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

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE 79	9.711E-07	9.711E-07	9.710E-07	9.701E-07	9.608E-07	8.728E-07	3.341E-07	2.256E-11
SR 90	4.852E+01	4.738E+01	3.824E+01	4.490E+00	2.233E-09	0.000E+00	0.000E+00	0.000E+00
Y 90	2.317E+02	2.263E+02	1.827E+02	2.145E+01	1.066E-08	0.000E+00	0.000E+00	0.000E+00
ZR 93	1.499E-04	1.499E-04	1.499E-04	1.499E-04	1.498E-04	1.492E-04	1.433E-04	9.529E-05
NB 93M	1.023E-04	1.080E-04	1.481E-04	2.165E-04	2.171E-04	2.162E-04	2.075E-04	1.380E-04
ZR 95	1.398E-02	2.673E-04	9.135E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NB 95	2.720E-02	5.800E-04	1.920E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TC 99	4.689E-03	4.689E-03	4.689E-03	4.688E-03	4.674E-03	4.539E-03	3.387E-03	1.811E-04
RU106	2.967E-01	1.492E-01	3.062E-04	4.078E-31	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RH106	4.786E+01	2.407E+01	4.939E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PD107	2.413E-06	2.413E-06	2.413E-06	2.413E-06	2.413E-06	2.410E-06	2.387E-06	2.169E-06
AG110M	2.655E-02	9.641E-03	1.057E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CD113M	2.458E-02	2.344E-02	1.528E-02	2.124E-04	5.714E-23	0.000E+00	0.000E+00	0.000E+00
SN123	9.027E-03	1.272E-03	2.772E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SB125	5.503E+00	4.285E+00	4.506E-01	7.456E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE125M	3.606E-01	2.811E-01	2.956E-02	4.891E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SN126	5.738E-04	5.738E-04	5.738E-04	5.734E-04	5.698E-04	5.354E-04	2.869E-04	5.606E-07
SB126	1.197E-03	1.190E-03	1.190E-03	1.189E-03	1.182E-03	1.110E-03	5.951E-04	1.163E-06
SB126M	5.858E-03	5.858E-03	5.858E-03	5.854E-03	5.818E-03	5.466E-03	2.929E-03	5.724E-06
I129	7.541E-09	7.541E-09	7.541E-09	7.541E-09	7.541E-09	7.538E-09	7.508E-09	7.215E-09
CS134	1.221E+01	8.727E+00	4.236E-01	3.058E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS135	8.378E-05	8.378E-05	8.378E-05	8.378E-05	8.375E-05	8.353E-05	8.129E-05	6.198E-05
CS137	5.642E+01	5.513E+01	4.478E+01	5.597E+00	5.209E-09	0.000E+00	0.000E+00	0.000E+00
BA137M	1.893E+02	1.851E+02	1.504E+02	1.880E+01	1.749E-08	0.000E+00	0.000E+00	0.000E+00
CE144	1.977E+01	8.113E+00	2.679E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR144	2.191E+02	8.991E+01	2.969E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR144M	1.225E-01	5.022E-02	1.658E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PM147	1.424E+01	1.094E+01	1.014E+00	4.774E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SM147	0.000E+00	3.095E-09	1.238E-08	1.333E-08	1.333E-08	1.333E-08	1.333E-08	1.333E-08
SM151	9.803E-02	9.728E-02	9.077E-02	4.538E-02	4.430E-05	3.479E-35	0.000E+00	0.000E+00
EU152	2.073E-02	1.970E-02	1.245E-02	1.268E-04	1.524E-24	0.000E+00	0.000E+00	0.000E+00
EU154	3.006E+00	2.773E+00	1.343E+00	9.499E-04	2.986E-35	0.000E+00	0.000E+00	0.000E+00
EU155	2.990E-01	2.600E-01	7.389E-02	2.544E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SUM	8.489E+02	6.637E+02	4.196E+02	5.039E+01	1.274E-02	1.210E-02	7.633E-03	4.860E-04
TOTAL	8.489E+02	6.637E+02	4.196E+02	5.039E+01	1.274E-02	1.210E-02	7.633E-03	4.860E-04

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SR	4.852E+01	4.738E+01	3.824E+01	4.490E+00	2.233E-09	0.000E+00	0.000E+00	0.000E+00
Y	2.317E+02	2.263E+02	1.827E+02	2.145E+01	1.066E-08	0.000E+00	0.000E+00	0.000E+00
ZR	1.413E-02	4.172E-04	1.499E-04	1.499E-04	1.498E-04	1.492E-04	1.433E-04	9.529E-05
NB	2.730E-02	6.886E-04	1.481E-04	2.165E-04	2.171E-04	2.162E-04	2.075E-04	1.380E-04
TC	4.689E-03	4.689E-03	4.689E-03	4.688E-03	4.674E-03	4.539E-03	3.387E-03	1.811E-04
RU	2.967E-01	1.492E-01	3.062E-04	4.078E-31	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RH	4.786E+01	2.407E+01	4.939E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PD	2.413E-06	2.413E-06	2.413E-06	2.413E-06	2.413E-06	2.410E-06	2.387E-06	2.169E-06
SN	1.262E-02	3.052E-03	7.587E-04	6.265E-04	5.698E-04	5.354E-04	2.869E-04	5.606E-07
SB	5.510E+00	4.292E+00	4.577E-01	7.043E-03	6.999E-03	6.576E-03	3.524E-03	6.887E-06
TE	3.662E-01	2.816E-01	2.956E-02	4.891E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS	6.863E+01	6.386E+01	4.520E+01	5.597E+00	8.376E-05	8.353E-05	8.129E-05	6.198E-05
BA	1.893E+02	1.851E+02	1.504E+02	1.880E+01	1.749E-08	0.000E+00	0.000E+00	0.000E+00
CE	1.977E+01	8.113E+00	2.679E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR	2.192E+02	8.996E+01	2.971E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PM	1.424E+01	1.094E+01	1.014E+00	4.774E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SM	9.803E-02	9.728E-02	9.077E-02	4.538E-02	4.431E-05	1.333E-08	1.333E-08	1.333E-08
EU	3.326E+00	3.053E+00	1.429E+00	1.077E-03	1.524E-24	0.000E+00	0.000E+00	0.000E+00
SUM	8.489E+02	6.637E+02	4.196E+02	5.039E+01	1.274E-02	1.210E-02	7.633E-03	4.860E-04
TOTAL	8.489E+02	6.637E+02	4.196E+02	5.039E+01	1.274E-02	1.210E-02	7.633E-03	4.860E-04

ELEMENTS CONTRIBUTING <0.0100% ARE OMITTED.

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

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

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	2.309E+15	1.687E+15	9.859E+14	1.164E+14	3.239E+10	3.135E+10	2.392E+10	6.472E+09
2.500E-02	5.229E+14	3.821E+14	2.065E+14	2.396E+13	1.083E+10	1.026E+10	6.070E+09	1.552E+08
3.750E-02	5.651E+14	4.030E+14	2.269E+14	2.706E+13	2.517E+09	2.412E+09	1.610E+09	7.728E+07
5.750E-02	4.549E+14	3.264E+14	1.877E+14	2.208E+13	4.668E+09	4.438E+09	2.721E+09	8.082E+07
8.500E-02	3.046E+14	2.095E+14	1.123E+14	1.311E+13	9.287E+09	8.745E+09	4.811E+09	3.540E+07
1.250E-01	3.157E+14	1.862E+14	7.427E+13	8.409E+12	6.621E+08	6.287E+08	3.801E+08	9.253E+06
2.250E-01	2.540E+14	1.753E+14	9.410E+13	1.098E+13	8.710E+08	8.199E+08	4.496E+08	2.777E+06
3.750E-01	1.396E+14	9.581E+13	4.195E+13	4.707E+12	1.853E+10	1.741E+10	9.330E+09	1.823E+07
5.750E-01	2.064E+15	1.939E+15	1.485E+15	1.849E+14	4.114E+10	3.865E+10	2.071E+10	4.048E+07
8.500E-01	6.904E+13	4.814E+13	1.046E+13	7.595E+11	2.059E+09	1.935E+09	1.037E+09	2.026E+06
1.250E+00	2.589E+13	1.675E+13	5.162E+12	2.505E+11	4.999E+08	4.696E+08	2.517E+08	4.918E+05
1.750E+00	2.370E+12	1.273E+12	2.535E+11	1.939E+10	2.132E+04	2.002E+04	1.073E+04	2.097E+01
2.250E+00	8.661E+12	3.580E+12	1.435E+09	2.133E+06	1.078E-03	1.718E-05	1.718E-05	1.718E-05
2.750E+00	4.721E+10	2.304E+10	4.197E+07	8.606E-06	8.606E-06	8.606E-06	8.606E-06	8.606E-06
3.500E+00	5.187E+09	2.608E+09	5.352E+06	6.337E-06	6.337E-06	6.337E-06	6.337E-06	6.337E-06
5.000E+00	0.000E+00	4.381E-07	1.752E-06	1.887E-06	1.887E-06	1.887E-06	1.887E-06	1.887E-06
7.000E+00	0.000E+00	2.843E-08	1.137E-07	1.224E-07	1.224E-07	1.224E-07	1.224E-07	1.224E-07
9.500E+00	0.000E+00	1.798E-09	7.190E-09	7.742E-09	7.742E-09	7.742E-09	7.742E-09	7.742E-09
TOTAL	7.036E+15	5.474E+15	3.430E+15	4.126E+14	1.235E+11	1.171E+11	7.129E+10	6.894E+09

TABLE 19-HANF (MAX). MASS OF ACTIVATION PRODUCTS IN DECAY OF HANFORD HLW GLASS: NUCLIDES

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

GRAMS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
MN 55	0.000E+00	1.319E-02	5.246E-02	5.638E-02	5.638E-02	5.638E-02	5.638E-02	5.638E-02
FE 55	5.638E-02	4.319E-02	3.921E-03	1.489E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO 59	0.000E+00	1.555E-05	1.555E-04	1.555E-03	1.549E-02	1.490E-01	1.040E+00	1.795E+00
CO 60	3.793E-03	3.326E-03	1.018E-03	7.352E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI 59	1.795E+00	1.795E+00	1.795E+00	1.794E+00	1.780E+00	1.646E+00	7.547E-01	3.099E-04
NI 60	0.000E+00	4.675E-04	2.775E-03	3.793E-03	3.793E-03	3.793E-03	3.793E-03	3.793E-03
NI 63	2.545E-01	2.526E-01	2.360E-01	1.198E-01	1.360E-04	4.842E-34	0.000E+00	0.000E+00
CU 63	0.000E+00	1.910E-03	1.847E-02	1.347E-01	2.543E-01	2.545E-01	2.545E-01	2.545E-01
SUM	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00
TOTAL	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00

NUCLIDES CONTRIBUTING <0.1000% ARE OMITTED.

