03	7.323E-03	9.383E-03	2.960E-02	1.901E-01	4.124E-01
NP	3.121E-01	3.124E-01	3.154E-01	3.429E-01	4.783E-01	5.187E-01	5.038E-01	3.764E-01
PU	5.192E+00	5.240E+00	5.252E+00	5.185E+00	4.586E+00	3.179E+00	2.131E-01	1.756E-05
AM	1.030E+03	1.029E+03	1.015E+03	8.789E+02	2.079E+02	1.737E-01	3.704E-05	7.220E-42
CM	1.327E+01	3.925E+00	1.130E+00	3.320E-01	5.132E-03	7.731E-21	0.0	0.0
SUMTOT	1.049E+03	1.038E+03	1.021E+03	8.848E+02	2.129E+02	3.940E+00	1.739E+00	2.833E+00
TOTAL	1.049E+03	1.038E+03	1.021E+03	8.848E+02	2.129E+02	3.940E+00	1.739E+00	2.833E+00

TABLE 9-HANF. (ALPHA,N) NEUTRON SOURCES
IN DECAY OF HANFORD HLW GLASS

BASED ON ONE CANISTER

NEUTRONS/SEC

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
PO210	0.0	9.590E-14	3.285E-10	4.977E-07	4.453E-04	3.069E-02	6.490E-01	4.576E+00
PO213	0.0	1.724E-07	1.800E-05	1.785E-03	2.088E-01	2.025E+01	4.413E+02	1.074E+03
PO214	0.0	8.250E-11	1.008E-08	2.834E-06	1.246E-03	8.586E-02	1.816E+00	1.281E+01
PO218	0.0	4.458E-11	5.449E-09	1.531E-06	6.734E-04	4.640E-02	9.814E-01	6.920E+00
AT217	0.0	1.276E-07	1.333E-05	1.322E-03	1.546E-01	1.500E+01	3.268E+02	7.953E+02
RN222	0.0	3.321E-11	4.059E-09	1.141E-06	5.016E-04	3.456E-02	7.310E-01	5.154E+00
FR221	0.0	9.893E-08	1.033E-05	1.025E-03	1.198E-01	1.162E+01	2.533E+02	6.164E+02
AC225	0.0	7.325E-08	7.651E-06	7.587E-04	8.871E-02	8.606E+00	1.875E+02	4.564E+02
TH229	0.0	4.564E-08	4.767E-06	4.727E-04	5.527E-02	5.362E+00	1.168E+02	2.844E+02
U233	0.0	7.879E-04	8.084E-03	8.289E-02	1.049E+00	1.251E+01	1.043E+02	2.305E+02
NP237	2.201E+02	2.203E+02	2.224E+02	2.419E+02	3.374E+02	3.659E+02	3.554E+02	2.655E+02
PU239	2.622E+03	2.622E+03	2.621E+03	2.616E+03	2.556E+03	2.017E+03	1.551E+02	8.554E-10
PU240	8.942E+02	8.942E+02	8.939E+02	8.868E+02	8.061E+02	3.104E+02	2.227E-02	0.0
AM241	9.880E+05	9.864E+05	9.727E+05	8.426E+05	1.990E+05	1.073E-01	0.0	0.0
AM243	3.789E+02	3.789E+02	3.785E+02	3.753E+02	3.449E+02	1.481E+02	3.160E-02	6.159E-39
CM242	1.651E+04	4.016E+03	6.294E+02	4.173E+02	6.889E+00	1.038E-17	0.0	0.0
CM244	1.107E+03	1.065E+03	7.546E+02	2.408E+01	2.636E-14	0.0	0.0	0.0
TOTALS								
TABLE	1.010E+06	9.961E+05	9.786E+05	8.476E+05	2.031E+05	2.919E+03	1.953E+03	3.768E+03
ACTUAL	1.010E+06	9.961E+05	9.786E+05	8.476E+05	2.031E+05	2.919E+03	1.953E+03	3.768E+03

TABLE 10-HANF. SPONTANEOUS FISSION NEUTRON SOURCES
IN DECAY OF HANFORD HLW GLASS

BASED ON ONE CANISTER

NEUTRONS/SEC

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
U238	2.219E+02	2.219E+02	2.219E+02	2.219E+02	2.219E+02	2.219E+02	2.219E+02	2.219E+02
PU238	6.377E+01	7.119E+01	7.329E+01	6.581E+01	1.855E+00	2.855E-18	0.0	0.0
PU240	4.714E+03	4.714E+03	4.712E+03	4.674E+03	4.249E+03	1.636E+03	1.174E-01	0.0
PU242	2.869E+01	2.877E+01	2.948E+01	3.520E+01	4.622E+01	4.566E+01	3.886E+01	7.750E+00
AM241	3.722E+02	3.716E+02	3.664E+02	3.174E+02	7.496E+01	4.041E-05	0.0	0.0
AM243	7.451E+00	7.450E+00	7.444E+00	7.381E+00	6.783E+00	2.913E+00	6.215E-04	1.211E-40
CM242	8.013E+04	1.949E+04	3.054E+03	2.025E+03	3.343E+01	5.036E-17	0.0	0.0
CM244	1.332E+05	1.282E+05	9.086E+04	2.900E+03	3.173E-12	0.0	0.0	0.0
TOTALS								
TABLE	2.188E+05	1.531E+05	9.933E+04	1.025E+04	4.636E+03	1.908E+03	2.611E+02	2.298E+02
ACTUAL	2.188E+05	1.531E+05	9.933E+04	1.025E+04	4.636E+03	1.908E+03	2.611E+02	2.298E+02

TABLE 11-HANF. PHOTON SPECTRUM OF ACTINIDES AND DAUGHTERS
IN DECAY OF HANFORD HLW GLASS

BASED ON ONE CANISTER

PHOTONS/SEC

18 GROUP PHOTON RELEASE RATES, PHOTONS/SECOND

EMEAN	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
1.000E-02	8.539E+12	8.508E+12	8.373E+12	7.253E+12	1.754E+12	4.511E+10	4.110E+10	5.161E+10
2.500E-02	9.653E+11	9.644E+11	9.510E+11	8.241E+11	1.965E+11	2.470E+09	2.827E+09	3.022E+09
3.750E-02	8.013E+10	8.029E+10	7.914E+10	6.867E+10	1.707E+10	6.939E+08	2.929E+09	7.000E+09
5.750E-02	1.417E+13	1.415E+13	1.396E+13	1.209E+13	2.855E+12	4.380E+08	7.519E+08	1.457E+09
8.500E-02	2.122E+10	2.867E+10	2.854E+10	2.739E+10	2.227E+10	1.500E+10	1.456E+10	1.913E+10
1.250E-01	9.287E+09	1.961E+10	1.942E+10	1.772E+10	1.068E+10	4.932E+09	2.555E+09	3.299E+09
2.250E-01	6.432E+08	6.265E+09	6.250E+09	6.136E+09	5.451E+09	2.647E+09	2.165E+09	4.584E+09
3.750E-01	4.889E+08	5.635E+09	5.671E+09	6.007E+09	7.647E+09	7.967E+09	9.484E+09	1.057E+10
5.750E-01	2.653E+08	2.698E+08	2.659E+08	2.310E+08	5.910E+07	1.150E+07	1.515E+08	4.351E+08
8.500E-01	7.784E+07	1.160E+08	1.134E+08	9.123E+07	1.796E+07	3.267E+06	2.864E+07	8.360E+07
1.250E+00	2.451E+05	2.450E+07	2.353E+07	1.605E+07	1.655E+06	2.810E+06	3.221E+07	1.213E+08
1.750E+00	1.134E+05	3.017E+05	2.825E+05	2.479E+05	2.828E+05	5.982E+06	1.257E+08	3.418E+08
2.250E+00	6.286E+04	4.898E+04	3.789E+04	1.797E+04	6.590E+03	1.150E+05	2.420E+06	1.706E+07
2.750E+00	3.497E+04	2.695E+04	2.055E+04	9.196E+03	2.595E+03	2.311E+03	4.221E+04	2.975E+05
3.500E+00	2.994E+04	2.273E+04	1.700E+04	6.968E+03	1.997E+03	6.511E+02	7.952E+03	5.579E+04
5.000E+00	1.193E+04	8.854E+03	6.412E+03	2.236E+03	6.735E+02	1.158E+02	1.904E+01	1.940E+01
7.000E+00	1.273E+03	9.196E+02	6.397E+02	1.713E+02	5.682E+01	1.295E+01	2.024E+00	1.959E+00
9.500E+00	1.398E+02	9.896E+01	6.685E+01	1.392E+01	5.143E+00	1.465E+00	2.216E-01	2.068E-01
TOTAL	2.379E+13	2.377E+13	2.342E+13	2.029E+13	4.869E+12	7.928E+10	7.672E+10	1.017E+11

TABLE 12-HANF. CONCENTRATIONS OF FISSION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

GRAMS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE 79	7.550E+00	7.550E+00	7.549E+00	7.542E+00	7.470E+00	6.786E+00	2.597E+00	1.750E-04
BR 79	0.0	8.056E-05	8.056E-04	8.052E-03	8.013E-02	7.641E-01	4.953E+00	7.550E+00
SR 90	5.357E+02	5.231E+02	4.222E+02	4.957E+01	2.465E-08	0.0	0.0	0.0
ZR 90	0.0	1.260E+01	1.135E+02	4.863E+02	5.358E+02	5.358E+02	5.358E+02	5.358E+02
ZR 93	9.709E+02	9.709E+02	9.709E+02	9.709E+02	9.705E+02	9.665E+02	9.279E+02	6.172E+02
NB 93	0.0	2.469E-04	2.848E-03	4.013E-02	4.359E-01	4.385E+00	4.300E+01	3.537E+02
TC 99	1.038E+03	1.038E+03	1.038E+03	1.038E+03	1.035E+03	1.005E+03	7.497E+02	4.008E+01
RU 99	0.0	3.378E-03	3.378E-02	3.377E-01	3.372E+00	3.323E+01	2.883E+02	9.979E+02
PD107	1.353E+02	1.353E+02	1.353E+02	1.353E+02	1.353E+02	1.352E+02	1.339E+02	1.216E+02
AG107	0.0	1.444E-05	1.444E-04	1.444E-03	1.444E-02	1.443E-01	1.436E+00	1.369E+01
SN126	2.921E+01	2.921E+01	2.921E+01	2.919E+01	2.901E+01	2.725E+01	1.461E+01	2.854E-02
TE126	0.0	2.024E-04	2.024E-03	2.024E-02	2.018E-01	1.956E+00	1.460E+01	2.918E+01
I129	1.212E+01	1.212E+01	1.212E+01	1.212E+01	1.212E+01	1.211E+01	1.207E+01	1.160E+01
CS135	4.038E+02	4.038E+02	4.038E+02	4.038E+02	4.037E+02	4.026E+02	3.918E+02	2.987E+02
BA135	0.0	1.217E-04	1.217E-03	1.217E-02	1.217E-01	1.215E+00	1.199E+01	1.051E+02
CS137	1.003E+03	9.801E+02	7.961E+02	9.950E+01	9.261E-08	0.0	0.0	0.0
BA137	0.0	2.291E+01	2.069E+02	9.035E+02	1.003E+03	1.003E+03	1.003E+03	1.003E+03
CE144	4.294E+00	1.762E+00	5.817E-04	8.972E-39	0.0	0.0	0.0	0.0
ND144	0.0	2.532E+00	4.294E+00	4.294E+00	4.294E+00	4.294E+00	4.294E+00	4.294E+00
PM147	5.685E+01	4.365E+01	4.048E+00	1.908E-10	0.0	0.0	0.0	0.0
SM147	0.0	1.320E+01	5.280E+01	5.685E+01	5.685E+01	5.685E+01	5.685E+01	5.685E+01
SM151	5.891E+01	5.846E+01	5.454E+01	2.727E+01	2.662E-02	2.090E-32	0.0	0.0
EU151	0.0	4.520E-01	4.367E+00	3.164E+01	5.888E+01	5.891E+01	5.891E+01	5.891E+01
SUMTOT	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03
TOTAL	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03

NUCLIDES CONTRIBUTING < 0.1000 % ARE OMITTED

TABLE 13-HANF. CONCENTRATIONS OF FISSION PRODUCTS IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

GRAMS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE	7.550E+00	7.550E+00	7.549E+00	7.542E+00	7.470E+00	6.786E+00	2.597E+00	1.750E-04
BR	0.0	8.056E-05	8.056E-04	8.052E-03	8.013E-02	7.641E-01	4.953E+00	7.550E+00
SR	5.357E+02	5.231E+02	4.222E+02	4.957E+01	2.465E-08	0.0	0.0	0.0
ZR	9.709E+02	9.835E+02	1.084E+03	1.457E+03	1.506E+03	1.502E+03	1.464E+03	1.153E+03
NB	4.343E-03	4.755E-03	8.714E-03	4.830E-02	4.441E-01	4.393E+00	4.301E+01	3.537E+02
TC	1.038E+03	1.038E+03	1.038E+03	1.038E+03	1.035E+03	1.005E+03	7.497E+02	4.008E+01
RU	1.781E+00	8.988E-01	3.561E-02	3.377E-01	3.372E+00	3.323E+01	2.883E+02	9.979E+02
PD	1.353E+02	1.362E+02	1.371E+02	1.371E+02	1.371E+02	1.369E+02	1.356E+02	1.234E+02
AG	1.774E-06	1.508E-05	1.444E-04	1.444E-03	1.444E-02	1.443E-01	1.436E+00	1.369E+01
SN	2.921E+01	2.921E+01	2.921E+01	2.919E+01	2.901E+01	2.725E+01	1.461E+01	2.898E-02
SB	2.275E+00	1.771E+00	1.867E-01	1.928E-03	2.545E-03	2.545E-03	2.544E-03	2.543E-03
TE	2.198E-02	5.358E-01	2.123E+00	2.327E+00	2.509E+00	4.263E+00	1.691E+01	3.149E+01
I	1.212E+01	1.212E+01	1.212E+01	1.212E+01	1.212E+01	1.211E+01	1.207E+01	1.160E+01
XE	0.0	5.352E-07	5.351E-06	5.351E-05	5.351E-04	5.350E-03	5.340E-02	5.235E-01
CS	1.408E+03	1.385E+03	1.200E+03	5.033E+02	4.037E+02	4.026E+02	3.918E+02	2.987E+02
BA	1.534E-04	2.321E+01	2.079E+02	9.046E+02	1.004E+03	1.005E+03	1.016E+03	1.109E+03
CE	4.294E+00	1.762E+00	5.817E-04	1.363E-13	1.377E-12	1.379E-11	1.379E-10	1.379E-09
ND	0.0	2.532E+00	4.294E+00	4.294E+00	4.294E+00	4.294E+00	4.294E+00	4.295E+00
PM	5.685E+01	4.365E+01	4.048E+00	1.908E-10	0.0	0.0	0.0	0.0
SM	5.891E+01	7.166E+01	1.074E+02	8.413E+01	5.689E+01	5.686E+01	5.686E+01	5.686E+01
EU	2.994E+00	3.139E+00	5.424E+00	3.164E+01	5.888E+01	5.891E+01	5.891E+01	5.891E+01
GD	1.247E-06	3.058E-01	1.931E+00	2.978E+00	2.979E+00	2.979E+00	2.979E+00	2.979E+00
SUMTOT	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03
TOTAL	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03	4.264E+03

ELEMENTS CONTRIBUTING < 0.0100 % ARE OMITTED

TABLE 14-HANF. RADIOACTIVITY OF FISSION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE 79	5.262E-01	5.262E-01	5.261E-01	5.256E-01	5.206E-01	4.729E-01	1.810E-01	1.220E-05
SR 90	7.310E+04	7.138E+04	5.762E+04	6.764E+03	3.364E-06	0.0	0.0	0.0
Y 90	7.310E+04	7.140E+04	5.763E+04	6.766E+03	3.365E-06	0.0	0.0	0.0
ZR 93	2.441E+00	2.441E+00	2.441E+00	2.440E+00	2.439E+00	2.429E+00	2.332E+00	1.551E+00
NB 93M	1.220E+00	1.275E+00	1.659E+00	2.312E+00	2.317E+00	2.308E+00	2.216E+00	1.474E+00
TC 99	1.760E+01	1.760E+01	1.760E+01	1.760E+01	1.755E+01	1.704E+01	1.271E+01	6.798E-01
RU106	5.961E+03	2.997E+03	6.151E+00	8.877E-27	0.0	0.0	0.0	0.0
RH106	5.961E+03	2.997E+03	6.151E+00	8.877E-27	0.0	0.0	0.0	0.0
PD107	6.962E-02	6.962E-02	6.962E-02	6.962E-02	6.961E-02	6.954E-02	6.888E-02	6.257E-02
CD113M	2.241E+01	2.137E+01	1.394E+01	1.937E-01	5.212E-20	0.0	0.0	0.0
SB125	2.350E+03	1.830E+03	1.924E+02	3.185E-08	0.0	0.0	0.0	0.0
TE125M	5.752E+02	4.465E+02	4.695E+01	7.772E-09	0.0	0.0	0.0	0.0
SN126	8.291E-01	8.290E-01	8.290E-01	8.285E-01	8.233E-01	7.735E-01	4.145E-01	8.101E-04
SB126	1.160E-01	1.161E-01	1.161E-01	1.160E-01	1.153E-01	1.083E-01	5.804E-02	1.134E-04
SB126M	8.290E-01	8.290E-01	8.290E-01	8.285E-01	8.233E-01	7.735E-01	4.145E-01	8.101E-04
I129	2.141E-03	2.141E-03	2.141E-03	2.140E-03	2.140E-03	2.140E-03	2.131E-03	2.048E-03
CS134	1.360E+03	9.720E+02	4.718E+01	3.414E-12	0.0	0.0	0.0	0.0
CS135	4.651E-01	4.651E-01	4.651E-01	4.651E-01	4.650E-01	4.637E-01	4.513E-01	3.441E-01
CS137	8.728E+04	8.529E+04	6.928E+04	8.659E+03	8.059E-06	0.0	0.0	0.0
BA137M	8.254E+04	8.068E+04	6.553E+04	8.191E+03	7.624E-06	0.0	0.0	0.0
CE144	1.370E+04	5.624E+03	1.856E+00	2.863E-35	0.0	0.0	0.0	0.0
PR144	1.370E+04	5.624E+03	1.857E+00	2.863E-35	0.0	0.0	0.0	0.0
PR144M	1.959E+02	6.749E+01	2.229E-02	3.436E-37	0.0	0.0	0.0	0.0
PM147	5.272E+04	4.048E+04	3.754E+03	1.769E-07	0.0	0.0	0.0	0.0
SM151	1.550E+03	1.539E+03	1.436E+03	7.177E+02	7.005E-01	5.501E-31	0.0	0.0
EU154	4.191E+02	3.866E+02	1.872E+02	1.325E-01	4.164E-33	0.0	0.0	0.0
EU155	6.612E+02	5.749E+02	1.634E+02	5.625E-04	0.0	0.0	0.0	0.0
SUMTOT	4.152E+05	3.723E+05	2.559E+05	3.112E+04	2.582E+01	2.444E+01	1.885E+01	4.115E+00
TOTAL	4.152E+05	3.723E+05	2.559E+05	3.112E+04	2.582E+01	2.444E+01	1.885E+01	4.115E+00

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 15-HANF. RADIOACTIVITY OF FISSION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE	5.262E-01	5.262E-01	5.261E-01	5.256E-01	5.206E-01	4.729E-01	1.810E-01	1.220E-05
SR	7.310E+04	7.138E+04	5.762E+04	6.764E+03	3.364E-06	0.0	0.0	0.0
Y	7.310E+04	7.140E+04	5.763E+04	6.766E+03	3.365E-06	0.0	0.0	0.0
ZR	2.932E+00	2.450E+00	2.441E+00	2.440E+00	2.439E+00	2.429E+00	2.332E+00	1.551E+00
NB	2.301E+00	1.296E+00	1.659E+00	2.312E+00	2.317E+00	2.308E+00	2.216E+00	1.474E+00
TC	1.760E+01	1.760E+01	1.760E+01	1.760E+01	1.755E+01	1.704E+01	1.271E+01	6.798E-01
RU	5.961E+03	2.997E+03	6.151E+00	8.877E-27	0.0	0.0	0.0	0.0
RH	5.961E+03	2.997E+03	6.151E+00	8.877E-27	0.0	0.0	0.0	0.0
PD	6.962E-02	6.962E-02	6.962E-02	6.962E-02	6.961E-02	6.954E-02	6.888E-02	6.257E-02
SN	3.566E+00	1.764E+00	9.562E-01	8.650E-01	8.233E-01	7.735E-01	4.145E-01	8.101E-04
SB	2.351E+03	1.831E+03	1.934E+02	9.445E-01	9.386E-01	8.818E-01	4.726E-01	9.235E-04
TE	5.763E+02	4.466E+02	4.695E+01	7.772E-09	0.0	0.0	0.0	0.0
I	2.141E-03	2.141E-03	2.141E-03	2.140E-03	2.140E-03	2.140E-03	2.131E-03	2.048E-03
CS	8.864E+04	8.626E+04	6.932E+04	8.659E+03	4.650E-01	4.637E-01	4.513E-01	3.441E-01
BA	8.254E+04	8.068E+04	6.553E+04	8.191E+03	7.624E-06	0.0	0.0	0.0
CE	1.370E+04	5.624E+03	1.856E+00	2.863E-35	0.0	0.0	0.0	0.0
PR	1.390E+04	5.691E+03	1.879E+00	2.898E-35	0.0	0.0	0.0	0.0
PM	5.272E+04	4.048E+04	3.754E+03	1.769E-07	0.0	0.0	0.0	0.0
SM	1.550E+03	1.539E+03	1.436E+03	7.177E+02	7.005E-01	1.293E-06	1.293E-06	1.293E-06
EU	1.084E+03	9.650E+02	3.527E+02	1.548E-01	2.622E-22	0.0	0.0	0.0
SUMTOT	4.152E+05	3.723E+05	2.559E+05	3.112E+04	2.582E+01	2.444E+01	1.885E+01	4.115E+00
TOTAL	4.152E+05	3.723E+05	2.559E+05	3.112E+04	2.582E+01	2.444E+01	1.885E+01	4.115E+00

ELEMENTS CONTRIBUTING < 0.0100 % ARE OMITTED

TABLE 16-HANF. THERMAL POWER OF FISSION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE 79	1.310E-04	1.310E-04	1.310E-04	1.309E-04	1.296E-04	1.177E-04	4.507E-05	3.037E-09
SR 90	8.484E+01	8.285E+01	6.687E+01	7.851E+00	3.904E-09	0.0	0.0	0.0
Y 90	4.051E+02	3.957E+02	3.194E+02	3.750E+01	1.865E-08	0.0	0.0	0.0
ZR 93	2.835E-04	2.835E-04	2.835E-04	2.835E-04	2.834E-04	2.823E-04	2.710E-04	1.802E-04
NB 93M	2.162E-04	2.258E-04	2.939E-04	4.096E-04	4.106E-04	4.089E-04	3.926E-04	2.611E-04
TC 99	8.828E-03	8.828E-03	8.828E-03	8.825E-03	8.800E-03	8.546E-03	6.376E-03	3.409E-04
RU106	3.544E-01	1.782E-01	3.657E-04	5.278E-31	0.0	0.0	0.0	0.0
RH106	5.717E+01	2.875E+01	5.899E-02	8.514E-29	0.0	0.0	0.0	0.0
PD107	4.127E-06	4.127E-06	4.127E-06	4.127E-06	4.126E-06	4.122E-06	4.083E-06	3.709E-06
CD113M	3.773E-02	3.598E-02	2.346E-02	3.260E-04	8.775E-23	0.0	0.0	0.0
SB125	7.347E+00	5.720E+00	6.016E-01	9.958E-11	0.0	0.0	0.0	0.0
TE125M	4.834E-01	3.753E-01	3.946E-02	6.533E-12	0.0	0.0	0.0	0.0
SN126	1.034E-03	1.034E-03	1.034E-03	1.033E-03	1.027E-03	9.647E-04	5.170E-04	1.010E-06
SB126	2.143E-03	2.145E-03	2.144E-03	2.143E-03	2.130E-03	2.001E-03	1.072E-03	2.095E-06
SB126M	1.055E-02	1.056E-02	1.056E-02	1.055E-02	1.048E-02	9.849E-03	5.278E-03	1.031E-05
I129	9.902E-07	9.902E-07	9.902E-07	9.902E-07	9.901E-07	9.897E-07	9.858E-07	9.474E-07
CS134	1.385E+01	9.893E+00	4.802E-01	3.475E-14	0.0	0.0	0.0	0.0
CS135	1.552E-04	1.552E-04	1.552E-04	1.552E-04	1.552E-04	1.548E-04	1.506E-04	1.148E-04
CS137	9.654E+01	9.434E+01	7.663E+01	9.578E+00	8.914E-09	0.0	0.0	0.0
BA137M	3.241E+02	3.168E+02	2.573E+02	3.216E+01	2.994E-08	0.0	0.0	0.0
CE144	9.090E+00	3.730E+00	1.231E-03	1.899E-38	0.0	0.0	0.0	0.0
PR144	1.007E+02	4.134E+01	1.365E-02	2.105E-37	0.0	0.0	0.0	0.0
PR144M	6.704E-02	2.309E-02	7.625E-06	1.176E-40	0.0	0.0	0.0	0.0
PM147	1.891E+01	1.452E+01	1.347E+00	6.346E-11	0.0	0.0	0.0	0.0
SM147	0.0	4.109E-09	1.644E-08	1.770E-08	1.770E-08	1.770E-08	1.770E-08	1.770E-08
SM151	1.818E-01	1.804E-01	1.683E-01	8.415E-02	8.213E-05	6.450E-35	0.0	0.0
EU152	2.693E-02	2.559E-02	1.618E-02	1.648E-04	1.983E-24	0.0	0.0	0.0
EU154	3.749E+00	3.459E+00	1.674E+00	1.185E-03	3.725E-35	0.0	0.0	0.0
EU155	4.809E-01	4.182E-01	1.189E-01	4.091E-07	0.0	0.0	0.0	0.0
SUMTOT	1.123E+03	9.984E+02	7.248E+02	8.720E+01	2.351E-02	2.233E-02	1.411E-02	9.152E-04
TOTAL	1.123E+03	9.984E+02	7.248E+02	8.720E+01	2.351E-02	2.233E-02	1.411E-02	9.152E-04

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 17-HANF. THERMAL POWER OF FISSION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE	1.310E-04	1.310E-04	1.310E-04	1.309E-04	1.296E-04	1.177E-04	4.507E-05	3.037E-09
SR	8.484E+01	8.285E+01	6.687E+01	7.851E+00	3.904E-09	0.0	0.0	0.0
Y	4.051E+02	3.957E+02	3.194E+02	3.750E+01	1.865E-08	0.0	0.0	0.0
ZR	2.771E-03	3.311E-04	2.835E-04	2.835E-04	2.834E-04	2.823E-04	2.710E-04	1.802E-04
NB	5.399E-03	3.294E-04	2.939E-04	4.096E-04	4.106E-04	4.089E-04	3.926E-04	2.611E-04
TC	8.828E-03	8.828E-03	8.828E-03	8.825E-03	8.800E-03	8.546E-03	6.376E-03	3.409E-04
RU	3.544E-01	1.782E-01	3.657E-04	5.278E-31	0.0	0.0	0.0	0.0
RH	5.717E+01	2.875E+01	5.899E-02	8.514E-29	0.0	0.0	0.0	0.0
PD	4.127E-06	4.127E-06	4.127E-06	4.127E-06	4.126E-06	4.122E-06	4.083E-06	3.709E-06
SN	4.256E-03	1.955E-03	1.289E-03	1.106E-03	1.027E-03	9.647E-04	5.170E-04	1.010E-06
SB	7.359E+00	5.733E+00	6.143E-01	1.269E-02	1.261E-02	1.185E-02	6.351E-03	1.241E-05
TE	4.845E-01	3.754E-01	3.946E-02	6.533E-12	0.0	0.0	0.0	0.0
I	9.902E-07	9.902E-07	9.902E-07	9.902E-07	9.901E-07	9.897E-07	9.858E-07	9.474E-07
CS	1.104E+02	1.042E+02	7.711E+01	9.578E+00	1.552E-04	1.548E-04	1.506E-04	1.148E-04
BA	3.241E+02	3.168E+02	2.573E+02	3.216E+01	2.994E-08	0.0	0.0	0.0
CE	9.090E+00	3.730E+00	1.231E-03	1.899E-38	0.0	0.0	0.0	0.0
PR	1.008E+02	4.136E+01	1.366E-02	2.106E-37	0.0	0.0	0.0	0.0
PM	1.891E+01	1.452E+01	1.347E+00	6.346E-11	0.0	0.0	0.0	0.0
SM	1.818E-01	1.804E-01	1.683E-01	8.415E-02	8.215E-05	1.770E-08	1.770E-08	1.770E-08
EU	4.257E+00	3.902E+00	1.809E+00	1.350E-03	1.983E-24	0.0	0.0	0.0
SUMTOT	1.123E+03	9.984E+02	7.248E+02	8.720E+01	2.351E-02	2.233E-02	1.411E-02	9.152E-04
TOTAL	1.123E+03	9.984E+02	7.248E+02	8.720E+01	2.351E-02	2.233E-02	1.411E-02	9.152E-04

ELEMENTS CONTRIBUTING < 0.0100 % ARE OMITTED

TABLE 18-HANF. PHOTON SPECTRUM OF FISSION PRODUCTS
IN DECAY OF HANFORD HLW GLASS

BASED ON ONE CANISTER

PHOTONS/SEC

18 GROUP PHOTON RELEASE RATES, PHOTONS/SECOND

EMEAN	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
1.000E-02	2.821E+15	2.430E+15	1.716E+15	2.028E+14	6.098E+10	5.902E+10	4.499E+10	1.223E+10
2.500E-02	6.400E+14	5.449E+14	3.582E+14	4.177E+13	1.987E+10	1.882E+10	1.118E+10	3.415E+08
3.750E-02	6.557E+14	5.605E+14	3.913E+14	4.681E+13	4.712E+09	4.515E+09	3.019E+09	1.598E+08
5.750E-02	5.438E+14	4.641E+14	3.269E+14	3.851E+13	8.577E+09	8.156E+09	5.012E+09	1.516E+08
8.500E-02	3.437E+14	2.867E+14	1.957E+14	2.288E+13	1.679E+10	1.581E+10	8.706E+09	6.586E+07
1.250E-01	2.800E+14	2.114E+14	1.284E+14	1.468E+13	1.210E+09	1.150E+09	6.973E+08	1.736E+07
2.250E-01	2.898E+14	2.411E+14	1.640E+14	1.919E+13	1.573E+09	1.481E+09	8.131E+08	5.161E+06
3.750E-01	1.589E+14	1.283E+14	7.246E+13	8.228E+12	3.339E+10	3.137E+10	1.681E+10	3.285E+07
5.750E-01	3.394E+15	3.244E+15	2.539E+15	3.164E+14	7.413E+10	6.965E+10	3.733E+10	7.294E+07
8.500E-01	7.594E+13	5.694E+13	1.612E+13	1.327E+12	3.711E+09	3.486E+09	1.868E+09	3.651E+06
1.250E+00	2.576E+13	1.886E+13	7.486E+12	4.369E+11	9.007E+08	8.463E+08	4.535E+08	8.862E+05
1.750E+00	2.157E+12	1.315E+12	3.985E+11	3.387E+10	3.842E+04	3.608E+04	1.934E+04	3.778E+01
2.250E+00	4.181E+12	1.746E+12	8.890E+08	3.729E+06	1.877E-03	2.281E-05	2.281E-05	2.281E-05
2.750E+00	5.087E+10	2.525E+10	4.939E+07	1.143E-05	1.143E-05	1.143E-05	1.143E-05	1.143E-05
3.500E+00	6.196E+09	3.115E+09	6.393E+06	8.415E-06	8.415E-06	8.415E-06	8.415E-06	8.415E-06
5.000E+00	0.0	5.817E-07	2.327E-06	2.505E-06	2.505E-06	2.505E-06	2.505E-06	2.505E-06
7.000E+00	0.0	3.774E-08	1.510E-07	1.626E-07	1.626E-07	1.626E-07	1.626E-07	1.626E-07
9.500E+00	0.0	2.387E-09	9.547E-09	1.028E-08	1.028E-08	1.028E-08	1.028E-08	1.028E-08
TOTAL	9.235E+15	8.190E+15	5.916E+15	7.131E+14	2.259E+11	2.143E+11	1.309E+11	1.308E+10

TABLE 19-HANF. CONCENTRATIONS OF ACTIVATION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

GRAMS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
C 14	2.151E-02	2.151E-02	2.148E-02	2.125E-02	1.906E-02	6.415E-03	1.200E-07	0.0
N 14	0.0	2.602E-06	2.601E-05	2.587E-04	2.451E-03	1.509E-02	2.151E-02	2.151E-02
CO 59	0.0	1.178E-06	1.178E-05	1.178E-04	1.173E-03	1.129E-02	7.882E-02	1.360E-01
CO 60	3.166E-02	2.776E-02	8.497E-03	6.173E-08	0.0	0.0	0.0	0.0
NI 59	1.360E-01	1.360E-01	1.360E-01	1.359E-01	1.348E-01	1.247E-01	5.718E-02	2.348E-05
NI 60	0.0	3.902E-03	2.316E-02	3.166E-02	3.166E-02	3.166E-02	3.166E-02	3.166E-02
NI 63	3.858E-02	3.829E-02	3.578E-02	1.816E-02	2.062E-05	7.341E-35	0.0	0.0
CU 63	0.0	2.896E-04	2.800E-03	2.042E-02	3.856E-02	3.858E-02	3.858E-02	3.858E-02
ZR 93	1.365E+01	1.365E+01	1.365E+01	1.365E+01	1.364E+01	1.359E+01	1.305E+01	8.677E+00
NB 93	0.0	1.768E-06	2.635E-05	5.301E-04	6.094E-03	6.162E-02	6.045E-01	4.973E+00
SB125	1.065E-01	8.292E-02	8.721E-03	1.442E-12	0.0	0.0	0.0	0.0
TE125	0.0	2.391E-02	9.915E-02	1.080E-01	1.080E-01	1.080E-01	1.080E-01	1.080E-01
SUMTOT	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01
TOTAL	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01

NUCLIDES CONTRIBUTING < 0.1000 % ARE OMITTED

TABLE 20-HANF. CONCENTRATIONS OF ACTIVATION PRODUCTS IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

GRAMS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
C	2.151E-02	2.151E-02	2.148E-02	2.125E-02	1.906E-02	6.415E-03	1.200E-07	0.0
N	0.0	2.602E-06	2.601E-05	2.587E-04	2.451E-03	1.509E-02	2.151E-02	2.151E-02
MN	0.0	1.179E-03	4.689E-03	5.039E-03	5.039E-03	5.039E-03	5.039E-03	5.039E-03
FE	5.039E-03	3.860E-03	3.504E-04	1.335E-14	0.0	0.0	0.0	0.0
CO	3.166E-02	2.776E-02	8.509E-03	1.178E-04	1.173E-03	1.129E-02	7.882E-02	1.360E-01
NI	1.746E-01	1.782E-01	1.949E-01	1.857E-01	1.665E-01	1.564E-01	8.884E-02	3.168E-02
CU	0.0	2.896E-04	2.800E-03	2.042E-02	3.856E-02	3.858E-02	3.858E-02	3.858E-02
ZR	1.365E+01	1.365E+01	1.365E+01	1.365E+01	1.364E+01	1.359E+01	1.305E+01	8.677E+00
NB	2.639E-05	3.257E-05	8.823E-05	6.448E-04	6.209E-03	6.173E-02	6.047E-01	4.973E+00
SN	7.710E-03	7.677E-03	7.420E-03	6.045E-03	5.492E-03	5.492E-03	5.492E-03	5.492E-03
SB	1.065E-01	8.295E-02	9.007E-03	1.662E-03	2.215E-03	2.215E-03	2.215E-03	2.215E-03
TE	1.493E-03	2.507E-02	9.927E-02	1.080E-01	1.080E-01	1.080E-01	1.080E-01	1.080E-01
SUMTOT	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01
TOTAL	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01	1.400E+01

ELEMENTS CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 21-HANF. RADIOACTIVITY OF ACTIVATION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
C 14	9.591E-02	9.590E-02	9.580E-02	9.476E-02	8.498E-02	2.861E-02	5.351E-07	0.0
FE 55	1.260E+01	9.653E+00	8.763E-01	3.339E-11	0.0	0.0	0.0	0.0
CO 60	3.581E+01	3.140E+01	9.611E+00	6.982E-05	0.0	0.0	0.0	0.0
NI 59	1.031E-02	1.031E-02	1.030E-02	1.030E-02	1.022E-02	9.450E-03	4.333E-03	1.779E-06
NI 63	2.381E+00	2.363E+00	2.208E+00	1.121E+00	1.272E-03	4.530E-33	0.0	0.0
ZR 93	3.431E-02	3.431E-02	3.431E-02	3.431E-02	3.430E-02	3.416E-02	3.279E-02	2.181E-02
NB 93M	7.462E-03	8.711E-03	1.750E-02	3.244E-02	3.258E-02	3.245E-02	3.115E-02	2.072E-02
IN113M	2.871E-02	3.184E-03	7.992E-12	0.0	0.0	0.0	0.0	0.0
SN113	2.870E-02	3.182E-03	7.988E-12	0.0	0.0	0.0	0.0	0.0
SN119M	2.460E+01	8.756E+00	8.030E-04	0.0	0.0	0.0	0.0	0.0
SN121M	1.310E-01	1.292E-01	1.140E-01	3.273E-02	1.240E-07	0.0	0.0	0.0
SB125	1.100E+02	8.566E+01	9.008E+00	1.490E-09	0.0	0.0	0.0	0.0
TE125M	2.690E+01	2.090E+01	2.198E+00	3.635E-10	0.0	0.0	0.0	0.0
SUMTOT	2.127E+02	1.590E+02	2.417E+01	1.325E+00	1.633E-01	1.047E-01	6.828E-02	4.253E-02
TOTAL	2.127E+02	1.590E+02	2.417E+01	1.325E+00	1.633E-01	1.047E-01	6.828E-02	4.253E-02

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 22-HANF. RADIOACTIVITY OF ACTIVATION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
C	9.591E-02	9.590E-02	9.580E-02	9.476E-02	8.498E-02	2.861E-02	5.351E-07	0.0
FE	1.260E+01	9.653E+00	8.763E-01	3.339E-11	0.0	0.0	0.0	0.0
CO	3.581E+01	3.140E+01	9.611E+00	6.982E-05	0.0	0.0	0.0	0.0
NI	2.391E+00	2.373E+00	2.218E+00	1.131E+00	1.149E-02	9.450E-03	4.333E-03	1.779E-06
ZR	3.431E-02	3.431E-02	3.431E-02	3.431E-02	3.430E-02	3.416E-02	3.279E-02	2.181E-02
NB	7.462E-03	8.711E-03	1.750E-02	3.244E-02	3.258E-02	3.245E-02	3.115E-02	2.072E-02
IN	2.871E-02	3.184E-03	7.992E-12	0.0	0.0	0.0	0.0	0.0
SN	2.476E+01	8.888E+00	1.148E-01	3.273E-02	1.240E-07	0.0	0.0	0.0
SB	1.100E+02	8.566E+01	9.008E+00	1.490E-09	0.0	0.0	0.0	0.0
TE	2.690E+01	2.090E+01	2.198E+00	3.635E-10	0.0	0.0	0.0	0.0
SUMTOT	2.127E+02	1.590E+02	2.417E+01	1.325E+00	1.633E-01	1.047E-01	6.828E-02	4.253E-02
TOTAL	2.127E+02	1.590E+02	2.417E+01	1.325E+00	1.633E-01	1.047E-01	6.828E-02	4.253E-02

ELEMENTS CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 23-HANF. THERMAL POWER OF ACTIVATION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: NUCLIDES

BASED ON ONE CANISTER

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
C 14	2.813E-05	2.812E-05	2.809E-05	2.779E-05	2.492E-05	8.388E-06	1.569E-10	0.0
FE 55	4.258E-04	3.262E-04	2.961E-05	1.128E-15	0.0	0.0	0.0	0.0
CO 60	5.521E-01	4.841E-01	1.482E-01	1.077E-06	0.0	0.0	0.0	0.0
NI 59	4.093E-07	4.093E-07	4.092E-07	4.089E-07	4.057E-07	3.753E-07	1.721E-07	7.067E-11
NI 63	2.399E-04	2.381E-04	2.225E-04	1.129E-04	1.282E-07	4.565E-37	0.0	0.0
ZR 93	3.986E-06	3.986E-06	3.986E-06	3.986E-06	3.985E-06	3.968E-06	3.810E-06	2.534E-06
NB 93M	1.322E-06	1.543E-06	3.100E-06	5.748E-06	5.773E-06	5.749E-06	5.519E-06	3.671E-06
IN113M	6.689E-05	7.417E-06	1.862E-14	0.0	0.0	0.0	0.0	0.0
SN119M	1.272E-02	4.526E-03	4.151E-07	0.0	0.0	0.0	0.0	0.0
SN121M	2.625E-04	2.589E-04	2.285E-04	6.557E-05	2.484E-10	0.0	0.0	0.0
SB125	3.439E-01	2.678E-01	2.816E-02	4.657E-12	0.0	0.0	0.0	0.0
TE125M	2.261E-02	1.757E-02	1.847E-03	3.055E-13	0.0	0.0	0.0	0.0
SUMTOT	9.324E-01	7.748E-01	1.787E-01	2.175E-04	3.521E-05	1.848E-05	9.502E-06	6.205E-06
TOTAL	9.324E-01	7.748E-01	1.787E-01	2.175E-04	3.521E-05	1.848E-05	9.502E-06	6.205E-06

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 24-HANF. THERMAL POWER OF ACTIVATION PRODUCTS
IN DECAY OF HANFORD HLW GLASS: ELEMENTS

BASED ON ONE CANISTER

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
C	2.813E-05	2.812E-05	2.809E-05	2.779E-05	2.492E-05	8.388E-06	1.569E-10	0.0
FE	4.258E-04	3.262E-04	2.961E-05	1.128E-15	0.0	0.0	0.0	0.0
CO	5.521E-01	4.841E-01	1.482E-01	1.077E-06	0.0	0.0	0.0	0.0
NI	2.403E-04	2.385E-04	2.229E-04	1.133E-04	5.340E-07	3.753E-07	1.721E-07	7.067E-11
ZR	3.986E-06	3.986E-06	3.986E-06	3.986E-06	3.985E-06	3.968E-06	3.810E-06	2.534E-06
NB	1.322E-06	1.543E-06	3.100E-06	5.748E-06	5.773E-06	5.749E-06	5.519E-06	3.671E-06
IN	6.689E-05	7.417E-06	1.862E-14	0.0	0.0	0.0	0.0	0.0
SN	1.299E-02	4.785E-03	2.289E-04	6.557E-05	2.484E-10	0.0	0.0	0.0
SB	3.439E-01	2.678E-01	2.816E-02	4.657E-12	0.0	0.0	0.0	0.0
TE	2.261E-02	1.757E-02	1.847E-03	3.055E-13	0.0	0.0	0.0	0.0
SUMTOT	9.324E-01	7.748E-01	1.787E-01	2.175E-04	3.521E-05	1.848E-05	9.502E-06	6.205E-06
TOTAL	9.324E-01	7.748E-01	1.787E-01	2.175E-04	3.521E-05	1.848E-05	9.502E-06	6.205E-06

ELEMENTS CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 25-HANF. PHOTON SPECTRUM OF ACTIVATION PRODUCTS
IN DECAY OF HANFORD HLW GLASS

BASED ON ONE CANISTER

PHOTONS/SEC

18 GROUP PHOTON RELEASE RATES, PHOTONS/SECOND

EMEAN	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
1.000E-02	4.347E+11	3.296E+11	4.623E+10	5.466E+08	3.100E+08	2.599E+08	2.258E+08	1.502E+08
2.500E-02	3.158E+12	2.289E+12	2.280E+11	2.613E+07	1.096E+07	4.039E+06	5.156E+05	3.429E+05
3.750E-02	7.168E+11	5.584E+11	5.995E+10	8.523E+06	5.106E+06	1.787E+06	1.002E+05	6.664E+04
5.750E-02	3.135E+10	2.492E+10	3.979E+09	4.691E+06	3.938E+06	1.331E+06	7.691E+03	5.099E+03
8.500E-02	1.333E+10	1.068E+10	1.665E+09	7.245E+05	6.444E+05	2.169E+05	4.057E+00	0.0
1.250E-01	2.146E+10	1.682E+10	1.977E+09	5.488E+04	4.715E+04	1.587E+04	2.969E-01	0.0
2.250E-01	2.478E+11	1.930E+11	2.036E+10	7.632E+02	2.801E+00	9.428E-01	1.763E-05	0.0
3.750E-01	1.469E+12	1.144E+12	1.203E+11	2.322E+02	0.0	0.0	0.0	0.0
5.750E-01	1.888E+12	1.470E+12	1.546E+11	3.776E+01	0.0	0.0	0.0	0.0
8.500E-01	9.895E+07	8.676E+07	2.656E+07	1.929E+02	0.0	0.0	0.0	0.0
1.250E+00	2.649E+12	2.323E+12	7.110E+11	5.165E+06	0.0	0.0	0.0	0.0
1.750E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.250E+00	1.404E+07	1.231E+07	3.768E+06	2.738E+01	0.0	0.0	0.0	0.0
2.750E+00	4.345E+04	3.809E+04	1.166E+04	8.471E-02	0.0	0.0	0.0	0.0
3.500E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.000E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.500E+00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	1.063E+13	8.359E+12	1.348E+12	5.919E+08	3.307E+08	2.673E+08	2.264E+08	1.506E+08

TABLE 1-INEL. CONCENTRATIONS OF ACTINIDES AND DAUGHTERS
IN DECAY OF INEL HLW: NUCLIDES

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

GRAMS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
HE 4	0.0	7.225E-04	7.045E-03	5.416E-02	1.317E-01	2.302E-01	4.872E-01	1.071E+00
PB206	0.0	2.388E-20	8.592E-15	5.718E-10	5.029E-06	3.484E-03	3.874E-01	4.147E+00
BI209	0.0	2.797E-17	4.717E-15	3.030E-12	1.407E-08	3.124E-05	1.031E-02	4.614E-01
TH230	0.0	5.659E-08	5.506E-06	4.413E-04	1.243E-02	1.332E-01	8.036E-01	1.360E-01
TH232	0.0	5.747E-09	5.797E-08	6.293E-07	1.109E-05	4.580E-04	1.002E-02	1.076E-01
U233	1.583E-07	1.861E-07	4.565E-07	6.921E-06	3.818E-04	6.926E-03	5.979E-02	1.325E-01
U234	8.785E-05	4.048E-02	3.900E-01	2.803E+00	5.119E+00	4.992E+00	3.868E+00	3.016E-01
U235	1.063E+00	1.063E+00	1.067E+00	1.104E+00	1.464E+00	4.604E+00	1.445E+01	1.523E+01
U236	1.973E-01	1.977E-01	2.011E-01	2.351E-01	5.584E-01	2.543E+00	3.776E+00	3.677E+00
U238	3.797E-05	3.903E-05	4.857E-05	1.440E-04	1.097E-03	1.055E-02	9.711E-02	4.932E-01
NP237	8.693E-02	8.754E-02	9.866E-02	3.685E-01	1.897E+00	2.363E+00	2.295E+00	1.715E+00
PU238	5.221E+00	5.180E+00	4.825E+00	2.370E+00	1.936E-03	2.571E-34	0.0	0.0
PU239	1.437E+01	1.437E+01	1.437E+01	1.433E+01	1.397E+01	1.080E+01	8.105E-01	4.468E-12
PU240	3.642E+00	3.642E+00	3.641E+00	3.611E+00	3.283E+00	1.264E+00	9.084E-05	0.0
PU241	1.983E+00	1.890E+00	1.225E+00	1.610E-02	2.463E-21	0.0	0.0	0.0
PU242	6.018E-01	6.018E-01	6.018E-01	6.017E-01	6.007E-01	5.911E-01	5.031E-01	1.003E-01
AM241	3.385E-01	4.311E-01	1.084E+00	2.019E+00	4.807E-01	2.592E-07	0.0	0.0
AM243	5.315E-02	5.315E-02	5.310E-02	5.265E-02	4.839E-02	2.078E-02	4.432E-06	8.638E-43
SUMTOT	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.759E+01
TOTAL	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.759E+01

NUCLIDES CONTRIBUTING < 0.1000 % ARE OMITTED

TABLE 2-INEL. CONCENTRATIONS OF ACTINIDES AND DAUGHTERS
IN DECAY OF INEL HLW: ELEMENTS

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

GRAMS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
HE	0.0	7.225E-04	7.045E-03	5.416E-02	1.317E-01	2.302E-01	4.872E-01	1.071E+00
PB	0.0	1.073E-16	2.582E-13	1.472E-09	5.599E-06	3.513E-03	3.881E-01	4.159E+00
BI	0.0	2.800E-17	4.816E-15	3.553E-12	1.442E-08	3.126E-05	1.031E-02	4.614E-01
RA	0.0	1.673E-13	1.633E-10	1.367E-07	4.327E-05	2.114E-03	1.655E-02	2.779E-03
TH	0.0	6.235E-08	5.564E-06	4.420E-04	1.244E-02	1.338E-01	8.161E-01	2.497E-01
PA	0.0	4.003E-09	1.367E-08	1.173E-07	1.277E-06	2.608E-05	4.977E-04	6.970E-04
U	1.260E+00	1.302E+00	1.658E+00	4.142E+00	7.143E+00	1.216E+01	2.225E+01	1.983E+01
NP	8.693E-02	8.754E-02	9.866E-02	3.685E-01	1.897E+00	2.363E+00	2.295E+00	1.715E+00
PU	2.582E+01	2.568E+01	2.466E+01	2.093E+01	1.785E+01	1.266E+01	1.314E+00	1.003E-01
AM	3.916E-01	4.842E-01	1.137E+00	2.072E+00	5.291E-01	2.078E-02	4.432E-06	8.638E-43
CM	8.452E-03	7.946E-03	5.593E-03	1.785E-04	1.956E-19	0.0	0.0	0.0
SUMTOT	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.759E+01
TOTAL	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.757E+01	2.759E+01

ELEMENTS CONTRIBUTING < 0.0001 % ARE OMITTED

TABLE 3-INEL. RADIOACTIVITY OF ACTINIDES AND DAUGHTERS
IN DECAY OF INEL HLW: NUCLIDES

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL207	0.0	7.638E-13	6.986E-11	3.440E-09	5.713E-08	1.225E-06	2.345E-05	3.284E-05
TL209	0.0	3.401E-15	6.066E-14	5.427E-12	2.765E-09	4.922E-07	1.141E-05	2.787E-05
PB209	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
PB210	0.0	1.261E-15	1.182E-11	6.450E-08	4.278E-05	2.090E-03	1.637E-02	2.748E-03
PB211	0.0	7.660E-13	7.005E-11	3.450E-09	5.729E-08	1.229E-06	2.352E-05	3.293E-05
PB214	0.0	1.655E-13	1.615E-10	1.352E-07	4.279E-05	2.090E-03	1.637E-02	2.748E-03
BI210	0.0	1.261E-15	1.182E-11	6.450E-08	4.278E-05	2.090E-03	1.637E-02	2.748E-03
BI211	0.0	7.660E-13	7.005E-11	3.450E-09	5.729E-08	1.229E-06	2.352E-05	3.293E-05
BI213	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
BI214	0.0	1.655E-13	1.615E-10	1.352E-07	4.279E-05	2.090E-03	1.637E-02	2.748E-03
PO210	0.0	3.446E-16	1.182E-11	6.450E-08	4.278E-05	2.090E-03	1.637E-02	2.748E-03
PO213	0.0	1.541E-13	2.748E-12	2.458E-10	1.253E-07	2.229E-05	5.169E-04	1.262E-03
PO214	0.0	1.654E-13	1.614E-10	1.352E-07	4.278E-05	2.090E-03	1.637E-02	2.748E-03
PO215	0.0	7.660E-13	7.005E-11	3.450E-09	5.729E-08	1.229E-06	2.352E-05	3.293E-05
PO218	0.0	1.655E-13	1.615E-10	1.352E-07	4.280E-05	2.091E-03	1.637E-02	2.749E-03
AT217	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
RN219	0.0	7.660E-13	7.005E-11	3.450E-09	5.729E-08	1.229E-06	2.352E-05	3.293E-05
RN222	0.0	1.655E-13	1.615E-10	1.352E-07	4.280E-05	2.091E-03	1.637E-02	2.749E-03
FR221	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
FR223	0.0	1.057E-14	9.662E-13	4.760E-11	7.906E-10	1.696E-08	3.245E-07	4.545E-07
RA223	0.0	7.660E-13	7.005E-11	3.450E-09	5.729E-08	1.229E-06	2.352E-05	3.293E-05
RA225	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
RA226	0.0	1.655E-13	1.615E-10	1.352E-07	4.280E-05	2.091E-03	1.637E-02	2.749E-03
AC225	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
AC227	0.0	7.660E-13	7.002E-11	3.449E-09	5.729E-08	1.229E-06	2.352E-05	3.293E-05
TH227	0.0	7.554E-13	6.909E-11	3.402E-09	5.650E-08	1.212E-06	2.319E-05	3.248E-05
TH229	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
TH230	0.0	1.143E-09	1.112E-07	8.913E-06	2.510E-04	2.691E-03	1.623E-02	2.746E-03
TH231	0.0	2.300E-06	2.307E-06	2.387E-06	3.166E-06	9.956E-06	3.124E-05	3.293E-05
PA231	0.0	4.864E-11	4.878E-10	4.952E-09	5.728E-08	1.229E-06	2.351E-05	3.293E-05
PA233	0.0	6.173E-05	6.957E-05	2.599E-04	1.338E-03	1.666E-03	1.618E-03	1.209E-03
U233	1.533E-09	1.802E-09	4.421E-09	6.703E-08	3.697E-06	6.708E-05	5.790E-04	1.283E-03
U234	5.492E-07	2.530E-04	2.438E-03	1.752E-02	3.200E-02	3.120E-02	2.418E-02	1.885E-03
U235	2.299E-06	2.300E-06	2.307E-06	2.387E-06	3.166E-06	9.956E-06	3.124E-05	3.293E-05
U236	1.277E-05	1.279E-05	1.302E-05	1.522E-05	3.614E-05	1.646E-04	2.444E-04	2.380E-04
U237	6.130E-09	4.778E-03	3.098E-03	4.069E-05	6.227E-24	0.0	0.0	0.0
NP237	6.130E-05	6.173E-05	6.957E-05	2.599E-04	1.338E-03	1.666E-03	1.618E-03	1.209E-03
NP239	0.0	1.060E-02	1.059E-02	1.050E-02	9.649E-03	4.144E-03	8.839E-07	1.723E-43
PU238	8.942E+01	8.872E+01	8.263E+01	4.058E+01	3.316E-02	4.403E-33	0.0	0.0
PU239	8.936E-01	8.936E-01	8.934E-01	8.911E-01	8.685E-01	6.716E-01	5.040E-02	2.779E-13
PU240	8.302E-01	8.302E-01	8.299E-01	8.232E-01	7.483E-01	2.882E-01	2.071E-05	0.0

TABLE 3-INEL. RADIOACTIVITY OF ACTINIDES AND DAUGHTERS
IN DECAY OF INEL HLW: NUCLIDES

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
PU241	2.044E+02	1.948E+02	1.263E+02	1.659E+00	2.538E-19	0.0	0.0	0.0
PU242	2.299E-03	2.299E-03	2.299E-03	2.298E-03	2.295E-03	2.258E-03	1.922E-03	3.832E-04
AM241	1.162E+00	1.480E+00	3.723E+00	6.932E+00	1.651E+00	8.900E-07	0.0	0.0
AM243	1.060E-02	1.060E-02	1.059E-02	1.050E-02	9.649E-03	4.144E-03	8.838E-07	1.723E-43
CM242	8.302E-01	1.760E-01	1.519E-07	0.0	0.0	0.0	0.0	0.0
CM244	6.638E-01	6.388E-01	4.527E-01	1.445E-02	1.584E-17	0.0	0.0	0.0
SUMTOT	2.982E+02	2.875E+02	2.148E+02	5.095E+01	3.358E+00	1.027E+00	2.486E-01	4.437E-02
TOTAL	2.982E+02	2.875E+02	2.148E+02	5.095E+01	3.358E+00	1.027E+00	2.486E-01	4.437E-02

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 4-INEL. RADIOACTIVITY OF ACTINIDES AND DAUGHTERS IN DECAY OF INEL HLW: ELEMENTS

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL	0.0	7.672E-13	6.992E-11	3.446E-09	5.990E-08	1.718E-06	3.486E-05	6.071E-05
PB	0.0	1.090E-12	2.461E-10	2.034E-07	8.575E-05	4.204E-03	3.329E-02	6.819E-03
BI	0.0	1.090E-12	2.461E-10	2.034E-07	8.575E-05	4.204E-03	3.329E-02	6.819E-03
PO	0.0	1.253E-12	4.077E-10	3.386E-07	1.285E-04	6.294E-03	4.965E-02	9.539E-03
AT	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
RN	0.0	9.315E-13	2.315E-10	1.387E-07	4.285E-05	2.092E-03	1.640E-02	2.782E-03
FR	0.0	1.680E-13	3.775E-12	2.989E-10	1.288E-07	2.280E-05	5.286E-04	1.291E-03
RA	0.0	1.089E-12	2.344E-10	1.389E-07	4.298E-05	2.115E-03	1.693E-02	4.072E-03
AC	0.0	9.235E-13	7.283E-11	3.701E-09	1.853E-07	2.401E-05	5.518E-04	1.323E-03
TH	0.0	2.301E-06	2.419E-06	1.130E-05	2.543E-04	2.725E-03	1.681E-02	4.102E-03
PA	0.0	6.173E-05	6.958E-05	2.599E-04	1.338E-03	1.667E-03	1.642E-03	1.242E-03
U	1.563E-05	5.046E-03	5.551E-03	1.758E-02	3.204E-02	3.145E-02	2.503E-02	3.439E-03
NP	6.130E-05	1.066E-02	1.066E-02	1.076E-02	1.099E-02	5.810E-03	1.619E-03	1.209E-03
PU	2.955E+02	2.852E+02	2.106E+02	4.396E+01	1.652E+00	9.621E-01	5.235E-02	3.832E-04
AM	1.173E+00	1.491E+00	3.733E+00	6.943E+00	1.660E+00	4.145E-03	8.838E-07	1.723E-43
CM	1.494E+00	8.148E-01	4.527E-01	1.445E-02	1.584E-17	0.0	0.0	0.0
SUMTOT	2.982E+02	2.875E+02	2.148E+02	5.095E+01	3.358E+00	1.027E+00	2.486E-01	4.437E-02
TOTAL	2.982E+02	2.875E+02	2.148E+02	5.095E+01	3.358E+00	1.027E+00	2.486E-01	4.437E-02

ELEMENTS CONTRIBUTING < 0.0001 % ARE OMITTED

TABLE 5-INEL. THERMAL POWER OF ACTINIDES AND DAUGHTERS IN DECAY OF INEL HLW: NUCLIDES

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL207	0.0	2.243E-15	2.051E-13	1.010E-11	1.678E-10	3.599E-09	6.886E-08	9.644E-08
TL209	0.0	5.651E-17	1.008E-15	9.018E-14	4.594E-11	8.177E-09	1.896E-07	4.630E-07
PB209	0.0	1.811E-16	3.230E-15	2.889E-13	1.472E-10	2.620E-08	6.075E-07	1.484E-06
PB210	0.0	2.922E-19	2.739E-15	1.494E-11	9.910E-09	4.841E-07	3.792E-06	6.365E-07
PB211	0.0	2.295E-15	2.099E-13	1.034E-11	1.717E-10	3.682E-09	7.047E-08	9.868E-08
PB214	0.0	5.276E-16	5.149E-13	4.311E-10	1.365E-07	6.666E-06	5.221E-05	8.764E-06
BI210	0.0	2.908E-18	2.726E-14	1.487E-10	9.864E-08	4.819E-06	3.774E-05	6.335E-06
BI211	0.0	3.055E-14	2.794E-12	1.376E-10	2.285E-09	4.902E-08	9.380E-07	1.314E-06
BI213	0.0	6.620E-16	1.181E-14	1.056E-12	5.382E-10	9.579E-08	2.221E-06	5.424E-06
BI214	0.0	2.120E-15	2.069E-12	1.732E-09	5.484E-07	2.679E-05	2.098E-04	3.522E-05
PO210	0.0	1.105E-17	3.790E-13	2.068E-09	1.371E-06	6.699E-05	5.247E-04	8.808E-05
PO213	0.0	7.796E-15	1.391E-13	1.244E-11	6.338E-09	1.128E-06	2.616E-05	6.388E-05
PO214	0.0	7.681E-15	7.495E-12	6.275E-09	1.986E-06	9.704E-05	7.600E-04	1.276E-04
PO215	0.0	3.419E-14	3.127E-12	1.540E-10	2.558E-09	5.486E-08	1.050E-06	1.470E-06
PO218	0.0	5.997E-15	5.852E-12	4.899E-09	1.551E-06	7.576E-05	5.933E-04	9.960E-05
AT217	0.0	6.720E-15	1.198E-13	1.072E-11	5.463E-09	9.723E-07	2.254E-05	5.506E-05
RN219	0.0	3.178E-14	2.907E-12	1.431E-10	2.377E-09	5.099E-08	9.758E-07	1.367E-06
RN222	0.0	5.484E-15	5.351E-12	4.480E-09	1.418E-06	6.928E-05	5.426E-04	9.108E-05
FR221	0.0	6.077E-15	1.084E-13	9.698E-12	4.941E-09	8.794E-07	2.039E-05	4.980E-05
RA223	0.0	2.727E-14	2.494E-12	1.228E-10	2.040E-09	4.376E-08	8.374E-07	1.173E-06
RA225	0.0	1.104E-16	1.969E-15	1.762E-13	8.977E-11	1.598E-08	3.705E-07	9.048E-07
RA226	0.0	4.778E-15	4.663E-12	3.904E-09	1.236E-06	6.037E-05	4.728E-04	7.936E-05
AC225	0.0	5.501E-15	9.811E-14	8.777E-12	4.472E-09	7.959E-07	1.845E-05	4.507E-05
AC227	0.0	3.709E-16	3.390E-14	1.670E-12	2.774E-11	5.951E-10	1.139E-08	1.595E-08
TH227	0.0	2.757E-14	2.521E-12	1.242E-10	2.062E-09	4.423E-08	8.464E-07	1.185E-06
TH229	0.0	4.817E-15	8.592E-14	7.687E-12	3.916E-09	6.971E-07	1.616E-05	3.947E-05
TH230	0.0	3.234E-11	3.147E-09	2.522E-07	7.103E-06	7.614E-05	4.593E-04	7.771E-05
TH231	0.0	1.290E-09	1.295E-09	1.339E-09	1.777E-09	5.586E-09	1.753E-08	1.848E-08
PA231	0.0	1.465E-12	1.470E-11	1.492E-10	1.726E-09	3.702E-08	7.085E-07	9.923E-07
PA233	0.0	1.401E-07	1.579E-07	5.899E-07	3.036E-06	3.782E-06	3.673E-06	2.744E-06
U233	4.456E-11	5.238E-11	1.285E-10	1.948E-09	1.075E-07	1.950E-06	1.683E-05	3.729E-05
U234	1.582E-08	7.288E-06	7.022E-05	5.047E-04	9.216E-04	8.988E-04	6.964E-04	5.430E-05
U235	6.020E-08	6.022E-08	6.043E-08	6.250E-08	8.292E-08	2.607E-07	8.181E-07	8.624E-07
U236	3.459E-07	3.466E-07	3.526E-07	4.123E-07	9.790E-07	4.459E-06	6.621E-06	6.447E-06
NP237	1.874E-06	1.887E-06	2.126E-06	7.943E-06	4.088E-05	5.092E-05	4.946E-05	3.695E-05
NP239	0.0	2.562E-05	2.560E-05	2.538E-05	2.333E-05	1.002E-05	2.137E-09	4.164E-46
PU238	2.963E+00	2.940E+00	2.738E+00	1.345E+00	1.099E-03	1.459E-34	0.0	0.0
PU239	2.754E-02	2.754E-02	2.753E-02	2.746E-02	2.677E-02	2.070E-02	1.553E-03	8.563E-15
PU240	2.585E-02	2.585E-02	2.584E-02	2.563E-02	2.330E-02	8.973E-03	6.448E-07	0.0
PU241	6.336E-03	6.038E-03	3.915E-03	5.143E-05	7.869E-24	0.0	0.0	0.0
PU242	6.788E-05	6.788E-05	6.788E-05	6.787E-05	6.776E-05	6.668E-05	5.675E-05	1.132E-05

TABLE 5-INEL. THERMAL POWER OF ACTINIDES AND DAUGHTERS
IN DECAY OF INEL HLW: NUCLIDES

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
AM241	3.861E-02	4.917E-02	1.237E-01	2.303E-01	5.483E-02	2.956E-08	0.0	0.0
AM243	3.407E-04	3.407E-04	3.404E-04	3.375E-04	3.102E-04	1.332E-04	2.841E-08	5.537E-45
CM242	3.059E-02	6.484E-03	5.597E-09	0.0	0.0	0.0	0.0	0.0
CM244	2.322E-02	2.235E-02	1.583E-02	5.053E-04	5.539E-19	0.0	0.0	0.0
SUMTOT	3.116E+00	3.078E+00	2.936E+00	1.630E+00	1.074E-01	3.133E-02	6.153E-03	1.034E-03
TOTAL	3.116E+00	3.078E+00	2.936E+00	1.630E+00	1.074E-01	3.133E-02	6.153E-03	1.034E-03

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 6-INEL. THERMAL POWER OF ACTINIDES AND DAUGHTERS
IN DECAY OF INEL HLW: ELEMENTS