TABLE 20-HANF (MAX). MASS OF ACTIVATION PRODUCTS IN DECAY OF HANFORD HLW GLASS: ELEMENTS

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

GRAMS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
MN	0.000E+00	1.319E-02	5.246E-02	5.638E-02	5.638E-02	5.638E-02	5.638E-02	5.638E-02
FE	5.638E-02	4.319E-02	3.921E-03	1.489E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO	3.793E-03	3.341E-03	1.174E-03	1.555E-03	1.549E-02	1.490E-01	1.040E+00	1.795E+00
NI	2.050E+00	2.048E+00	2.034E+00	1.917E+00	1.784E+00	1.650E+00	7.585E-01	4.103E-03
CU	0.000E+00	1.910E-03	1.847E-02	1.347E-01	2.543E-01	2.545E-01	2.545E-01	2.545E-01
SUM	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00
TOTAL	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00	2.110E+00

ELEMENTS CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
FE 55	1.410E+02	1.080E+02	9.805E+00	3.724E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO 60	4.291E+00	3.762E+00	1.152E+00	8.316E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI 59	1.360E-01	1.360E-01	1.360E-01	1.359E-01	1.348E-01	1.247E-01	5.719E-02	2.348E-05
NI 63	1.570E+01	1.558E+01	1.456E+01	7.392E+00	8.393E-03	0.000E+00	0.000E+00	0.000E+00
IN113M	0.000E+00	2.796E-03	7.066E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SN113	2.520E-02	2.794E-03	7.061E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SUM	1.612E+02	1.275E+02	2.566E+01	7.528E+00	1.432E-01	1.247E-01	5.719E-02	2.348E-05
TOTAL	1.612E+02	1.275E+02	2.566E+01	7.528E+00	1.432E-01	1.247E-01	5.719E-02	2.348E-05

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
FE	1.410E+02	1.080E+02	9.805E+00	3.724E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO	4.291E+00	3.762E+00	1.152E+00	8.316E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI	1.584E+01	1.572E+01	1.470E+01	7.528E+00	1.432E-01	1.247E-01	5.719E-02	2.348E-05
IN	0.000E+00	2.796E-03	7.066E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SN	2.520E-02	2.794E-03	7.061E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SUM	1.612E+02	1.275E+02	2.566E+01	7.528E+00	1.432E-01	1.247E-01	5.719E-02	2.348E-05
TOTAL	1.612E+02	1.275E+02	2.566E+01	7.528E+00	1.432E-01	1.247E-01	5.719E-02	2.348E-05

ELEMENTS CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
FE 55	4.765E-03	3.650E-03	3.313E-04	1.258E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO 60	6.615E-02	5.800E-02	1.775E-02	1.282E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI 59	5.402E-06	5.402E-06	5.402E-06	5.397E-06	5.355E-06	4.954E-06	2.271E-06	9.326E-10
NI 63	1.582E-03	1.570E-03	1.467E-03	7.449E-04	8.457E-07	3.011E-36	0.000E+00	0.000E+00
IN113M	0.000E+00	6.513E-06	1.646E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SN113	4.198E-06	4.654E-07	1.176E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SUM	7.251E-02	6.323E-02	1.956E-02	7.504E-04	6.201E-06	4.954E-06	2.271E-06	9.326E-10
TOTAL	7.251E-02	6.323E-02	1.956E-02	7.504E-04	6.201E-06	4.954E-06	2.271E-06	9.326E-10

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
FE	4.765E-03	3.650E-03	3.313E-04	1.258E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO	6.615E-02	5.800E-02	1.775E-02	1.282E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI	1.588E-03	1.576E-03	1.473E-03	7.503E-04	6.201E-06	4.954E-06	2.271E-06	9.326E-10
IN	0.000E+00	6.513E-06	1.646E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SN	4.198E-06	4.654E-07	1.176E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SUM	7.251E-02	6.323E-02	1.956E-02	7.504E-04	6.201E-06	4.954E-06	2.271E-06	9.326E-10
TOTAL	7.251E-02	6.323E-02	1.956E-02	7.504E-04	6.201E-06	4.954E-06	2.271E-06	9.326E-10

ELEMENTS CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, MAXIMUM CASE (1989), 1650 KG GLASS]

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	1.164E+10	1.056E+10	5.236E+09	1.512E+09	1.717E+06	6.111E-24	0.000E+00	0.000E+00
2.500E-02	2.319E+09	1.543E+09	5.717E+08	9.215E+07	1.046E+05	3.724E-25	0.000E+00	0.000E+00
3.750E-02	8.697E+08	7.671E+08	2.596E+08	1.868E+07	2.120E+04	7.548E-26	0.000E+00	0.000E+00
5.750E-02	9.404E+08	8.249E+08	2.55DE+08	1.891E+06	2.145E+03	7.636E-27	0.000E+00	0.000E+00
8.500E-02	3.682E+08	3.228E+08	9.882E+07	7.136E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1.250E-01	1.414E+08	1.240E+08	3.795E+07	2.741E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2.250E-01	6.887E+07	4.325E+07	1.248E+07	9.013E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
3.750E-01	1.305E+07	1.144E+07	3.501E+06	2.528E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
5.750E-01	7.491E+05	6.568E+05	2.010E+05	1.452E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8.500E-01	1.186E+07	1.039E+07	3.182E+06	2.298E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1.250E+00	3.174E+11	2.783E+11	8.519E+10	6.152E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1.750E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2.250E+00	1.682E+06	1.475E+06	4.515E+05	3.261E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2.750E+00	5.206E+03	4.564E+03	1.397E+03	1.009E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
3.500E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
5.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
7.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9.500E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TOTAL	3.338E+11	2.925E+11	9.167E+10	1.625E+09	1.845E+06	6.567E-24	0.000E+00	0.000E+00

TABLE 1-HANF (NOM.). MASS OF ACTINIDES AND DAUGHTERS IN DECAY OF HANFORD HLW GLASS: NUCLIDES

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

GRAMS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
BI209	0.000E+00	3.922E-15	4.521E-12	4.430E-09	4.718E-06	4.520E-03	1.329E+00	5.897E+01
U233	0.000E+00	7.048E-05	7.216E-04	7.256E-03	8.330E-02	9.263E-01	7.665E+00	1.692E+01
U235	8.834E+01	8.834E+01	8.834E+01	8.839E+01	8.886E+01	9.298E+01	1.060E+02	1.069E+02
U238	1.044E+04	1.044E+04	1.044E+04	1.044E+04	1.044E+04	1.044E+04	1.044E+04	1.044E+04
NP237	2.213E+02	2.214E+02	2.225E+02	2.333E+02	2.863E+02	3.018E+02	2.931E+02	2.190E+02
PU239	1.882E+01	1.882E+01	1.881E+01	1.876E+01	1.830E+01	1.420E+01	1.071E+00	5.904E-12
AM241	8.273E+01	8.260E+01	8.146E+01	7.058E+01	1.667E+01	8.988E-06	0.000E+00	0.000E+00
SUM	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04
TOTAL	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04

NUCLIDES CONTRIBUTING <0.1000% ARE OMITTED.

TABLE 2-HANF (NOM.). MASS OF ACTINIDES AND DAUGHTERS IN DECAY OF HANFORD HLW GLASS: ELEMENTS

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

GRAMS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
HE	0.000E+00	2.256E-03	2.235E-02	2.063E-01	1.114E+00	1.495E+00	2.045E+00	1.014E+01
PB	0.000E+00	8.732E-15	9.063E-12	5.739E-09	1.908E-06	6.128E-04	6.668E-02	1.495E+00
BI	0.000E+00	3.924E-15	4.522E-12	4.430E-09	4.719E-06	4.520E-03	1.329E+00	5.897E+01
TH	0.000E+00	2.379E-06	2.246E-05	2.265E-04	2.448E-03	3.698E-02	4.757E-01	1.190E+00
U	1.053E+04	1.053E+04	1.053E+04	1.053E+04	1.053E+04	1.054E+04	1.056E+04	1.057E+04
NP	2.213E+02	2.214E+02	2.225E+02	2.333E+02	2.863E+02	3.018E+02	2.931E+02	2.190E+02
PU	2.071E+01	2.071E+01	2.067E+01	2.056E+01	1.993E+01	1.484E+01	1.088E+00	3.322E-03
AM	8.292E+01	8.279E+01	8.165E+01	7.077E+01	1.684E+01	7.431E-02	1.585E-05	0.000E+00
CM	6.221E-02	5.983E-02	4.239E-02	1.353E-03	1.483E-18	0.000E+00	0.000E+00	0.000E+00
SUM	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04
TOTAL	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04	1.086E+04

ELEMENTS CONTRIBUTING <0.0001% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL207	0.000E+00	6.347E-11	5.798E-09	2.816E-07	4.001E-06	3.737E-05	1.958E-04	2.306E-04
TL209	0.000E+00	6.961E-13	7.261E-11	7.104E-09	7.672E-07	6.806E-05	1.464E-03	3.560E-03
PB209	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
PB210	0.000E+00	9.020E-14	8.534E-11	4.909E-08	7.937E-06	3.155E-04	2.722E-03	3.614E-03
PB211	0.000E+00	6.365E-11	5.814E-09	2.824E-07	4.012E-06	3.747E-05	1.963E-04	2.312E-04
PB214	0.000E+00	8.910E-12	8.906E-10	8.848E-08	7.939E-06	3.156E-04	2.723E-03	3.614E-03
BI210	0.000E+00	9.020E-14	8.535E-11	4.909E-08	7.937E-06	3.155E-04	2.722E-03	3.614E-03
BI211	0.000E+00	6.365E-11	5.814E-09	2.824E-07	4.012E-06	3.747E-05	1.963E-04	2.312E-04
BI213	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
BI214	0.000E+00	8.910E-12	8.906E-10	8.848E-08	7.939E-06	3.156E-04	2.723E-03	3.614E-03
PO210	0.000E+00	2.924E-14	8.535E-11	4.909E-08	7.937E-06	3.155E-04	2.722E-03	3.614E-03
PO213	0.000E+00	3.153E-11	3.289E-09	3.218E-07	3.475E-05	3.083E-03	6.630E-02	1.612E-01
PO214	0.000E+00	8.908E-12	8.904E-10	8.846E-08	7.937E-06	3.155E-04	2.722E-03	3.614E-03
PO215	0.000E+00	6.365E-11	5.814E-09	2.824E-07	4.012E-06	3.747E-05	1.963E-04	2.312E-04
PO218	0.000E+00	8.912E-12	8.907E-10	8.849E-08	7.940E-06	3.156E-04	2.723E-03	3.615E-03
AT217	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
RN219	0.000E+00	6.365E-11	5.814E-09	2.824E-07	4.012E-06	3.747E-05	1.963E-04	2.312E-04
RN222	0.000E+00	8.912E-12	8.907E-10	8.849E-08	7.940E-06	3.156E-04	2.723E-03	3.615E-03
FR221	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
RA223	0.000E+00	6.365E-11	5.814E-09	2.824E-07	4.012E-06	3.747E-05	1.963E-04	2.312E-04
RA225	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
RA226	0.000E+00	8.912E-12	8.907E-10	8.849E-08	7.940E-06	3.156E-04	2.723E-03	3.615E-03
AC225	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
AC227	0.000E+00	6.365E-11	5.811E-09	2.824E-07	4.012E-06	3.747E-05	1.963E-04	2.312E-04
TH227	0.000E+00	6.277E-11	5.734E-09	2.785E-07	3.957E-06	3.695E-05	1.936E-04	2.280E-04
TH229	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
TH230	0.000E+00	4.115E-08	4.120E-07	4.157E-06	4.219E-05	4.055E-04	2.701E-03	3.614E-03
TH231	0.000E+00	1.910E-04	1.910E-04	1.911E-04	1.922E-04	2.011E-04	2.291E-04	2.312E-04
TH234	0.000E+00	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.510E-03
PA231	0.000E+00	4.041E-09	4.046E-08	4.039E-07	4.011E-06	3.746E-05	1.963E-04	2.312E-04
PA233	0.000E+00	1.561E-01	1.569E-01	1.645E-01	2.019E-01	2.128E-01	2.067E-01	1.544E-01
PA234M	0.000E+00	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.510E-03
U233	0.000E+00	6.825E-07	6.988E-06	7.027E-05	8.067E-04	8.970E-03	7.423E-02	1.639E-01
U234	4.571E-03	4.572E-03	4.583E-03	4.657E-03	4.727E-03	4.696E-03	4.429E-03	3.582E-03
U235	1.910E-04	1.910E-04	1.910E-04	1.911E-04	1.922E-04	2.011E-04	2.291E-04	2.312E-04
U236	4.211E-04	4.211E-04	4.212E-04	4.222E-04	4.325E-04	4.952E-04	5.331E-04	5.191E-04