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL	0.0	2.300E-15	2.062E-13	1.019E-11	2.137E-10	1.178E-08	2.585E-07	5.596E-07
PB	0.0	3.004E-15	7.308E-13	4.567E-10	1.467E-07	7.180E-06	5.668E-05	1.098E-05
BI	0.0	3.334E-14	4.902E-12	2.020E-09	6.498E-07	3.175E-05	2.507E-04	4.829E-05
PO	0.0	5.578E-14	1.700E-11	1.341E-08	4.917E-06	2.410E-04	1.905E-03	3.806E-04
AT	0.0	6.720E-15	1.198E-13	1.072E-11	5.463E-09	9.723E-07	2.254E-05	5.506E-05
RN	0.0	3.727E-14	8.258E-12	4.623E-09	1.420E-06	6.933E-05	5.435E-04	9.245E-05
FR	0.0	6.105E-15	1.109E-13	9.821E-12	4.943E-09	8.794E-07	2.039E-05	4.980E-05
RA	0.0	3.216E-14	7.159E-12	4.027E-09	1.238E-06	6.043E-05	4.740E-04	8.144E-05
AC	0.0	5.872E-15	1.320E-13	1.045E-11	4.500E-09	7.965E-07	1.847E-05	4.509E-05
TH	0.0	1.323E-09	4.444E-09	2.537E-07	7.110E-06	7.689E-05	4.763E-04	1.184E-04
PA	0.0	1.401E-07	1.579E-07	5.900E-07	3.038E-06	3.819E-06	4.382E-06	3.737E-06
U	4.220E-07	1.674E-05	7.649E-05	5.053E-04	9.228E-04	9.054E-04	7.206E-04	9.891E-05
NP	1.874E-06	2.751E-05	2.772E-05	3.333E-05	6.421E-05	6.094E-05	4.946E-05	3.695E-05
PU	3.023E+00	3.000E+00	2.796E+00	1.398E+00	5.123E-02	2.974E-02	1.611E-03	1.132E-05
AM	3.895E-02	4.951E-02	1.240E-01	2.306E-01	5.514E-02	1.332E-04	2.841E-08	5.537E-45
CM	5.381E-02	2.883E-02	1.583E-02	5.053E-04	5.539E-19	0.0	0.0	0.0
SUMTOT	3.116E+00	3.078E+00	2.936E+00	1.630E+00	1.074E-01	3.133E-02	6.153E-03	1.034E-03
TOTAL	3.116E+00	3.078E+00	2.936E+00	1.630E+00	1.074E-01	3.133E-02	6.153E-03	1.034E-03

ELEMENTS CONTRIBUTING < 0.0001 % ARE OMITTED

TABLE 7-INEL. ALPHA RADIOACTIVITY OF ACTINIDES AND DAUGHTERS
IN DECAY OF INEL HLW: NUCLIDES

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
BI211	0.0	7.638E-13	6.986E-11	3.440E-09	5.713E-08	1.225E-06	2.345E-05	3.284E-05
BI213	0.0	3.401E-15	6.066E-14	5.427E-12	2.765E-09	4.922E-07	1.141E-05	2.787E-05
BI214	0.0	3.475E-17	3.391E-14	2.839E-11	8.986E-09	4.390E-07	3.438E-06	5.771E-07
PO210	0.0	3.446E-16	1.182E-11	6.450E-08	4.278E-05	2.090E-03	1.637E-02	2.748E-03
PO213	0.0	1.541E-13	2.748E-12	2.458E-10	1.253E-07	2.229E-05	5.169E-04	1.262E-03
PO214	0.0	1.654E-13	1.614E-10	1.352E-07	4.278E-05	2.090E-03	1.637E-02	2.748E-03
PO215	0.0	7.660E-13	7.005E-11	3.450E-09	5.729E-08	1.229E-06	2.352E-05	3.293E-05
PO218	0.0	1.655E-13	1.615E-10	1.352E-07	4.279E-05	2.090E-03	1.637E-02	2.748E-03
AT217	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
RN219	0.0	7.660E-13	7.005E-11	3.450E-09	5.729E-08	1.229E-06	2.352E-05	3.293E-05
RN222	0.0	1.655E-13	1.615E-10	1.352E-07	4.280E-05	2.091E-03	1.637E-02	2.749E-03
FR221	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
RA223	0.0	7.660E-13	7.005E-11	3.450E-09	5.729E-08	1.229E-06	2.352E-05	3.293E-05
RA226	0.0	1.655E-13	1.615E-10	1.352E-07	4.280E-05	2.091E-03	1.637E-02	2.749E-03
AC225	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
AC227	0.0	1.057E-14	9.662E-13	4.760E-11	7.906E-10	1.696E-08	3.245E-07	4.545E-07
TH227	0.0	7.554E-13	6.909E-11	3.402E-09	5.650E-08	1.212E-06	2.319E-05	3.248E-05
TH229	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
TH230	0.0	1.143E-09	1.112E-07	8.913E-06	2.510E-04	2.691E-03	1.623E-02	2.746E-03
PA231	0.0	4.864E-11	4.878E-10	4.952E-09	5.728E-08	1.229E-06	2.351E-05	3.293E-05
U233	1.533E-09	1.802E-09	4.421E-09	6.703E-08	3.697E-06	6.708E-05	5.790E-04	1.283E-03
U234	5.492E-07	2.530E-04	2.438E-03	1.752E-02	3.200E-02	3.120E-02	2.418E-02	1.885E-03
U235	2.299E-06	2.300E-06	2.307E-06	2.387E-06	3.166E-06	9.956E-06	3.124E-05	3.293E-05
U236	1.277E-05	1.279E-05	1.302E-05	1.522E-05	3.614E-05	1.646E-04	2.444E-04	2.380E-04
NP237	6.130E-05	6.173E-05	6.957E-05	2.599E-04	1.338E-03	1.666E-03	1.618E-03	1.209E-03
PU238	8.942E+01	8.872E+01	8.263E+01	4.058E+01	3.316E-02	4.403E-33	0.0	0.0
PU239	8.936E-01	8.936E-01	8.934E-01	8.911E-01	8.685E-01	6.716E-01	5.040E-02	2.779E-13
PU240	8.302E-01	8.302E-01	8.299E-01	8.232E-01	7.483E-01	2.882E-01	2.071E-05	0.0
PU241	5.007E-03	4.772E-03	3.094E-03	4.064E-05	6.219E-24	0.0	0.0	0.0
PU242	2.299E-03	2.299E-03	2.299E-03	2.298E-03	2.295E-03	2.258E-03	1.922E-03	3.832E-04
AM241	1.162E+00	1.480E+00	3.723E+00	6.932E+00	1.651E+00	8.900E-07	0.0	0.0
AM243	1.060E-02	1.060E-02	1.059E-02	1.050E-02	9.649E-03	4.144E-03	8.838E-07	1.723E-43
CM242	8.302E-01	1.760E-01	1.519E-07	0.0	0.0	0.0	0.0	0.0
CM244	6.638E-01	6.388E-01	4.527E-01	1.445E-02	1.584E-17	0.0	0.0	0.0
SUMTOT	9.381E+01	9.275E+01	8.854E+01	4.928E+01	3.346E+00	1.013E+00	1.799E-01	2.817E-02
TOTAL	9.381E+01	9.275E+01	8.854E+01	4.928E+01	3.346E+00	1.013E+00	1.799E-01	2.817E-02

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 8-INEL. ALPHA RADIOACTIVITY OF ACTINIDES AND DAUGHTERS IN DECAY OF INEL HLW: ELEMENTS

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
BI	0.0	7.673E-13	6.995E-11	3.474E-09	6.888E-08	2.157E-06	3.830E-05	6.129E-05
PO	0.0	1.253E-12	4.077E-10	3.385E-07	1.285E-04	6.294E-03	4.965E-02	9.539E-03
AT	0.0	1.575E-13	2.808E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
RN	0.0	9.315E-13	2.315E-10	1.387E-07	4.285E-05	2.092E-03	1.640E-02	2.782E-03
FR	0.0	1.575E-13	2.809E-12	2.513E-10	1.280E-07	2.279E-05	5.283E-04	1.290E-03
RA	0.0	9.315E-13	2.315E-10	1.387E-07	4.285E-05	2.092E-03	1.640E-02	2.782E-03
AC	0.0	1.680E-13	3.775E-12	2.989E-10	1.288E-07	2.280E-05	5.286E-04	1.291E-03
TH	0.0	1.144E-09	1.113E-07	8.916E-06	2.512E-04	2.715E-03	1.678E-02	4.069E-03
PA	0.0	4.864E-11	4.878E-10	4.952E-09	5.728E-08	1.229E-06	2.351E-05	3.293E-05
U	1.562E-05	2.681E-04	2.453E-03	1.754E-02	3.204E-02	3.145E-02	2.503E-02	3.439E-03
NP	6.130E-05	6.173E-05	6.957E-05	2.599E-04	1.338E-03	1.666E-03	1.618E-03	1.209E-03
PU	9.115E+01	9.045E+01	8.436E+01	4.230E+01	1.652E+00	9.621E-01	5.235E-02	3.832E-04
AM	1.173E+00	1.491E+00	3.733E+00	6.943E+00	1.660E+00	4.145E-03	8.838E-07	1.723E-43
CM	1.494E+00	8.148E-01	4.527E-01	1.445E-02	1.584E-17	0.0	0.0	0.0
SUMTOT	9.381E+01	9.275E+01	8.854E+01	4.928E+01	3.346E+00	1.013E+00	1.799E-01	2.817E-02
TOTAL	9.381E+01	9.275E+01	8.854E+01	4.928E+01	3.346E+00	1.013E+00	1.799E-01	2.817E-02

TABLE 9-INEL. (ALPHA,N) NEUTRON SOURCES
IN DECAY OF INEL HLW

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

NEUTRONS/SEC

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
BI211	0.0	1.291E-09	1.180E-07	5.812E-06	9.653E-05	2.070E-03	3.962E-02	5.548E-02
PO210	0.0	2.910E-13	9.986E-09	5.447E-05	3.613E-02	1.765E+00	1.382E+01	2.320E+00
PO213	0.0	4.211E-10	7.510E-09	6.719E-07	3.423E-04	6.093E-02	1.413E+00	3.450E+00
PO214	0.0	3.909E-10	3.815E-07	3.194E-04	1.011E-01	4.939E+00	3.868E+01	6.493E+00
PO215	0.0	1.674E-09	1.531E-07	7.539E-06	1.252E-04	2.686E-03	5.139E-02	7.197E-02
PO218	0.0	2.112E-10	2.061E-07	1.726E-04	5.463E-02	2.669E+00	2.090E+01	3.509E+00
AT217	0.0	3.118E-10	5.561E-09	4.975E-07	2.535E-04	4.511E-02	1.046E+00	2.555E+00
RN219	0.0	1.419E-09	1.298E-07	6.393E-06	1.062E-04	2.277E-03	4.358E-02	6.103E-02
RN222	0.0	1.573E-10	1.535E-07	1.286E-04	4.069E-02	1.988E+00	1.557E+01	2.613E+00
FR221	0.0	2.417E-10	4.310E-09	3.856E-07	1.965E-04	3.497E-02	8.107E-01	1.980E+00
RA223	0.0	9.255E-10	8.464E-08	4.168E-06	6.923E-05	1.485E-03	2.841E-02	3.979E-02
RA226	0.0	9.286E-11	9.062E-08	7.587E-05	2.402E-02	1.173E+00	9.188E+00	1.542E+00
AC225	0.0	1.789E-10	3.191E-09	2.855E-07	1.455E-04	2.589E-02	6.003E-01	1.466E+00
TH227	0.0	9.853E-10	9.011E-08	4.438E-06	7.370E-05	1.581E-03	3.025E-02	4.236E-02
TH229	0.0	1.115E-10	1.988E-09	1.779E-07	9.064E-05	1.613E-02	3.740E-01	9.135E-01
TH230	0.0	5.893E-07	5.733E-05	4.595E-03	1.294E-01	1.387E+00	8.368E+00	1.416E+00
U233	8.846E-07	1.040E-06	2.551E-06	3.868E-05	2.134E-03	3.871E-02	3.341E-01	7.403E-01
U234	3.050E-04	1.405E-01	1.354E+00	9.732E+00	1.777E+01	1.733E+01	1.343E+01	1.047E+00
U236	5.443E-03	5.454E-03	5.548E-03	6.487E-03	1.540E-02	7.016E-02	1.042E-01	1.014E-01
NP237	4.324E-02	4.354E-02	4.908E-02	1.833E-01	9.435E-01	1.175E+00	1.141E+00	8.528E-01
PU238	8.507E+04	8.440E+04	7.861E+04	3.861E+04	3.155E+01	4.189E-30	0.0	0.0
PU239	6.509E+02	6.509E+02	6.507E+02	6.490E+02	6.326E+02	4.892E+02	3.671E+01	2.024E-10
PU240	6.291E+02	6.291E+02	6.288E+02	6.238E+02	5.670E+02	2.184E+02	1.569E-02	0.0
PU242	1.414E+00	1.414E+00	1.414E+00	1.413E+00	1.411E+00	1.388E+00	1.182E+00	2.357E-01
AM241	1.115E+03	1.420E+03	3.571E+03	6.649E+03	1.583E+03	8.536E-04	0.0	0.0
AM243	9.043E+00	9.042E+00	9.034E+00	8.958E+00	8.232E+00	3.535E+00	7.540E-04	1.470E-40
CM242	1.115E+03	2.362E+02	2.039E-04	0.0	0.0	0.0	0.0	0.0
CM244	7.575E+02	7.290E+02	5.166E+02	1.649E+01	1.807E-14	0.0	0.0	0.0
TOTALS								
TABLE	8.935E+04	8.808E+04	8.399E+04	4.657E+04	2.843E+03	7.452E+02	1.639E+02	3.154E+01
ACTUAL	8.935E+04	8.808E+04	8.399E+04	4.657E+04	2.843E+03	7.452E+02	1.639E+02	3.154E+01

TABLE 10-INEL. SPONTANEOUS FISSION NEUTRON SOURCES
IN DECAY OF INEL HLW

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

NEUTRONS/SEC

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
PU238	1.387E+04	1.376E+04	1.282E+04	6.297E+03	5.145E+00	6.832E-31	0.0	0.0
PU240	3.316E+03	3.316E+03	3.315E+03	3.288E+03	2.989E+03	1.151E+03	8.271E-02	0.0
PU242	1.014E+03	1.014E+03	1.014E+03	1.014E+03	1.013E+03	9.964E+02	8.481E+02	1.691E+02
CM242	5.408E+03	1.146E+03	9.895E-04	0.0	0.0	0.0	0.0	0.0
CM244	9.120E+04	8.777E+04	6.220E+04	1.985E+03	2.176E-12	0.0	0.0	0.0
TOTALS								
TABLE	1.148E+05	1.070E+05	7.935E+04	1.259E+04	4.008E+03	2.148E+03	8.482E+02	1.692E+02
ACTUAL	1.148E+05	1.070E+05	7.935E+04	1.259E+04	4.008E+03	2.148E+03	8.482E+02	1.692E+02

TABLE 11-INEL. PHOTON SPECTRUM OF ACTINIDES AND DAUGHTERS
IN DECAY OF INEL HLW

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

PHOTONS/SEC

EMEAN	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
				18 GROUP PHOTON RELEASE RATES, PHOTONS/SECOND				
1.000E-02	5.469E+11	5.418E+11	5.216E+11	2.995E+11	2.033E+10	3.557E+09	1.139E+09	3.080E+08
2.500E-02	1.088E+09	1.396E+09	3.492E+09	6.493E+09	1.555E+09	2.134E+07	1.019E+08	2.552E+07
3.750E-02	1.631E+09	1.638E+09	1.703E+09	1.240E+09	1.554E+08	2.107E+07	6.931E+07	3.252E+07
5.750E-02	1.601E+10	2.046E+10	5.129E+10	9.542E+10	2.274E+10	2.897E+07	1.167E+08	2.372E+07
8.500E-02	5.276E+08	6.258E+08	6.151E+08	4.895E+08	3.088E+08	1.711E+08	2.295E+08	9.276E+07
1.250E-01	1.790E+07	2.629E+08	2.623E+08	2.534E+08	1.960E+08	8.712E+07	4.099E+07	1.625E+07
2.250E-01	2.457E+07	1.959E+08	1.804E+08	1.430E+08	1.209E+08	8.653E+07	2.725E+08	6.025E+07
3.750E-01	2.651E+06	1.867E+07	1.894E+07	2.154E+07	3.453E+07	6.131E+07	2.655E+08	7.362E+07
5.750E-01	4.668E+05	5.383E+05	1.094E+06	1.917E+06	1.422E+06	4.227E+07	3.307E+08	5.648E+07
8.500E-01	1.870E+06	1.863E+06	1.879E+06	1.272E+06	3.485E+05	1.023E+07	8.009E+07	1.365E+07
1.250E+00	1.383E+05	1.314E+05	1.083E+05	3.740E+04	5.451E+05	2.645E+07	2.072E+08	3.493E+07
1.750E+00	4.373E+04	4.095E+04	3.133E+04	8.233E+03	4.388E+05	2.136E+07	1.675E+08	2.898E+07
2.250E+00	2.511E+04	2.350E+04	1.793E+04	4.273E+03	1.358E+05	6.580E+06	5.153E+07	8.651E+06
2.750E+00	1.441E+04	1.348E+04	1.026E+04	2.167E+03	2.958E+03	1.148E+05	8.964E+05	1.506E+05
3.500E+00	1.284E+04	1.200E+04	9.110E+03	1.870E+03	9.867E+02	2.178E+04	1.685E+05	2.828E+04
5.000E+00	5.419E+03	5.061E+03	3.827E+03	7.604E+02	2.319E+02	1.229E+02	4.819E+01	9.596E+00
7.000E+00	6.155E+02	5.744E+02	4.325E+02	8.270E+01	2.637E+01	1.405E+01	5.532E+00	1.102E+00
9.500E+00	7.015E+01	6.541E+01	4.913E+01	9.190E+00	3.013E+00	1.610E+00	6.356E-01	1.267E-01
TOTAL	5.662E+11	5.664E+11	5.792E+11	4.035E+11	4.545E+10	4.142E+09	3.074E+09	7.755E+08

TABLE 12-INEL. CONCENTRATIONS OF FISSION AND ACTIVATION PRODUCTS IN DECAY OF INEL HLW: NUCLIDES

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

GRAMS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE 79	1.173E+00	1.173E+00	1.173E+00	1.172E+00	1.161E+00	1.054E+00	4.035E-01	2.728E-05
BR 79	0.0	1.252E-05	1.252E-04	1.251E-03	1.245E-02	1.187E-01	7.695E-01	1.173E+00
RB 87	5.252E+01	5.252E+01	5.252E+01	5.252E+01	5.252E+01	5.252E+01	5.252E+01	5.252E+01
SR 90	1.217E+02	1.188E+02	9.592E+01	1.126E+01	5.601E-09	0.0	0.0	0.0
ZR 90	0.0	2.863E+00	2.578E+01	1.105E+02	1.217E+02	1.217E+02	1.217E+02	1.217E+02
ZR 93	1.575E+02	1.575E+02	1.575E+02	1.575E+02	1.574E+02	1.568E+02	1.505E+02	1.001E+02
NB 93	0.0	2.210E-05	3.177E-04	6.150E-03	7.035E-02	7.110E-01	6.976E+00	5.738E+01
TC 99	1.582E+02	1.582E+02	1.582E+02	1.581E+02	1.577E+02	1.531E+02	1.143E+02	6.109E+00
RU 99	0.0	5.148E-04	5.148E-03	5.147E-02	5.140E-01	5.065E+00	4.394E+01	1.521E+02
PD107	4.965E+00	4.965E+00	4.965E+00	4.965E+00	4.964E+00	4.960E+00	4.912E+00	4.463E+00
SN126	1.440E+00	1.440E+00	1.440E+00	1.439E+00	1.430E+00	1.344E+00	7.200E-01	1.407E-03
TE126	0.0	1.040E-05	1.002E-04	9.981E-04	9.946E-03	9.643E-02	7.200E-01	1.439E+00
CS134	3.256E+00	2.326E+00	1.129E-01	8.545E-15	0.0	0.0	0.0	0.0
BA134	0.0	9.296E-01	3.143E+00	3.256E+00	3.256E+00	3.256E+00	3.256E+00	3.256E+00
CS135	8.316E+01	8.316E+01	8.316E+01	8.316E+01	8.313E+01	8.291E+01	8.069E+01	6.152E+01
BA135	0.0	2.506E-05	2.506E-04	2.506E-03	2.506E-02	2.502E-01	2.469E+00	2.164E+01
CS137	1.908E+02	1.864E+02	1.514E+02	1.893E+01	1.762E-08	0.0	0.0	0.0
BA137	0.0	4.358E+00	3.936E+01	1.719E+02	1.908E+02	1.908E+02	1.908E+02	1.908E+02
CE144	3.282E+00	1.347E+00	4.450E-04	6.861E-39	0.0	0.0	0.0	0.0
ND144	0.0	1.935E+00	3.282E+00	3.282E+00	3.282E+00	3.282E+00	3.282E+00	3.282E+00
PM147	1.653E+01	1.269E+01	1.177E+00	5.541E-11	0.0	0.0	0.0	0.0
SM147	0.0	3.838E+00	1.535E+01	1.653E+01	1.653E+01	1.653E+01	1.653E+01	1.653E+01
SM151	8.250E+00	8.187E+00	7.638E+00	3.819E+00	3.728E-03	2.928E-33	0.0	0.0
EU151	0.0	6.330E-02	6.116E-01	4.431E+00	8.246E+00	8.250E+00	8.250E+00	8.250E+00
EU154	8.513E-01	7.854E-01	3.802E-01	2.690E-04	8.457E-36	0.0	0.0	0.0
GD154	0.0	6.592E-02	4.711E-01	8.510E-01	8.513E-01	8.513E-01	8.513E-01	8.513E-01
SUMTOT	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02
TOTAL	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02

NUCLIDES CONTRIBUTING < 0.1000 % ARE OMITTED

TABLE 13-INEL. CONCENTRATIONS OF FISSION AND ACTIVATION PRODUCTS IN DECAY OF INEL HLW: ELEMENTS

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

GRAMS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE	1.173E+00	1.173E+00	1.173E+00	1.172E+00	1.161E+00	1.054E+00	4.035E-01	2.728E-05
BR	0.0	1.252E-05	1.252E-04	1.251E-03	1.245E-02	1.187E-01	7.695E-01	1.173E+00
RB	5.252E+01	5.252E+01	5.252E+01	5.252E+01	5.252E+01	5.252E+01	5.252E+01	5.252E+01
SR	1.217E+02	1.188E+02	9.592E+01	1.126E+01	7.808E-07	7.752E-06	7.752E-05	7.752E-04
ZR	1.575E+02	1.604E+02	1.833E+02	2.680E+02	2.792E+02	2.785E+02	2.723E+02	2.218E+02
NB	3.387E-04	4.101E-04	1.052E-03	7.474E-03	7.168E-02	7.123E-01	6.977E+00	5.738E+01
TC	1.582E+02	1.582E+02	1.582E+02	1.581E+02	1.577E+02	1.531E+02	1.143E+02	6.109E+00
RU	3.701E-01	1.866E-01	5.530E-03	5.147E-02	5.140E-01	5.065E+00	4.394E+01	1.521E+02
PD	4.965E+00	5.149E+00	5.335E+00	5.335E+00	5.335E+00	5.330E+00	5.282E+00	4.833E+00
AG	0.0	5.298E-07	5.298E-06	5.298E-05	5.298E-04	5.295E-03	5.270E-02	5.025E-01
SN	1.440E+00	1.440E+00	1.440E+00	1.439E+00	1.430E+00	1.344E+00	7.200E-01	1.407E-03
TE	0.0	1.040E-05	1.002E-04	9.981E-04	9.946E-03	9.643E-02	7.200E-01	1.439E+00
CS	2.772E+02	2.719E+02	2.347E+02	1.021E+02	8.313E+01	8.291E+01	8.069E+01	6.152E+01
BA	2.848E-05	5.288E+00	4.251E+01	1.751E+02	1.941E+02	1.943E+02	1.965E+02	2.157E+02
CE	3.282E+00	1.347E+00	4.450E-04	1.042E-13	1.053E-12	1.054E-11	1.054E-10	1.054E-09
ND	0.0	1.935E+00	3.282E+00	3.282E+00	3.282E+00	3.282E+00	3.282E+00	3.282E+00
PM	1.653E+01	1.269E+01	1.177E+00	5.541E-11	0.0	0.0	0.0	0.0
SM	8.250E+00	1.202E+01	2.299E+01	2.035E+01	1.653E+01	1.653E+01	1.653E+01	1.653E+01
EU	8.513E-01	8.487E-01	9.918E-01	4.431E+00	8.246E+00	8.250E+00	8.250E+00	8.250E+00
GD	0.0	6.592E-02	4.711E-01	8.510E-01	8.513E-01	8.513E-01	8.513E-01	8.513E-01
SUMTOT	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02
TOTAL	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02	8.040E+02

ELEMENTS CONTRIBUTING < 0.0100 % ARE OMITTED

TABLE 14-INEL. RADIOACTIVITY OF FISSION AND ACTIVATION PRODUCTS
IN DECAY OF INEL HLW: NUCLIDES

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE 79	8.175E-02	8.175E-02	8.174E-02	8.166E-02	8.088E-02	7.347E-02	2.812E-02	1.901E-06
SR 90	1.661E+04	1.622E+04	1.309E+04	1.537E+03	7.643E-07	0.0	0.0	0.0
Y 90	1.661E+04	1.622E+04	1.309E+04	1.537E+03	7.645E-07	0.0	0.0	0.0
ZR 93	3.959E-01	3.959E-01	3.959E-01	3.959E-01	3.957E-01	3.941E-01	3.784E-01	2.517E-01
NB 93M	9.577E-02	1.097E-01	2.077E-01	3.744E-01	3.759E-01	3.744E-01	3.594E-01	2.391E-01
TC 99	2.683E+00	2.683E+00	2.683E+00	2.682E+00	2.674E+00	2.597E+00	1.938E+00	1.036E-01
RU106	1.239E+03	6.228E+02	1.278E+00	1.723E-27	0.0	0.0	0.0	0.0
RH106	1.239E+03	6.228E+02	1.278E+00	1.723E-27	0.0	0.0	0.0	0.0
PD107	2.555E-03	2.555E-03	2.555E-03	2.555E-03	2.554E-03	2.552E-03	2.528E-03	2.296E-03
SN126	4.087E-02	4.087E-02	4.087E-02	4.084E-02	4.059E-02	3.813E-02	2.044E-02	3.993E-05
SB126	4.087E-02	5.722E-03	5.722E-03	5.718E-03	5.682E-03	5.339E-03	2.861E-03	5.591E-06
SB126M	4.087E-02	4.087E-02	4.087E-02	4.084E-02	4.059E-02	3.813E-02	2.044E-02	3.993E-05
CS134	4.215E+03	3.011E+03	1.462E+02	1.106E-11	0.0	0.0	0.0	0.0
CS135	9.579E-02	9.579E-02	9.579E-02	9.579E-02	9.576E-02	9.550E-02	9.295E-02	7.087E-02
CS137	1.660E+04	1.622E+04	1.318E+04	1.647E+03	1.533E-06	0.0	0.0	0.0
BA137M	1.533E+04	1.535E+04	1.247E+04	1.558E+03	1.450E-06	0.0	0.0	0.0
CE144	1.047E+04	4.298E+03	1.420E+00	2.190E-35	0.0	0.0	0.0	0.0
PR144	1.048E+04	4.299E+03	1.420E+00	2.190E-35	0.0	0.0	0.0	0.0
PR144M	0.0	5.158E+01	1.704E-02	2.628E-37	0.0	0.0	0.0	0.0
PM147	1.533E+04	1.177E+04	1.092E+03	5.139E-08	0.0	0.0	0.0	0.0
SM151	2.171E+02	2.155E+02	2.010E+02	1.005E+02	9.811E-02	7.705E-32	0.0	0.0
EU154	2.299E+02	2.121E+02	1.027E+02	7.265E-02	2.284E-33	0.0	0.0	0.0
SUMTOT	1.086E+05	8.912E+04	5.338E+04	6.383E+03	3.810E+00	3.619E+00	2.843E+00	6.676E-01
TOTAL	1.086E+05	8.912E+04	5.338E+04	6.383E+03	3.810E+00	3.619E+00	2.843E+00	6.676E-01

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 15-INEL. RADIOACTIVITY OF FISSION AND ACTIVATION PRODUCTS
IN DECAY OF INEL HLW: ELEMENTS

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE	8.175E-02	8.175E-02	8.174E-02	8.166E-02	8.088E-02	7.347E-02	2.812E-02	1.901E-06
SR	1.661E+04	1.622E+04	1.309E+04	1.537E+03	7.643E-07	0.0	0.0	0.0
Y	1.661E+04	1.622E+04	1.309E+04	1.537E+03	7.645E-07	0.0	0.0	0.0
ZR	3.959E-01	3.959E-01	3.959E-01	3.959E-01	3.957E-01	3.941E-01	3.784E-01	2.517E-01
NB	9.577E-02	1.097E-01	2.077E-01	3.744E-01	3.759E-01	3.744E-01	3.594E-01	2.391E-01
TC	2.683E+00	2.683E+00	2.683E+00	2.682E+00	2.674E+00	2.597E+00	1.938E+00	1.036E-01
RU	1.239E+03	6.228E+02	1.278E+00	1.723E-27	0.0	0.0	0.0	0.0
RH	1.239E+03	6.228E+02	1.278E+00	1.723E-27	0.0	0.0	0.0	0.0
PD	2.555E-03	2.555E-03	2.555E-03	2.555E-03	2.554E-03	2.552E-03	2.528E-03	2.296E-03
SN	4.087E-02	4.087E-02	4.087E-02	4.084E-02	4.059E-02	3.813E-02	2.044E-02	3.993E-05
SB	8.174E-02	4.659E-02	4.659E-02	4.656E-02	4.627E-02	4.347E-02	2.330E-02	4.552E-05
CS	2.082E+04	1.924E+04	1.332E+04	1.647E+03	9.576E-02	9.550E-02	9.295E-02	7.087E-02
BA	1.533E+04	1.535E+04	1.247E+04	1.558E+03	1.450E-06	0.0	0.0	0.0
CE	1.047E+04	4.298E+03	1.420E+00	2.190E-35	0.0	0.0	0.0	0.0
PR	1.048E+04	4.350E+03	1.437E+00	2.216E-35	0.0	0.0	0.0	0.0
PM	1.533E+04	1.177E+04	1.092E+03	5.139E-08	0.0	0.0	0.0	0.0
SM	2.171E+02	2.155E+02	2.010E+02	1.005E+02	9.811E-02	3.758E-07	3.758E-07	3.758E-07
EU	2.299E+02	2.121E+02	1.027E+02	7.265E-02	2.284E-33	0.0	0.0	0.0
SUMTOT	1.086E+05	8.912E+04	5.338E+04	6.383E+03	3.810E+00	3.619E+00	2.843E+00	6.676E-01
TOTAL	1.086E+05	8.912E+04	5.338E+04	6.383E+03	3.810E+00	3.619E+00	2.843E+00	6.676E-01

ELEMENTS CONTRIBUTING < 0.0100 % ARE OMITTED

TABLE 16-INEL. THERMAL POWER OF FISSION AND ACTIVATION PRODUCTS IN DECAY OF INEL HLW: NUCLIDES

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE 79	2.035E-05	2.035E-05	2.035E-05	2.033E-05	2.014E-05	1.829E-05	7.002E-06	4.733E-10
RB 87	3.843E-09	3.843E-09	3.843E-09	3.843E-09	3.843E-09	3.843E-09	3.843E-09	3.842E-09
SR 90	1.927E+01	1.882E+01	1.519E+01	1.784E+00	8.870E-10	0.0	0.0	0.0
Y 90	9.204E+01	8.990E+01	7.256E+01	8.519E+00	4.237E-09	0.0	0.0	0.0
ZR 93	4.600E-05	4.600E-05	4.600E-05	4.599E-05	4.598E-05	4.579E-05	4.396E-05	2.924E-05
NB 93M	1.697E-05	1.944E-05	3.680E-05	6.633E-05	6.661E-05	6.634E-05	6.369E-05	4.236E-05
TC 99	1.346E-03	1.346E-03	1.345E-03	1.345E-03	1.341E-03	1.302E-03	9.718E-04	5.196E-05
RU106	7.365E-02	3.703E-02	7.599E-05	1.024E-31	0.0	0.0	0.0	0.0
RH106	1.188E+01	5.974E+00	1.226E-02	1.652E-29	0.0	0.0	0.0	0.0
PD107	1.514E-07	1.514E-07	1.514E-07	1.514E-07	1.514E-07	1.513E-07	1.498E-07	1.361E-07
SN126	5.097E-05	5.097E-05	5.097E-05	5.094E-05	5.062E-05	4.756E-05	2.549E-05	4.980E-08
SB126	7.552E-04	1.057E-04	1.057E-04	1.056E-04	1.050E-04	9.864E-05	5.286E-05	1.033E-07
SB126M	5.203E-04	5.204E-04	5.204E-04	5.200E-04	5.168E-04	4.855E-04	2.602E-04	5.085E-07
CS134	4.290E+01	3.065E+01	1.488E+00	1.126E-13	0.0	0.0	0.0	0.0
CS135	3.197E-05	3.197E-05	3.197E-05	3.197E-05	3.196E-05	3.187E-05	3.102E-05	2.365E-05
CS137	1.837E+01	1.795E+01	1.458E+01	1.822E+00	1.696E-09	0.0	0.0	0.0
BA137M	6.017E+01	6.026E+01	4.895E+01	6.118E+00	5.694E-09	0.0	0.0	0.0
CE144	6.947E+00	2.851E+00	9.419E-04	1.452E-38	0.0	0.0	0.0	0.0
PR144	7.700E+01	3.160E+01	1.044E-02	1.609E-37	0.0	0.0	0.0	0.0
PR144M	0.0	1.765E-02	5.830E-06	8.990E-41	0.0	0.0	0.0	0.0
PM147	5.499E+00	4.222E+00	3.916E-01	1.843E-11	0.0	0.0	0.0	0.0
SM147	0.0	1.195E-09	4.780E-09	5.146E-09	5.146E-09	5.146E-09	5.146E-09	5.146E-09
SM151	2.546E-02	2.526E-02	2.357E-02	1.178E-02	1.150E-05	9.034E-36	0.0	0.0
EU154	2.056E+00	1.897E+00	9.184E-01	6.498E-04	2.043E-35	0.0	0.0	0.0
SUMTOT	3.362E+02	2.642E+02	1.541E+02	1.826E+01	2.190E-03	2.097E-03	1.456E-03	1.480E-04
TOTAL	3.362E+02	2.642E+02	1.541E+02	1.826E+01	2.190E-03	2.097E-03	1.456E-03	1.480E-04

NUCLIDES CONTRIBUTING < 0.0010 % ARE OMITTED

TABLE 17-INEL. THERMAL POWER OF FISSION AND ACTIVATION PRODUCTS
IN DECAY OF INEL HLW: ELEMENTS

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE	2.035E-05	2.035E-05	2.035E-05	2.033E-05	2.014E-05	1.829E-05	7.002E-06	4.733E-10
SR	1.927E+01	1.882E+01	1.519E+01	1.784E+00	8.870E-10	0.0	0.0	0.0
Y	9.204E+01	8.990E+01	7.256E+01	8.519E+00	4.237E-09	0.0	0.0	0.0
ZR	4.600E-05	4.600E-05	4.600E-05	4.599E-05	4.598E-05	4.579E-05	4.396E-05	2.924E-05
NB	1.697E-05	1.944E-05	3.680E-05	6.633E-05	6.661E-05	6.634E-05	6.369E-05	4.236E-05
TC	1.346E-03	1.346E-03	1.345E-03	1.345E-03	1.341E-03	1.302E-03	9.718E-04	5.196E-05
RU	7.365E-02	3.703E-02	7.599E-05	1.024E-31	0.0	0.0	0.0	0.0
RH	1.188E+01	5.974E+00	1.226E-02	1.652E-29	0.0	0.0	0.0	0.0
PD	1.514E-07	1.514E-07	1.514E-07	1.514E-07	1.514E-07	1.513E-07	1.498E-07	1.361E-07
SN	5.097E-05	5.097E-05	5.097E-05	5.094E-05	5.062E-05	4.756E-05	2.549E-05	4.980E-08
SB	1.276E-03	6.261E-04	6.261E-04	6.257E-04	6.218E-04	5.842E-04	3.131E-04	6.118E-07
CS	6.126E+01	4.860E+01	1.606E+01	1.822E+00	3.196E-05	3.187E-05	3.102E-05	2.365E-05
BA	6.017E+01	6.026E+01	4.895E+01	6.118E+00	5.694E-09	0.0	0.0	0.0
CE	6.947E+00	2.851E+00	9.419E-04	1.452E-38	0.0	0.0	0.0	0.0
PR	7.700E+01	3.161E+01	1.044E-02	1.610E-37	0.0	0.0	0.0	0.0
PM	5.499E+00	4.222E+00	3.916E-01	1.843E-11	0.0	0.0	0.0	0.0
SM	2.546E-02	2.526E-02	2.357E-02	1.178E-02	1.151E-05	5.146E-09	5.146E-09	5.146E-09
EU	2.056E+00	1.897E+00	9.184E-01	6.498E-04	2.043E-35	0.0	0.0	0.0
SUMTOT	3.362E+02	2.642E+02	1.541E+02	1.826E+01	2.190E-03	2.097E-03	1.456E-03	1.480E-04
TOTAL	3.362E+02	2.642E+02	1.541E+02	1.826E+01	2.190E-03	2.097E-03	1.456E-03	1.480E-04

ELEMENTS CONTRIBUTING < 0.0100 % ARE OMITTED

TABLE 18-INEL. PHOTON SPECTRUM OF FISSION AND ACTIVATION PRODUCTS
IN DECAY OF INEL HLW

BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1277 KG CALCINE

PHOTONS/SEC

18 GROUP PHOTON RELEASE RATES, PHOTONS/SECOND

EMEAN	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
1.000E-02	8.508E+14	6.360E+14	3.809E+14	4.483E+13	8.146E+09	7.929E+09	6.367E+09	1.986E+09
2.500E-02	1.767E+14	1.315E+14	7.869E+13	9.262E+12	1.524E+09	1.454E+09	9.442E+08	4.594E+07
3.750E-02	1.955E+14	1.421E+14	8.207E+13	9.770E+12	5.346E+08	5.158E+08	3.676E+08	2.346E+07
5.750E-02	1.671E+14	1.229E+14	7.304E+13	8.577E+12	7.499E+08	7.196E+08	4.841E+08	2.395E+07
8.500E-02	1.096E+14	7.709E+13	4.341E+13	5.109E+12	9.462E+08	8.945E+08	5.152E+08	8.809E+06
1.250E-01	1.142E+14	6.924E+13	2.948E+13	3.290E+12	1.006E+08	9.646E+07	6.410E+07	2.633E+06
2.250E-01	9.143E+13	6.494E+13	3.707E+13	4.323E+12	8.729E+07	8.246E+07	4.713E+07	6.398E+05
3.750E-01	4.195E+13	2.892E+13	1.586E+13	1.858E+12	1.646E+09	1.546E+09	8.288E+08	1.619E+06
5.750E-01	8.266E+14	7.523E+14	4.904E+14	6.034E+13	3.655E+09	3.434E+09	1.840E+09	3.596E+06
8.500E-01	1.498E+14	1.073E+14	9.133E+12	3.014E+11	1.829E+08	1.719E+08	9.210E+07	1.800E+05
1.250E+00	1.907E+13	1.359E+13	3.156E+12	9.982E+10	4.440E+07	4.172E+07	2.236E+07	4.369E+04
1.750E+00	8.144E+11	4.702E+11	1.257E+11	7.718E+09	1.897E+03	1.779E+03	9.532E+02	1.863E+00
2.250E+00	3.016E+12	1.244E+12	4.764E+08	8.471E+05	4.280E-04	6.631E-06	6.631E-06	6.631E-06
2.750E+00	1.250E+10	6.038E+09	1.052E+07	3.322E-06	3.322E-06	3.322E-06	3.322E-06	3.322E-06
3.500E+00	1.288E+09	6.474E+08	1.329E+06	2.447E-06	2.447E-06	2.447E-06	2.447E-06	2.447E-06
5.000E+00	0.0	1.691E-07	6.766E-07	7.284E-07	7.284E-07	7.284E-07	7.284E-07	7.284E-07
7.000E+00	0.0	1.097E-08	4.390E-08	4.727E-08	4.727E-08	4.727E-08	4.727E-08	4.726E-08
9.500E+00	0.0	6.940E-10	2.776E-09	2.989E-09	2.989E-09	2.989E-09	2.989E-09	2.989E-09
TOTAL	2.747E+15	2.148E+15	1.243E+15	1.478E+14	1.762E+10	1.689E+10	1.157E+10	2.097E+09

APPENDIX 3B

INTERIM HIGH-LEVEL WASTE FORMS

CONTENTS

APPENDIX 3B. INTERIM HIGH-LEVEL WASTE FORMS

3B.1 INTRODUCTION

This appendix presents detailed data on the amounts and compositions of the interim high-level wastes in storage at each of the sites, both current and projected, and on the conversion of these wastes to immobilized forms for repository disposal. It thus serves to provide the necessary backup data for the calculation of the immobilized waste quantities and compositions presented in Section 3.

As stated in Section 3, all of the HLW produced thus far is currently (1987) in interim storage at WVDP, SRP, HANF, and INEL. The storage forms vary from site to site and include liquids, sludges, salt cake, slurry, calcine, and encapsulated strontium fluoride and cesium chloride. These interim forms of high-level waste have been produced as the result of a number of treatment and separation operations (e.g., neutralization, precipitation, decantation, evaporation, and calcination) carried out on the effluent streams from fuel reprocessing, and their volumes and compositions have changed as a result of these operations as well as from the natural processes of radioactive decay. Further changes in form, density, and composition will take place when the interim forms are converted to borosilicate glass or other solid form for shipment to the repository for final disposal, and the volumes of the final solid waste forms will be much less, in most cases, than those of the interim forms now in storage at the sites.

Quantitative relationships on the conversion to immobilized forms are scarce but are presented where available so that the reader can follow the rationale used in the calculation of immobilized waste quantities, compositions, and radioactivity per canister. The discussion is arranged by site location and is in the same order as in Section 3: WVDP, SRP, HANF, and INEL.

3B.2 WEST VALLEY DEMONSTRATION PROJECT

The HLW stored at West Valley is the result of commercial operations during the period 1966–1972 and consists of both alkaline and acidic waste. The alkaline waste was generated by the reprocessing of commercial power reactor fuels and some Hanford N-Reactor fuels. The acidic waste, which is much smaller in volume, was generated by reprocessing a small amount of commercial fuel containing thorium. The total quantity of fuel reprocessed from 1966 to 1972 was about 662 metric tons; the sources of this fuel, which represented about 4,000,000 MWd of irradiation exposure, are listed in Table 3B.1.

3B.2.1 HLW Inventories at WVDP

HLW inventory in storage at WVDP consists of 2270 m^3 of alkaline waste and 45 m^3 of acid waste, both generated during fuel reprocessing operations at the NFS plant; these operations ended in 1972. The alkaline waste was derived from the PUREX reprocessing of low-burnup commercial and Hanford N-Reactor spent fuels. These wastes, originally acidic, were treated with excess sodium hydroxide to produce an alkaline sludge and a clear supernatant alkaline solution. The acid waste currently in storage was generated from the THOREX reprocessing of thorium-uranium fuel from the Indian Point 1 Reactor.

The alkaline and acid wastes are stored in underground tanks, carbon steel for the alkaline PUREX waste and stainless steel for the acid THOREX waste. There are two 2800 m^3 carbon steel tanks, 8D-1 and 8D-2. The alkaline waste is stored in tank 8D-2, with 8D-1 serving as a backup for this service. There are also two 57 m^3 stainless steel tanks, 8D-3 and 8D-4. The acid waste is stored in 8D-4, with 8D-3 as backup. All four tanks are in underground concrete storage vaults. The acidic wastes in Tank 8D-4 are considered to be a single-phase solution (Hannum 1983, Barnes et al 1986).

Tables 3B.2 and 3B.3 summarize the total volumes and radioactivity of WVDP wastes of all types, both current and projected to the year 2020. Chemical compositions of the interim wastes are shown in Table 3B.4; Table 3B.5 gives the estimated radionuclide composition of the PUREX supernatant liquid, the PUREX solids, the Thorex waste, and of the total WVDP waste as of the end of 1987 (Eisenstatt 1986 and Bixby, 1987). No further additions to these wastes are anticipated at present.

3B.2.2 Treatment and Conversion to Glass

Fig. 3B.1 shows a schematic flowsheet of the existing and future HLW treatment and vitrification facilities at WVDP. Vitrification of the waste now in storage is scheduled to begin in 1990 and to be completed in 1991; however, this schedule may be delayed.

The initial waste treatment steps consist of decanting the supernatant from Tank 8D-2 and passing it through zeolite ion exchange columns. As the zeolite ion exchange medium becomes loaded with cesium and strontium radioisotopes, it is discharged to the bottom of Tank 8D-1. After decanting the supernatant, the hydroxide sludge is washed to remove its interstitial liquids and sodium sulphate. This process requires three to four cycles of washing, settling and decanting. The wash solutions are treated by the zeolite ion exchange. The decontaminated effluent from the ion exchange system will be solidified into concrete and disposed of as low-level waste.

After the supernatant decontamination and the sludge wash cycles, the tank farm configuration will be cesium- and strontium-loaded zeolite in Tank 8D-1, washed sludge in Tank 8D-2, and the THOREX wastes in Tank 8D-4. These wastes will then be combined and homogenized in Tank 8D-2, and the homogeneous mixture will be batched to the waste concentrator in the vitrification facility for solidification into borosilicate glass (Barnes et al 1986).

The radionuclide composition of the HLW glass was supplied by WVDP for the year 1990 in terms of average, minimum, and maximum curies per canister (Eisenstatt 1986). Table 3B.6 was calculated from these data and shows curies and grams of each radionuclide for the maximum activity canister for the year 1990.

3B.2.3 Radioactivity and Decay Heat per Canister

Using the average and maximum radionuclide contents per canister supplied by WVDP for the year 1990 (Eisenstatt 1986), ORIGEN2 decay calculations were made to determine radioactivity and thermal power per canister as a function of decay time from 0 to 10^6 years, the contribution of each isotope being shown individually. These results are given in Appendix 3A for the average and maximum canisters, and are the basis for the summarized results shown in Section 3 of this report.

The reference material balance shows a total glass production of 520,000 kg, and the reference canister design at the 100% fill level would contain 2,229 kg of glass, assuming a density of 2.7 g/ml. At the reference-case fill level of 85%, each canister contains 1895 kg of glass. The number of canisters to be produced is therefore approximately 275 (Rykken 1987). The volume of glass per canister calculated by WVDP is about 12% higher than that estimated by SRP and HANF; if the volume per canister is adjusted downward to correspond to that used by the defense sites, the number of canisters required would be 308, and the activity per canister would be about 12% less than that shown in Section 3. The most recent IDB submittal from WVDP (Bixby 1987) estimated that ~300 canisters would be produced.

3B.2.4 Volume Conversion Factor to Glass

The total volume of waste before vitrification is 2315 m^3, and the total volume of glass produced (assuming a density of 2.7 g/ml) is about 180 m^3; the ratio of interim waste volume to glass volume is about 12.8 to 1. The volume of low-level waste produced, in final solidified form, is estimated to be about 2750 m^3 (Rykken 1986d).

3B.2.5 Assessment of Data

The volumes and radionuclide compositions of the wastes and the vitrification flowsheet at WVDP are well established. The number of canisters of HLW glass and the average activity per canister have been determined within reasonable tolerances.

3B.3 SAVANNAH RIVER PLANT

At the Savannah River Plant (SRP), operated by E.I. duPont de Nemours and Co., the acidic HLW from the reprocessing of defense reactor fuel is made alkaline by the addition of caustic and is stored in large underground tanks. The total volume of HLW produced since plant operations started in 1954 is about 300,000 m^3. The primary operations on this waste are shown schematically in Fig. 3B.2. The initial steps of neutralization and settling result in the formation of a sludge and a supernatant liquid in the storage tanks. The supernate is then concentrated by evaporation, and the concentrate is cooled, causing saltcake (salt crystals) to separate out of the saturated salt solution. By tankage selection and transfer operations, the saltcake is kept essentially separate from the sludge. The volume reduction that occurs as a result of evaporation has reduced the total volume in storage as of the end of CY 1986 to 127,800 m^3 (Chandler 1987). The sludge, which represents about 11 vol% of the total waste in the tanks, is composed largely of the precipitated hydroxides of iron, aluminum, manganese, and other metals; it contains about 60-65% of the total radioactivity, including most of the Sr-90 and small amounts of actinides that were not recovered from the fuel during reprocessing. The major components of the supernatant liquid, salt solution, and saltcake are sodium nitrate, sodium nitrite, sodium aluminate, and sodium hydroxide, together with most of the Cs-137 and smaller amounts of other radionuclides. Almost all of the radioactivity in the liquid and saltcake is due to Cs-137 and its short-lived daughter Ba-137m.

Generation of new HLW is expected to continue at the rate of about 10,000 m^3/yr, depending on future production requirements (Baxter 1986a). Currently there are 51 waste tanks, in sizes ranging up to 4900 m^3, with a combined capacity of about 222,000 m^3 (Boore 1986).

Immobilization of essentially all of the radioactivity of the interim HLW in borosilicate glass will begin in late 1990. This will take place in the Defense Waste Processing Facility (DWPF), which is now under construction at SRP and was about 63% complete at the end of July 1987.

3B.3.1 HLW Inventories at SRP

The volumes of the interim HLW phases in storage at the end of CY 1986 were as follows: sludge 13,800 m^3; saltcake 41,200 m^3; and total liquid 72,900 m^3. Table 3B.7 shows the current and projected cumulative volumes of the liquid, sludge, saltcake, and glass, based on estimated future production, through the year 2020. Glass volumes in Table 3B.7 are based on the same canister production schedule that was shown in the immobilized HLW section of this report (Chapter 3); about 6800 canisters are projected by the end of year 2020, with a glass volume of 0.626 m^3 per canister (Chandler 1987). Table 3B.8, from the same source, shows the estimated radioactivity and the total thermal power in the interim waste forms and in the HLW glass projected from the present through the year 2020. This projection assumes that the amount of radioactivity in the glass product in a given year is the same as the average radioactivity in the tank farm, and should not be used for year-by-year estimation of radioactivity per canister. The longer-term estimates of cumulative radioactivity in the glass should be more useful. Table 3B.9 shows approximate chemical compositions of the interim waste forms and glass.

3B.3.2 Treatment and Conversion to Glass

Glass produced at the DWPF will be made from a blend composed of (1) washed sludge, (2) washed precipitate produced by treatment of salt solution to precipitate the cesium, and (3) glass frit. Figure 3B.3 is a simplified representation of sludge and precipitate feed preparation and glass production.

3B.3.2.1 Sludge feed preparation

In the tank farm, sludge with a minimum average age of 5 years is washed with caustic to remove aluminum (this step is omitted for low-aluminum sludges) and then washed with water to remove nitrate salts. The washed sludge is then pumped to the DWPF feed collection tank as a 13% solids slurry.

3B.3.2.2 Precipitate feed preparation

The salt fraction from supernate aged to an acceptable Ru-106 limit is dissolved with water to form an alkaline solution saturated with sodium salts. This solution is diluted with recycled wash water and then treated with sodium tetraphenylborate (NaTPB) and sodium titanate. The NaTPB reacts with potassium and cesium to form precipitates of potassium and cesium tetraphenylborates. Strontium and plutonium are adsorbed into the precipitate phase by the sodium titanate. The solids, containing essentially all of the radioactivity, are then concentrated by filtration. The decontaminated filtrate is mixed with cement and fly ash to form a stable saltstone for engineered storage as low-level waste. The concentrated solids fraction from filtration is washed and filtered again and collected in a storage tank for transfer to the DWPF. The process described gives decontamination factors of about 4×10^4 for cesium, 200 for strontium, and 500 for plutonium (Doherty 1986). The concentrated and washed tetraphenylborate-titanate precipitate thus contains virtually all of the radionuclide activity present in the original salt solution. However, it has only about one-tenth the original volume. The estimated radionuclide composition of the precipitate slurry feed to the DWPF is shown in Table 3B.10. This is from the DWPF Basic Data Report DPSP-80-1033 and is based on supernate aged to an acceptable Ru-106 level.

The precipitate is further treated in the DWPF by hydrolysis with formic acid to isolate and remove aromatic species derived from tetraphenylborate. This step permits collection of the aromatics as a separate benzene-rich phase that does not go the melter but is incinerated separately, thus simplifying and reducing the size of the melter off-gas system.

3B.3.2.3 Melter feed preparation

The washed sludge stream and the washed hydrolyzed precipitate are mixed in a slurry adjustment tank and concentrated by boiling with formic acid. Mercury is reduced to its elemental state and is separated and collected. The adjusted slurry is mixed with glass frit slurry and concentrated by evaporation to a 40 wt% slurry which then goes to the melter feed tank (Baxter 1986a).

3B.3.2.4 Melter operation

The electrically-heated melter is a refractory-lined steel vessel with a diameter of 2.6 m, a height of 3.2 m, and a shell thickness of 3.8 cm. The melter is operated with a "cold cap" composed of calcine and frit about 15 cm thick on top of the melt surface; the feed slurry is introduced on top of this cap to facilitate evaporation of water. The glass melt beneath the cold cap is at about 1050°-1170°C, enabling the cap to melt from below. Residence time in the melter is about 65 hr, based on a nominal pour rate of 100 kg/hr and a nominal melt weight of 6500 kg.

3B.3.2.5 Canister filling, sealing, and decontamination

Pouring is accomplished by lowering the pour spout pressure to 740 mm Hg while maintaining the vapor space above the melt at 750 mm Hg. The time required to fill a canister is about 17 hr. The canister is then rotated from beneath the melter pour spout, and the canister shrink fit closure plug is inserted into the canister nozzle sleeve. The canister is then cooled to a surface temperature of 100°C over a period of about 31 hr. Shrinkage of the canister nozzle and sleeve during cooling seals the closure plug tightly. The outer surface of the canister is then decontaminated by frit blasting, the plug and sleeve are pushed into the nozzle, and sealing of the closure is completed by welding the plug in place (Baxter 1986a).

3B.3.3 Radioactivity and Decay Heat Per Canister

A detailed radionuclide analysis of feed batches to the DWPF will not be available until just before each batch is processed. Each feed batch is prepared in a 1.3 million gallon tank, which is equivalent to about 2.4 years of melter feed. Estimates for the first feed batch will be available by 1988; for subsequent batches the analysis will be available about one year prior to feeding to the DWPF. The best available data (DPSP-80-1033, Rev. 91) were used to estimate the radionuclide composition of the most highly radioactive glass that will be made; that is, the glass made from sludge aged 5 years and supernate aged for an average of 15 years (Baxter 1986c). This composition, shown in Table 3B.11, was used to calculate the radioactivity and decay heat per canister for decay times up to 10^6 years; these are the results that were presented in Section 3. As stated there, the radioactivity and decay heat at the time of filling, based on ORIGEN2 calculations, were 234,400 curies and 709 watts per canister. Recent curie balances at SRP indicate that the glass produced during the first 5 years of operation will not exceed an activity of about 154,000 curies and a heat generation rate of about 460 watts per canister (SRP 1987).

3B.3.4 Volume Conversion Factors to Glass

In DOE/RL-86-10, it was estimated that the sludge, salt, and liquid in storage at SRP at the end of 1986 are equivalent to about 4900 canisters when converted to glass. Referring to Table 3B.7, the volume in storage at the end of 1986 was 127,800 m^3. The volume of glass in 4900 canisters is about 3100 m^3. This gives a volume reduction factor from interim forms to glass of about 41. The volume of saltstone (low-level waste) is not included in this calculation.

3B.3.5 Assessment of Data

Using the best information available at present, it is believed that the maximum values of radioactivity and thermal power per canister will not exceed 234,400 Ci and 709 W. These estimates are based on sludge cooled 5 years and supernate cooled 15 years, which is the design basis for the DWPF. For repository design and other purposes, it would be useful to have an estimated schedule of the radionuclide content of the vitrification plant feed as a function of the year of operation; but, as indicated above, these estimates will not be available until about one year before each batch is processed.

3B.4 HANFORD SITE

Acidic high-level wastes generated at Hanford (HANF) by the reprocessing of defense reactor fuel have been made alkaline with caustic and placed in storage tanks. Separation of phases into liquid, sludge, and salt cake occurs during storage.

Prior to 1985, the HLW at HANF was processed to remove most of the strontium and cesium; the separated strontium and cesium were encapsulated as strontium fluoride and cesium chloride, and the capsules were placed in interim storage. During 1985, some of the capsules were distributed to industrial users under DOE agreements. Separation of Sr and Cs from the HLW was discontinued in 1985 and is not expected to be reinstated. Thus any quantities of these nuclides produced in the future will appear in HLW tank inventories. Production, distribution, and disposal of capsules are discussed in Section 5.5.

3B.4.1 HLW Inventories at HANF

The alkaline HLW stored at HANF (232,000 m^3 at the end of 1986) has been accumulating since 1944 and was generated by reprocessing fuel from production reactors for the recovery of plutonium, uranium, and neptunium for defense and other federal programs. The waste consists of four phases: alkaline liquid, slurry (an interim phase only), sludge, and salt cake. Most of the old waste has been treated to remove radioactive strontium and cesium. The Sr-90 and Cs-137 have been converted to solid strontium fluoride and cesium chloride and, together with their daughters, have been placed in double-wall steel capsules and stored in water basins. The liquid, sludge, slurry, and salt cake wastes are stored in underground concrete tanks lined with carbon steel (ORNL 1986). Tables 3B.12 and 3B.13 summarize the current and future volumes and radioactivities of these wastes, projected to the year 2020. The estimates of the relative amounts of radioactivity in the interim forms and in the glass are based on preliminary assumptions regarding the scheduling of melter feeds and should not be used for short-term analyses of radioactivity per canister. Representative chemical compositions of interim wastes are shown in Table 3B.14.

3B.4.2 Treatment and Conversion to Glass

Fig. 3B.4 shows a schematic flowsheet of the existing and future HLW treatment and vitrification facilities at HANF. The current plan is that the Hanford Waste Vitrification Plant (HWVP) will have three feeds: neutralized current acid waste (NCAW), complexant concentrate (CC), and plutonium finishing plant waste (PFP). According to the present plan, these feeds will be run separately, producing canistered glasses of three different levels of radioactivity and heat generation. As previously indicated, the NCAW produces the highest heat load per canister, and is the reference feed for HWVP design purposes. The CC and PFP wastes will produce glass of much lower activity, with a heat load of about 50 W/canister (Wolfe 1985a,b). The Hanford "B" plant will be used to pretreat the waste before it is sent to the HWVP. The treatment includes removal of sulfate (to produce glass of acceptable quality) and partial removal of Na, Al, F, and Zr to reduce glass volume (Wolfe 1985a,b). Vitrification is scheduled to begin in 1996.

There are no plans at present to convert the Sr-Cs capsules to glass. The current reference plan is to overpack the capsules in canisters and ship the canisters to a repository (White, 1986). This is discussed in Section 5.5.

3B.4.3 Radioactivity and Decay Heat per Canister

No data have been made available on the radionuclide composition of the initial NCAW feed to the vitrification plant. However, estimates are available for the projected (end of year 1995) radionuclide contents of the double-shell tank slurry and the single-shell tank liquid, sludge, and salt cake; these are from Coony 1987 and are shown in Table 3B.15. The reference also contains similar data for all years from 1982 to 2020. In Table 3B.15, slurry represents the total contents of all double-shell tanks; liquid, sludge, and salt cake represent the total contents of all single-shell tanks. The liquid includes both supernatant and interstitial liquids. The table assumes single-shell tank liquids are transferred to double-shell tanks according to the following schedule:

End of Year	Cumulative gallons transferred
1983	973,000
1984	1,078,000
1985	1,433,000
1986	1,465,000
1987	1,637,000
1988	1,792,000
1989	1,792,000
1990	2,030,000
1991	2,635,000
1992	2,880,000
1993	4,095,000
1994	5,862,000
1995	6,881,000
1996	6,955,000

Other assumptions in Table 3B.15 are as follows: (1) The N Reactor operates through the year 2000, (2) PUREX plant operates through the year 2001, (3) Only Fast Flux Test Facility and Shippingport fuels are processed through the shear-leach facility; N Reactor fuels are chemically declad, (4) only Area 100 low-level waste has been converted to grout, and (5) Plutonium Finishing Plant wastes are accumulated as TRU wastes.

The data in Table 3B.15 do not provide a direct means of estimating the radionuclide composition of the NCAW feed to the melter in a given year because (1) they represent total inventories and do not give the compositions of the tanks specifically selected to provide the feeds to the waste treatment and vitrification plant, and (2) the quantitative relationships needed to calculate melter feed composition from tank inventory data are not available.

Hanford, however, has provided an estimated radionuclide composition of the most active NCAW melter feed anticipated. This is shown in Table 3B.16 on a per canister basis and represents the "upper bound" of radioactivity for glass produced from HANF (White 1986). As stated in Section 3, this results in a glass with an activity of 416,000 Ci/canister and a decay heat of 1,158 W/canister at the time of filling, based on a glass load of 1650 kg (0.62 m^3). Glass of this activity is not expected to be produced before approximately the year 1999, when the vitrification plant starts using the third of its three feed tanks, which represents essentially fresh waste. Glass initially produced may have a decay heat load as low as 390-400 W/canister; this is the minimum activity glass anticipated (Watrous 1986, Coony 1987).

Hanford has also provided data on the estimated radionuclide contents of NCAW glasses produced during the 1996-2000 period (Mitchell 1986). One of the these has a higher radioactivity than the one given as the upper-bound case in Coony 1987 (478,000 Ci/canister vs 416,500 Ci/canister. However, Coony 1987 represents an official transmittal of more recent data and therefore has been used here to define the estimated maximum radioactivity and thermal power per canister.

3B.4.4 Volume Conversion Factors to Glass

Hanford projections of glass production are based on a waste solids production of 17 kg per metric ton of uranium processed. This is more efficient than the current operation of the PUREX plant, which now produces about 32 kg of waste oxides per metric ton of uranium; however, the 17 kg target is expected to be achieved. At 17 kg, less inert solid material accompanies a given mass of active radionuclides; hence a canister of waste glass will have greater activity. Waste solids constitute 25% of waste glass by weight. The volumetric reduction factor for NCAW to glass is about 30:1 based on feed to the pretreatment plant (White 1986).

3B.4.5 Assessment of Data

Although Hanford's estimates of waste activity are based on projections 10 years in the future, the upper-bound estimate for the activity of vitrified NCAW waste appears to have been conservatively calculated. More definitive data on the expected radionuclide composition of NCAW glass produced in the 1996-2000 period would be useful but will probably have to wait until actual tankage allocations have been determined.

3B.5 IDAHO NATIONAL ENGINEERING LABORATORY

The high-level waste generated and stored at INEL results primarily from the reprocessing of spent fuels from naval propulsion nuclear reactors and reactor testing programs; a small amount is produced from the reprocessing of fuel from nondefense research reactors. The composition of the acidic liquid initially produced depends on the type of fuel processed; the most common composition contains fluorides and nitrates of aluminum and zirconium in nitric and hydrofluoric acids. The principal radionuclides are the fission products such as Sr-90 and Cs-137, and transuranium elements. These acidic liquid wastes are stored in large, underground, doubly contained, stainless steel tanks, and are subsequently processed to yield a calcine. This is a dry powder consisting predominantly of aluminum oxide, zirconium oxide, and calcium fluoride; it contains the radionuclides that were present in the acidic liquid. The calcine is stored retrievably in stainless steel bins housed in reinforced concrete vaults, and is segregated into different layers within the bins according to the composition of the waste from which it was derived (Knecht et al. 1985).

3B.5.1 HLW Inventories at INEL

Tables 3B.17 and 3B.18 summarize the current and projected future volumes and radioactivities of the liquid and calcine stored at INEL, projected to the year 2020. Table 3B.17 also shows the canister production schedule on which the estimates are based; immobilization is assumed to start in year 2011 at a rate of 500 canisters/year and reaches a steady rate of 1000 canisters/year in year 2013. Production of immobilized waste is expected to continue after year 2020.

The estimates shown in Table 3B.18 of radioactivity in the immobilized form were based on the assumptions that two-thirds of the glass-ceramic produced each year would be made from calcine with an age of about 5 to 8 years and one-third would be made from old calcine. These assumptions are unlikely to hold precisely true in practice, so the estimates in Table 3B.18 should not be used for near-term estimates of the total radioactivity in the immobilized form.

Table 3B.19 shows representative chemical compositions of various HLW liquids and calcines produced at INEL.

3B.5.2 Treatment and Conversion to Glass or Ceramic Form

As already indicated, immobilization of HLW at INEL is scheduled to start in the year 2011. Various alternatives for immobilization are being studied, and no decision has been made as to what form the immobilized waste will be in for repository disposal. Fig. 3B.5 shows a schematic flowsheet illustrating some of the possibilities for treatment and immobilization. Both glass and glass-ceramic compositions are being considered as the final waste form for the calcine and liquid HLW. As the flowsheet shows, the conversion of liquid waste to glass without passing through the calciner is one of the alternatives under study.

Based on the glass-ceramic form, the future annual production of immobilized HLW is now estimated to be in the range of 450 to 650 canisters/year. The larger quantity corresponds to fuel dissolution using cadmium and boron for criticality control, while the smaller does not. These canister production rates are based on the annual generation of new waste. If stored calcine from old waste is also retrieved and immobilized, an additional 350 to 550 canisters of ceramic would be produced annually, resulting in a total production of about 1000 canisters/year. Other options described in WINCO-1031, such as neutralization, are potentially capable of reducing the annual volume of immobilized HLW, but are not as far developed as the ceramic forms described here, and would also produce large volumes of low-level waste. Also, these latter options at present are based on rather advanced processes and therefore are not as technically favorable as the glass-ceramic forms for near-term implementation. The remaining options shown in WINCO-1031 have been shown to be less promising and are not being developed any further (Knecht 1986a). The estimates in Sect. 3 of this report were based on 1000 canisters/year of the glass-ceramic form, since that appears currently to be the most favorable case.

3B.5.3 Radioactivity and Decay Heat per Canister

The estimated radioactivity and decay heat per canister shown in Section 3 of this report were based on an estimated radionuclide composition of 3-year old calcine taken from a 1982 INEL study (IDO 1982). This composition, shown in Table 3B.20, is the most recent available. To complete the calculation, it was also necessary to estimate the mass of calcine per canister. Based on the high-density glass-ceramic form, calculations indicated that about 1277 kg of calcine could be incorporated in a canister load. Assumptions used in making this estimate were as follows: (1) the volume of glass-ceramic per canister is 0.57 m^3, (2) the density of the glass-ceramic is 3.2 g/cm^3, and (3) the amount of calcine in the glass-ceramic is 70% by weight. These assumptions were based on data in Berreth and Knecht 1984, Knecht et al. 1985, Knecht 1986a, and Berreth 1986a. The radionuclide content per canister that resulted from the foregoing assumptions is shown in Table 3B.21; this is the composition that was used in Sect. 3 to develop radioactivity and decay heat per canister. For purposes of this report, this composition is estimated to represent the maximum radioactivity per canister as well as we can estimate it at the present time.

3B.5.4 Volume Conversion Factor to Ceramic

The bulk density of calcine is about 1.4 g/cm^3 (Berreth 1986b). Thus the 1277 kg of calcine in a canister load would have a volume of 0.91 m^3 as calcine. Since its volume as glass-ceramic was estimated to be 0.57 m^3, the volume reduction factor from calcine to glass-ceramic is 1.6:1.