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
U238	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.510E-03
NP237	1.560E-01	1.561E-01	1.569E-01	1.645E-01	2.019E-01	2.128E-01	2.067E-01	1.544E-01
NP239	0.000E+00	3.790E-02	3.787E-02	3.755E-02	3.451E-02	1.482E-02	3.161E-06	0.000E+00
PU238	4.431E-01	4.403E-01	4.103E-01	2.015E-01	1.647E-04	0.000E+00	0.000E+00	0.000E+00
PU239	1.170E+00	1.170E+00	1.170E+00	1.167E+00	1.138E+00	8.833E-01	6.660E-02	3.671E-13
PU240	3.931E-01	3.935E-01	3.971E-01	4.024E-01	3.661E-01	1.410E-01	1.011E-05	0.000E+00
PU241	1.260E+01	1.201E+01	7.787E+00	1.023E-01	1.564E-20	0.000E+00	0.000E+00	0.000E+00
PU242	7.611E-05	7.611E-05	7.611E-05	7.609E-05	7.597E-05	7.476E-05	6.362E-05	1.269E-05
AM241	2.840E+02	2.836E+02	2.797E+02	2.423E+02	5.722E+01	3.086E-05	0.000E+00	0.000E+00
AM242	2.210E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
AM243	3.791E-02	3.790E-02	3.787E-02	3.755E-02	3.451E-02	1.482E-02	3.161E-06	0.000E+00
CM242	1.820E-01	3.874E-02	3.346E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CM244	5.031E+00	4.842E+00	3.431E+00	1.095E-01	1.200E-16	0.000E+00	0.000E+00	0.000E+00
SUM	3.043E+02	3.029E+02	2.933E+02	2.447E+02	5.922E+01	1.534E+00	1.141E+00	1.844E+00
TOTAL	3.043E+02	3.029E+02	2.933E+02	2.447E+02	5.922E+01	1.534E+00	1.141E+00	1.844E+00

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL	0.000E+00	6.416E-11	5.870E-09	2.887E-07	4.768E-06	1.054E-04	1.659E-03	3.790E-03
PB	0.000E+00	1.049E-10	1.015E-08	7.489E-07	5.541E-05	3.819E-03	7.340E-02	1.723E-01
BI	0.000E+00	1.049E-10	1.015E-08	7.489E-07	5.541E-05	3.819E-03	7.340E-02	1.723E-01
PO	0.000E+00	1.132E-10	1.099E-08	8.310E-07	6.259E-05	4.067E-03	7.466E-02	1.723E-01
AT	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
RN	0.000E+00	7.256E-11	6.705E-09	3.709E-07	1.195E-05	3.531E-04	2.920E-03	3.846E-03
FR	0.000E+00	3.311E-11	3.442E-09	3.328E-07	3.558E-05	3.151E-03	6.776E-02	1.648E-01
RA	0.000E+00	1.048E-10	1.007E-08	6.998E-07	4.747E-05	3.504E-03	7.068E-02	1.686E-01
AC	0.000E+00	9.587E-11	9.173E-09	6.113E-07	3.953E-05	3.188E-03	6.796E-02	1.650E-01
TH	0.000E+00	3.702E-03	3.702E-03	3.706E-03	3.784E-03	7.305E-03	7.439E-02	1.724E-01
PA	0.000E+00	1.596E-01	1.605E-01	1.680E-01	2.054E-01	2.164E-01	2.104E-01	1.582E-01
U	8.693E-03	8.990E-03	8.904E-03	8.854E-03	9.669E-03	1.787E-02	8.293E-02	1.717E-01
NP	1.560E-01	1.940E-01	1.948E-01	2.021E-01	2.364E-01	2.276E-01	2.067E-01	1.544E-01
PU	1.461E+01	1.401E+01	9.764E+00	1.873E+00	1.504E+00	1.024E+00	6.667E-02	1.269E-05
AM	2.843E+02	2.836E+02	2.797E+02	2.424E+02	5.726E+01	1.485E-02	3.161E-06	0.000E+00
CM	5.213E+00	4.881E+00	3.431E+00	1.095E-01	1.200E-16	0.000E+00	0.000E+00	0.000E+00
SUM	3.043E+02	3.029E+02	2.933E+02	2.447E+02	5.922E+01	1.534E+00	1.141E+00	1.844E+00
TOTAL	3.043E+02	3.029E+02	2.933E+02	2.447E+02	5.922E+01	1.534E+00	1.141E+00	1.844E+00

ELEMENTS CONTRIBUTING <0.0001% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL207	0.000E+00	1.864E-13	1.703E-11	8.270E-10	1.175E-08	1.097E-07	5.749E-07	6.771E-07
TL209	0.000E+00	1.157E-14	1.206E-12	1.180E-10	1.275E-08	1.131E-06	2.432E-05	5.914E-05
PB209	0.000E+00	3.706E-14	3.865E-12	3.782E-10	4.085E-08	3.623E-06	7.792E-05	1.895E-04
PB210	0.000E+00	2.089E-17	1.977E-14	1.137E-11	1.839E-09	7.309E-08	6.306E-07	8.371E-07
PB211	0.000E+00	1.907E-13	1.742E-11	8.463E-10	1.202E-08	1.123E-07	5.882E-07	6.928E-07
PB214	0.000E+00	2.842E-14	2.840E-12	2.822E-10	2.532E-08	1.006E-06	8.683E-06	1.153E-05
BI210	0.000E+00	2.080E-16	1.968E-13	1.132E-10	1.830E-08	7.275E-07	6.277E-06	8.332E-06
BI211	0.000E+00	2.539E-12	2.319E-10	1.127E-08	1.600E-07	1.495E-06	7.830E-06	9.222E-06
BI213	0.000E+00	1.355E-13	1.413E-11	1.383E-09	1.493E-07	1.325E-05	2.849E-04	6.928E-04
BI214	0.000E+00	1.142E-13	1.141E-11	1.134E-09	1.017E-07	4.044E-06	3.489E-05	4.632E-05
PO210	0.000E+00	9.372E-16	2.736E-12	1.574E-09	2.544E-07	1.011E-05	8.726E-05	1.158E-04
PO213	0.000E+00	1.596E-12	1.664E-10	1.628E-08	1.759E-06	1.560E-04	3.355E-03	8.159E-03
PO214	0.000E+00	4.136E-13	4.134E-11	4.107E-09	3.685E-07	1.465E-05	1.264E-04	1.678E-04
PO215	0.000E+00	2.841E-12	2.595E-10	1.261E-08	1.791E-07	1.673E-06	8.764E-06	1.032E-05
PO218	0.000E+00	3.229E-13	3.228E-11	3.207E-09	2.877E-07	1.144E-05	9.868E-05	1.310E-04
AT217	0.000E+00	1.375E-12	1.434E-10	1.403E-08	1.516E-06	1.345E-04	2.892E-03	7.032E-03
RN219	0.000E+00	2.641E-12	2.412E-10	1.172E-08	1.665E-07	1.555E-06	8.146E-06	9.594E-06
RN222	0.000E+00	2.953E-13	2.952E-11	2.932E-09	2.631E-07	1.046E-05	9.024E-05	1.198E-04
FR221	0.000E+00	1.244E-12	1.297E-10	1.269E-08	1.371E-06	1.216E-04	2.615E-03	6.360E-03
RA223	0.000E+00	2.266E-12	2.070E-10	1.006E-08	1.429E-07	1.334E-06	6.990E-06	8.233E-06
RA225	0.000E+00	2.260E-14	2.357E-12	2.306E-10	2.491E-08	2.210E-06	4.752E-05	1.156E-04
RA226	0.000E+00	2.573E-13	2.572E-11	2.555E-09	2.293E-07	9.114E-06	7.863E-05	1.044E-04
AC225	0.000E+00	1.126E-12	1.174E-10	1.149E-08	1.241E-06	1.101E-04	2.367E-03	5.757E-03
TH227	0.000E+00	2.291E-12	2.093E-10	1.017E-08	1.444E-07	1.349E-06	7.066E-06	8.322E-06
TH229	0.000E+00	9.859E-13	1.028E-10	1.006E-08	1.087E-06	9.639E-05	2.073E-03	5.041E-03
TH230	0.000E+00	1.164E-09	1.166E-08	1.176E-07	1.194E-06	1.148E-05	7.642E-05	1.023E-04
TH234	0.000E+00	1.423E-06	1.423E-06	1.423E-06	1.423E-06	1.423E-06	1.423E-06	1.423E-06
PA231	0.000E+00	1.218E-10	1.219E-09	1.217E-08	1.208E-07	1.129E-06	5.914E-06	6.966E-06
PA233	0.000E+00	3.543E-04	3.562E-04	3.734E-04	4.582E-04	4.830E-04	4.691E-04	3.505E-04
PA234M	0.000E+00	1.735E-05	1.735E-05	1.735E-05	1.735E-05	1.735E-05	1.735E-05	1.735E-05
U233	0.000E+00	1.984E-08	2.031E-07	2.043E-06	2.345E-05	2.607E-04	2.158E-03	4.763E-03
U234	1.316E-04	1.317E-04	1.320E-04	1.341E-04	1.361E-04	1.353E-04	1.276E-04	1.032E-04
U235	5.003E-06	5.003E-06	5.003E-06	5.006E-06	5.032E-06	5.266E-06	6.001E-06	6.055E-06
U236	1.141E-05	1.141E-05	1.141E-05	1.144E-05	1.172E-05	1.341E-05	1.444E-05	1.406E-05
U238	8.904E-05	8.904E-05	8.904E-05	8.904E-05	8.904E-05	8.904E-05	8.904E-05	8.903E-05
NP237	4.769E-03	4.771E-03	4.797E-03	5.029E-03	6.170E-03	6.504E-03	6.317E-03	4.720E-03

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
NP239	0.000E+00	9.162E-05	9.154E-05	9.077E-05	8.341E-05	3.582E-05	7.641E-09	0.000E+00
PU238	1.468E-02	1.459E-02	1.360E-02	6.678E-03	5.457E-06	7.246E-37	0.000E+00	0.000E+00
PU239	3.606E-02	3.606E-02	3.605E-02	3.596E-02	3.507E-02	2.722E-02	2.052E-03	1.131E-14
PU240	1.224E-02	1.225E-02	1.236E-02	1.253E-02	1.140E-02	4.390E-03	3.147E-07	0.000E+00
PU241	3.907E-04	3.723E-04	2.414E-04	3.171E-06	4.849E-25	0.000E+00	0.000E+00	0.000E+00
PU242	2.248E-06	2.248E-06	2.248E-06	2.247E-06	2.244E-06	2.208E-06	1.879E-06	3.747E-07
AM241	9.436E+00	9.421E+00	9.291E+00	8.050E+00	1.901E+00	1.025E-06	0.000E+00	0.000E+00
AM242	2.509E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
AM243	1.218E-03	1.218E-03	1.217E-03	1.207E-03	1.109E-03	4.764E-04	1.016E-07	0.000E+00
CM242	6.707E-03	1.427E-03	1.233E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CM244	1.760E-01	1.694E-01	1.200E-01	3.830E-03	4.198E-18	0.000E+00	0.000E+00	0.000E+00
SUM	9.688E+00	9.662E+00	9.480E+00	8.116E+00	1.956E+00	4.036E-02	2.564E-02	4.433E-02
TOTAL	9.688E+00	9.662E+00	9.480E+00	8.116E+00	1.956E+00	4.036E-02	2.564E-02	4.433E-02

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
TL	0.000E+00	1.979E-13	1.823E-11	9.451E-10	2.450E-08	1.241E-06	2.489E-05	5.982E-05
PB	0.000E+00	2.562E-13	2.415E-11	1.518E-09	8.003E-08	4.815E-06	8.782E-05	2.026E-04
BI	0.000E+00	2.789E-12	2.576E-10	1.389E-08	4.294E-07	1.951E-05	3.339E-04	7.567E-04
PO	0.000E+00	5.182E-12	5.031E-10	3.781E-08	2.849E-06	1.939E-04	3.676E-03	8.584E-03
AT	0.000E+00	1.375E-12	1.434E-10	1.403E-08	1.516E-06	1.345E-04	2.892E-03	7.032E-03
RN	0.000E+00	2.936E-12	2.708E-10	1.465E-08	4.296E-07	1.201E-05	9.838E-05	1.294E-04
FR	0.000E+00	1.246E-12	1.299E-10	1.270E-08	1.371E-06	1.216E-04	2.615E-03	6.360E-03
RA	0.000E+00	2.546E-12	2.351E-10	1.284E-08	3.970E-07	1.266E-05	1.331E-04	2.282E-04
AC	0.000E+00	1.157E-12	1.202E-10	1.163E-08	1.243E-06	1.101E-04	2.367E-03	5.757E-03
TH	0.000E+00	1.532E-06	1.543E-06	1.668E-06	3.956E-06	1.108E-04	2.158E-03	5.154E-03
PA	0.000E+00	3.718E-04	3.736E-04	3.909E-04	4.757E-04	5.015E-04	4.925E-04	3.749E-04
U	2.371E-04	2.377E-04	2.380E-04	2.417E-04	2.654E-04	5.037E-04	2.395E-03	4.976E-03
NP	4.769E-03	4.863E-03	4.888E-03	5.119E-03	6.253E-03	6.540E-03	6.317E-03	4.720E-03
PU	6.338E-02	6.328E-02	6.226E-02	5.518E-02	4.648E-02	3.161E-02	2.055E-03	3.747E-07
AM	9.437E+00	9.422E+00	9.292E+00	8.051E+00	1.902E+00	4.774E-04	1.016E-07	0.000E+00
CM	1.827E-01	1.708E-01	1.200E-01	3.830E-03	4.198E-18	0.000E+00	0.000E+00	0.000E+00
SUM	9.688E+00	9.662E+00	9.480E+00	8.116E+00	1.956E+00	4.036E-02	2.564E-02	4.433E-02
TOTAL	9.688E+00	9.662E+00	9.480E+00	8.116E+00	1.956E+00	4.036E-02	2.564E-02	4.433E-02

ELEMENTS CONTRIBUTING <0.0001% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
BI211	0.000E+00	6.347E-11	5.798E-09	2.816E-07	4.001E-06	3.737E-05	1.958E-04	2.306E-04
BI213	0.000E+00	6.961E-13	7.261E-11	7.104E-09	7.672E-07	6.806E-05	1.464E-03	3.560E-03
PO210	0.000E+00	2.924E-14	8.535E-11	4.909E-08	7.937E-06	3.155E-04	2.722E-03	3.614E-03
PO213	0.000E+00	3.153E-11	3.289E-09	3.218E-07	3.475E-05	3.083E-03	6.630E-02	1.612E-01
PO214	0.000E+00	8.908E-12	8.904E-10	8.846E-08	7.937E-06	3.155E-04	2.722E-03	3.614E-03
PO215	0.000E+00	6.365E-11	5.814E-09	2.824E-07	4.012E-06	3.747E-05	1.963E-04	2.312E-04
PO218	0.000E+00	8.910E-12	8.906E-10	8.848E-08	7.939E-06	3.156E-04	2.723E-03	3.614E-03
AT217	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
RN219	0.000E+00	6.365E-11	5.814E-09	2.824E-07	4.012E-06	3.747E-05	1.963E-04	2.312E-04
RN222	0.000E+00	8.912E-12	8.907E-10	8.849E-08	7.940E-06	3.156E-04	2.723E-03	3.615E-03
FR221	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
RA223	0.000E+00	6.365E-11	5.814E-09	2.824E-07	4.012E-06	3.747E-05	1.963E-04	2.312E-04
RA226	0.000E+00	8.912E-12	8.907E-10	8.849E-08	7.940E-06	3.156E-04	2.723E-03	3.615E-03
AC225	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
TH227	0.000E+00	6.277E-11	5.734E-09	2.785E-07	3.957E-06	3.695E-05	1.936E-04	2.280E-04
TH229	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
TH230	0.000E+00	4.115E-08	4.120E-07	4.157E-06	4.219E-05	4.055E-04	2.701E-03	3.614E-03
PA231	0.000E+00	4.041E-09	4.046E-08	4.039E-07	4.011E-06	3.746E-05	1.963E-04	2.312E-04
U233	0.000E+00	6.825E-07	6.988E-06	7.027E-05	8.067E-04	8.970E-03	7.423E-02	1.639E-01
U234	4.571E-03	4.572E-03	4.583E-03	4.657E-03	4.727E-03	4.696E-03	4.429E-03	3.582E-03
U235	1.910E-04	1.910E-04	1.910E-04	1.911E-04	1.922E-04	2.011E-04	2.291E-04	2.312E-04
U236	4.211E-04	4.211E-04	4.212E-04	4.222E-04	4.325E-04	4.952E-04	5.331E-04	5.191E-04
U238	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.511E-03	3.510E-03
NP237	1.560E-01	1.561E-01	1.569E-01	1.645E-01	2.019E-01	2.128E-01	2.067E-01	1.544E-01
PU238	4.431E-01	4.403E-01	4.103E-01	2.015E-01	1.647E-04	0.000E+00	0.000E+00	0.000E+00
PU239	1.170E+00	1.170E+00	1.170E+00	1.167E+00	1.138E+00	8.833E-01	6.660E-02	3.671E-13
PU240	3.931E-01	3.935E-01	3.971E-01	4.024E-01	3.661E-01	1.410E-01	1.011E-05	0.000E+00
PU242	7.611E-05	7.611E-05	7.611E-05	7.609E-05	7.597E-05	7.476E-05	6.362E-05	1.269E-05
AM241	2.840E+02	2.836E+02	2.797E+02	2.423E+02	5.722E+01	3.086E-05	0.000E+00	0.000E+00
AM243	3.791E-02	3.790E-02	3.787E-02	3.755E-02	3.451E-02	1.482E-02	3.161E-06	0.000E+00
CM242	1.820E-01	3.874E-02	3.346E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CM244	5.031E+00	4.842E+00	3.431E+00	1.095E-01	1.200E-16	0.000E+00	0.000E+00	0.000E+00
SUM	2.915E+02	2.907E+02	2.853E+02	2.444E+02	5.898E+01	1.288E+00	7.126E-01	1.173E+00
TOTAL	2.915E+02	2.907E+02	2.853E+02	2.444E+02	5.898E+01	1.288E+00	7.126E-01	1.173E+00

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
BI	0.000E+00	6.417E-11	5.871E-09	2.888E-07	4.770E-06	1.055E-04	1.660E-03	3.791E-03
PO	0.000E+00	1.132E-10	1.099E-08	8.310E-07	6.259E-05	4.067E-03	7.466E-02	1.723E-01
AT	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
RN	0.000E+00	7.256E-11	6.705E-09	3.709E-07	1.195E-05	3.531E-04	2.920E-03	3.846E-03
FR	0.000E+00	3.223E-11	3.361E-09	3.289E-07	3.552E-05	3.151E-03	6.776E-02	1.648E-01
RA	0.000E+00	7.256E-11	6.705E-09	3.709E-07	1.195E-05	3.531E-04	2.920E-03	3.846E-03
AC	0.000E+00	3.311E-11	3.442E-09	3.328E-07	3.558E-05	3.151E-03	6.776E-02	1.648E-01
TH	0.000E+00	4.124E-08	4.211E-07	4.764E-06	8.167E-05	3.593E-03	7.065E-02	1.686E-01
PA	0.000E+00	4.041E-09	4.046E-08	4.039E-07	4.011E-06	3.746E-05	1.963E-04	2.312E-04
U	8.693E-03	8.695E-03	8.713E-03	8.852E-03	9.669E-03	1.787E-02	8.293E-02	1.717E-01
NP	1.560E-01	1.561E-01	1.569E-01	1.645E-01	2.019E-01	2.128E-01	2.067E-01	1.544E-01
PU	2.007E+00	2.004E+00	1.977E+00	1.771E+00	1.504E+00	1.024E+00	6.667E-02	1.269E-05
AM	2.841E+02	2.836E+02	2.797E+02	2.424E+02	5.726E+01	1.485E-02	3.161E-06	0.000E+00
CM	5.213E+00	4.881E+00	3.431E+00	1.095E-01	1.200E-16	0.000E+00	0.000E+00	0.000E+00
SUM	2.915E+02	2.907E+02	2.853E+02	2.444E+02	5.898E+01	1.288E+00	7.126E-01	1.173E+00
TOTAL	2.915E+02	2.907E+02	2.853E+02	2.444E+02	5.898E+01	1.288E+00	7.126E-01	1.173E+00