The volume reduction factor for liquid HLW to calcine is about 6.1 (Mairson et al. 1986).

3B.5.5 Assessment of Data

Because of security restrictions, INEL has not released any estimates of radionuclide content per canister based on either glass or glass-ceramic. The estimates of radionuclide composition in this report, which served as the basis for ORIGEN decay calculations to determine maximum radioactivity and thermal power as a function of time, were based on 1982 data. Thus the maximum radioactivity and decay heat loads per canister shown in Section 3 for decay times up to 10^6 years should be considered preliminary. Also, final decisions on processing options for INEL have not yet been made; thus the processing route, schedule, and canistered waste characteristics presented here are based on assumptions that are subject to change.

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Wolfe 1985a. Personal communication, B. A. Wolfe, Rockwell Hanford Operations, to Royes Salmon, ORNL, November 8, 1985.

Wolfe 1985b. Personal communication, B. A. Wolfe, Rockwell Hanford Operations, to Royes Salmon, November 12, 1985. (Project Status, HWVP, Nov. 6, 1985).

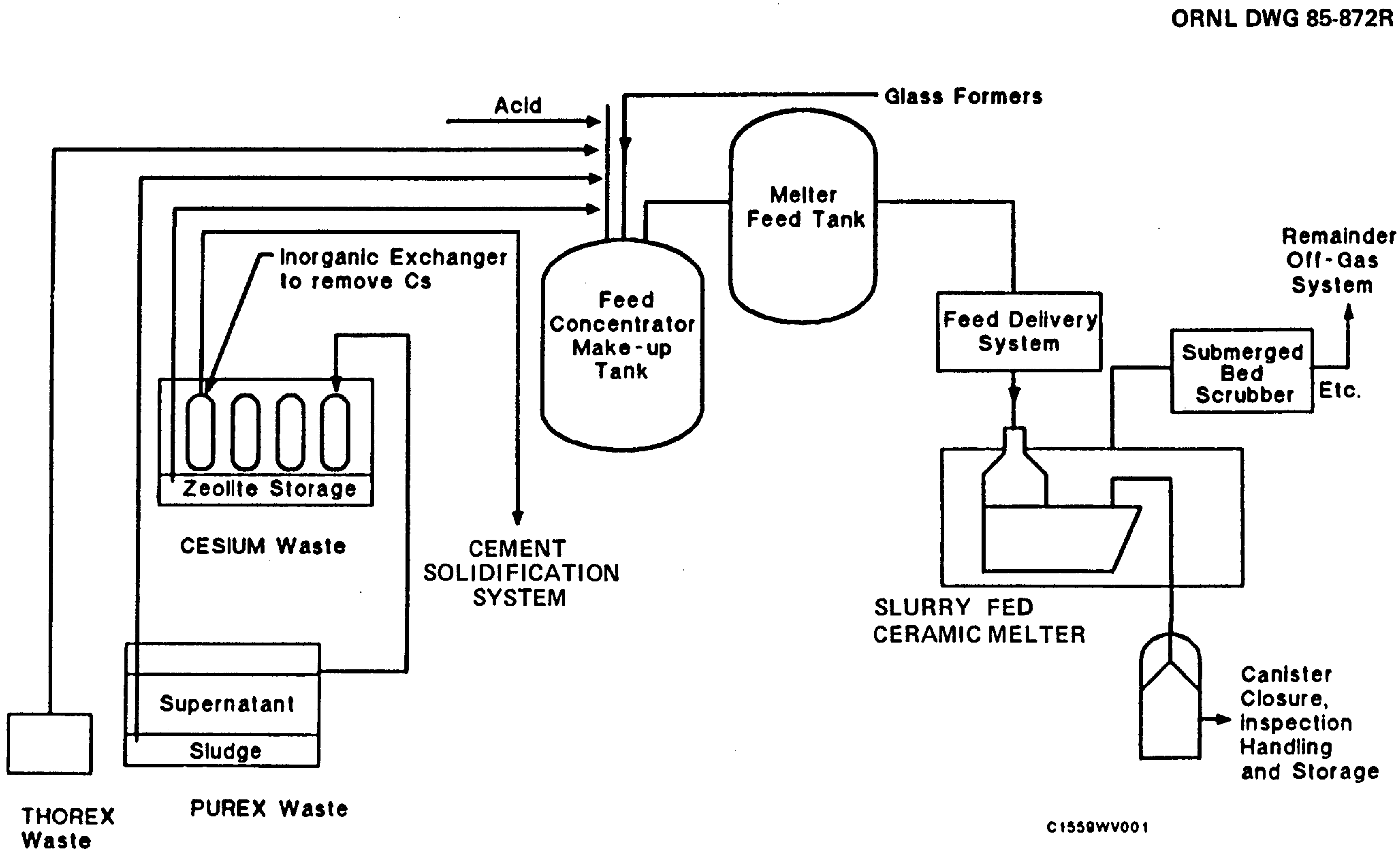


Fig. 3B.1. HLW treatment and vitrification at WVDP.

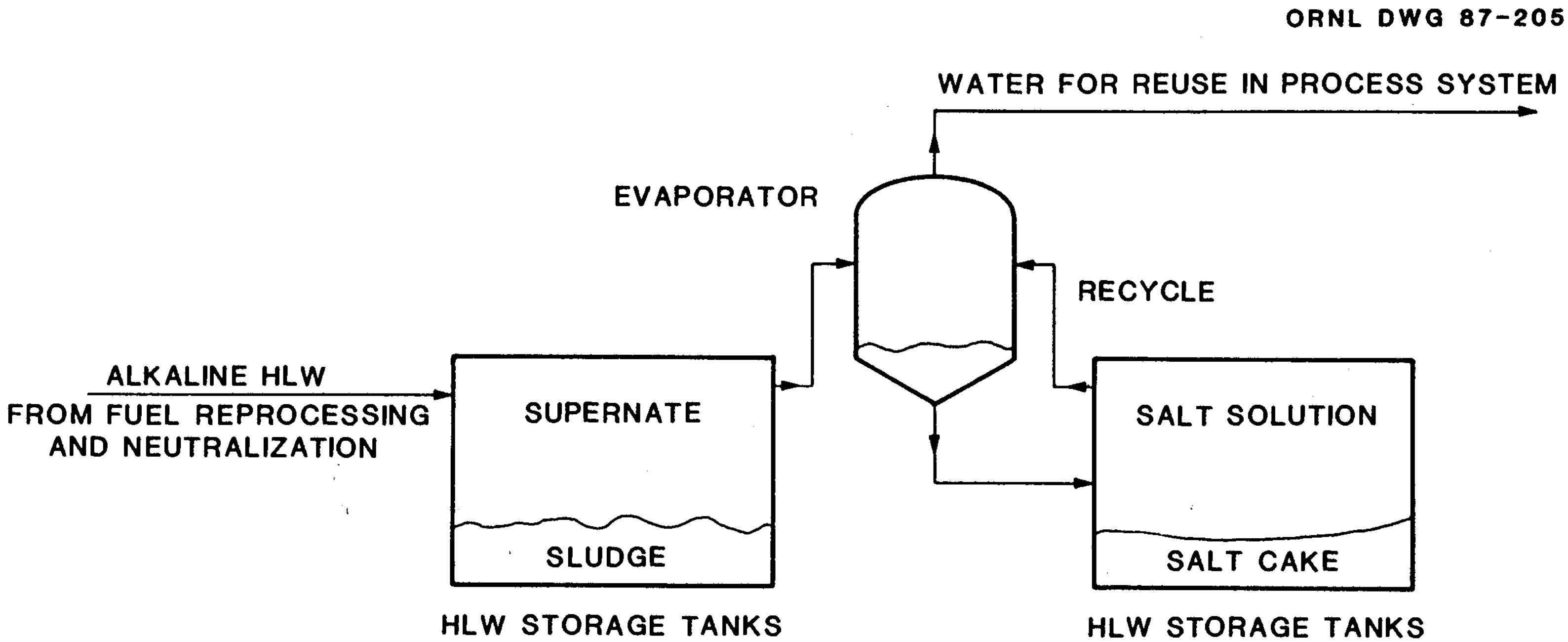


Fig. 3B.2. Simplified Representation of Primary HLW Operations at Savannah River Plant.

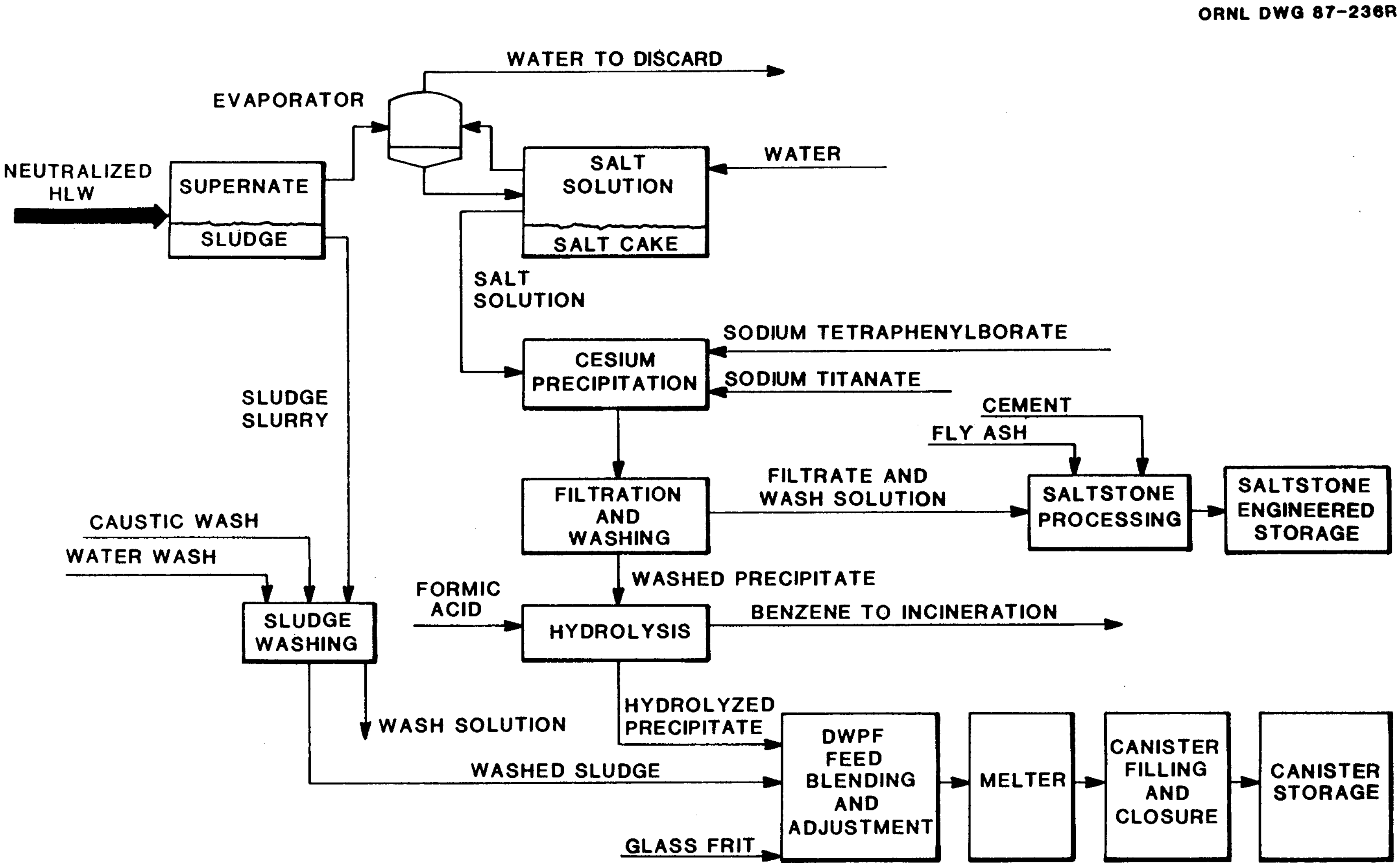


Fig. 3B.3. High-level waste processing at Savannah River Plant after startup of DWPF.

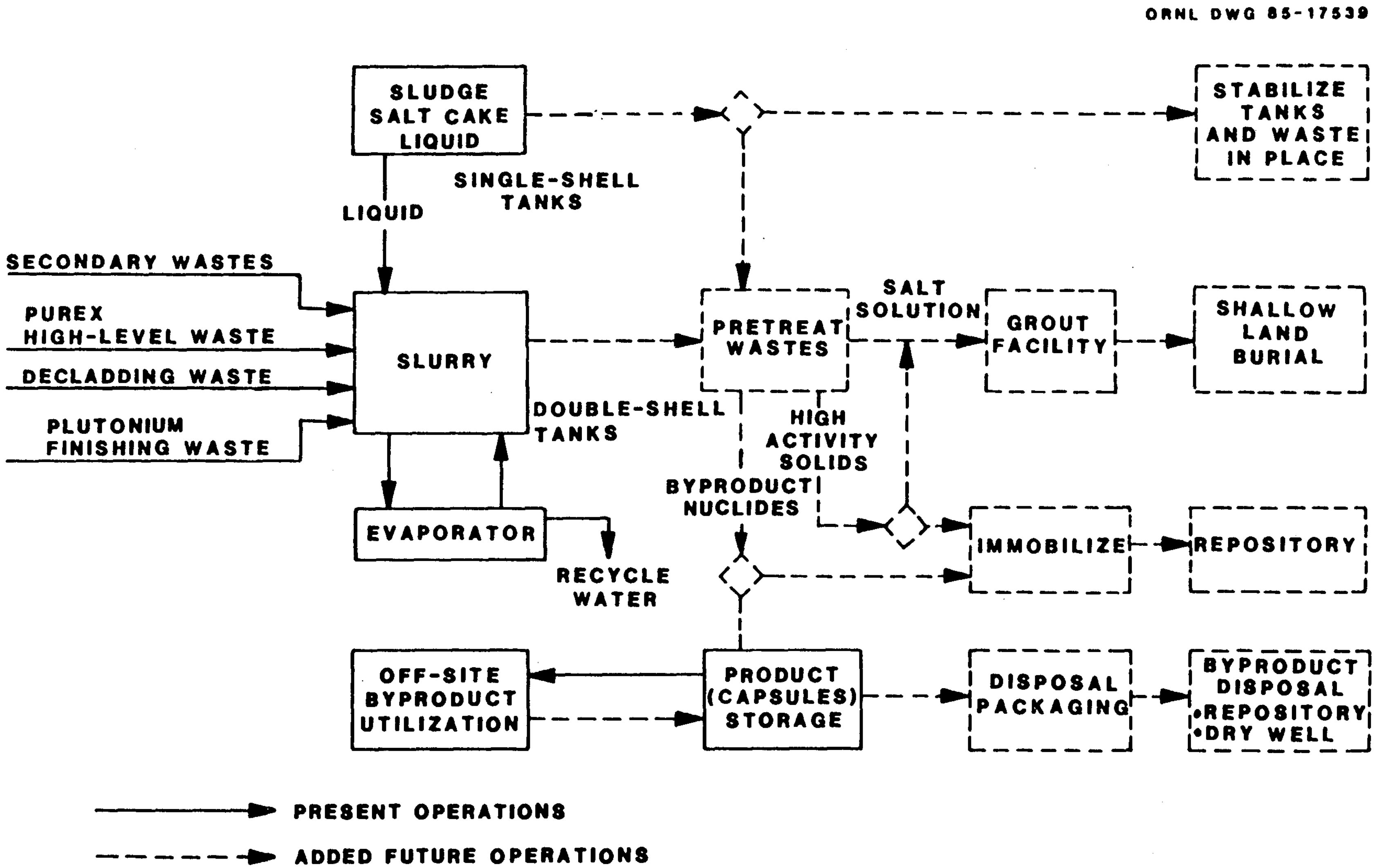


Fig. 3B.4. HLW treatment and vitrification at HANF.
Source: DOE/RW-0006 Rev. 1, December 1985.

ORNL DWG 83-311R

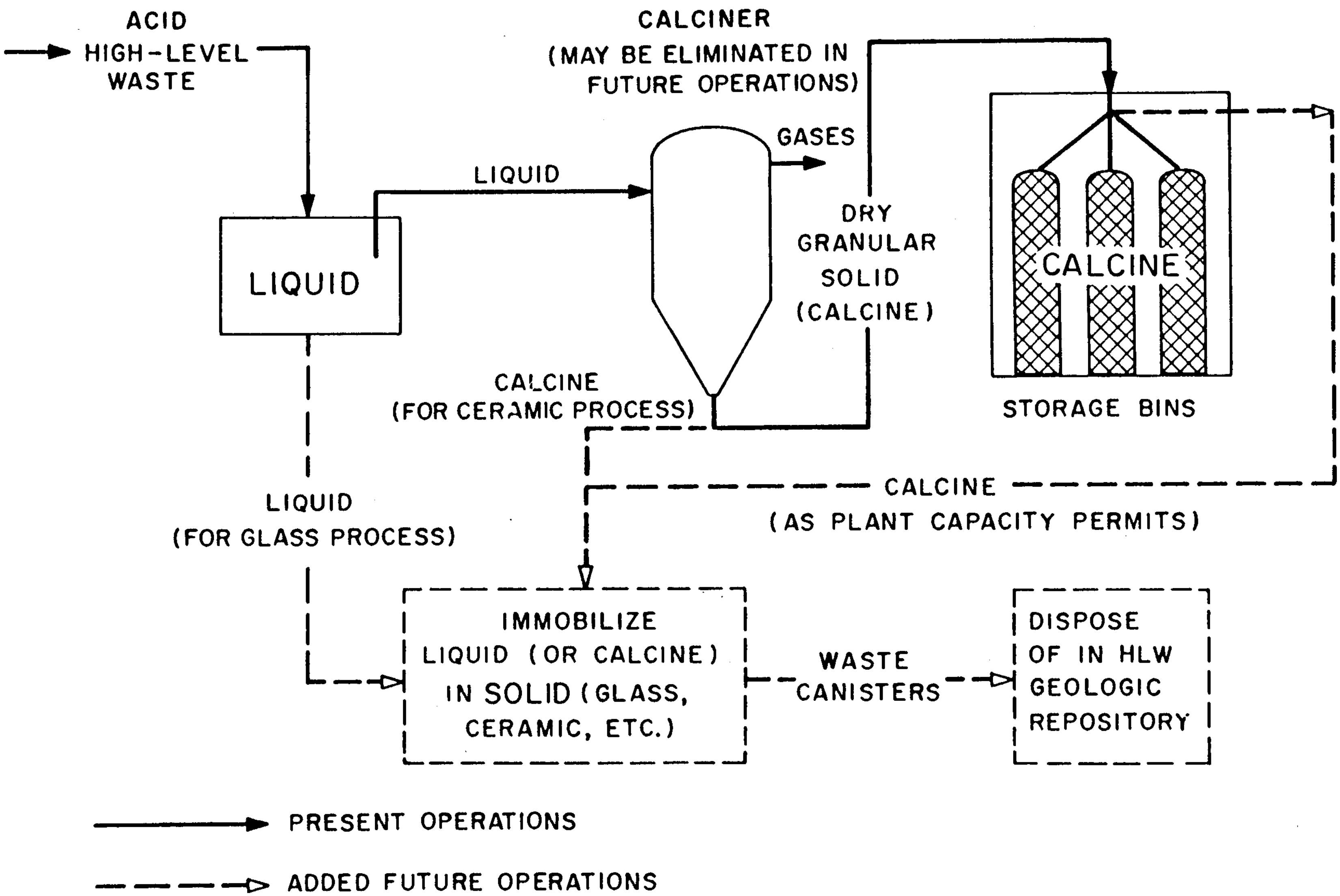


Fig. 3B.5. HLW treatment and vitrification at INEL.

Source: DOE/RW-0006, Rev. 1, December 1985.

Table 3B.1. West Valley Reprocessing Summary, 1966-1972[a]

Reactor	Type	Fuel	Cladding	Campaigns	Uranium (metric tons)	Exposure (MWD)
Yankee/Rowe	PWR	UO_2	SS	4	88	1,412,000
CON ED/Indian PT-1	PWR	UO_2	SS	2	23	426,000
CVNPA	PWR	UO_2	Zr	1	4	35,000
COMM ED/Dresden-1	BWR	UO_2	Zr	2	72	661,000
CP/Big Rock PT	BWR	UO_2	SS	2	24	252,000
PG&E/Humboldt Bay	BWR	UO_2	Zr	1	21	220,000
NSP/Pathfinder	BWR	UO_2	SS	1	10	15,000
PR/Bonus	BWR	UO_2	SS	1	4	11,000
NPR	Graphite	Metal	Zr	11	380	774,000
CON ED/Indian PT-1	PWR	ThO_2/UO_2[c]	Zr	1	16[b]	260,000
SEFOR	Test	PuO_2/UO_2		1	20[d]	
Total				27	662	4,066,000

[a]Source: WVDP.
[b]Uranium plus thorium.
[c]93% U-235.
[d]Plutonium only processed.

Table 3B.2. Volumes of interim and immobilized HLW at WVDP[a]

End of calendar year	Volume, $10^3 m^3$						
	Liquid	Sludge	Salt cake	Slurry	Calcine	Glass	Total
1987	2.145	0.170	-	-	-	-	2.315
1988	2.145	0.170	-	-	-	-	2.315
1989	2.145	0.170	-	-	-	-	2.315
1990	1.131	0.090	-	-	-	0.100	1.321
1991	-	-	-	-	-	0.210	0.210
2020	-	-	-	-	-	0.210	0.210

[a]This table is based on the current plan to convert all of the interim HLW at WVDP to glass between 1990 and 1991. The total volume of glass produced represents about 275-300 canisters. Quantities after year 1991 are constant, indicating that no additional HLW production is planned. Liquid consists of 2100 m^3 alkaline liquid from PUREX processing and 45 m^3 acid liquid from THOREX processing. Sludge is alkaline sludge from PUREX processing. Sources: Bixby 1987, Rykken 1987.

Table 3B.3. Radioactivity and thermal power of HLW at WVDP[a]

End of calendar year	Radioactivity, 10^6 Ci							Thermal power (10^3 W)
	Liquid	Sludge	Salt cake	Slurry	Calcine	Glass	Total	
1987	16.0	14.1	–	–	–	–	30.1	89.4
1988	15.6	13.7	–	–	–	–	29.3	87.2
1989	15.2	13.4	–	–	–	–	28.6	85.3
1990	7.8	6.9	–	–	–	13.2	27.9	83.1
1991	–	–	–	–	–	27.2	27.2	81.1
1995	–	–	–	–	–	24.7	24.7	73.9
2000	–	–	–	–	–	22.0	22.0	65.7
2005	–	–	–	–	–	19.5	19.5	58.6
2010	–	–	–	–	–	17.4	17.4	52.2
2015	–	–	–	–	–	15.4	15.4	46.6
2020	–	–	–	–	–	13.7	13.7	41.6

[a]Source: ORIGEN2 decay calculations based on Bixby 1987 and Rykken 1987.

Table 3B.4. West Valley Demonstration Project. Representative chemical compositions of interim high-level wastes[a]

A. Chemical composition of WVDP alkaline liquid HLW (from reprocessing via a PUREX flowsheet)

Compound	Wet basis (wt %)	Dry basis (wt %)	Total (kg)
$NaNO_3$	21.10	53.38	602,659
$NaNO_2$	10.90	27.57	311,326
Na_2SO_4	2.67	6.76	76,261
$NaHCO_3$	1.49	3.77	42,557
KNO_3	1.27	3.21	36,274
Na_2CO_3	0.884	2.24	25,249
NaOH	0.614	1.55	17,537
K_2CrO_4	0.179	0.45	5,113
NaCl	0.164	0.42	4,684
Na_3PO_4	0.133	0.34	3,799
Na_2MoO_4	0.0242	0.06	691
Na_3BO_3	0.0209	0.05	597
$CsNO_3$	0.0187	0.05	534
NaF	0.0176	0.04	503
$Sn(NO_3)_4$	0.00859	0.02	245
$Na_2U_2O_7$	0.00808	0.02	231
$Si(NO_3)_4$	0.00806	0.02	230
$NaTcO_4$	0.00620	0.02	177
$RbNO_3$	0.00416	0.01	119
Na_2TeO_4	0.00287	0.007	82
AlF_3	0.00271	0.007	77
$Fe(NO_3)_3$	0.00152	0.004	43
Na_2SeO_4	0.00054	0.001	15
$LiNO_3$	0.00048	0.001	14
H_2CO_3	0.00032	0.0008	9
$Cu(NO_3)_3$	0.00022	0.0005	6
$Sr(NO_3)_2$	0.00013	0.0004	4
$Mg(NO_3)_2$	0.00008	0.0002	2
Subtotal	39.53	100.00	1,129,038
H_2O (by difference)	60.47	0.00	1,727,163
Grand total	100.00	100.00	2,856,201

[a]Sources: ORNL 1986 and Bixby 1987.

Table 3B.4. (continued)

B. Chemical composition of WVDP alkaline sludge HLW (from reprocessing via a PUREX flowsheet)[a]

Compound	Mass, kg
1. Other than fission products and actinide elements	
$Fe(OH)_3$	66,040
$FePO_4$	6,351
$Al(OH)_3$	5,852
AlF_3	536
MnO_2	4,581
$CaCO_3$	3,208
$Ni(OH)_2$	1,088
SiO_2	1,263
$Zr(OH)_4$	159[b]
$MgCO_3$	826
$Cr(OH)_3$	65
$Hg(OH)_3$	23
$Cu(OH)_2$	376
$Zn(OH)_2$	128
Subtotal	90,496
2. Fission products	
$SrSO_4$	204
$Y(OH)_3$	105
$Zr(OH)_4$	917
$Ru(OH)_4$	447
$Rh(OH)_4$	123
$Pd(OH)_4$	166
$AgOH$	9.7
$Cd(OH)_2$	13.3
$In(OH)_3$	1.1
$Ge(OH)_3$	0.2
$Sn(OH)_4$	18.8
$Sb(OH)_3$	3.4
$BaSO_4$	423
$La(OH)_3$	226
$Ce(OH)_3$	432
$Pr(OH)_3$	210
$Nd(OH)_3$	739
$Pm(OH)_3$	0.1
$Sm(OH)_3$	132
$Eu(OH)_3$	15.8
$Gd(OH)_3$	11.2
$Tb(OH)_3$	0.3
$Dy(OH)_3$	0.2
Subtotal	4,198
3. Actinide elements	
$UO_2(OH)_2$	3,087
NpO_2	38
PuO_2	37
AmO_2	19
CmO_2	0.1
Subtotal	3,181
Grand total	97,892

[a]Sources: ORNL 1986 and Bixby 1987.

[b]Excludes fission product zirconium.

Table 3B.4 (continued)

C. Chemical composition of WVDP acid liquid HLW (from reprocessing via a THOREX flowsheet)[a]

Compound	Weight %	Mass, kg	Compound	Weight %	Mass, kg
$Th(NO_3)_4$	34.53	31,054	Na_3PO_4	0.013	12
$Fe(NO_3)_3$	9.41	8,462	$NaTcO_4$	0.013	11
$Al(NO_3)_3$	4.64	4,175	$Y(NO_3)_3$	0.016	14
HNO_3	3.12	2,805	$Rh(NO_3)_4$	0.012	11
$Cr(NO_3)_3$	2.13	1,918	$Zn(NO_3)$	0.011	10
$Ni(NO_3)$	0.88	791	$Pd(NO_3)_4$	0.0084	8
H_3BO_3	0.53	480	$UO\ (NO_3)$	0.0069	6
$NaNO_3$	0.25	227	$RbNO_3$	0.0066	6
$Na\ SO_4$	0.20	180	$Na\ TeO_4$	0.0058	5
KNO_3	0.21	191	$Co(NO_3)_3$	0.0028	3
$Na\ SiO_3$	0.14	126	$Na\ SeO_4$	0.0013	1
$KMnO_4$	0.11	98	NaF	0.0012	1
$Mg(NO_3)_3$	0.063	57	$Eu(NO_3)_3$	0.0011	1
$Na\ MoO_4$	0.061	54	$Np(NO_3)_4$	0.0010	0.9
NaCl	0.056	50	$Sn(NO_3)_3$	0.00080	0.7
$Nd(NO_3)_3$	0.081	73	$Cu(NO_3)$	0.00086	0.8
$Ce(NO_3)_4$	0.057	51	$Pa(NO_3)_4$	0.00074	0.7
$Ru(NO_3)_4$	0.046	42	$Pu(NO_3)_4$	0.00073	0.7
ZrO	0.039	35	$Gd(NO_3)$	0.00039	0.4
$Ca(NO_3)$	0.034	30	$Cd(NO_3)$	0.00031	0.3
$CsNO_3$	0.031	28	$Sb(NO_3)$	0.00017	0.1
$Ba(NO_3)$	0.030	27	$AgNO_3$	0.00009	0.08
$La(NO_3)_3$	0.025	22	$In(NO_3)_3$	0.00004	0.04
$Pr(NO_3)_3$	0.023	21	$Ge(NO_3)_4$	0.00002	0.02
$Sr(NO_3)$	0.018	16	$Pm(NO_3)$	0.00001	0.01
$Sm(NO_3)_3$	0.016	14	$Tb(NO_3)_3$	0.000005	0.004
$Zr(NO_3)_4$	0.014	12	$Dy(NO_3)_3$	0.000002	0.002
			Total	56.83	51,106
			H_2O (by difference)	43.17	38,826

[a]Sources: ORNL 1986 and Bixby 1987.

Table 3B.5. Reference 1987 radionuclide content (curies) of West Valley Waste[a]

Radionuclide	PUREX Supernatant	PUREX Solids	THOREX	Total
H-3	9.5E+1	~0	<2.0E+0	9.5E+1
C-14	1.4E+2	~0	-	1.4E+2
Fe-55	~0	1.0E+3	-	1.0E+3
Ni-59	~0	8.2E+1	-	8.2E+1
Ni-63	8.9E+2	6.4E+3	-	6.4E+3
Co-60	~0	4.7E+0	1.2E+3	1.2E+3
Se-79	3.7E+1	~0	-	3.7E+1
Sr-90	2.9E+3	6.9E+6	5.0E+5	7.4E+6
Y-90	2.9E+3	6.9E+76	5.0E+5	7.4E+7
Zr-93	~0	2.3E+2	-	2.3E+2
Nb-93m	~0	2.3E+2	-	2.3E+2
Tc-99	1.6E+3	~0	8.0E+1	1.7E+3
Ru-106	~0	1.3E+2	<3.1E-1	1.3E+2
Rh-106	~0	1.3E+2	<3.1E-1	1.3E+2
Pd-107	~0	1.2E+0	-	1.2E+0
Sb-125	4.8E+1	4.5E+3	-	4.5E+3
Te-125m	1.1E+1	1.0E+3	-	1.0E+3
Sn-126	~0	4.0E+1	-	4.0E+1
Sb-126m	~0	4.0E+1	-	4.0E+1
Sb-126	~0	5.6E+1	-	5.6E+1
I-129	2.1E-1	~0	<1.5E-1	<3.6E-1
Cs-134	1.4E+4	~0	2.9E+2	1.4E+4
Cs-135	1.6E+2	~0	-	1.6E+2
Cs-137	7.3E+6	~0	5.1E+5	7.8E+6
Ba-137m	6.8E+6	~0	4.8E+5	7.3E+6
Ce-144	2.9E-5	1.4E+1	<2.0E-2	1.4E+1
Pr-144	2.9E-5	1.4E+1	<2.0E-2	1.4E+1
Pm-147	1.7E+2	3.1E+5	4.5E+3	3.1E+5
Sm-151	1.1E+0	2/1E+5	1.5E+1	2.1E+5
Eu-152	4.2E-2	4.2E+2	5.8E+0	4.2E+2
Eu-154	1.4E+1	1.3E+5	2.6E+3	1.3E+5
Eu-155	2.3E+0	2.3E+4	3.1E+2	2.3E+4
Th-232	~0	~0	1.6E+0	1.6E+0
U-233	4.9E-1	6.9E+0	2.6E+0	1.0E+1
U-234	2.9E-1	4.0E+0	3.0E-1	4.6E+0
U-235	6.4E-3	8.9E-2	4.9E-3	1.0E-1
U-236	1.9E-2	2.7E-1	1.0E-2	3.0E-1
U-238	5.7E-2	7.9E-1	6.1E-4	8.5E-1
Np-237	~0	1.1E+1	-	1.1E+1
Np-239	~0	2.4E+3	-	2.4E+3
Pu-238	1.3E+2	6.5E+3	5.3E+2	7.2E+3
Pu-239	2.5E+1	1.7E+3	1.7E+1	1.7E+3
Pu-240	1.9E+1	1.3E+3	9.0E+0	1.3E+3
Pu-241	1.5E+3	8.5E+4	9.3E+2	8.7E+4
Pu-242	2.5E-2	1.7E+0	1.3E-2	1.7E+0
Am-241	~0	7.2E+4	2.7E+2	7.2E+4
Am-242	~0	2.1E+1	-	2.1E+1
Am-242m	~0	2.1E+1	-	2.1E+1
Am-243	~0	2.4E+3	8.8E+0	2.4E+3
Cm-242	~0	2.2E+0	<1.1E-3	2.2E+0
Cm-243	~0	1.7E+2	5.0E-2	1.7E+2
Cm-244	~0	2.2E+4	1.6E+1	2.2E+4
Cm-245	~0	1.0E+1	1.2E-3	1.0E+1
Cm-246	~0	4.3E+0	-	4.3E+0
Total				3.08E+7

[a]Source: Eisenstatt 1986.

Table 3B.6. Radioisotope composition of West Valley Demonstration Project Vitrified High-Level Waste[a]

Radioisotope	Curies/canister	Grams/canister
Fe-55	0.2100E+01	0.8397E-03
Ni-59	0.3600E+00	0.4752E+01
Ni-63	0.2700E+02	0.4377E+00
Co-60	0.3600E+01	0.3183E-02
Se-79	0.1600E-01	0.2297E+00
Sr-90	0.3000E+05	0.2199E+03
Y-90	0.3000E+05	0.5514E-01
Zr-93	0.1100E+01	0.4377E+03
Nb-93M	0.8600E+00	0.3042E-02
Tc-99	0.7400E+01	0.4363E+03
Ru-106	0.3600E-01	0.1076E-04
Rh-106	0.3600E-01	0.1011E-10
Pd-107	0.5300E-02	0.1030E+02
Sb-125	0.9300E+01	0.9003E-02
Te-125m	0.2100E+01	0.1165E-03
Sn-126	0.1800E+00	0.6342E+01
Sb-126M	0.1800E+00	0.2291E-08
Sb-126	0.2500E+00	0.2990E-05
Cs-134	0.1600E+02	0.1236E-01
Cs-135	0.7000E+00	0.6076E+03
Cs-137	0.3200E+05	0.3678E+03
Ba-137m	0.3000E+05	0.5576E-04
Ce-144	0.4300E-02	0.1348E-05
Pr-144	0.4300E-02	0.5690E-10
Pm-147	0.6300E+03	0.6795E+00
Sm-151	0.9000E+03	0.3421E+02
Eu-152	0.1600E+01	0.9249E-02
Eu-154	0.4500E+03	0.1667E+01
Eu-155	0.6500E+02	0.1398E+00
Th-232	0.8000E-02	0.7293E+05
U-233	0.4200E-01	0.4337E+01
U-234	0.1900E-01	0.3040E+01
U-235	0.4400E-03	0.2035E+03
U-236	0.1200E-02	0.1854E+02
U-238	0.3500E-02	0.1041E+05
Np-237	0.6900E-01	0.9786E+02
Np-239	0.1500E+02	0.6466E-04
Pu-238	0.3000E+02	0.1752E+01
Pu-239	0.7600E+01	0.1222E+03
Pu-240	0.1900E+02	0.8337E+02
Pu-241	0.3300E+03	0.3204E+01
Pu-242	0.7500E-02	0.1964E+01
Am-241	0.5000E+03	0.1456E+03
Am-242	0.1300E+00	0.1608E-06
Am-242m	0.1300E+00	0.1337E-01
Am-243	0.1500E+02	0.7523E+02
Cm-242	0.1300E+00	0.3931E-04
Cm-243	0.1000E+01	0.1936E-01
Cm-244	0.1200E+03	0.1482E+01
Cm-245	0.6300E-01	0.3669E+00
Cm-246	0.2700E-01	0.8786E-01
Total	0.1252E+05	0.8623E+05

[a]Calculated from data in Eisenstatt 1986. Data shown are for the maximum activity canister and are for the year 1990.

Table 3B.7. Current and projected volumes of HLW at SRP

End of calendar year	Volume, 10^3 m^3				
	Liquid	Sludge	Saltcake	Glass	Total
1986	72.90	13.80	41.20	0.00	127.80
1987	53.17	9.17	46.49	0.00	108.83
1988	44.74	9.52	50.83	0.00	105.09
1989	42.37	7.13	49.78	0.00	99.28
1990	43.76	7.45	47.47	0.06	98.74
1991	41.89	7.76	46.77	0.32	96.74
1992	39.75	5.81	43.35	0.58	89.49
1993	36.41	6.13	42.63	0.84	86.01
1994	40.34	6.38	38.83	1.10	86.65
1995	39.99	3.74	36.71	1.36	81.80
1996	31.70	4.03	36.49	1.62	73.84
1997	29.87	4.33	34.90	1.88	70.98
1998	34.42	3.71	31.37	2.14	71.64
1999	34.82	3.78	31.40	2.40	72.40
2000	36.12	2.54	30.03	2.66	71.35
2001	33.12	2.66	27.49	2.80	66.07
2002	33.41	1.12	26.37	2.94	63.84
2003	37.60	1.39	23.05	3.08	65.12
2004	38.79	0.61	20.85	3.22	63.47
2005	36.68	0.88	22.26	3.36	63.18
2006	39.44	1.16	24.20	3.50	68.30
2007	39.44	1.16	24.20	3.56	68.36
2008	39.44	1.16	24.20	3.62	68.42
2009	39.44	1.16	24.20	3.68	68.48
2010	39.44	1.16	24.20	3.74	68.54
2011	39.44	1.16	24.20	3.80	68.60
2012	39.44	1.16	24.20	3.86	68.66
2013	39.44	1.16	24.20	3.92	68.72
2014	39.44	1.16	24.20	3.98	68.78
2015	39.44	1.16	24.20	4.04	68.84
2016	39.44	1.16	24.20	4.10	68.90
2017	39.44	1.16	24.20	4.16	68.96
2018	39.44	1.16	24.20	4.22	69.02
2019	39.44	1.16	24.20	4.28	69.08
2020	39.44	1.16	24.20	4.34	69.14

[a]Source: Chandler 1987.

Table 3B.8. Radioactivity and thermal power of HLW at SRP[a]

End of calendar year	Radioactivity, millions of curies					Thermal power (1000 W)
	Liquid	Sludge	Salt Cake	Glass	Total	
1987	83.9	619.4	163.7	0	867.0	2666
1988	80.0	590.1	163.8	0	833.9	2553
1989	88.0	686.8	167.0	0	941.8	2976
1990	87.6	696.9	156.7	6.1	947.3	2995
1991	93.7	747.1	154.2	27.0	1022.0	3284
1992	97.5	796.2	139.5	50.8	1084.0	3509
1993	93.2	758.0	129.6	74.2	1055.0	3374
1994	90.3	712.3	120.0	98.4	1021.0	3238
1995	94.6	738.9	106.6	127.9	1068.0	3418
1996	91.9	706.9	89.7	156.5	1045.0	3324
1997	93.8	724.0	87.5	171.7	1077.0	3443
1998	91.3	694.4	77.5	192.8	1056.0	3358
1999	93.2	707.8	68.7	214.3	1084.0	3462
2000	85.7	620.7	55.6	242.0	1004.0	3148
2001	91.6	678.4	55.0	249.0	1074.0	3425
2002	84.2	612.9	54.6	251.3	1003.0	3144
2003	87.4	639.4	54.3	256.9	1038.0	3288
2004	87.7	643.4	54.5	261.4	1047.0	3319
2005	87.5	640.5	54.5	268.5	1051.0	3336
2006	87.0	636.1	54.2	276.7	1054.0	3345
2007	87.0	637.7	54.4	277.9	1057.0	3353
2008	87.0	635.7	54.9	281.4	1059.0	3359
2009	86.6	635.7	54.9	283.8	1061.0	3366
2010	86.6	633.9	55.4	287.1	1063.0	3372
2011	86.5	635.4	55.4	287.7	1065.0	3378
2012	86.1	637.4	55.2	288.3	1067.0	3383
2013	86.0	638.9	55.2	288.9	1069.0	3388
2014	86.0	640.4	55.2	289.4	1071.0	3393
2015	82.7	643.9	54.2	291.1	1072.0	3398
2016	82.3	645.7	54.0	292.0	1074.0	3403
2017	82.2	647.2	54.0	292.6	1076.0	3408
2018	82.1	648.8	54.0	293.1	1078.0	3413
2019	81.7	649.9	53.7	293.7	1079.0	3418
2020	81.6	651.5	53.6	294.3	1081.0	3422

[a]Source: Chandler 1987. Values shown are for fission products only. Radioactivity will be about 1% greater and thermal power about 6% greater when actinides are included.

Table 3B.9. Savannah River Plant.
Estimated chemical compositions of interim and immobilized HLW.[a]

Liquid		Sludge		Salt cake		Glass	
Component	Wt %	Component	Wt %	Component	Wt %	Component	Wt %
Ag	Trace	$Fe(OH)_3$	11.8	$NaNO_3$	65.4	SiO_2	45.6
Hg	Trace	MnO_2	2.0	$NaNO_2$	0.9	Na_2O	11.0
Pb	Trace	$UO_2(OH)_2$	1.3	NaOH	3.4	B_2O_3	10.3
U	Trace	$Al(OH)_2$	13.7	$NaAl(OH)_4$	7.8	Fe_2O_3	7.0
F	0.003	AlO(OH)	5.2	Na_2CO_3	2.7	Al_2O_3	4.0
Fe	Trace	$CaCO_3$	1.5	Na_2SO_4	9.4	K_2O	3.6
Cl^-	0.023	$CaSO_4$	0.2	Na_3PO_4	Trace	Li_2O	3.2
OH^-	1.63	CaC_2O_4	0.2	NaF	0.2	FeO	3.1
NO_2^-	1.10	$Ni(OH)_2$	0.8	$Na_2C_2O_4$	0.1	U_3O_8	2.2
NO_3^-	9.63	HgO	0.4	Insoluble	3.7	MnO	2.0
$AL(OH)_4^-$	4.54	SiO_2	0.2	H_2O	6.4	Other	8.0
$CO_3(2^-)$	0.72	ThO_2	1.8				
$CrO_4(2^-)$	0.014	$Ce(OH)_3$	0.2			Total	100.0
$SO_4(2^-)$	0.22	$ZrO(OH)_2$	0.2				
$PO_4(3^-)$	0.12	$Cr(OH)_3$	0.2				
NH_4^+	Trace	$Mg(OH)_2$	0.2				
Na	11.0	$NaNO_3$	1.1				
H_2O	71.0	NaOH	1.3				
		Zeolite	1.5				
		Others	1.2				
		H_2O	55.0				

[a]Source: Chandler 1987.

Table 3B.10. SRP. Radionuclide content of precipitate slurry feed[a]

Isotope	Ci/gal	Isotope	Ci/gal	Isotope	Ci/gal
H-3	9.06E-05	Sb-124	8.88E-30	Tb-160	2.64E-27
C-14	1.98E-09	Sb-125	1.50E-02	Tl-208	2.67E-08
Co-60	3.28E-04	Sb-126	3.22E-05	U-232	1.67E-07
Ni-59	2.25E-07	Sb-126M	2.30E-04	U-233	2.45E-11
Ni-63	2.72E-05	Te-125M	2.15E-07	U-234	8.35E-07
Se-79	3.75E-07	Te-127	9.73E-20	U-235	1.48E-09
Rb-87	2.25E-10	Te-127M	9.94E-20	U-236	1.07E-08
Sr-89	7.92E-32	I-129	1.51E-10	U-238	9.91E-08
Sr-90	3.99E-01	Cs-134	1.66E-01	Np-236	1.96E-13
Y-90	4.12E-01	Cs-135	8.37E-05	Np-237	1.00E-07
Y-91	4.93E-28	Cs-137	3.60E+01	Pu-236	1.20E-07
Zr-93	4.08E-07	Ba-137M	3.44E+01	Pu-237	8.04E-41
Zr-95	6.26E-26	Ce-141	2.17E-50	Pu-238	1.53E-02
Nb-94	9.10E-10	Ce-142	3.63E-11	Pu-239	1.44E-04
Nb-95	1.32E-25	Ce-144	5.11E-06	Pu-240	9.71E-05
Nb-95M	7.74E-28	Pr-144	5.13E-06	Pu-241	1.16E-02
Tc-99	6.97E-05	Pr-144M	6.13E-08	Pu-242	1.37E-07
Ru-103	3.85E-41	Nd-144	1.85E-15	Am-241	2.40E-04
Ru-106	3.14E-05	Pm-147	6.56E-03	Am-242	1.55E-07
Rh-103M	3.75E-41	Pm-148	6.31E-43	Am-242M	1.56E-07
Rh-106	3.15E-05	Pm-148M	9.16E-42	Am-243	6.52E-08
Pd-107	1.38E-07	Sm-147	3.35E-11	Cm-242	1.28E-07
Ag-110M	3.18E-10	Sm-148	7.56E-17	Cm-243	4.94E-08
Cd-113	5.23E-20	Sm-149	2.32E-17	Cm-244	1.20E-03
Cd-115M	2.81E-40	Sm-151	3.02E-03	Cm-245	7.53E-11
Sn-121M	3.93E-05	Eu-152	1.07E-05	Cm-246	6.00E-12
Sn-123	1.21E-12	Eu-154	1.37E-03	Cm-247	7.38E-18
Sn-126	2.30E-04	Eu-155	5.54E-04	Cm-248	7.73E-18
		Total activity	7.14E+01 Ci/gal		
		Total thermal power	1.67E-01 w/gal		

[a]Source: DPSP-80-1033, Rev. 91. Values shown are based on supernate aged 15 years.

Table 3B.11. SRP. Radionuclide content of sludge-precipitate glass[a]

Isotope	Concentration (Ci/lb)	Isotope	Concentration (Ci/lb)	Isotope	Concentration (Ci/lb)
Cr-51	2.51E-20	Te-125m	7.44E-02	Eu-155	1.28E-01
Co-60	4.58E-02	Te-127	3.24E-05	Eu-156	1.41E-35
Ni-59	6.46E-06	Te-127m	3.31E-05	Tb-160	3.02E-10
Ni-63	8.02E-04	Te-129	8.23E-16	Ti-208	3.04E-07
Se-79	4.58E-05	Te-129m	1.28E-15	U-232	3.61E-06
Rb-87	2.35E-10	Cs-134	9.09E-02	U-233	4.27E-10
Sr-89	1.15E-08	Cs-135	2.68E-05	U-234	9.24E-06
Sr-90	1.26E+01	Cs-136	2.11E-43	U-235	4.24E-08
Y-90	1.29E+01	Cs-137	1.17E+01	U-236	3.04E-07
Y-91	2.04E-07	Ba-136m	2.32E-42	U-238	2.83E-06
Zr-93	3.01E-04	Ba-137m	1.12E+01	Np-236	4.70E-12
Zr-95	2.71E-06	Ba-140	2.76E-40	Np-237	2.40E-06
Nb-94	2.60E-08	La-140	1.16E-40	Pu-236	3.29E-05
Nb-95	5.70E-06	Ce-141	9.68E-15	Pu-237	2.41E-15
Nb-95m	3.36E-08	Ce-142	2.59E-09	Pu-238	4.00E-01
Tc-99	8.30E-04	Ce-144	2.66E+00	Pu-239	3.48E-03
Ru-103	4.54E-12	Pr-143	3.23E-38	Pu-240	2.34E-03
Ru-106	6.07E-01	Pr-144	2.66E+00	Pu-241	4.50E-01
Rh-103m	4.41E-12	Pr-144m	3.20E-02	Pu-242	3.30E-06
Rh-106	6.09E-01	Nd-144	1.31E-13	Am-241	2.97E-03
Pd-107	3.97E-06	Nd-147	3.40E-48	Am-242	3.87E-06
Ag-110m	3.39E-05	Pm-147	6.52E+00	Am-242m	3.90E-06
Cd-113	1.35E-17	Pm-148	1.88E-14	Am-243	1.56E-06
Cd-115m	3.27E-13	Pm-148m	2.72E-13	Cm-242	9.42E-06
Sn-121m	2.13E-05	Sm-147	5.39E-10	Cm-243	1.50E-06
Sn-123	6.87E-05	Sm-148	1.56E-15	Cm-244	2.90E-02
Sn-126	1.19E-04	Sm-149	4.80E-16	Cm-245	1.81E-09
Sb-124	1.92E-11	Sm-151	6.68E-02	Cm-246	1.44E-10
Sb-125	2.29E-01	Eu-152	9.94E-04	Cm-247	1.78E-16
Sb-126	1.66E-05	Eu-154	1.67E-01	Cm-248	1.85E-16
Sb-126m	1.19E-04				

Total activity	6.31E+01 ci/lb
Decay heat	
Total primary	1.42E-01 watts/lb
Total gammas	4.45E-02 watts/lb
Total	1.87E-01 watts/lb

[a]Source: DPSP 80-1033, Rev. 91. Data shown represent the estimated maximum activity per canister, not the average, and are based on sludge aged 5 years and supernate aged 15 years.

Table 3B.12. Hanford Operations. Historical and projected volumes of single-shell tank waste, double-shell tank waste, and borosilicate glass[a]

End of calendar year	Single-shell tanks cumulative volume, m^3			Double-shell tanks	Borosilicate glass	
	Liquid	Sludge	Salt cake	Cumulative volume, m^3	Number of canisters	Cumulative volume, m^3
1982	3.3E+04	4.7E+04	9.7E+04	3.6E+04	0	0
1983	3.0E+04	4.7E+04	9.4E+04	5.9E+04	0	0
1984	2.9E+04	4.6E+04	9.3E+04	5.7E+04	0	0
1985	2.8E+04	4.6E+04	9.3E+04	5.5E+04	0	0
1986	2.8E+04	4.6E+04	9.3E+04	6.5E+04	0	0
1987	2.7E+04	4.6E+04	9.3E+04	6.3E+04	0	0
1988	2.7E+04	4.6E+04	9.3E+04	5.4E+04	0	0
1989	2.7E+04	4.6E+04	9.3E+04	5.7E+04	0	0
1990	2.6E+04	4.6E+04	9.3E+04	5.7E+04	0	0
1991	2.4E+04	4.6E+04	9.3E+04	5.7E+04	0	0
1992	2.3E+04	4.6E+04	9.3E+04	5.7E+04	0	0
1993	1.8E+04	4.6E+04	9.3E+04	5.9E+04	0	0
1994	1.1E+04	4.6E+04	9.3E+04	6.4E+04	0	0
1995	7.4E+03	4.6E+04	9.3E+04	6.0E+04	0	0
1996	7.2E+03	4.6E+04	9.3E+04	5.3E+04	145	90
1997	7.2E+03	4.6E+04	9.3E+04	4.3E+04	290	181
1998	7.2E+03	4.6E+04	9.3E+04	3.1E+04	435	271
1999	7.2E+03	4.6E+04	9.3E+04	2.8E+04	508	316
2000	7.2E+03	4.6E+04	9.3E+04	2.5E+04	653	407
2001	7.2E+03	4.6E+04	9.3E+04	2.4E+04	798	497
2002	7.2E+03	4.6E+04	9.3E+04	1.7E+04	870	542
2003	7.2E+03	4.6E+04	9.3E+04	1.3E+04	1,015	632
2004	7.2E+03	4.6E+04	9.3E+04	9.4E+03	1,160	722
2005	7.2E+03	4.6E+04	9.3E+04	2.3E+03	1,305	812
2006	7.2E+03	4.6E+04	9.3E+04	2.8E+03	1,378	858
2007	7.2E+03	4.6E+04	9.3E+04	3.4E+03	1,523	948
2008	7.2E+03	4.6E+04	9.3E+04	3.9E+03	1,668	1,038
2009	7.2E+03	4.6E+04	9.3E+04	4.5E+03	1,740	1,083
2010	7.2E+03	4.6E+04	9.3E+04	5.1E+03	1,860	1,158
2011	7.2E+03	4.6E+04	9.3E+04	5.6E+03	1,860	1,158
2012	7.2E+03	4.6E+04	9.3E+04	6.2E+03	1,860	1,158
2013	7.2E+03	4.6E+04	9.3E+04	2.9E+03	1,860	1,158
2014	7.2E+03	4.6E+04	9.3E+04	3.5E+03	1,860	1,158
2015	7.2E+03	4.6E+04	9.3E+04	4.0E+03	1,860	1,158
2016	7.2E+03	4.6E+04	9.3E+04	5.2E+01	1,860	1,158
2017	7.2E+03	4.6E+04	9.3E+04	5.2E+01	1,860	1,158
2018	7.2E+03	4.6E+04	9.3E+04	5.2E+01	1,860	1,158
2019	7.2E+03	4.6E+04	9.3E+04	5.2E+01	1,860	1,158
2020	7.2E+03	4.6E+04	9.3E+04	5.2E+01	1,860	1,158

[a]Source: Coony 1987. Volumes shown are total cumulative volumes at end of year. It was assumed that there is no fuel reprocessing after CY 2001. Each additional year of fuel reprocessing after CY 2001 was estimated to generate an equivalent of 50 canisters per year and an equivalent of 35 m^3 of borosilicate glass per year after CY 2010. The amount of residual volume remaining in double-shell tanks after CY 2015 was assumed to be 0.05% of the tank capacity.

Table 3B.13. Hanford Operations. Cumulative historical and projected radioactivity of single-shell tank wastes, double-shell tanks wastes, and borosilicate glass[a]

End of calendar year	Single-shell tanks Liquid (Ci)	Sludge (Ci)	Salt cake (Ci)	Double-shell tanks (Ci)	Borosilicate glass (Ci)
1982	3.4E+07	1.4E+08	1.5E+07	2.3E+05	0
1983	2.9E+07	1.4E+08	1.4E+07	3.8E+06	0
1984	2.8E+07	1.3E+08	1.4E+07	1.4E+08	0
1985	2.6E+07	1.3E+08	1.4E+07	1.7E+08	0
1986	2.6E+07	1.3E+08	1.3E+07	1.8E+08	0
1987	2.4E+07	1.2E+08	1.3E+07	1.6E+08	0
1988	2.3E+07	1.2E+08	1.3E+07	1.8E+08	0
1989	2.3E+07	1.2E+08	1.2E+07	2.0E+08	0
1990	2.1E+07	1.2E+08	1.2E+07	2.1E+08	0
1991	1.9E+07	1.1E+08	1.2E+07	2.2E+08	0
1992	1.8E+07	1.1E+08	1.2E+07	2.4E+08	0
1993	1.4E+07	1.1E+08	1.1E+07	2.6E+08	0
1994	8.6E+06	1.1E+08	1.1E+07	2.8E+08	0
1995	5.5E+06	1.0E+08	1.1E+07	2.8E+08	0
1996	5.2E+06	1.0E+08	1.0E+07	2.4E+08	4.7E+07
1997	5.1E+06	9.8E+07	1.0E+07	1.7E+08	7.6E+07
1998	5.0E+06	9.6E+07	1.0E+07	1.3E+08	1.0E+08
1999	4.8E+06	9.3E+07	9.8E+06	1.0E+08	1.1E+08
2000	4.7E+06	9.1E+07	9.5E+06	6.4E+07	1.3E+08
2001	4.6E+06	8.9E+07	9.3E+06	3.2E+07	1.6E+08
2002	4.5E+06	8.7E+07	9.1E+06	1.2E+07	1.7E+08
2003	4.4E+06	8.5E+07	8.9E+06	2.5E+05	1.7E+08
2004	4.3E+06	8.3E+07	8.7E+06	2.1E+05	1.7E+08
2005	4.2E+06	8.1E+07	8.5E+06	1.7E+05	1.6E+08
2006	4.1E+06	7.9E+07	8.3E+06	1.5E+05	1.6E+08
2007	4.0E+06	7.7E+07	8.1E+06	1.1E+05	1.5E+08
2008	3.9E+06	7.5E+07	7.9E+06	9.8E+04	1.5E+08
2009	3.8E+06	7.3E+07	7.7E+06	9.0E+04	1.4E+08
2010	3.8E+06	7.2E+07	7.5E+06	7.3E+04	1.4E+08
2011	3.7E+06	7.0E+07	7.4E+06	7.1E+04	1.4E+08
2012	3.6E+06	6.8E+07	7.2E+06	7.0E+04	1.3E+08
2013	3.5E+06	6.7E+07	7.0E+06	6.8E+04	1.3E+08
2014	3.4E+06	6.5E+07	6.9E+06	6.6E+04	1.3E+08
2015	3.3E+06	6.4E+07	6.7E+06	6.5E+04	1.3E+08
2016	3.3E+06	6.2E+07	6.6E+06	6.3E+04	1.2E+08
2017	3.2E+06	6.1E+07	6.4E+06	6.2E+04	1.2E+08
2018	3.1E+06	5.9E+07	6.3E+06	6.0E+04	1.2E+08
2019	3.1E+06	5.8E+07	6.1E+06	5.9E+04	1.1E+08
2020	3.0E+06	5.6E+07	6.0E+06	5.8E+04	1.1E+08

[a]Source: Coony 1987. No fuel reprocessing operations are assumed after CY 2001; however, some planning scenarios have been identified at Hanford that will extend reprocessing beyond CY 2001. Each additional year of fuel reprocessing generates an equivalent of 50 canisters per year and an equivalent borosilicate glass activity of 7.3E+6 curies per year after CY 2010. The amount of residual activity remaining in double-shell tanks is assumed to be 0.05% of the original activity.

Table 3B.14. Hanford Operations. Representative chemical compositions of tank wastes[a]

Component	Single-shell tanks			Double-shell tanks
	Liquid	Sludge	Salt cake	
$NaNO_3$	20.8	25.3	81.5	14.8
$NaNO_2$	15.8	3.8	1.7	5.6
Na_2CO_3	0.6	2.2	0.5	1.9
NaOH	6.2	5.3	1.5	7.0
$NaAlO_2$	12.5	1.2	1.4	6.0
NaF	--	--	--	0.4
Na_2SO_4	--	1.0	1.3	0.3
Na_3PO_4	2.3	15.8	1.6	0.8
KF	--	--	--	0.4
FeO(OH)	--	1.3	--	0.2
Organic carbon	0.17	--	--	1.2
NH_4^+	--	--	--	0.08
$Al(OH)_3$	--	2.9	--	4.9
$SrO \cdot H_2O$	--	0.1	--	--
Na_2CrO_4	1.3	--	--	--
$Cr(OH)_3$	--	0.2	--	0.02
$Cd(OH)_2$	--	0.1	--	--
$Ni(OH)_2$	--	--	--	<0.1
$BiPO_4$	--	0.5	--	--
Cl^-	--	0.1	--	--
$Ni_2Fe(CN)_6$	--	0.6	--	--
$P_2O_5 \cdot 24WO_2 \cdot 44H_2O$	--	<0.1	--	--
$ZrO_2 \cdot 2H_2O$	--	0.5	--	0.2
Fission products	--	--	--	<0.01
H_2O	38.8	33.6	10.5	56.2
Other	<0.1	5.5	--	<0.01
Hg^+	--	0.12 ppm	--	--
	100	100	100	100
Density, g/mL	1.6	1.7	1.4	~1.3

[a]Source: Coony 1987. Unless stated otherwise, all values are weight percent.

Table 3B.15. Estimated radionuclide content of HANF tank wastes at the end of CY 1995 (curies)[a]

	Slurry (double shell tanks)	Single shell tanks		
		Liquid	Sludge	Salt Cake
		1. Fission Products		
C-14	6.6E+02	5.6E+02		2.5E+03
Se-79	2.2E+02			
Sr-89	1.1E+05			
Sr-90	3.6E+07	1.1E+05	4.74E+07	2.0E+06
Y-91	3.6E+05			
Zr-93	1.0E+03		9.70E+03	
Zr-95	7.0E+05			
Tc-99	2.0E+04	5.3E+03		
Ru-103	1.3E+04			
Ru-106	8.4E+06		1.25E+00	
Pd-107	3.0E+01			
Ag-110m	2.8E+01			
Cd-113m	1.2E+04			
Cd-115m	4.9E+01			
Sn-119m	4.5E+03			
Sn-121m	6.6E+01			
Sn-123	1.9E+04			
Te-123m	9.9E-12			
Sb-124	1.4E+01			
Sb-125	1.3E+06			
Sn-126	3.5E+02			
Te-127m	3.9E+04			
Te-129m	8.5E+01			
I-129	9.0E-01			
Cs-134	8.7E+05			
Cs-135	2.0E+02			
Cs-137	4.6E+07	2.7E+06	3.37E+06	3.4E+06
Ce-141	2.6E+03			
Pr-143	2.6E-04			
Ce-144	3.3E+07			
Pm-147	2.9E+07			
Pm-148m	1.6E+02			
Sm-151	7.2E+05		8.14E+05	
Eu-152	2.1E+03			
Gd-153	1.6E+01			
Eu-154	2.7E+05			
Eu-155	3.4E+05			
Tb-160	1.2E+01			
Y-90	3.6E+07	1.1E+05	4.74E+07	2.0E+06
Nb-93m	3.9E+02		8.41E+03	
Nb-95	1.5E+06			
Rh-103m	1.3E+04			
Rh-106	8.4E+06		1.25E+00	
Ag-110	3.8E-01			
Te-125m	3.2E+05			
Sb-126	5.0E+01			
Sb-126m	3.5E+02			
Te-127	3.8E+04			
Te-129	5.4E+01			
Ba-137m	4.3E+07	2.6E+06	3.19E+06	3.2E+06
Pr-144	3.3E+07			
Pr-144m	4.8E+05			
Pm-148	7.9E+00			
Total FP	2.8E+08	5.5E+06	1.02E+08	1.1E+07

Table 3B.15 (continued)

	Slurry (double shell tanks)	Single shell tanks		
		Liquid	Sludge	Salt Cake
		2. Activation Products		
C-14	8.4E+01			
Fe-55	7.3E+03			
Ni-59	1.0E+01			
Co-60	2.1E+04		2.20E+03	
Ni-63	2.0E+03		3.02E+05	
Zr-93	3.0E+01			
Sn-113	1.2E+03			
Sn-119m	5.3E+04			
Sn-121m	1.1E+02			
Sb-125	6.3E+04			
Nb-93m	1.1E+01			
In-113m	1.2E+03			
Te-125m	1.5E+04			
Total activation products	1.6E+05	0	3.04E+05	0
		3. Actinides		
U-234	8.7E-03			
U-235	1.5E-01			
U-236	3.7E-01			
U-238	2.8E+00			
Np-237	1.4E+02			
Pu-238	8.8E+03			
Pu-239	8.8E+03		2.20E+04	
Pu-240	2.6E+03		5.29E+03	
Pu-241	1.0E+03		4.54E+04	
Pu-242	3.1E+05			
Am-241	2.6E-01	2.2E+02	4.41E+04	
Am-242m	2.5E+05			
Am-243	1.7E+02			
Cm-242	4.6E+02			
Cm-244	6.6E+02		1.40E+02	
Total actinides	2.8E+05	2.2E+02	1.17E+05	0
Total	2.8E+08	5.5E+06	1.03E+08	1.1E+07

[a]Source: Coony 1987. Slurry represents total contents of double-shell tanks. Liquid, sludge, and salt cake represent total contents of single-shell tanks. Liquid includes both supernatant and interstitial liquids. Zeros do not rule out the possibility of the presence of trace quantities. Activities are estimated as of 12/31/95, assuming no vitrification has taken place and only Area 100 low-level waste has been converted to grout. See text for other assumptions.

Table 3B.16. Hanford Operations. Radioisotope content per HLW canister[a]

Isotope[b]	Curies/canister	Grams/canister
C-14	0.9600E+01	0.2154E-01
Se-79	0.5260E+00	0.7553E+01
Sr-89	0.1150E-01	0.3961E-06
Sr-90	0.7310E+05	0.5265E+03
Y-91	0.1280E+00	0.5218E-05
Zr-93	0.2470E+01	0.9828E+03
Zr-95	0.4910E+00	0.2285E-04
Tc-99	0.1760E+02	0.2046E+05
Ru-103	0.1040E-03	0.3221E-08
Ru-106	0.5960E+04	0.1781E+01
Pd-107	0.6960E-01	0.1354E+03
Ag-110M	0.8430E-02	0.1774E-05
Cd-113M	0.2240E+02	0.9697E-01
Cd-115M	0.1570E-05	0.6164E-10
Sn-119M	0.2660E+02	0.7101E-02
Sn-121M	0.2770E+00	0.4685E-02
Sn-123	0.6100E+00	0.7422E-04
Sb-124	0.6330E-05	0.3618E-09
Sb-125	0.2460E+04	0.2382E+01
Sn-126	0.8290E+00	0.2921E+02
Te-127M	0.5850E+00	0.6200E-04
Te-129M	0.9810E-07	0.3256E-11
I-129	0.2140E-02	0.1212E+02
Cs-134	0.1360E+04	0.1051E+01
Cs-135	0.4650E+00	0.4038E+03
Cs-137	0.8730E+05	0.1009E+04
Ce-141	0.1880E-05	0.6598E-10
Pr-143	0.6440E-21	0.9575E-26
Ce-144	0.1370E+05	0.4294E+01
Pm-147	0.5270E+05	0.5682E+02
Pm-148M	0.2280E-05	0.1067E-09
Sm-151	0.1550E+04	0.5891E+02
Eu-152	0.3560E+01	0.2058E-01
Gd-153	0.4400E-02	0.1247E-05
Eu-154	0.4190E+03	0.1588E+01
Eu-155	0.6610E+03	0.1421E+01
Tb-160	0.2010E-04	0.1780E-08
Y-90	0.7310E+05	0.1344E+00
Nb-93M	0.1230E+01	0.4670E-02
Nb-95	0.1080E+01	0.2757E-04
Rh-103M	0.1040E-03	0.3190E-11
Rh-106	0.5960E+04	0.1674E-05
Ag-110	0.1120E-03	0.2664E-13
Te-125M	0.6020E+03	0.3342E-01
Sb-126	0.1160E+00	0.1386E-05

Table 3B.16 (continued)

Isotope	Curies/canister	Grams/canister
Sb-126M	0.8290E+00	0.1055E-07
Te-127	0.5760E+00	0.2189E-06
Te-129	0.6170E-07	0.2893E-14
Ba-137M	0.8250E+05	0.1532E-03
Pr-144	0.1370E+05	0.1812E-03
Pr-144M	0.1960E+03	0.1080E-05
Fe-55	0.1260E+02	0.5039E-02
Ni-59	0.1030E-01	0.1360E+00
Co-60	0.3580E+02	0.3166E-01
Ni-63	0.2380E+01	0.4197E-01
Sn-113	0.2870E-01	0.2858E-05
In-113M	0.2870E-01	0.1723E-08
U-234	0.1750E-04	0.2863E-02
U-235	0.3250E-03	0.1504E+03
U-236	0.8190E-03	0.1265E+02
U-238	0.5880E-02	0.1726E+05
Np-237	0.3120E+00	0.4425E+03
Pu-238	0.4110E+00	0.2400E-01
Pu-239	0.3600E+01	0.5799E+02
Pu-240	0.1180E+01	0.5202E+01
Pu-241	0.3740E+02	0.3630E+00
Pu-242	0.6500E-04	0.1654E-01
Am-241	0.1030E+04	0.3000E+03
Am-242M	0.5960E+00	0.6131E-01
Am-243	0.4440E+00	0.2227E+01
Cm-242	0.1230E+02	0.3715E-02
Cm-244	0.9700E+00	0.1198E-01
Total	0.4165E+06	0.4193E+05

[a]Source: J. D. White, July 1986. Same composition also given in Coony 1987. Quantities are based on 1650 kg of HLW glass per canister.