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

NEUTRONS/SEC

	IMMOBLZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KYR	100.0KYR	1.0MYR
PO210	0.000E-01	1.086E-09	3.171E-06	1.824E-03	2.949E-01	1.172E+01	1.011E+02	1.343E+02
PO213	0.000E-01	5.405E-06	5.639E-04	5.517E-02	5.958E+00	5.285E+02	1.137E+04	2.764E+04
PO214	0.000E-01	1.206E-06	1.205E-04	1.197E-02	1.074E+00	4.270E+01	3.684E+02	4.892E+02
PO218	0.000E-01	5.090E-07	5.088E-05	5.055E-03	4.535E-01	1.803E+01	1.556E+02	2.065E+02
AT217	0.000E-01	3.277E-06	3.417E-04	3.344E-02	3.611E+00	3.203E+02	6.889E+03	1.675E+04
RN222	0.000E-01	3.729E-07	3.727E-05	3.703E-03	3.322E-01	1.321E+01	1.139E+02	1.513E+02
FR221	0.000E-01	2.262E-06	2.359E-04	2.308E-02	2.493E+00	2.211E+02	4.756E+03	1.157E+04
RA226	0.000E-01	2.193E-07	2.192E-05	2.178E-03	1.954E-01	7.766E+00	6.701E+01	8.896E+01
AC225	0.000E-01	1.599E-06	1.667E-04	1.632E-02	1.762E+00	1.563E+02	3.362E+03	8.176E+03
TH229	0.000E-01	8.537E-07	8.903E-05	8.712E-03	9.409E-01	8.346E+01	1.795E+03	4.365E+03
TH230	0.000E-01	9.167E-04	9.178E-03	9.261E-02	9.399E-01	9.033E+00	6.017E+01	8.051E+01
U233	0.000E-01	1.738E-02	1.779E-01	1.789E+00	2.054E+01	2.284E+02	1.890E+03	4.173E+03
U234	1.124E+02	1.124E+02	1.127E+02	1.145E+02	1.162E+02	1.155E+02	1.089E+02	8.807E+01
U238	4.834E+01	4.834E+01	4.834E+01	4.834E+01	4.834E+01	4.834E+01	4.834E+01	4.833E+01
NP237	3.792E+03	3.795E+03	3.814E+03	3.999E+03	4.908E+03	5.173E+03	5.025E+03	3.753E+03
PU238	1.866E+04	1.855E+04	1.728E+04	8.487E+03	6.937E+00	0.000E-01	0.000E-01	0.000E-01
PU239	3.890E+04	3.890E+04	3.890E+04	3.880E+04	3.783E+04	2.936E+04	2.214E+03	1.220E-08
PU240	1.312E+04	1.313E+04	1.325E+04	1.343E+04	1.222E+04	4.706E+03	3.374E-01	0.000E-01
PU242	2.062E+00	2.062E+00	2.062E+00	2.061E+00	2.058E+00	2.025E+00	1.723E+00	3.438E-01
AM241	1.182E+07	1.180E+07	1.164E+07	1.008E+07	2.381E+06	1.284E+00	0.000E-01	0.000E-01
CM242	1.106E+04	2.354E+03	2.033E-03	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01
CM244	2.571E+05	2.475E+05	1.754E+05	5.596E+03	6.133E-12	0.000E-01	0.000E-01	0.000E-01
CM246	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01
TOTAL	1.216E+07	1.213E+07	1.189E+07	1.015E+07	2.436E+06	4.105E+04	3.832E+04	7.771E+04

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

NEUTRONS/SEC

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
U238	1.324E+02	1.324E+02	1.324E+02	1.324E+02	1.324E+D2	1.324E+02	1.324E+02	1.324E+02
PU238	6.874E+01	6.832E+01	6.366E+01	3.127E+01	2.555E-02	3.392E-33	0.000E+00	0.000E+00
PU240	1.570E+03	1.572E+03	1.586E+03	1.607E+03	1.462E+03	5.631E+02	4.037E-02	0.000E+00
PU242	3.359E+01	3.359E+01	3.359E+01	3.358E+01	3.353E+01	3.299E+01	2.808E+01	5.599E+00
AM241	1.026E+02	1.025E+02	1.011E+02	8.756E+01	2.068E+01	1.115E-05	0.000E+00	0.000E+00
CM242	1.186E+03	2.523E+02	2.179E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CM244	6.912E+05	6.652E+05	4.714E+05	1.504E+04	1.649E-11	0.000E+00	0.000E+00	0.000E+00
SUM	6.943E+05	6.674E+05	4.733E+05	1.694E+04	1.650E+03	7.292E+02	1.607E+02	1.381E+02
TOTAL	6.943E+05	6.674E+05	4.733E+05	1.694E+04	1.650E+03	7.292E+02	1.607E+02	1.381E+02

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

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	2.369E+12	2.363E+12	2.323E+12	1.998E+12	4.850E+11	1.548E+10	1.699E+10	2.128E+10
2.500E-02	2.666E+11	2.661E+11	2.625E+11	2.276E+11	5.450E+10	9.945E+08	1.178E+09	1.253E+09
3.750E-02	2.199E+10	2.191E+10	2.160E+10	1.869E+10	4.515E+09	1.360E+08	1.214E+09	2.880E+09
5.750E-02	3.909E+12	3.903E+12	3.849E+12	3.335E+12	7.876E+11	1.390E+08	3.315E+08	6.136E+08
8.500E-02	4.949E+09	6.622E+09	6.601E+09	6.398E+09	5.359E+09	4.603E+09	6.008E+09	7.872E+09
1.250E-01	3.233E+09	3.670E+09	3.637E+09	3.333E+09	1.811E+09	1.018E+09	1.055E+09	1.358E+09
2.250E-01	2.289E+08	7.435E+08	7.405E+08	7.221E+08	6.271E+08	4.064E+08	9.319E+08	1.908E+09
3.750E-01	1.380E+08	2.487E+09	2.497E+09	2.592E+09	3.053E+09	3.208E+09	3.928E+09	4.360E+09
5.750E-01	7.296E+07	7.473E+07	7.372E+07	6.418E+07	1.707E+07	1.104E+07	1.113E+08	2.071E+08
8.500E-01	2.238E+07	2.347E+07	2.288E+07	1.939E+07	5.518E+06	3.191E+06	2.394E+07	4.152E+07
1.250E+00	5.033E+05	1.306E+06	1.171E+06	8.526E+05	9.328E+05	5.219E+06	4.394E+07	6.762E+07
1.750E+00	2.458E+05	3.633E+05	2.974E+05	1.424E+05	2.358E+05	5.594E+06	7.622E+07	1.545E+08
2.250E+00	1.416E+05	1.363E+05	9.811E+04	8.029E+03	2.645E+04	9.936E+05	8.571E+06	1.138E+07
2.750E+00	8.168E+04	7.860E+04	5.646E+04	4.161E+03	1.200E+03	1.740E+04	1.491E+05	1.982E+05
3.500E+00	7.314E+04	7.037E+04	5.044E+04	3.381E+03	6.822E+02	3.350E+03	2.803E+04	3.719E+04
5.000E+00	3.105E+04	2.987E+04	2.134E+04	1.240E+03	2.075E+02	4.407E+01	1.101E+01	1.063E+01
7.000E+00	3.553E+03	3.417E+03	2.434E+03	1.191E+02	1.815E+01	4.949E+00	1.199E+00	1.110E+00
9.500E+00	4.064E+02	3.907E+02	2.778E+02	1.210E+01	1.703E+00	5.610E-01	1.332E-01	1.200E-01
TOTAL	6.574E+12	6.568E+12	6.469E+12	5.592E+12	1.342E+12	2.601E+10	3.190E+10	4.201E+10

TABLE 12-HANF (NOM.). MASS OF FISSION PRODUCTS IN DECAY OF HANFORD HLW GLASS: NUCLIDES

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

GRAMS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SR 90	2.184E+02	2.133E+02	1.721E+02	2.021E+01	1.005E-08	0.000E+00	0.000E+00	0.000E+00
ZR 90	0.000E+00	5.138E+00	4.627E+01	1.982E+02	2.185E+02	2.185E+02	2.185E+02	2.185E+02
ZR 93	4.178E+02	4.178E+02	4.178E+02	4.178E+02	4.176E+02	4.159E+02	3.993E+02	2.656E+02
NB 93	0.000E+00	1.222E-04	1.354E-03	1.759E-02	1.879E-01	1.887E+00	1.850E+01	1.522E+02
TC 99	4.429E+02	4.429E+02	4.428E+02	4.427E+02	4.414E+02	4.287E+02	3.198E+02	1.710E+01
RU 99	0.000E+00	1.441E-03	1.441E-02	1.441E-01	1.439E+00	1.418E+01	1.230E+02	4.258E+02
PD107	5.870E+01	5.870E+01	5.870E+01	5.870E+01	5.870E+01	5.864E+01	5.808E+01	5.276E+01
AG107	0.000E+00	6.264E-06	6.264E-05	6.264E-04	6.263E-03	6.260E-02	6.230E-01	5.941E+00
SN126	1.286E+01	1.286E+01	1.286E+01	1.285E+01	1.277E+01	1.200E+01	6.431E+00	1.257E-02
TE126	0.000E+00	8.914E-05	8.914E-04	8.911E-03	8.884E-02	8.613E-01	6.431E+00	1.285E+01
CS135	1.754E+02	1.754E+02	1.754E+02	1.754E+02	1.753E+02	1.749E+02	1.702E+02	1.298E+02
BA135	0.000E+00	5.286E-05	5.286E-04	5.286E-03	5.285E-02	5.278E-01	5.207E+00	4.564E+01
CS137	4.149E+02	4.054E+02	3.293E+02	4.116E+01	3.831E-08	0.000E+00	0.000E+00	0.000E+00
BA137	0.000E+00	9.477E+00	8.560E+01	3.737E+02	4.149E+02	4.149E+02	4.149E+02	4.149E+02
PM147	5.619E+00	4.314E+00	4.001E-01	1.884E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SM147	0.000E+00	1.305E+00	5.219E+00	5.619E+00	5.619E+00	5.619E+00	5.619E+00	5.619E+00
SM151	2.652E+01	2.632E+01	2.456E+01	1.228E+01	1.199E-02	9.413E-33	0.000E+00	0.000E+00
EU151	0.000E+00	2.035E-01	1.966E+00	1.425E+01	2.651E+01	2.652E+01	2.652E+01	2.652E+01
SUM	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03
TOTAL	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03

NUCLIDES CONTRIBUTING <0.1000% ARE OMITTED.

TABLE 13-HANF (NOM.). MASS OF FISSION PRODUCTS IN DECAY OF HANFORD HLW GLASS: ELEMENTS

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

GRAMS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SR	2.184E+02	2.133E+02	1.721E+02	2.021E+01	1.005E-08	0.000E+00	0.000E+00	0.000E+00
ZR	4.178E+02	4.229E+02	4.641E+02	6.160E+02	6.361E+02	6.344E+02	6.177E+02	4.840E+02
NB	2.179E-03	2.368E-03	4.072E-03	2.111E-02	1.914E-01	1.891E+00	1.851E+01	1.522E+02
TC	4.429E+02	4.429E+02	4.428E+02	4.427E+02	4.414E+02	4.287E+02	3.198E+02	1.710E+01
RU	1.249E-02	7.721E-03	1.442E-02	1.441E-01	1.439E+00	1.418E+01	1.230E+02	4.258E+02
PD	5.870E+01	5.871E+01	5.871E+01	5.871E+01	5.871E+01	5.865E+01	5.809E+01	5.277E+01
AG	4.672E-07	6.433E-06	6.264E-05	6.264E-04	6.263E-03	6.260E-02	6.230E-01	5.941E+00
SN	1.286E+01	1.286E+01	1.286E+01	1.285E+01	1.277E+01	1.200E+01	6.431E+00	1.257E-02
SB	2.459E-01	1.915E-01	2.031E-02	9.849E-04	1.313E-03	1.313E-03	1.312E-03	1.312E-03
TE	3.441E-03	5.798E-02	2.301E-01	2.583E-01	3.382E-01	1.111E+00	6.680E+00	1.310E+01
CS	5.904E+02	5.809E+02	5.047E+02	2.165E+02	1.753E+02	1.749E+02	1.702E+02	1.298E+02
BA	6.319E-05	9.497E+00	8.567E+01	3.738E+02	4.150E+02	4.155E+02	4.202E+02	4.606E+02
PM	5.619E+00	4.314E+00	4.001E-01	1.884E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SM	2.652E+01	2.763E+01	2.978E+01	1.790E+01	5.637E+00	5.625E+00	5.625E+00	5.625E+00
EU	8.396E-01	9.627E-01	2.284E+00	1.425E+01	2.651E+01	2.652E+01	2.652E+01	2.652E+01
GD	3.827E-09	8.011E-02	5.198E-01	8.336E-01	8.338E-01	8.338E-01	8.338E-01	8.338E-01
SUM	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03
TOTAL	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03	1.774E+03

ELEMENTS CONTRIBUTING <0.0100% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE 79	3.150E-03	3.150E-03	3.150E-03	3.147E-03	3.117E-03	2.832E-03	1.084E-03	7.319E-08
SR 90	2.980E+04	2.910E+04	2.349E+04	2.758E+03	1.371E-06	0.000E+00	0.000E+00	0.000E+00
Y 90	2.980E+04	2.911E+04	2.350E+04	2.759E+03	1.372E-06	0.000E+00	0.000E+00	0.000E+00
ZR 93	1.050E+00	1.050E+00	1.050E+00	1.050E+00	1.050E+00	1.045E+00	1.004E+00	6.676E-01
NB 93M	6.161E-01	6.351E-01	7.685E-01	9.953E-01	9.972E-01	9.932E-01	9.535E-01	6.342E-01
TC 99	7.511E+00	7.511E+00	7.511E+00	7.508E+00	7.487E+00	7.270E+00	5.425E+00	2.900E-01
RU106	4.181E+01	2.102E+01	4.314E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RH106	4.180E+01	2.102E+01	4.314E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PD107	3.020E-02	3.020E-02	3.020E-02	3.020E-02	3.020E-02	3.017E-02	2.988E-02	2.715E-02
CD113M	8.531E+00	8.135E+00	5.305E+00	7.373E-02	1.983E-20	0.000E+00	0.000E+00	0.000E+00
SB125	2.540E+02	1.978E+02	2.080E+01	3.442E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE125M	6.201E+01	4.826E+01	5.075E+00	8.398E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SN126	3.651E-01	3.651E-01	3.650E-01	3.648E-01	3.625E-01	3.406E-01	1.825E-01	3.567E-04
SB126	5.101E-02	5.111E-02	5.110E-02	5.107E-02	5.075E-02	4.769E-02	2.556E-02	4.994E-05
SB126M	3.650E-01	3.651E-01	3.650E-01	3.648E-01	3.625E-01	3.406E-01	1.825E-01	3.567E-04
CS134	9.311E+01	6.653E+01	3.229E+00	2.340E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS135	2.020E-01	2.020E-01	2.020E-01	2.020E-01	2.020E-01	2.014E-01	1.960E-01	1.495E-01
CS137	3.611E+04	3.528E+04	2.866E+04	3.582E+03	3.334E-06	0.000E+00	0.000E+00	0.000E+00
BA137M	3.400E+04	3.338E+04	2.711E+04	3.388E+03	3.154E-06	0.000E+00	0.000E+00	0.000E+00
CE144	8.001E+01	3.284E+01	1.084E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR144	8.001E+01	3.284E+01	1.084E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PM147	5.211E+03	4.001E+03	3.711E+02	1.747E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SM151	6.981E+02	6.927E+02	6.464E+02	3.232E+02	3.155E-01	0.000E+00	0.000E+00	0.000E+00
EU152	1.400E+00	1.331E+00	8.412E-01	8.567E-03	1.029E-22	0.000E+00	0.000E+00	0.000E+00
EU154	1.450E+02	1.338E+02	6.477E+01	4.583E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
EU155	1.370E+02	1.191E+02	3.387E+01	1.166E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SUM	1.366E+05	1.323E+05	1.039E+05	1.282E+04	1.086E+01	1.027E+01	7.999E+00	1.769E+00
TOTAL	1.366E+05	1.323E+05	1.039E+05	1.282E+04	1.086E+01	1.027E+01	7.999E+00	1.769E+00

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE	3.150E-03	3.150E-03	3.150E-03	3.147E-03	3.117E-03	2.832E-03	1.084E-03	7.319E-08
SR	2.980E+04	2.910E+04	2.349E+04	2.758E+03	1.371E-06	0.000E+00	0.000E+00	0.000E+00
Y	2.980E+04	2.911E+04	2.350E+04	2.759E+03	1.372E-06	0.000E+00	0.000E+00	0.000E+00
ZR	1.050E+00	1.050E+00	1.050E+00	1.050E+00	1.050E+00	1.045E+00	1.004E+00	6.676E-01
NB	6.161E-01	6.351E-01	7.685E-01	9.953E-01	9.972E-01	9.932E-01	9.535E-01	6.342E-01
TC	7.511E+00	7.511E+00	7.511E+00	7.508E+00	7.487E+00	7.270E+00	5.425E+00	2.900E-01
RU	4.181E+01	2.102E+01	4.314E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RH	4.180E+01	2.102E+01	4.314E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PO	3.020E-02	3.020E-02	3.020E-02	3.020E-02	3.020E-02	3.017E-02	2.988E-02	2.715E-02
SN	4.495E-01	4.440E-01	4.326E-01	3.842E-01	3.625E-01	3.406E-01	1.825E-01	3.567E-04
SB	2.545E+02	1.982E+02	2.122E+01	4.159E-01	4.133E-01	3.883E-01	2.081E-01	4.066E-04
TE	6.201E+01	4.826E+01	5.075E+00	8.398E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS	3.620E+04	3.535E+04	2.866E+04	3.582E+03	2.020E-01	2.014E-01	1.960E-01	1.495E-01
BA	3.400E+04	3.338E+04	2.711E+04	3.388E+03	3.154E-06	0.000E+00	0.000E+00	0.000E+00
CE	8.001E+01	3.284E+01	1.084E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR	8.097E+01	3.323E+01	1.097E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PM	5.211E+03	4.001E+03	3.711E+02	1.747E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SM	6.981E+02	6.927E+02	6.464E+02	3.232E+02	3.155E-01	1.277E-07	1.277E-07	1.277E-07
EU	2.834E+02	2.543E+02	9.948E+01	5.451E-02	1.029E-22	0.000E+00	0.000E+00	0.000E+00
SUM	1.366E+05	1.323E+05	1.039E+05	1.282E+04	1.086E+01	1.027E+01	7.999E+00	1.769E+00
TOTAL	1.366E+05	1.323E+05	1.039E+05	1.282E+04	1.086E+01	1.027E+01	7.999E+00	1.769E+00

ELEMENTS CONTRIBUTING <0.0100% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SE 79	7.843E-07	7.843E-07	7.843E-07	7.835E-07	7.760E-07	7.050E-07	2.698E-07	1.822E-11
SR 90	3.459E+01	3.378E+01	2.726E+01	3.201E+00	1.592E-09	0.000E+00	0.000E+00	0.000E+00
Y 90	1.652E+02	1.613E+02	1.302E+02	1.529E+01	7.603E-09	0.000E+00	0.000E+00	0.000E+00
ZR 93	1.220E-04	1.220E-04	1.220E-04	1.220E-04	1.220E-04	1.215E-04	1.166E-04	7.756E-05
NB 93M	1.092E-04	1.125E-04	1.362E-04	1.763E-04	1.767E-04	1.760E-04	1.689E-04	1.124E-04
TC 99	3.767E-03	3.767E-03	3.766E-03	3.765E-03	3.754E-03	3.646E-03	2.720E-03	1.454E-04
RH106	4.009E-01	2.016E-01	4.137E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PD107	1.790E-06	1.790E-06	1.790E-06	1.790E-06	1.790E-06	1.789E-06	1.771E-06	1.609E-06
CD113M	1.436E-02	1.369E-02	8.930E-03	1.241E-04	3.338E-23	0.000E+00	0.000E+00	0.000E+00
SB125	7.942E-01	6.184E-01	6.503E-02	1.076E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE125M	5.212E-02	4.056E-02	4.266E-03	7.059E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SN126	4.553E-04	4.553E-04	4.553E-04	4.550E-04	4.521E-04	4.248E-04	2.277E-04	4.449E-07
SB126	9.424E-04	9.443E-04	9.442E-04	9.436E-04	9.378E-04	8.811E-04	4.722E-04	9.227E-07
SB126M	4.648E-03	4.648E-03	4.648E-03	4.645E-03	4.616E-03	4.337E-03	2.324E-03	4.542E-06
I129	5.968E-09	5.968E-09	5.968E-09	5.968E-09	5.968E-09	5.965E-09	5.942E-09	5.710E-09
CS134	9.476E-01	6.771E-01	3.286E-02	2.382E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS135	6.742E-05	6.742E-05	6.742E-05	6.742E-05	6.740E-05	6.722E-05	6.542E-05	4.988E-05
CS137	3.994E+01	3.902E+01	3.170E+01	3.962E+00	3.688E-09	0.000E+00	0.000E+00	0.000E+00
BA137M	1.335E+02	1.310E+02	1.064E+02	1.330E+01	1.238E-08	0.000E+00	0.000E+00	0.000E+00
CE144	5.307E-02	2.178E-02	7.193E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR144	5.881E-01	2.414E-01	7.971E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PM147	1.869E+00	1.435E+00	1.331E-01	6.267E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SM151	8.185E-02	8.122E-02	7.578E-02	3.789E-02	3.699E-05	2.905E-35	0.000E+00	0.000E+00
EU152	1.059E-02	1.007E-02	6.362E-03	6.480E-05	7.785E-25	0.000E+00	0.000E+00	0.000E+00
EU154	1.297E+00	1.197E+00	5.794E-01	4.099E-04	1.289E-35	0.000E+00	0.000E+00	0.000E+00
EU155	9.965E-02	8.666E-02	2.463E-02	8.479E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SUM	3.794E+02	3.698E+02	2.966E+02	3.580E+01	1.017E-02	9.656E-03	6.097E-03	3.928E-04
TOTAL	3.794E+02	3.698E+02	2.966E+02	3.580E+01	1.017E-02	9.656E-03	6.097E-03	3.928E-04

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
SR	3.459E+01	3.378E+01	2.726E+01	3.201E+00	1.592E-09	0.000E+00	0.000E+00	0.000E+00
Y	1.652E+02	1.613E+02	1.302E+02	1.529E+01	7.603E-09	0.000E+00	0.000E+00	0.000E+00
ZR	1.220E-04	1.220E-04	1.220E-04	1.220E-04	1.220E-04	1.215E-04	1.166E-04	7.756E-05
NB	1.092E-04	1.125E-04	1.362E-04	1.763E-04	1.767E-04	1.760E-04	1.689E-04	1.124E-04
TC	3.767E-03	3.767E-03	3.766E-03	3.765E-03	3.754E-03	3.646E-03	2.720E-03	1.454E-04
RH	4.009E-01	2.016E-01	4.137E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PD	1.790E-06	1.790E-06	1.790E-06	1.790E-06	1.790E-06	1.789E-06	1.771E-06	1.609E-06
SN	6.144E-04	6.099E-04	5.906E-04	4.938E-04	4.521E-04	4.248E-04	2.277E-04	4.449E-07
SB	7.998E-01	6.240E-01	7.062E-02	5.589E-03	5.554E-03	5.218E-03	2.796E-03	5.464E-06
TE	5.212E-02	4.056E-02	4.266E-03	7.059E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS	4.088E+01	3.970E+01	3.173E+01	3.962E+00	6.741E-05	6.722E-05	6.542E-05	4.988E-05
BA	1.335E+02	1.310E+02	1.064E+02	1.330E+01	1.238E-08	0.000E+00	0.000E+00	0.000E+00
CE	5.307E-02	2.178E-02	7.193E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR	5.884E-01	2.415E-01	7.975E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PM	1.869E+00	1.435E+00	1.331E-01	6.267E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SM	8.185E-02	8.122E-02	7.578E-02	3.789E-02	3.699E-05	1.749E-09	1.749E-09	1.749E-09
EU	1.407E+00	1.293E+00	6.104E-01	4.748E-04	7.785E-25	0.000E+00	0.000E+00	0.000E+00
SUM	3.794E+02	3.698E+02	2.966E+02	3.580E+01	1.017E-02	9.656E-03	6.097E-03	3.928E-04
TOTAL	3.794E+02	3.698E+02	2.966E+02	3.580E+01	1.017E-02	9.656E-03	6.097E-03	3.928E-04