[b]Isotopes are listed in the order in which they were presented in the source document; i.e. fission products, daughters, activation products, and actinides.

Table 3B.17. INEL. Historical and projected volumes of interim and immobilized high-level wastes[a]

Calendar year end	Liquid $10^3 m^3$	Calcine 10^3 m^3	Glass-ceramic 10^3 m^3	Glass-ceramic Cumulative number of canisters	Total 10^3 m^3
1986	6.5	3.0	0.0	0	9.5
1987	7.6	3.1	0.0	0	10.7
1988	7.5	3.4	0.0	0	10.9
1989	7.8	3.7	0.0	0	11.5
1990	6.8	4.0	0.0	0	10.8
1991	6.6	4.2	0.0	0	10.8
1992	6.2	4.5	0.0	0	10.7
1993	5.6	4.9	0.0	0	10.5
1994	6.1	4.9	0.0	0	11.0
1995	5.2	5.2	0.0	0	10.4
1996	5.8	5.3	0.0	0	11.1
1997	6.3	5.8	0.0	0	12.1
1998	7.1	6.3	0.0	0	13.4
1999	7.9	6.8	0.0	0	14.7
2000	8.6	7.4	0.0	0	16.0
2001	8.8	7.9	0.0	0	16.7
2002	9.2	8.4	0.0	0	17.6
2003	9.6	8.9	0.0	0	18.5
2004	8.3	9.4	0.0	0	17.7
2005	6.1	9.9	0.0	0	16.0
2006	7.4	9.9	0.0	0	17.3
2007	8.5	9.9	0.0	0	18.4
2008	4.7	10.5	0.0	0	15.2
2009	4.4	11.2	0.0	0	15.6
2010	4.5	11.9	0.0	0	16.4
2011	3.9	12.15	0.28	500	16.33
2012	3.1	12.30	0.63	1100	16.03
2013	2.7	12.36	1.03	1800	16.09
2014	3.0	12.05	1.60	2800	16.65
2015	3.3	11.74	2.17	3800	17.21
2016	3.7	11.53	2.74	4800	17.97
2017	3.1	11.32	3.31	5800	17.73
2018	1.3	10.70	3.88	6800	15.88
2019	1.6	10.49	4.45	7800	16.54
2020	1.7	10.28	5.02	8800	17.00

[a]Source: Berreth 1987. Quantities shown are based on the assumptions that immobilization starts in year 2011 and that the glass-ceramic form is used. Each canister is assumed to contain 0.57 m^3 of ceramic (1825 kg), with a calcine loading of 70 wt% of 1277 kg; this is the equivalent of 0.91 m^3 of calcine prior to immobilization. The reader is cautioned that these projections are based on estimates and assumptions that are subject to change.

Table 3B.18. INEL. Historical and projected radioactivity and thermal power of interim and immobilized high-level wastes[a]

Calendar year end	Liquid		Calcine		Glass-ceramic		Total	
	10^6 Ci	kW	10^6 Ci	kW	10^6 Ci	kW	10^6 Ci	kW
1986	12.9	38.5	47.7	137.4	0.0	0.0	60.6	175.9
1987	10.6	31.0	52.3	151.1	0.0	0.0	62.9	182.1
1988	17.7	52.4	54.2	156.7	0.0	0.0	71.9	209.1
1989	26.0	79.4	57.4	165.9	0.0	0.0	83.4	245.3
1990	15.5	46.3	62.6	181.2	0.0	0.0	78.1	227.5
1991	9.2	27.0	75.0	217.6	0.0	0.0	84.2	244.6
1992	16.5	50.1	77.3	224.4	0.0	0.0	93.8	274.5
1993	10.5	30.9	89.3	268.0	0.0	0.0	99.8	298.9
1994	11.1	32.5	85.0	246.9	0.0	0.0	96.1	279.4
1995	3.6	11.6	90.0	262.0	0.0	0.0	93.6	273.6
1996	13.3	42.5	98.1	285.5	0.0	0.0	111.4	328.0
1997	18.0	54.0	107.8	313.3	0.0	0.0	125.8	367.3
1998	27.2	81.5	121.4	353.4	0.0	0.0	148.6	434.9
1999	28.4	83.9	133.0	387.0	0.0	0.0	161.4	470.9
2000	47.3	144.7	139.0	403.9	0.0	0.0	186.3	548.6
2001	55.1	164.4	146.9	426.5	0.0	0.0	202.0	590.9
2002	63.2	189.5	158.7	460.9	0.0	0.0	221.9	650.4
2003	73.1	225.7	172.5	501.4	0.0	0.0	245.6	727.1
2004	64.9	200.0	183.1	532.1	0.0	0.0	248.0	732.1
2005	52.5	160.6	189.9	552.1	0.0	0.0	242.4	712.7
2006	57.7	176.3	184.0	535.0	0.0	0.0	241.7	711.3
2007	54.1	163.7	185.0	538.2	0.0	0.0	239.1	701.9
2008	39.8	122.2	199.2	579.9	0.0	0.0	239.0	702.1
2009	55.2	177.4	217.3	634.6	0.0	0.0	272.5	812.0
2010	58.9	189.6	242.9	715.5	0.0	0.0	301.8	905.1
2011	53.3	172.2	248.0	736.6	20.0	56.0	321.3	964.8
2012	46.7	151.9	244.2	728.6	44.0	124.0	334.9	1004.5
2013	41.5	133.6	242.1	724.2	70.0	202.0	353.6	1059.8
2014	45.0	145.4	226.2	676.9	107.0	313.0	378.2	1135.3
2015	47.0	151.6	208.2	621.2	143.0	421.0	398.2	1193.8
2016	46.6	149.5	190.0	560.7	177.0	526.0	413.6	1236.2
2017	26.9	82.9	174.4	514.2	210.0	624.0	411.3	1221.1
2018	18.1	53.6	134.8	383.1	242.0	726.0	394.9	1162.7
2019	20.4	60.7	121.5	340.5	272.0	819.0	413.9	1220.2
2020	22.7	68.1	108.9	300.4	301.0	908.0	432.6	1276.5

[a]Source: Berreth 1987 and ORNL calculations based on the assumption that two-thirds of the glass-ceramic produced each year is made from fresh calcine (average age 5 to 8 years) and the other third is made from old calcine. Each canister is assumed to contain 0.57 m^3 of ceramic (1825 kg), with a calcine loading of 70 wt% or 1277 kg; this is the equivalent of 0.91 m^3 of calcine prior to immobilization. The reader is cautioned that the assumptions and estimates used here are subject to change.

Table 3B.19. INEL. Representative chemical compositions of interim high-level wastes[a]

A. Chemical composition of HLW liquid, wt %

Component	Zirconium fluoride	Sodium bearing	Nonfluoride	Fluorinel
Al	1.3	0.8-1.6	1.51	0.742
B	0.15	0.005-0.01	0.003	0.241
Ca	-	0.03-0.2	0.27	-
Cl^-	-	0.06-0.1	0.023	-
Cd	-	-	-	1.42
Cr	-	-	0.036	0.0087
F^-	3.4	0.005-0.06	0.032	5.99
Fe	0.04	0.05-0.09	0.19	0.023
H^+	1.12	0.03-0.15	0.12	0.18
K	-	0.5-0.7	0.33	-
Mg	-	-	0.062	-
Mn	-	-	0.048	0.0004
Na	0.12	2.1-4.0	1.31	-
Ni	-	-	0.016	0.0049
NO_3^-	13.7	19.4-23.3	23.1	11.47
SO_4^{2-}	-	0.33-0.5	0.65	1.52
Zr	2.47	-	-	3.80
H_2O	78.7	76.6-69.2	72.3	74.6
Total	100.0	100.0	100.0	100.0
Density, g/mL	1.2	1.2-1.3	2	1.2

Table 3B.19. (continued)

B. Chemical composition of HLW calcine, wt %

Component	Alumina	Zirconium fluoride	Zirconium-sodium blend	Stainless steel sulfate	Fluorinel-sodium blend
Al_2O_3	82-95	13-17	10-16	4.4	6.5-7.5
$Al_2(SO_4)_3$	-	-	-	81	-
B_2O_3	0.5-2	3-4	2-3	-	3.0-3.2
CaO	-	2-4	13-17	-	3.3-3.6
CaF_2	-	50-56	33-39	-	46-49
Cd	-	-	-	-	6.0-6.5
Cr_2O_3	-	-	-	2.0	0.05
Fe_2O_3	-	-	-	7.0	0.2-0.3
Na_2O	1.3	-	6-8	-	1.5-4
NiO	-	-	-	0.9	0.02-0.03
NO_3^-	5-9	0.5-2	7-9.5	-	10-15
SO_4^{2-}	-	-	-	-	-
ZrO_2	-	21-27	16-19	-	19-20
Miscellaneous	0.5-1.5	0.5-1.5	0.5-1.5	4.4	-
Fission products and actinides	0.2-1	0.2-1	0.2-1	0.2-1	<0.1%
Density, g/mL	1.1	1.4	1.8	1.2	1.4

[a]Source: ORNL 1986.

Table 3B.20. INEL.
Radionuclide concentrations in 3-year-cooled calcined wastes[a,b]

Nuclide	Activity (Ci/kg)	Nuclide	Activity (Ci/kg)	Nuclide	Activity (Ci/kg)
Se-79	6.4×10^{-5}	Rb-87	3.6×10^{-9}	Sr-90	1.3×10^{1}
Y-90	1.3×10^{1}	Zr-93	3.1×10^{-4}	Nb-93m	7.5×10^{-5}
Tc-99	2.1×10^{-3}	Ru-106	9.7×10^{-1}	Rh-106	9.7×10^{-1}
Pd-107	2.0×10^{-6}	Sn-126	3.2×10^{-5}	Sb-126m	3.2×10^{-5}
Sb-126	3.2×10^{-5}	Cs-134	3.3	Cs-135	7.5×10^{-5}
Cs-137	1.3×10^{1}	Ba-137m	1.2×10^{1}	Ce-144	8.2
Pr-144m	0	Pr-144	8.2	Nd-144	0
Pm-147	1.2×10^{1}	Sm-147	0	Sm-151	1.7×10^{-1}
Eu-154	1.8×10^{-1}	Tl-207	0	Tl-208	0
Tl-209	0	Tl-210	0	Pb-209	0
Pb-210	0	Pb-211	0	Pb-212	0
Pb-214	0	Bi-210	0	Bi-211	0
Bi-212	0	Bi-213	0	Bi-214	0
Bi-215	0	Po-210	0	Po-211	0
Po-212	0	Po-213	0	Po-214	0
Po-215	0	Po-216	0	Po-218	0
At-217	0	At-218	0	At-219	0
Rn-217	0	Rn-218	0	Rn-219	0
Rn-220	0	Rn-222	0	Fr-221	0
Fr-223	0	Ra-223	0	Ra-224	0
Ra-225	0	Ra-226	0	Ra-228	0
Ac-225	0	Ac-227	0	Ac-228	0
Th-227	0	Th-228	0	Th-229	0
Th-230	0	Th-231	0	Th-232	0
Th-234	0	Pa-231	0	Pa-233	0
Pa-234m	0	Pa-234	0	U-233	1.2×10^{-12}
U-234	4.3×10^{-10}	U-235	1.8×10^{-9}	U-236	1.0×10^{-8}
U-237	4.8×10^{-12}	U-238	1.0×10^{-14}	Np-237	4.8×10^{-8}
Np-239	0	Pu-238	7.0×10^{-2}	Pu-239	7.0×10^{-4}
Pu-240	6.5×10^{-4}	Pu-241	1.6×10^{-1}	Pu-242	1.8×10^{-6}
Am-241	9.1×10^{-4}	Am-243	8.3×10^{-6}	Cm-242	6.5×10^{-4}
Cm-244	5.2×10^{-4}				

[a]Source: IDO-10105, September 1982 (Table A-2).

[b]The isotopes shown to have initial concentrations of zero are those which have been removed during fuel production processes. Over long periods of time, the parent uranium present in the waste again produces these daughter products.

Table 3B.21. Idaho National Engineering Laboratory. Radioisotope content per HLW Canister.[a]

	Isotope	Curies/canister	Grams/canister
1	SE-79	0.8173E-01	0.1173E+01
2	RB-87	0.4597E-05	0.5252E+02
3	SR-90	0.1660E+05	0.1217E+03
4	Y-90	0.1660E+05	0.3051E-01
5	ZR-93	0.3959E+00	0.1575E+03
6	NB-93M	0.9577E-01	0.3387E-03
7	TC-99	0.2682E+01	0.1582E+03
8	RU-106	0.1239E+04	0.3701E+00
9	RH-106	0.1239E+04	0.3479E-06
10	PD-107	0.2554E-02	0.4965E+01
11	SN-126	0.4086E-01	0.1440E+01
12	SB-126M	0.4086E-01	0.5201E-09
13	SB-126	0.4086E-01	0.4887E-06
14	CS-134	0.4214E+04	0.3256E+01
15	CS-135	0.9577E-01	0.8316E+02
16	CS-137	0.1660E+05	0.1908E+03
17	BA-137M	0.1532E+05	0.2848E-04
18	CE-144	0.1047E+05	0.3282E+01
19	PR-144	0.1047E+05	0.1386E-03
20	PM-147	0.1532E+05	0.1653E+02
21	SM-151	0.2171E+03	0.8250E+01
22	EU-154	0.2299E+03	0.8513E+00
23	U-233	0.1532E-08	0.1583E-06
24	U-234	0.5491E-06	0.8785E-04
25	U-235	0.2299E-05	0.1063E+01
26	U-236	0.1277E-04	0.1973E+00
27	U-237	0.6130E-08	0.7507E-13
28	U-238	0.1277E-10	0.3797E-04
29	NP-237	0.6130E-04	0.8693E-01
30	PU-238	0.8939E+02	0.5221E+01
31	PU-239	0.8939E+00	0.1437E+02
32	PU-240	0.8300E+00	0.3642E+01
33	PU-241	0.2043E+03	0.1983E+01
34	PU-242	0.2299E-02	0.6018E+00
35	AM-241	0.1162E+01	0.3385E+00
36	AM-243	0.1060E-01	0.5315E-01
37	CM-242	0.8300E+00	0.2510E-03
38	CM-244	0.6640E+00	0.8201E-02
	Total	0.1088E+06	0.8315E+03

[a]Quantities are at time of filling canister and are based on 3-yr old calcine immobilized in glass-ceramic with a load of 1277 kg of calcine per canister (1825 kg of glass-ceramic per canister). Based on IDO-10105 (1982) and Berreth 1986c. This is estimated to represent the maximum activity per canister.

APPENDIX 3C

USER'S GUIDE TO THE HIGH-LEVEL WASTE PC DATA BASE

TABLE OF CONTENTS

1.0 INTRODUCTION

This User's Guide is for the High Level Waste (HLW) Database System of the Waste Characterization Data Base. The HLW Database describes the physical, chemical, and radiological properties of the Nation's high level radioactive waste inventories, both current and projected. Much of the information in this system comes directly from the main body of the Characteristics of Potential Repository Wastes Report, of which this User's Guide is an appendix. This system concentrates data from Chapter 3 and Appendix 3C, and expands on the ORIGEN2 generated data provided in the Report for the decay and photon emissions of immobilized forms of waste by adding additional decay times for each high level site.

1.1 SYSTEM CAPABILITIES

The HLW Database System is a user-friendly, interactive menu-driven computer program. It can provide screen, printer, and disk file output of all available on-line data. Its unique non-hierarchical design allows you to change your selections at any time without the need to recycle through a series of menus. Your current selections appear on the screen at all times, allowing easy review should you ever forget what information you had requested.

1.2 OPERATING ENVIRONMENT

The HLW Database System is written in dBASE III and distributed in compiled form, using Nantucket's Clipper compiler. You do not have to own a copy of Ashton-Tate's dBASE III to run the system. It will operate on any MS-DOS based personal computer (such as IBM PCs and compatibles) with at least 384kb of memory, and two flexible (floppy) disk drives or one floppy disk drive and one fixed disk. It is distributed on 5 1/4" DS/DD floppy disks, but the system can be transferred to a fixed disk drive for improved system performance and convenience. Three floppy disks are included in the system. They are labeled "HLW Programs Master", "HLW Data #1 Master", and "HLW Data #2 Master".

2.0 DESCRIPTION OF DATA AVAILABLE

The HLW Database System provides you with a variety of data on both the immobilized and interim types of High Level Waste for any site. Described in this section are the data available, and both a list of selection options and a flowchart of the HLW Database System's option sequence.

2.1 LIST OF AVAILABLE OPTIONS

There are three basic selections which must be made before any data can be retrieved. These are: site, waste type, and data requested.

The options for site are:

Site: West Valley Demonstration Project (WVDP)
Savannah River Plant (SRP)
Hanford (HANF)
Idaho National Engineering Laboratory (INEL)
Defense Sites (DEF)
All Sites (ALL)

In some cases, as will be shown later, particular requests may be applicable to only the individual sites and not to the multi-site (DEF and ALL) choices.

The options for the waste type are:

Waste Type: Immobilized
Interim

The options for data requested depend of which Waste Type was selected. For the immobilized waste, the types of data available are:

Data Available:
- Physical description of canisters and waste form
- Number of canisters produced vs. years
- Maximum radionuclide content per canister at fill time
- Maximum radioactivity and thermal power per canister vs. decay time
- Average radioactivity per canister by year of production
- Cumulative average radioactivity and thermal power per canister by year
- Chemical composition
- Radionuclide content (grams, total curies, alpha curies, watts) per canister vs. decay time
- Photon spectrum per canister vs. decay time
- Calculated integrated heat release per canister vs. decay time

For interim waste, the types of data available are:

Data Available:
- Volume of waste vs. years
- Radioactivity and thermal power vs. years
- Chemical composition
- Radionuclide composition in reference year

In addition to selecting an option from each of the categories above, you will be required to define your selections even more if either the Radionuclide content per canister vs. decay time, or Photon spectrum per canister vs. decay time options for the immobilized waste type are selected.

For the Radionuclide content per canister vs. decay time option, you must specify what isotopes are desired, which set of decay times are desired, and whether grams, curies, watts, or alpha curies are to be displayed.

For the Photon spectrum per canister vs. decay time option, you must specify whether actinides and daughters, fission products, or total photons are desired, and which set of decay times are to be displayed.

You can choose the output destination of the data: screen, printer, or disk file. This is option D on the system menu. A useful method of system operation is to leave the output directed to the screen (its initial setting) until you have found the data you were looking for, and then switch the output destination to the printer to generate hard-copy.

You may find it useful to direct the data to a disk file if you want to use the data file as input to another program or document. If you choose to send data to a disk file, you will be prompted for the name of the file to which the data will be written. If the file already exists, the system will ask if you want to append data to the existing file, or overwrite the old file with the new data.

2.2 TABLES AVAILABLE FROM THE CHARACTERIZATION REPORT

The HLW Database System contains large data files for radionuclide content and photon spectrum per canister vs. decay time generated by the ORIGEN2 computer code. The system provides powerful extraction capabilities for selecting portions of this data in an adhoc manner. The combination of possible outputs are too numerous to include in hard copy. In addition, much data in the HLW Database System replicates information printed in the main body of the Characteristics of Potential Repository Wastes Report. Table 3C.1 below provides a cross reference between the table numbers in the Report and the questions for which these table are answers for in the HLW Database System.

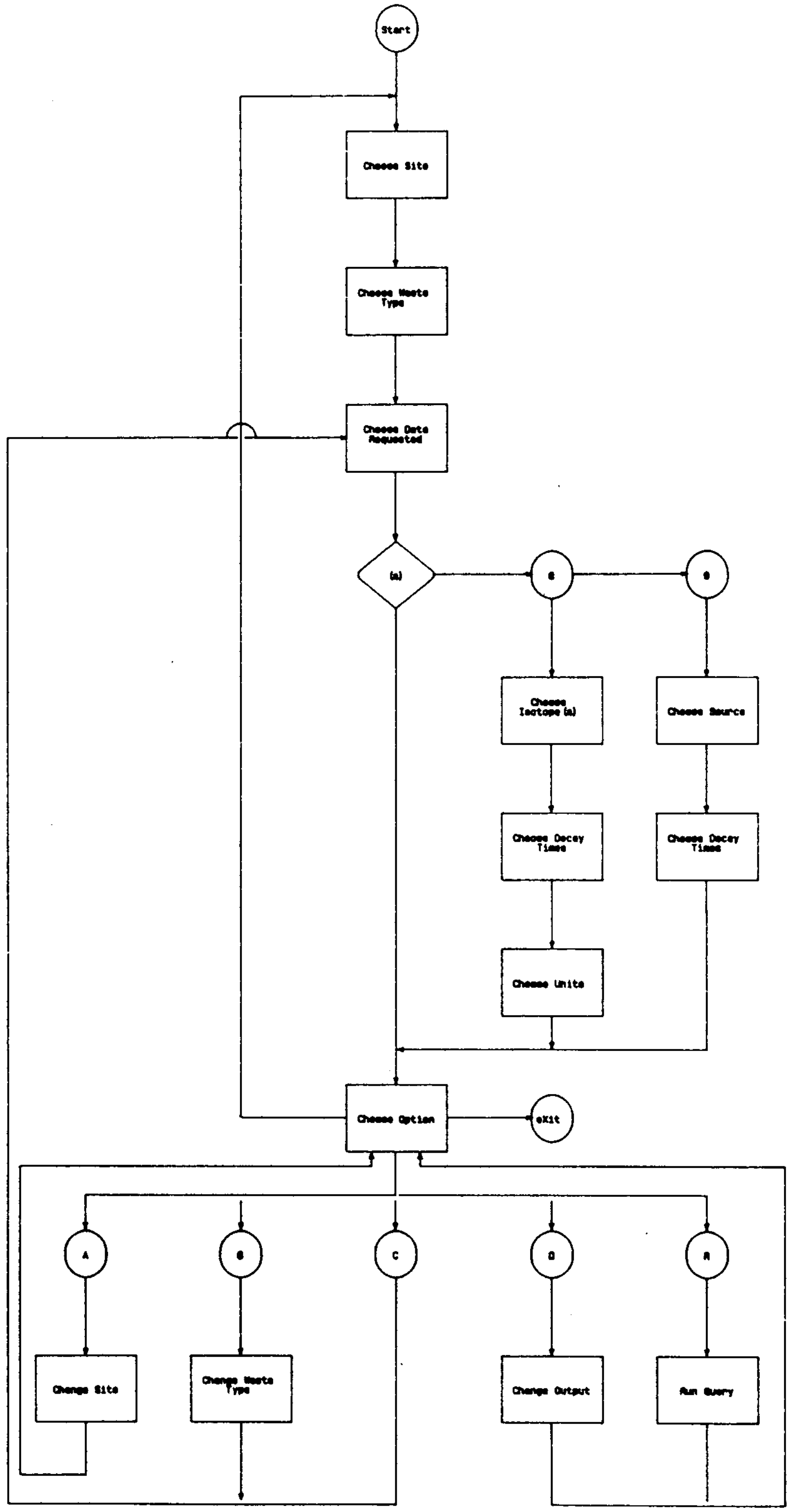
TABLE 3C.1. QUESTION AND TABLE CROSS REFERENCE

	WVDP	SRP	HANF	INEL
Immobilized Waste				
Physical descr. of canisters and waste form	3.2.1	3.3.1	3.4.1	3.5.1
Number of canisters produced vs. years	3.2.2	3.3.2	3.4.2	3.5.2
Maximum radionuclide content / canister at fill time	3.2.3	3.3.3	3.4.3	3.5.3
Maximum radioactivity and thermal power / canister vs. decay time	3.2.4	3.3.4	3.4.4	3.5.4
Average radioactivity / canister by year of of production	----	-----	3.4.5	----
Cumulative average radioactivity and thermal power / canister	----	3.3.5	3.4.6	3.5.5
Chemical composition	3.2.5	3.3.6	3.4.7	3.5.6
Radionuclide content (grams, curies, alpha curies, watts) / canister vs. decay time	(a)	(a)	(a)	(a)
Photon spectrum / canister vs. decay time	(a)	(a)	(a)	(a)
Calculated integrated heat release / canister vs. decay time	(b)	(b)	(b)	(b)
Interim Waste				
Volume of waste vs. years	3B.2	3B.7	3B.12	3B.17
Radioactivity and thermal power vs. years	3B.3	3B.8	3B.13	3B.18
Chemical composition	3B.4	3B.9	3B.14	3B.19
Radionuclide composition in reference year	3B.5	3B.10	3B.15	3B.20

(a) Data generated by ORIGEN2.
(b) Calculated from data generated by ORIGEN2.

2.3 PROGRAM SELECTION FLOWCHART

Figure 3C.1 on the next page is a diagram of all possible selections which you can make in the HLW Database System. As the diagram shows, after you first make your initial selections, you will come to the "Choose Option" box on the chart. From here, you can invoke the display of the desired results (option R), change any single selection criterion currently chosen (options A,B or C, and in certain situations, options E,F and G which are not shown), sequence back through all questions (option S), change whether the output is directed to the screen or printer (option D), or exit the program (option X). This provides a quick and easy mechanism for retrieving similar, but slightly different data from the database. All choices which you have previously made are displayed on the screen for your reference.



(a) If Waste Type is immobilized and Data Requested is either (6.) Radionuclide content per canister vs. decay time, or (9.) photon spectrum per canister vs. decay time, additional questions are asked.

Figure 3C.1 HLW Database System Options Flowchart

3.0 SAMPLES OF DATA AVAILABLE

This section contains some sample reports generated by the High Level Waste Database system. The reports included show some, but not all, of the data available. They are included here to give a brief look at the kinds of reports available. Each report is for a specific site. Similar reports can be obtained from the system for different sites. Also, two of the reports, Figures 3C.3 and 3C.4 contain data on specific isotopes, decay times, and units. These reports can be obtained for many different combinations of isotopes, decay times, and units.

The following reports are included:

Figure 3C.2 Number of canisters produced vs. years

Figure 3C.3 Radionuclide content per canister vs. decay time

Figure 3C.4 Photon spectrum per canister vs. decay time

Figure 3C.5 Volume of waste (interim forms) vs. years

Table 3.5.2 Idaho National Engineering Laboratory. Estimated production schedule of canisters of HLW glass-ceramic.[a]

Calendar year	Number of canisters produced during year	Cumulative number of canisters produced
2010	0	0
2011	500	500
2012	600	1,100
2013	700	1,800
2014	1,000	2,800
2015	1,000	3,800
2016	1,000	4,800
2017	1,000	5,800
2018	1,000	6,800
2019	1,000	7,800
2020	1,000	8,800

[a]This assumes that a glass-ceramic form (density 3.2 g/cm^3) is selected for HLW disposal and that each canister contains 1277 kg of calcine (1825 kg of glass-ceramic). Waste loading is 70 wt%, and inerts are not removed prior to immobilization. Canister production will continue after 2020 but is not shown. Source: Berreth 1987.

Figure 3C.2 Sample Report

Number of canisters produced vs. years

RADIONUCLIDE CONTENT PER CANISTER VS. DECAY TIME
SITE: Idaho National Engineering Laboratory
WASTE TYPE: Immobilized (in canisters)
ISOTOPE(S): All fission products UNITS: Total curies

ISOTOPE	15YR	20YR	30YR	50YR	100YR
SE 79	8.173E-02	8.173E-02	8.172E-02	8.170E-02	8.166E-02
SR 90	1.162E+04	1.032E+04	8.132E+03	5.052E+03	1.537E+03
Y 90	1.162E+04	1.032E+04	8.134E+03	5.053E+03	1.537E+03
ZR 93	3.959E-01	3.959E-01	3.959E-01	3.959E-01	3.959E-01
NB 93M	2.456E-01	2.749E-01	3.153E-01	3.542E-01	3.744E-01
TC 99	2.683E+00	2.683E+00	2.683E+00	2.683E+00	2.682E+00
RU106	4.106E-02	1.319E-03	1.384E-06	1.473E-12	1.723E-27
RH106	4.106E-02	1.319E-03	1.384E-06	1.473E-12	1.723E-27
PD107	2.555E-03	2.555E-03	2.555E-03	2.555E-03	2.555E-03
SN126	4.087E-02	4.087E-02	4.086E-02	4.086E-02	4.084E-02
SB126	5.721E-03	5.721E-03	5.721E-03	5.720E-03	5.718E-03
SB126M	4.087E-02	4.087E-02	4.086E-02	4.086E-02	4.084E-02
CS134	2.722E+01	5.069E+00	1.758E-01	2.205E-04	1.106E-11
CS135	9.579E-02	9.579E-02	9.579E-02	9.579E-02	9.579E-02
CS137	1.174E+04	1.046E+04	8.302E+03	5.230E+03	1.647E+03
BA137M	1.111E+04	9.895E+03	7.853E+03	4.947E+03	1.558E+03
CE144	1.653E-02	1.924E-04	2.608E-08	4.790E-16	2.190E-35
PR144	1.653E-02	1.924E-04	2.608E-08	4.790E-16	2.190E-35
PR144M	1.984E-04	2.309E-06	3.129E-10	5.748E-18	2.628E-37
PM147	2.913E+02	7.774E+01	5.536E+00	2.806E-02	5.139E-08
SM151	1.934E+02	1.861E+02	1.723E+02	1.477E+02	1.005E+02
EU154	6.862E+01	4.586E+01	2.048E+01	4.087E+00	7.265E-02

Figure 3C.3 Sample Report

Radionuclide content per canister vs. decay time

PHOTON SPECTRUM PER CANISTER VS. DECAY TIME

SITE: Hanford

WASTE TYPE: Immobilized (in canisters)

ISOTOPES: Actinides and daughters UNITS: Photons/sec

EMEAN	15YR	20YR	30YR	50YR	100YR
1.000E-02	8.307E+12	8.242E+12	8.111E+12	7.857E+12	7.253E+12
2.500E-02	9.436E+11	9.362E+11	9.215E+11	8.926E+11	8.241E+11
3.750E-02	7.853E+10	7.792E+10	7.670E+10	7.432E+10	6.867E+10
5.750E-02	1.385E+13	1.374E+13	1.352E+13	1.310E+13	1.209E+13
8.500E-02	2.847E+10	2.840E+10	2.827E+10	2.800E+10	2.739E+10
1.250E-01	1.931E+10	1.921E+10	1.901E+10	1.862E+10	1.772E+10
2.250E-01	6.243E+09	6.235E+09	6.221E+09	6.196E+09	6.136E+09
3.750E-01	5.691E+09	5.711E+09	5.750E+09	5.826E+09	6.007E+09
5.750E-01	2.639E+08	2.618E+08	2.578E+08	2.498E+08	2.310E+08
8.500E-01	1.119E+08	1.106E+08	1.079E+08	1.027E+08	9.123E+07
1.250E+00	2.303E+07	2.253E+07	2.158E+07	1.981E+07	1.605E+07
1.750E+00	2.768E+05	2.721E+05	2.648E+05	2.561E+05	2.479E+05
2.250E+00	3.462E+04	3.190E+04	2.772E+04	2.268E+04	1.797E+04
2.750E+00	1.867E+04	1.711E+04	1.471E+04	1.182E+04	9.196E+03
3.500E+00	1.531E+04	1.391E+04	1.178E+04	9.227E+03	6.968E+03
5.000E+00	5.698E+03	5.106E+03	4.204E+03	3.140E+03	2.236E+03
7.000E+00	5.582E+02	4.907E+02	3.882E+02	2.685E+02	1.713E+02
9.500E+00	5.754E+01	4.983E+01	3.816E+01	2.461E+01	1.392E+01

Figure 3C.4 Sample Report

Photon spectrum per canister vs. decay time

Table 3B.17. INEL. Historical and projected volumes of interim and immobilized high-level wastes*a

Calendar year end	Liquid 103m3	Calcine 103 m3	Glass-ceramic 103 m3	Glass-ceramic Cumulative number of canisters	Total 103 m3
1986	6.5	3.0	0.0	0	9.5
1987	7.6	3.1	0.0	0	10.7
1988	7.5	3.4	0.0	0	10.9
1989	7.8	3.7	0.0	0	11.5
1990	6.8	4.0	0.0	0	10.8
1991	6.6	4.2	0.0	0	10.8
1992	6.2	4.5	0.0	0	10.7
1993	5.6	4.9	0.0	0	10.5
1994	6.1	4.9	0.0	0	11.0
1995	5.2	5.2	0.0	0	10.4
1996	5.8	5.3	0.0	0	11.1
1997	6.3	5.8	0.0	0	12.1
1998	7.1	6.3	0.0	0	13.4
1999	7.9	6.8	0.0	0	14.7
2000	8.6	7.4	0.0	0	16.0
2001	8.8	7.9	0.0	0	16.7
2002	9.2	8.4	0.0	0	17.6
2003	9.6	8.9	0.0	0	18.5
2004	8.3	9.4	0.0	0	17.7
2005	6.1	9.9	0.0	0	16.0
2006	7.4	9.9	0.0	0	17.3
2007	8.5	9.9	0.0	0	18.4
2008	4.7	10.5	0.0	0	15.2
2009	4.4	11.2	0.0	0	15.6
2010	4.5	11.9	0.0	0	16.4
2011	3.9	12.15	0.28	500	16.33
2012	3.1	12.30	0.63	1100	16.03
2013	2.7	12.36	1.03	1800	16.09
2014	3.0	12.05	1.60	2800	16.65
2015	3.3	11.74	2.17	3800	17.21
2016	3.7	11.53	2.74	4800	17.97
2017	3.1	11.32	3.31	5800	17.73
2018	1.3	10.70	3.88	6800	15.88
2019	1.6	10.49	4.45	7800	16.54
2020	1.7	10.28	5.02	8800	17.00

*aSource: Berreth 1987. Quantities shown are based on the assumptions that immobilization starts in year 2011 and that the glass-ceramic form is used. Each canister is assumed to contain 0.57 m3 of ceramic (1825 kg), with a calcine loading of 70 wt% of 1277 kg; this is the equivalent of 0.91 m3 of calcine prior to immobilization.