ELEMENTS CONTRIBUTING <0.0100% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

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	8.969E+14	8.725E+14	6.992E+14	8.289E+13	2.604E+10	2.521E+10	1.927E+10	5.259E+09
2.500E-02	1.908E+14	1.844E+14	1.446E+14	1.707E+13	8.623E+09	8.164E+09	4.837E+09	1.247E+08
3.750E-02	2.058E+14	2.003E+14	1.598E+14	1.922E+13	2.012E+09	1.928E+09	1.288E+09	6.212E+07
5.750E-02	1.706E+14	1.660E+14	1.333E+14	1.573E+13	3.720E+09	3.537E+09	2.171E+09	6.491E+07
8.500E-02	1.026E+14	9.968E+13	7.946E+13	9.341E+12	7.375E+09	6.944E+09	3.822E+09	2.836E+07
1.250E-01	6.820E+13	6.601E+13	5.197E+13	5.991E+12	5.274E+08	5.008E+08	3.030E+08	7.429E+06
2.250E-01	8.580E+13	8.341E+13	6.672E+13	7.828E+12	6.916E+08	6.510E+08	3.571E+08	2.223E+06
3.750E-01	3.980E+13	3.807E+13	2.877E+13	3.357E+12	1.470E+10	1.381E+10	7.403E+09	1.447E+07
5.750E-01	1.324E+15	1.297E+15	1.048E+15	1.309E+14	3.264E+10	3.067E+10	1.644E+10	3.212E+07
8.500E-01	1.149E+13	1.025E+13	5.844E+12	5.410E+11	1.634E+09	1.535E+09	8.227E+08	1.608E+06
1.250E+00	5.026E+12	4.669E+12	2.789E+12	1.780E+11	3.966E+08	3.726E+08	1.997E+08	3.902E+05
1.750E+00	2.440E+11	2.286E+11	1.553E+11	1.380E+10	1.692E+04	1.589E+04	8.514E+03	1.664E+01
2.250E+00	2.481E+10	1.040E+10	1.835E+07	1.520E+06	7.583E-04	2.254E-06	2.254E-06	2.254E-06
2.750E+00	3.526E+08	1.754E+08	3.458E+05	1.129E-06	1.129E-06	1.129E-06	1.129E-06	1.129E-06
3.500E+00	4.345E+07	2.185E+07	4.484E+04	8.317E-07	8.317E-07	8.317E-07	8.317E-07	8.317E-07
5.000E+00	0.000E+00	5.749E-08	2.300E-07	2.476E-07	2.476E-07	2.476E-07	2.476E-07	2.476E-07
7.000E+00	0.000E+00	3.730E-09	1.492E-08	1.607E-08	1.607E-08	1.607E-08	1.607E-08	1.607E-08
9.500E+00	0.000E+00	2.359E-10	9.436E-10	1.016E-09	1.016E-09	1.016E-09	1.016E-09	1.016E-09
TOTAL	3.101E+15	3.023E+15	2.421E+15	2.930E+14	9.837E+10	9.332E+10	5.691E+10	5.598E+09

TABLE 19-HANF (NOM.). MASS OF ACTIVATION PRODUCTS IN DECAY OF HANFORD HLW GLASS: NUCLIDES

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

GRAMS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
MN 55	0.000E+00	1.684E-03	6.697E-03	7.198E-03	7.198E-03	7.198E-03	7.198E-03	7.198E-03
FE 55	7.198E-03	5.514E-03	5.005E-04	1.902E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO 59	0.000E+00	1.247E-05	1.246E-04	1.246E-03	1.241E-02	1.194E-01	8.338E-01	1.438E+00
NI 59	1.439E+00	1.439E+00	1.439E+00	1.437E+00	1.426E+00	1.319E+00	6.049E-01	2.484E-04
NI 63	1.961E-01	1.946E-01	1.819E-01	9.232E-02	1.048E-04	3.731E-34	0.000E+00	0.000E+00
CU 63	0.000E+00	1.472E-03	1.423E-02	1.038E-01	1.960E-01	1.961E-01	1.961E-01	1.961E-01
SUM	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00
TOTAL	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00

NUCLIDES CONTRIBUTING <0.1000% ARE OMITTED.

TABLE 20-HANF (NOM.). MASS OF ACTIVATION PRODUCTS IN DECAY OF HANFORD HLW GLASS: ELEMENTS

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

GRAMS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
MN	0.000E+00	1.684E-03	6.697E-03	7.198E-03	7.198E-03	7.198E-03	7.198E-03	7.198E-03
FE	7.198E-03	5.514E-03	5.005E-04	1.902E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO	1.326E-03	1.175E-03	4.806E-04	1.246E-03	1.241E-02	1.194E-01	8.338E-01	1.438E+00
NI	1.635E+00	1.633E+00	1.621E+00	1.531E+00	1.428E+00	1.321E+00	6.062E-01	1.575E-03
CU	0.000E+00	1.472E-03	1.423E-02	1.038E-01	1.960E-01	1.961E-01	1.961E-01	1.961E-01
SUM	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00
TOTAL	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00	1.643E+00

ELEMENTS CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
FE 55	1.800E+01	1.379E+01	1.252E+00	4.756E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO 60	1.500E+00	1.315E+00	4.026E-01	2.929E-06	0.DDDE+00	0.000E+00	0.000E+00	0.000E+00
NI 59	1.090E-01	1.090E-01	1.09DE-01	1.089E-01	1.081E-01	9.997E-02	4.583E-02	1.882E-05
NI 63	1.210E+01	1.201E+01	1.122E+01	5.697E+00	6.468E-03	0.000E+00	0.000E+00	0.000E+00
SUM	3.171E+01	2.722E+01	1.299E+01	5.806E+00	1.145E-01	9.997E-02	4.583E-02	1.882E-05
TOTAL	3.171E+01	2.722E+01	1.299E+01	5.806E+00	1.145E-01	9.997E-02	4.583E-02	1.882E-05

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

CURIES

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
FE	1.800E+01	1.379E+01	1.252E+00	4.756E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO	1.500E+00	1.315E+00	4.026E-01	2.929E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI	1.221E+01	1.212E+01	1.133E+01	5.806E+00	1.145E-01	9.997E-02	4.583E-02	1.882E-05
SUM	3.171E+01	2.722E+01	1.299E+01	5.806E+00	1.145E-01	9.997E-02	4.583E-02	1.882E-05
TOTAL	3.171E+01	2.722E+01	1.299E+01	5.806E+00	1.145E-01	9.997E-02	4.583E-02	1.882E-05

ELEMENTS CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
FE 55	6.083E-04	4.659E-04	4.229E-05	1.607E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO 60	2.313E-02	2.028E-02	6.208E-03	4.516E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI 59	4.330E-06	4.330E-06	4.329E-06	4.326E-06	4.292E-06	3.970E-06	1.820E-06	7.475E-10
NI 63	1.219E-03	1.210E-03	1.131E-03	5.741E-04	6.518E-07	2.320E-36	0.000E+00	0.000E+00
SUM	2.496E-02	2.196E-02	7.385E-03	5.785E-04	4.944E-06	3.970E-06	1.820E-06	7.475E-10
TOTAL	2.496E-02	2.196E-02	7.385E-03	5.785E-04	4.944E-06	3.970E-06	1.820E-06	7.475E-10

NUCLIDES CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

WATTS

ELEMENT	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
FE	6.083E-04	4.659E-04	4.229E-05	1.607E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO	2.313E-02	2.028E-02	6.208E-03	4.516E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI	1.224E-03	1.215E-03	1.135E-03	5.784E-04	4.944E-06	3.970E-06	1.820E-06	7.475E-10
SUM	2.496E-02	2.196E-02	7.385E-03	5.785E-04	4.944E-06	3.970E-06	1.820E-06	7.475E-10
TOTAL	2.496E-02	2.196E-02	7.385E-03	5.785E-04	4.944E-06	3.970E-06	1.820E-06	7.475E-10

ELEMENTS CONTRIBUTING <0.0010% ARE OMITTED.

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

[BASED ON ONE CANISTER, NOMINAL CASE (1989), 1650 KG GLASS]

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	5.417E+09	5.035E+09	3.085E+09	1.165E+09	1.323E+06	4.710E-24	0.000E+00	0.000E+00
2.500E-02	6.592E+08	5.954E+08	2.763E+08	7.102E+07	8.063E+04	2.870E-25	0.000E+00	0.000E+00
3.750E-02	3.208E+08	2.848E+08	1.062E+08	1.439E+07	1.634E+04	5.817E-26	0.000E+00	0.000E+00
5.750E-02	3.305E+08	2.901E+08	9.074E+07	1.457E+06	1.653E+03	5.885E-27	0.000E+00	0.000E+00
8.500E-02	1.287E+08	1.129E+08	3.455E+07	2.513E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1.250E-01	4.944E+07	4.335E+07	1.327E+07	9.653E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2.250E-01	1.626E+07	1.426E+07	4.364E+06	3.174E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
3.750E-01	4.562E+06	3.999E+06	1.224E+06	8.905E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
5.750E-01	2.619E+05	2.296E+05	7.030E+04	5.113E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8.500E-01	4.145E+06	3.634E+06	1.113E+06	8.093E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1.250E+00	1.110E+11	9.731E+10	2.979E+10	2.167E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1.750E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2.250E+00	5.882E+05	5.157E+05	1.579E+05	1.148E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2.750E+00	1.820E+03	1.596E+03	4.885E+02	3.553E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
3.500E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
5.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
7.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
9.500E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TOTAL	1.179E+11	1.037E+11	3.340E+10	1.252E+09	1.422E+06	5.061E-24	0.000E+00	0.000E+00

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

[BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1825 KG 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
SUM	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. MASS OF ACTINIDES AND DAUGHTERS IN DECAY OF INEL HLW: ELEMENTS

[BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1825 KG 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
SUM	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; 1825 KG 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

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

[BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1825 KG GLASS-CERAMIC (1277 KG CALCINE)]

CURIES

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
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
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
SUM	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; 1825 KG 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
SUM	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; 1825 KG 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

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

[BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1825 KG GLASS-CERAMIC (1277 KG CALCINE)]

WATTS

NUCLIDE	IMMOBILZN	1.0YR	10.0YR	100.0YR	1000.0YR	10.0KY	100.0KY	1.0MY
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
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
SUM	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; 1825 KG 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
SUM	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; 1825 KG 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
SUM	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; 1825 KG 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
SUM	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 10-INEL. SPONTANEOUS FISSION NEUTRON SOURCES IN DECAY OF INEL HLW

[BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1825 KG 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
SUM	1.148E+05	1.070E+05	7.935E+04	1.259E+04	4.008E+03	2.148E+03	8.482E+02	1.692E+02
TOTAL	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; 1825 KG 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. MASS OF FISSION AND ACTIVATION PRODUCTS IN DECAY OF INEL HLW: NUCLIDES

[BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1825 KG 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
SUM	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. MASS OF FISSION AND ACTIVATION PRODUCTS IN DECAY OF INEL HLW: NUCLIDES

[BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1825 KG 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
SUM	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; 1825 KG 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
SUM	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; 1825 KG 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
SUM	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; 1825 KG 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
SUM	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; 1825 KG 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
SUM	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 PRODUCT IN DECAY OF INEL HLW

[BASED ON ONE CANISTER OF INEL HLW IN GLASS-CERAMIC; 1825 KG 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	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

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 (HLW) 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 Sect. 3.