Figure 3C.5 Sample Report

Volume of waste (interim forms) vs. years

4.0 INSTALLATION AND USE OF SOFTWARE

This section provides step by step information on how to install and start the High Level Waste(HLW) Database system. There are 3 sets of instructions: section 4.1 has instructions for users who have a 2 floppy disk PC system, section 4.2 has instructions for users who have a fixed disk PC system, and section 4.3 has instructions for users who are running the system from a Bernoulli cartridge. Please read the instructions that apply to your system.

4.1 INSTALLATION AND STARTUP ON A 2 FLOPPY DISK PC

There are 3 steps to installing the HLW Database system for use on your system:

1. Set up a CONFIG.SYS file.
2. Make copies of your master diskettes to working copies.
3. Copy a DOS file, COMMAND.COM to the working Program copy.

4.1.1 Setting up a CONFIG.SYS File

A file named CONFIG.SYS must be present on the disk you use to start your computer. It must have the following lines:

FILES = 20

BUFFERS = 24

If the numbers are larger, that's fine, but if they are smaller they should be set to the above numbers. This file must be on the floppy disk you use to start your computer.

You can use a text editor to create this file or add these lines to an existing CONFIG.SYS file you may already have. Or, you can create the file by following these steps:

1. Put the DOS disk that you use to start your computer into drive A.
2. If you don't see the A prompt (A:>), then make the A drive the default drive by entering the command:

   A:<Enter>

3. Enter these lines:

   COPY CON: CONFIG.SYS<Enter>

   FILES = 20<Enter>

   BUFFERS = 24<Enter>

   <Ctrl>Z<Enter>

You will then need to activate the file. This can be done by pressing the following keys: <Ctrl><Alt><Del> all together. Once your CONFIG.SYS file has been set up you do not need to change it again.

4.1.2 Copying the Master Diskettes

First start up your computer as you usually do with your DOS diskette. You will see the prompt "A>". Then enter this command:

DISKCOPY A: B:<Enter>

You will see a message on the screen telling you to put the SOURCE diskette in drive A and the TARGET diskette in drive B. Place your HLW Programs Master diskette in drive A and a new blank floppy disk in drive B. When both diskettes are in place strike the <ENTER> key. When the copying is complete, remove both diskettes, and label the new copy "HLW Programs Working Copy".

You will see a prompt on the PC screen asking if you want to copy another diskette. Respond by typing the letter Y and <ENTER>. Place the HLW Data #1 Master diskette in drive A and another blank floppy disk in drive B. When both diskettes are in place strike the <ENTER> key. When the copying is complete, remove both diskettes, and label the new copy "HLW Data #1 Working Copy". You will see the prompt on the PC screen again asking if you want to copy another diskette. Type the letter Y and <ENTER>. Place the HLW Data #2 Master diskette in drive A and another blank floppy disk in drive B. When both diskettes are in place strike the <ENTER> key. When the copying is complete, remove both diskettes, and label the new copy "HLW Data #3 Working Copy". Place your DOS diskette back in drive A.

Then respond with the letter N when the PC asks you if you want to copy another diskette. You will be returned to the "A>" prompt.

4.1.3 Copying COMMAND.COM to the Programs Working Diskette

This is the final step. Place your DOS diskette in drive A, and your newly made HLW Programs Working Copy diskette in drive B. Enter the following command, followed by the <ENTER> key.

COPY COMMAND.COM B:<Enter>

You will see a message saying that 1 file has been copied.

4.1.4 Starting the HLW Database System from a 2 Floppy Drive PC

You are now ready to start the system. Place your HLW Programs Working Copy in drive A and your HLW Data #1 Working Copy in drive B. Enter the command:

HLW<Enter>

The main menu should appear and you can start selecting what data you would like to see. Proceed to chapter 5, OPERATING INSTRUCTIONS, for information on how to use the system.

4.2 INSTALLATION AND STARTUP ON A FIXED DISK PC

There are 2 steps to installing the HLW Database system for use on your system:

1. Set up a CONFIG.SYS file.
2. Install the distribution diskettes onto your fixed disk.

4.2.1 Setting up a CONFIG.SYS File

A file named CONFIG.SYS must be present on the disk you use to start your computer. It must have the following lines:

FILES = 20

BUFFERS = 24

If the numbers are larger, that's fine, but if they are smaller they should be set to the above numbers. This file must be in the root directory of the fixed disk you use to start your computer.

You can use a text editor to create this file or add these lines to an existing CONFIG.SYS file you may already have. Or, you can create the file by following these steps:

1. Enter the command:

   CD \<Enter>

2. Enter these lines:

   COPY CON: CONFIG.SYS<Enter>

   FILES = 20<Enter>

   BUFFERS = 24<Enter>

   <Ctrl>Z<Enter>

You will then need to activate the file. This can be done by pressing the following keys: <Ctrl><Alt><Del> all together. Once your CONFIG.SYS file has been set up you do not need to change it again.

4.2.2 Installing the Master Diskettes

First start up your computer as you usually do. Then place the HLW Programs Master diskette in drive A and enter this command:

A:<Enter>

The next step is to enter the install command followed by the letter of your fixed disk. This is usually C, but sometimes is D or E. If your fixed disk is C, enter the command:

INSTALL C:<Enter>

Substitute the correct letter of your fixed disk for C.

This will execute a batch file that will create a subdirectory HLWD and copy the programs to the fixed disk. After the programs have all been copied, you will be asked to insert the HLW Database Data #1 Master diskette. Do so and press <ENTER>. The data files will be copied to the fixed disk. Then you will be asked to insert the HLW Database Data #2 Master diskette. Do so and press <ENTER>. When this operation is complete, you may put away your master distribution diskettes for safekeeping.

4.2.3 <u>Starting the HLW Database System from a Fixed Disk PC</u>

You are now ready to start the system. Make the root directory the current directory by entering the command:

CD \<Enter>

Then enter the command:

HLW<Enter>

The main menu should appear and you can start selecting what data you would like to see. You can proceed to section 5 for instructions and examples that describe system operation.

4.3 INSTALLATION AND STARTUP ON A BERNOULLI CARTRIDGE

If you have received the HLW Database system on a Bernoulli cartridge, you will only need to check that your system has the proper CONFIG.SYS file in the root directory of the disk you use to start your computer. You can follow the directions in section 4.2.1 in order to do this.

In general, since the system is already installed on a Bernoulli cartridge, you will not need any further installation procedures. There is one exception. If you start your computer from a Bernoulli cartridge, you will need to copy 1 DOS file, COMMAND.COM to the HLW Bernoulli cartridge. You can do this by placing your DOS diskette in drive A, and entering the following command (assuming that your Bernoulli drive is drive C):

COPY A:COMMAND.COM C:<Enter>

If your Bernoulli drive is another letter (such as D), then substitute that letter plus a colon for C: in the above command.

4.3.1 <u>Starting the HLW Database System from a Bernoulli Cartridge</u>

To start the database system, make the Bernoulli drive the default drive. Then make the root directory of your Bernoulli drive the default directory by entering the command:

CD \<Enter>

Then enter the command:

HLW<Enter>

The main menu should appear within a few seconds.

5.0 OPERATING INSTRUCTIONS

This section describes the operation of the High Level Waste Database system. First, an overview of the system design is presented in section 5.1. Next, section 5.2 describes a step-by-step scenario of using the program, with sample screen outlines showing exactly what will appear on your screen.

5.1 OVERVIEW

The High Level Waste Database system has a flexible full-screen menu that allows you to specify the information you wish to retrieve. You must supply these parameters:

SITE: You can choose the site for which to retrieve data.

WASTE TYPE: You can choose either Immobilized waste (in canisters) or interim forms (liquid, sludge, etc.).

DATA REQUESTED: You can choose from a list of reports available. The options vary according to the WASTE TYPE you have selected.

Certain options under DATA REQUESTED require some additional information, such as specific isotopes or decay time periods. When you have selected one of these options, the system will automatically prompt you for the required inputs, and these additional selections will also be displayed on the screen.

You can change any individual item at any time. For example, suppose you had selected the following:

SITE: West Valley Demonstration Plant

WASTE TYPE: Immobilized (in canisters)

DATA REQUESTED: Radionuclide content of canisters at fill time

You can change any of the three parameters in any order to retrieve different data. If you wanted to see information about a different site, you could select a different SITE value. If you wanted to see information about interim forms of waste, you could select a different WASTE TYPE value. If you wanted to see different data for the same site, West Valley, you could select another DATA

REQUESTED value. This flexibility makes it easy to quickly specify exactly what data you wish to see.

This flexibility can lead to a situation where some of the parameters specified are not appropriate. For example, suppose you had selected the following:

SITE: West Valley Demonstration Plant

WASTE TYPE: Immobilized (in canisters)

DATA REQUESTED: Radionuclide content of canisters at fill time

If you change the WASTE TYPE to Interim forms, the DATA REQUESTED is no longer appropriate. In such cases, the system will detect which selections are inappropriate and automatically prompt the user to enter new selections for these items. In this example, the system will prompt the user to make a new selection for DATA REQUESTED that is appropriate for Interim forms.

5.2 NOTES FOR OPERATION ON A FLOPPY DISK PC

This section contains information about the data diskettes for users of floppy disk PC. If you are using the HLW Database system on a fixed disk PC, you may skip this section.

The data for the HLW Database system would not fit on 1 floppy diskette, and so 2 diskettes are included with your system. When you first start the system, you need to place the HLW Programs Working Copy in drive A, and the HLW Data #1 Working Copy in drive B. This enables the program to begin correctly.

As you operate the system to obtain different reports, the program will instruct you when to change data diskettes. If the requested data is not on the floppy diskette currently in drive B, the program will ask you to put in the correct data diskette.

For your information, the data for options 8 and 9 under Immobilized Waste forms are contained on the Data #1 diskette, and the data for all other options are on the Data #2 diskette. It is necessary to begin the system with the Data #1 diskette in the B drive. Other than that, you need not be concerned about when to put the different data diskettes in drive B, because the program will tell you whenever a switch is necessary.

5.3 SAMPLE OPERATING SCENARIO

This section takes you through a sample session with the High Level Waste Database system, showing exactly what you will see on the screen as you operate the program.

HIGH LEVEL WASTE DATABASE

Welcome to the OCRWM/ORNL
High Level Radioactive Waste PC Database System -- September 1987

This database was assembled by the Waste Characterization task group at Oak Ridge National Laboratory under the sponsorship of the Department of Energy Office of Civilian Radioactive Waste Management as part of the Waste Systems Data and Development Program.

The database includes information on the quantities and characteristics of interim and immobilized forms of commercial and defense high level waste. Decay calculations for projecting future radioactivity characteristics were made by means of the ORIGEN2 computer code.

A user's guide to this data base has been issued as Appendix 3D to report DOE/RW-XXXX, "Characteristics of Potential Repository Wastes", September 1987. For more information or to offer comments and suggestions, please contact Royes Salmon, Oak Ridge National Laboratory, P. O. Box X, Oak Ridge, TN. 37831 (615)574-6607 or FTS 624-6607.

Strike any key to continue . . .

This is the introductory screen that will be displayed when you first start the program. Press any key to move into the next screen, the main menu.

```
                    HIGH LEVEL WASTE DATABASE

A.  SITE:
B.  WASTE TYPE:

   C.  DATA REQUESTED:

D.  OUTPUT TO:  Screen

Your choices are:
      A-D Change indicated item
      S   Sequence through choices A-C
      R   Run the Query you have defined
      X   eXit to DOS
Enter your choice:

(A.) Select the Site:
      1. West Valley Demonstration Project
      2. Savannah River Plant
      3. Hanford
      4. Idaho National Engineering Laboratory
      5. All Defense Sites (SRP,HANF,INEL)
      6. All Sites
Enter your selection (1-6):  4
```

The main menu is displayed. The large box occupying the top half of the screen shows the currently selected options. Since this is the first time the screen is displayed, no selections have been made. The program will sequence through the different items A-C, asking you to select options for data retrieval.

When selecting a value for a parameter, the options will be listed on the bottom half of the screen. Once you have made a selection, it will be displayed in the box in the top half of the screen.

The first parameter to be selected is SITE. You can select any of the listed sites, 1-6, by typing in the appropriate digit. You do not need to press the <Enter> key.

In this case, the user has selected option 4, Idaho National Engineering Laboratory.

```
                    HIGH LEVEL WASTE DATABASE
A.  SITE:           Idaho National Engineering Laboratory
B.  WASTE TYPE:

   C.  DATA REQUESTED:

D.  OUTPUT TO:  Screen

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:
(B.) Select the Waste Type:
     1. Immobilized (in canisters)
     2. Interim (liquid, sludge, etc.)



Enter your selection (1-2):  2
```

The next parameter to be selected is WASTE TYPE. You can select either of the two options listed.

Note that the selection for site, Idaho National Engineering Laboratory, that was made in the previous screen, is now displayed on the screen opposite the word SITE.

In this case, the user has selected option 2, Interim (liquid,sludge,etc.).

```
                    HIGH LEVEL WASTE DATABASE

A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Interim (liquid, sludge, etc.)

   C.  DATA REQUESTED:

D.  OUTPUT TO:  Screen

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:
(C.) Select the Data Requested for Idaho National Engineering Laboratory  :
     1. Volume of waste vs. years
     2. Radioactivity and thermal power vs. years
     3. Chemical composition
     4. Radionuclide composition

Enter your selection (1-4):  1
```

The next parameter is DATA REQUESTED. You can select one of the three options shown. These options are specific for the WASTE TYPE selected, Interim forms. A later screen will show the options available for Immobilized WASTE TYPE.
Note that the selection for WASTE TYPE, Interim forms, is now displayed on the screen opposite the words WASTE TYPE.
In this case, the user has selected option 1, Volume of waste vs. years.

```
HIGH LEVEL WASTE DATABASE

A.  SITE:         Idaho National Engineering Laboratory
B.  WASTE TYPE:   Interim (liquid, sludge, etc.)

   C.  DATA REQUESTED:   Volume of waste vs. years

D.  OUTPUT TO:  Screen

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   R
```

All three parameters have now been specified. Now you can choose from the choices listed inside the screen box. Entering a letter A-D allows you to change that one parameter. The letter S will Sequence through all the parameters, allowing you to change everything. The letter R will Run the query, producing a report of the data that has been specified.

In this case, the user has specified R, to produce a report. Since the output device is Screen, the report will go to the screen.

Filename: mb2inel.tab

Table 3.26. Idaho National Engineering Laboratory. Estimated production schedule of canisters of HLW glass-ceramic.*a

Calendar year	Number of canisters produced during year	Cumulative number of canisters produced
2010	0	0
2011	500	500
2012	600	1,100
2013	700	1,800
2014	1,000	2,800
2015	1,000	3,800
2016	1,000	4,800
2017	1,000	5,800
2018	1,000	6,800
2019	1,000	7,800
2020	1,000	8,800

*aThis assumes that a glass-ceramic form (density 3.2 g/cm3) is selected for HLW disposal and that each canister contains 1277 kg of calcine (1825 kg of glass-ceramic). Waste loading is 70 wt%, and inerts

Command: KEYS: PgUp PgDn HOME END ?-Help X-eXit

The report requested is displayed on the screen. In this case, the entire report does not fit on one screen. You can hit the PgDn and PgUp keys to page down and up through the report. Other commands are available while browsing the report. The most important commands are listed on the command line, which is the last line of the screen. There are also a few more, such as the Find command. All the commands are described on the help screen, which you can see by typing a ? from this screen.

Enter an X to eXit this report display and return to the main menu.

```
HIGH LEVEL WASTE DATABASE

A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Interim (liquid, sludge, etc.)

   C.  DATA REQUESTED:   Volume of waste vs. years

D.  OUTPUT TO:  Screen

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   D
```

The system returns to the main menu. You can choose any of the options listed inside the screen box. In this case, the user has entered the letter D, to change the output device.

```
                         HIGH LEVEL WASTE DATABASE
 A.  SITE:            Idaho National Engineering Laboratory
 B.  WASTE TYPE:      Interim (liquid, sludge, etc.)

    C.  DATA REQUESTED:    Volume of waste vs. years

 D.  OUTPUT TO:  Screen

 Your choices are:
      A-D Change indicated item
      S   Sequence through choices A-C
      R   Run the Query you have defined
      X   eXit to DOS
 Enter your choice:   D
(D.) Select the output device:
      1. Screen
      2. Print
      3. Disk File

    If you select Disk File, you will be prompted for the file name.

Enter your selection (1-3):  2
```

The options for output device are displayed on the bottom part of the screen. You can choose either Screen, Print, or Disk File. Directing output to the screen is useful for a quick preview of certain information. Directing output to the printer will provide hard copy reports. The disk file option can be used to capture a report that can then later be taken to another computer and printed, if your computer does not have a printer attached. This option can also be used to capture some data in a text file that you could later use as input to another program. Once you select the disk file option, the system will prompt you for the name of the file to which you want to send the data. If the file already exists, you will be asked if you want to overwrite the existing file, or append additional data.

The user enters a 2, to select the printer as the output device.

HIGH LEVEL WASTE DATABASE

A. SITE:	Idaho National Engineering Laboratory
B. WASTE TYPE:	Interim (liquid, sludge, etc.)
C. DATA REQUESTED:	Volume of waste vs. years

D. OUTPUT TO: Print

Your choices are:

- A-D Change indicated item
- S Sequence through choices A-C
- R Run the Query you have defined
- X eXit to DOS

Enter your choice: R

Note that the OUTPUT TO has been changed from Screen to Print.

The user has entered an R, to Run the query, with the report going to the printer this time instead of the screen.

HIGH LEVEL WASTE DATABASE

Your report is being sent to the printer.

Strike any key to continue.

This screen tells the user that the report has been sent to the printer. Press any key to return to the main menu.

```
HIGH LEVEL WASTE DATABASE

A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Interim (liquid, sludge, etc.)

   C.  DATA REQUESTED:   Volume of waste vs. years

D.  OUTPUT TO:  Print

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   D
```

The main menu is again displayed, with the choices inside the screen box available. In this case, the user has entered a D, to change the output device.

```
HIGH LEVEL WASTE DATABASE

A.  SITE:           Idaho National Engineering Laboratory
B.  WASTE TYPE:     Interim (liquid, sludge, etc.)

   C.  DATA REQUESTED:   Volume of waste vs. years

D.  OUTPUT TO:  Print

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   D

(D.) Select the output device:
     1. Screen
     2. Print
     3. Disk File

   If you select Disk File, you will be prompted for the file name.

Enter your selection (1-3):  1
```

The output device options are displayed on the bottom half of the screen. You can select either Screen, Print, or Disk File.

In this case, the user selects 1, to send output to the screen.

```
HIGH LEVEL WASTE DATABASE

A.  SITE:           Idaho National Engineering Laboratory
B.  WASTE TYPE:     Interim (liquid, sludge, etc.)

   C.  DATA REQUESTED:   Volume of waste vs. years

D.  OUTPUT TO:  Screen

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   B
```

Note that the OUTPUT TO has been changed back to Screen, so that subsequent reports will go to the screen. It is often a good idea to preview reports on the screen. Once you are sure that the report is the information you want, you can change the output device to the printer or a disk file, then run the query again, with the report going to the new destination.

The next few pages will show how you can easily specify new reports. First, the user wants to examine data for immobilized waste, rather than interim forms of waste, so he enters a B, to change the WASTE TYPE.

```
                     HIGH LEVEL WASTE DATABASE
A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Interim (liquid, sludge, etc.)

   C.  DATA REQUESTED:   Volume of waste vs. years

D.  OUTPUT TO:  Screen

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   B
(B.) Select the Waste Type:
     1. Immobilized (in canisters)
     2. Interim (liquid, sludge, etc.)



Enter your selection (1-2):  1
```

The WASTE TYPE options are displayed. The user has selected option 1, Immobilized (in canisters).

```
HIGH LEVEL WASTE DATABASE

A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Immobilized (in canisters)

    C.  DATA REQUESTED:   *** Must be re-defined for the Waste Type

D.  OUTPUT TO:   Screen

(C.) Select the Data Requested for Idaho National Engineering Laboratory  :
    1. Physical description of canisters and waste form
    2. Number of canisters produced vs. years
    3. Maximum radionuclide content per canister at fill time
    4. Maximum radioactivity and thermal power per canister vs. decay time
    5. Average radioactivity per canister by year of production
    6. Cumulative average radioactivity and thermal power per canister by year
    7. Chemical composition
    8. Radionuclide content (grams, total curies, alpha curies, watts)
       per canister vs. decay time
    9. Photon spectrum per canister vs. decay time
   10. Calculated integrated heat release per canister vs. decay time
*** Item 5 is not selectable for Idaho National Engineering Laboratory
Enter your selection (1-4,6-10):   8
```

Note that the WASTE TYPE has been changed to Immobilized (in canisters), and the DATA REQUESTED box has a message. Once the WASTE TYPE was changed, the previous DATA REQUESTED was no longer appropriate, so a new option for DATA REQUESTED must be selected. The system automatically displays the DATA REQUESTED options for Immobilized waste, and prompts the user to select one. Note the message on the second line up from the bottom that says that option 5 is not available for this site, Idaho. In a few cases, some of the data is not available for certain sites. In these cases, you will see a notice like the one above, and you will not be able to select those options.

In this case, the user has selected option 8, Radionuclide content per canister vs. decay time.

```
HIGH LEVEL WASTE DATABASE

A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Immobilized (in canisters)

   C.  DATA REQUESTED:   Radionuclide content per canister vs. decay time

D.  OUTPUT TO:  Screen        E. CASE: Maximum Radioactivity (one case)
                              F. ISOTOPES:
Your choices are:             G. DECAY TIME:
     A-D Change indicated item H. UNITS:
     S   Sequence through choi
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:

(F.) Select the Isotope:
     1. One specific isotope
     2. All activation products
     3. All actinides and daughters
     4. All fission products
     5. Summary (totals only) of all isotopes

Enter your selection (1-5):  4
```

Note that the DATA REQUESTED box has the new value displayed. Also, a new box is displayed with some new parameters: CASE, ISOTOPES, DECAY TIME, AND UNITS. This particular DATA REQUESTED option requires additional parameters to retrieve the correct information. The system will automatically sequence through these additional required parameters, asking the user to make a selection.

There are 2 different cases for the West Valley site: average radioactivity and maximum radioactivity. If the site chosen had been West Valley, you would be prompted for which CASE you wanted to see. Since there is only 1 case available for the site Idaho, the maximum radioactivity case, you will see that listed opposite the CASE parameter, and the system will prompt you for the next parameter, ISOTOPES. The options for ISOTOPES are displayed on the bottom half of the screen. The user selects 4, or all fission products.

```
HIGH LEVEL WASTE DATABASE

A.  SITE:           Idaho National Engineering Laboratory
B.  WASTE TYPE:     Immobilized (in canisters)

   C.  DATA REQUESTED:   Radionuclide content per canister vs. decay time

D.  OUTPUT TO:  Screen            E. CASE: Maximum Radioactivity (one case)
                                  F. ISOTOPES: All fission products
Your choices are:                 G. DECAY TIME:
     A-D Change indicated item    H. UNITS:
     S   Sequence through choi
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:

(G.) Select the Decay Time:
     1. 0, 1, 2, 5, 10 years
     2. 15, 20, 30, 50, 100 years
     3. 200, 300, 350, 500, 1000, 1050 years
     4. 2K, 5K, 10K, 20K years
     5. 50K, 100K, 500K, 1000K years

Enter your selection (1-5):  1
```

The next parameter to be selected is DECAY TIME. You can select one of the listed sets of decay times. In this case, the user has selected option 1, for times 0, 1, 2, 5, 10 years.

```
                    HIGH LEVEL WASTE DATABASE
A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Immobilized (in canisters)

   C.  DATA REQUESTED:   Radionuclide content per canister vs. decay time

D.  OUTPUT TO:  Screen          E. CASE: Maximum Radioactivity (one case)
                                F. ISOTOPES: All fission products
Your choices are:               G. DECAY TIME: 0, 1, 2, 5, 10 years
     A-D Change indicated item  H. UNITS:
     S   Sequence through choi
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:

(H.) Select the Units:
     1. Grams
     2. Total curies
     3. Alpha curies
     4. Total watts

Enter your selection (1-4):  2
```

The next parameter is UNITS. You can choose which units you are interested in. The user has selected option 2, total curies.

```
                    HIGH LEVEL WASTE DATABASE
A.  SITE:           Idaho National Engineering Laboratory
B.  WASTE TYPE:     Immobilized (in canisters)
   C.  DATA REQUESTED:   Radionuclide content per canister vs. decay time
D.  OUTPUT TO:  Screen        E. CASE: Maximum Radioactivity (one case)
                              F. ISOTOPES: All fission products
Your choices are:             G. DECAY TIME: 0, 1, 2, 5, 10 years
      A-D Change indicated item  H. UNITS: Total curies
      S   Sequence through choi
      R   Run the Query you have defined
      X   eXit to DOS
Enter your choice:   R
```

Now everything needed for the report has been specified. Any of the choices inside the screen box are available: A-H, S, R, or X. You can Run the query as defined or change any of the parameters, including the new ones added (ISOTOPES, DECAY TIME, AND UNITS). For this site, Idaho, you could not choose option E, CASE, since there is only 1 case available. If you tried to enter an E, the system would display a message saying that there is only 1 case available, and you could then enter another option.

The user has selected R, to run the query.

Filename: mb8inel.tab

RADIONUCLIDE CONTENT PER CANISTER VS. DECAY TIME

SITE: Idaho National Engineering Laboratory MAXIMUM RADIOACTIVITY (ONE CASE)

WASTE TYPE: Immobilized (in canisters)

ISOTOPE(S): All fission products UNITS: Total curies

ISOTOPE	0YR	1YR	2YR	5YR	10YR
SE 79	8.175E-02	8.175E-02	8.175E-02	8.174E-02	8.174E-02
SR 90	1.661E+04	1.622E+04	1.583E+04	1.474E+04	1.309E+04
Y 90	1.661E+04	1.622E+04	1.584E+04	1.475E+04	1.309E+04
ZR 93	3.959E-01	3.959E-01	3.959E-01	3.959E-01	3.959E-01
NB 93M	9.577E-02	1.097E-01	1.229E-01	1.588E-01	2.077E-01
TC 99	2.683E+00	2.683E+00	2.683E+00	2.683E+00	2.683E+00
RU106	1.239E+03	6.228E+02	3.131E+02	3.979E+01	1.278E+00
RH106	1.239E+03	6.228E+02	3.131E+02	3.979E+01	1.278E+00
PD107	2.555E-03	2.555E-03	2.555E-03	2.555E-03	2.555E-03
SN126	4.087E-02	4.087E-02	4.087E-02	4.087E-02	4.087E-02
SB126	4.087E-02	5.722E-03	5.722E-03	5.722E-03	5.722E-03
SB126M	4.087E-02	4.087E-02	4.087E-02	4.087E-02	4.087E-02
CS134	4.215E+03	3.011E+03	2.152E+03	7.849E+02	1.462E+02
CS135	9.579E-02	9.579E-02	9.579E-02	9.579E-02	9.579E-02
CS137	1.660E+04	1.622E+04	1.585E+04	1.479E+04	1.318E+04
BA137M	1.533E+04	1.535E+04	1.500E+04	1.399E+04	1.247E+04
CE144	1.047E+04	4.298E+03	1.764E+03	1.219E+02	1.420E+00

Command: KEYS: PgUp PgDn HOME END ?-Help X-eXit

The report requested is displayed on the screen. This report is longer than one screen. You can browse through the report using the PgUp and PgDn keys. Other commands are available while browsing the report. For more information on the browse mode, enter a ? from this screen.

Enter an X to eXit this report display and return to the main menu.

```
HIGH LEVEL WASTE DATABASE

A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Immobilized (in canisters)

   C.  DATA REQUESTED:   Radionuclide content per canister vs. decay time

D.  OUTPUT TO:  Screen          E. CASE: Maximum Radioactivity (one case)
                                F. ISOTOPES: All fission products
Your choices are:               G. DECAY TIME: 0, 1, 2, 5, 10 years
     A-D Change indicated item  H. UNITS: Total curies
     S   Sequence through choi
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   C
```

The system returns to the main menu, where you can choose any of the options inside the screen box: A-H, S, R, or X.

The user enters a C, to change the DATA REQUESTED.

HIGH LEVEL WASTE DATABASE

A. SITE:	Idaho National Engineering Laboratory
B. WASTE TYPE:	Immobilized (in canisters)
C. DATA REQUESTED:	Radionuclide content per canister vs. decay time
D. OUTPUT TO: Screen	E. CASE: Maximum Radioactivity (one case) F. ISOTOPES: All fission products

(C.) Select the Data Requested for Idaho National Engineering Laboratory:

1. Physical description of canisters and waste form
2. Number of canisters produced vs. years
3. Maximum radionuclide content per canister at fill time
4. Maximum radioactivity and thermal power per canister vs. decay time
5. Average radioactivity per canister by year of production
6. Cumulative average radioactivity and thermal power per canister by year
7. Chemical composition
8. Radionuclide content (grams, total curies, alpha curies, watts) per canister vs. decay time
9. Photon spectrum per canister vs. decay time
10. Calculated integrated heat release per canister vs. decay time

*** Item 5 is not selectable for Idaho National Engineering Laboratory
Enter your selection (1-4,6-10): 2

The options for DATA REQUESTED for the current WASTE TYPE, immobilized, are displayed. The user selects option 2, Number of canisters produced vs. years.

```
                    HIGH LEVEL WASTE DATABASE

A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Immobilized (in canisters)

   C.  DATA REQUESTED:   Number of canisters produced vs. years

D.  OUTPUT TO:  Screen

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   R
```

Note that the new value for DATA REQUESTED displayed. Also, the box with the additional information for CASE, ISOTOPES, DECAY TIME, and UNITS has disappeared. The current DATA REQUESTED option does not require this information, so the prompts are removed from the screen.

The choices inside the large menu box are available: A-D, S, R, or X. You can Run the query as defined or change any of the parameters.

The user has entered R, to run the query.

Filename: ntlinel.tab

Table 3C.17. INEL. Historical and projected volumes of interim and immobilized high-level wastesa

Calendar year end	Liquid 103m3	Calcine 103 m3	Glass-ceramic 103 m3	Glass-ceramic Cumulative number of canisters	Total 103 m3
1986	6.5	3.0	0.0	0	9.5
1987	7.6	3.1	0.0	0	10.7
1988	7.5	3.4	0.0	0	10.9
1989	7.8	3.7	0.0	0	11.5
1990	6.8	4.0	0.0	0	10.8
1991	6.6	4.2	0.0	0	10.8
1992	6.2	4.5	0.0	0	10.7
1993	5.6	4.9	0.0	0	10.5
1994	6.1	4.9	0.0	0	11.0
1995	5.2	5.2	0.0	0	10.4
1996	5.8	5.3	0.0	0	11.1
1997	6.3	5.8	0.0	0	12.1
1998	7.1	6.3	0.0	0	13.4
1999	7.9	6.8	0.0	0	14.7
2000	8.6	7.4	0.0	0	16.0

Command: KEYS: PgUp PgDn HOME END ?-Help X-eXit

The report requested is displayed on the screen. This report is longer than one screen. You can browse through the report using the PgUp and PgDn keys. Other commands are available while browsing the report. For more information on the browse mode, enter a ? from this screen.

Enter an X to eXit this report display and return to the main menu.

HIGH LEVEL WASTE DATABASE

```
A.  SITE:            Idaho National Engineering Laboratory
B.  WASTE TYPE:      Immobilized (in canisters)

   C.  DATA REQUESTED:   Number of canisters produced vs. years

D.  OUTPUT TO:  Screen

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   X
```

You are returned to the main menu. The user has obtained all the desired information and is ready to exit the system. He enters an X.

```
                         HIGH LEVEL WASTE DATABASE

A.  SITE:          Idaho National Engineering Laboratory
B.  WASTE TYPE:    Immobilized (in canisters)

   C.  DATA REQUESTED:   Number of canisters produced vs. years

D.  OUTPUT TO:   Screen

Your choices are:
     A-D Change indicated item
     S   Sequence through choices A-C
     R   Run the Query you have defined
     X   eXit to DOS
Enter your choice:   X


                         EXIT SYSTEM SELECTED !

                 Do you wish to end this session (Y/N)? Y
```

This final prompt is displayed to be sure that you want to exit the system. If so, enter a Y. If not, enter an N, and all the main menu options will be available.