As stated in Sect. 3, all of the HLW produced thus far is currently (1991) in interim storage at WVDP, SRS, HANF, and INEL. The storage forms vary from site to site and include liquids, sludges, salt cake, slurry, loaded zeolite resins, calcine, and encapsulated strontium fluoride and cesium chloride. These interim forms of HLW 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 a 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 Sect. 3: WVDP, SRS, 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 wastes. 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 2,270 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 liquid. The acidic 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 2,800 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 waste in Tank 8D-4 is 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 Tables 3B.4, 5, and 6. Table 3B.7 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 1989 (IDB 1990, Maestas 1990). No further additions to these wastes are anticipated at present.

Because zeolite ion-exchange pretreatment of the alkaline waste in Tank 8D-2 (described in the next subsection) has already started, the waste inventories at WVDP at the end of 1989 included about 31 m^3 of cesium-loaded zeolite ion-exchange resins (Maestas 1990).

3B.2.2 Treatment and Conversion to Glass

Figure 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 1993 and to be completed in 1995.

Zeolite ion exchange was selected as the most suitable technology for pretreatment of the WVDP waste. The high decontamination factor for cesium achievable and the simplicity of the process were contributing factors in this choice.

The initial waste treatment steps consist of decanting the supernatant liquid from Tank 8D-2 and passing it through zeolite ion exchange columns. As the zeolite ion exchange medium becomes loaded with cesium, it is discharged to the bottom of Tank 8D-1. The hydroxide sludge remaining in Tank 8D-2 is washed to remove interstitial liquids and sodium sulfate. This process requires three to four cycles of washing, settling, and decanting. The wash solutions are treated by zeolite ion exchange. The decontaminated supernatant liquid and wash effluents 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-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 borosilicate glass product will contain about 23% PUREX and THOREX wastes and about 10% cesium-loaded zeolite.

Some of the pretreatment activities have already been started. The supernatant treatment system began processing the high-level supernatant liquid waste in May 1988. By the end of FY 1989, about 200,000 gal (757 m^3) of liquid HLW had been processed through the ion exchange system. Other components of the integrated radwaste treatment system have also started operations, including the low-level waste (LLW) cement solidification system. Nonradioactive test runs of the vitrification plant melter have been completed (WVDP 1990).

3B.2.3 Radioactivity and Thermal Power Per Canister

In the previous (1987) edition of this report, the radionuclide compositions of the HLW glass were supplied by WVDP for the year 1990 in terms of average, minimum, and maximum curies per canister (Eisenstatt 1986). For the present edition of this report, new data were obtained from WVDP based on the most recent revision (Revision 7) of the vitrification plant mass balance (Crocker 1989). Table 3B.8 was calculated from these data and shows curies and grams of each radionuclide for an average activity canister loaded to an 85% fill level, with radioactivity calculated as of the end of year 1989. The WVDP Revision 7 mass balance does not give radionuclide contents for a maximum activity canister. The new data show about 2.6% less radioactivity per average canister than the 1987 data (109,600 vs 112,700 Ci, both calculated as of the end of year 1989).

Using the Revision 7 mass balance average radionuclide content per canister supplied by WVDP for the end of year 1989, 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, and are the basis for the summary table showing total radioactivity per canister as a function of time given in Sect. 3 of this report. The Revision 7 mass balance did not include any estimate of the range of variation from batch to batch, but based on previous estimates it appears that a maximum activity canister might contain about 10% more radioactivity than the average.

The Revision 7 mass balance shows a total glass production of 484,000 kg. At 100% fill level, a canister would contain 2,229 kg of glass, based on a density of 2.7 g/mL. At the reference-case fill level of 85%, each canister will contain about 1,900 kg of glass. The number of canisters to be produced, assuming an average fill of 85%, is therefore approximately 255. In this report, an allowance was added to account for operational variations, increasing the estimated number of canisters to 275. The volume of glass per canister calculated by WVDP is about 12% higher than that estimated by SRS and HANF; this is due to the fact that the canister design used at WVDP is different from the one used at SRS and HANF. IDB submittals from WVDP have estimated 300 as the upper limit of the number of canisters that would be produced. WVDP is providing facilities for the on-site storage of up to 312 filled canisters until a repository or MRS becomes available.

3B.2.4 Volume Conversion Factor to Glass

As of 1986, the total volume of waste before vitrification was about 2,200 m^3, and the total volume of glass to be 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 12.2 to 1. The volume of LLW produced, in final solidified form, is estimated to be about 2,750 m^3 (Rykken 1986d, IDB 1990).

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 SITE

At the Savannah River Site (SRS), 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 (Doherty 1986). The volume reduction that occurs as a result of evaporation has reduced the total volume in

storage as of the end of CY 1989 to 122,000 m^3 (Garvin 1990).

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. Throughout the following discussion, this liquid is always referred to as "the supernate." Referring to Fig. 3B.2, the supernate is then concentrated by evaporation, and the concentrate is cooled, causing salt cake (salt crystals) to separate out of the saturated salt solution. The supernate has thus been converted to saturated salt solution and salt cake.

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, principally isotopes of uranium, plutonium, and curium, that were not recovered from the fuel during reprocessing. The largest portion of the actinide radioactivity is due to the plutonium isotopes Pu-238 and Pu-241. The sludge is kept essentially separate from the salt solution and salt cake by tankage selection and transfer operations.

The major components of the supernate, and hence of the salt solution and salt cake, are sodium nitrate, 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 salt solution and salt cake 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/year, depending on future production requirements (Baxter 1986a). Currently there are 51 waste tanks, in sizes ranging up to 4,900 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 1993. This will take place in the Defense Waste Processing Facility (DWPF), which is now under construction at SRS.

As of March 1991, design of the DWPF was >99% complete, and construction was 99% complete. The facility includes storage buildings where the filled canisters of HLW can be stored on-site until a repository becomes available.

3B.3.1 HLW Inventories at SRS

The volumes of the interim HLW phases in storage at the end of CY 1988 were as follows: sludge 14,100 m^3; salt cake 50,000 m^3; and liquid 64,300 m^3. Table 3B.9 shows the current and projected cumulative volumes of the liquid, sludge, salt cake, and glass, based on estimated future production, through the year 2020. Glass volumes in Table 3B.9 are based on the same canister production schedule that was shown in the immobilized HLW section of this report (Chapter 3); about 5,280 canisters are projected by the end of year 2020, with a glass volume of 0.626 m^3 per canister (Garvin 1989). Tables 3B.10 and 3B.11, from the same source, show 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. These projections assume 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 therefore should not be used for year-by-year estimation of actual radioactivity per canister. The long-term estimates of cumulative radioactivity in the glass, however, should be useful. Table 3B.12 shows approximate chemical compositions of the interim waste forms and glass (IDB 1989, based on Garvin 1989).

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. The salt solution that goes to the precipitation process contains the redissolved salt cake; thus the washed precipitate will contain essentially all the radioactivity originally in the supernate.

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 combined salt solution and salt cake from a supernate aged to an acceptable Ru-106 limit are 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 LLW. 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 originally present in the supernate. However, it has only about one-tenth the original volume.

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 h, based on a nominal pour rate of 100 kg/h and a nominal melt weight of 6,500 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 h. 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 h. 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 Thermal Power Per Canister

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.13, was used to calculate the radioactivity and thermal power per canister for decay times up to 10^6 years; these are the results that were presented in Sect. 3. As stated there, the radioactivity and thermal power at the time of filling, based on ORIGEN2 calculations, were 234,400 Ci and 709 W per canister. Detailed radionuclide analyses of individual feed batches to the DWPF will not be available until about one year before each batch is processed. Recent curie balances at SRS indicate that the glass produced during the first year of vitrification (1992) will have a radioactivity of about 154,000 Ci/canister and a heat generation rate of about 418 W per canister (Garvin 1990).

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 SRS at the end of 1986 are equivalent to about 4,900 canisters when converted to glass (DOE 1986). The IDB for 1987 gives the volumes of these wastes in storage at SRS at the end of 1986 as 128,000 m^3 (IDB 1987). Referring to Table 3B.9, the volume in storage at the end of 1988 was 128,400 m^3. The volume of glass in 4,900 canisters is about 3,100 m^3. This gives a volume reduction factor from interim forms to glass of about 41. The volume of saltstone (LLW) 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 a 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 by the reprocessing of defense reactor fuel have been made alkaline with caustic soda and stored in underground concrete tanks lined with carbon steel. Separation of solid and liquid phases occurs during storage. Storage tanks of both the single-shell tank (SST) and double-shell (DST) type are in use. All of the new waste goes to DSTs: no waste is currently being added to SSTs.

Prior to 1985, the HLW at Hanford 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. There are no definite plans at present to convert the Sr-Cs capsules to glass, but this possibility is still under consideration. It has been definitely decided that the Sr-Cs will go to a repository, but no decision has been made as to whether the capsules will be opened and their contents vitrified along with defense HLW, or whether the capsules will be encased in overpacks and shipped to a repository in that form (HANF 1989). Additional details are given in Sect. 3B.4.5.

3B.4.1 HLW Inventories at Hanford

The alkaline HLW stored at Hanford (245,000 m^3 at the end of 1989) has been accumulating since 1944 and was generated by reprocessing fuel from production reactors for the recovery of plutonium, uranium, and other elements for defense and other federal programs. Tables 3B.14 and 3B.15 summarize the current and future volumes and radioactivities of these wastes, projected to the year 2020. Data in these tables are from Hanford's 1990 submittal to the IDB (Turner 1990). Volumes and radioactivities have not been adjusted downward to reflect the production of HLW glass, because the required year-by-year projections for glass are not yet available. Representative chemical compositions of interim wastes are shown in Table 3B.16.

The waste inventories at Hanford that are reported to the IDB as HLW are reported in terms of four phases. The first three of these (liquid, sludge, and salt cake) are terms used to describe the inventories held in SSTs. The fourth (slurry) is used to describe the total averaged inventory held in DSTs. Although the entire contents of both SSTs and DSTs are reported as part of the HLV submittal to the IDB, they actually include wastes in the TRU and LLW categories as well.

Most of the old waste (the waste in SSTs) 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 stainless-steel capsules and stored in water basins. These capsules represent an interim HLW form that is considered separately from the tanked waste inventory.

Twenty-eight DSTs are in service with a total capacity of 118,400 m^3. As of December 31, 1988, 78,000 m^3 of DST waste were in storage. More DST wastes are expected, the primary source being the PUREX plant operations. Neutralized current acid waste (NCAW) from the PUREX plant will be the primary high-heat source of feed to vitrification. NCAW can be stored in any of four DSTs (called aging waste tanks) that are specifically designed for this self-boiling waste. The other 24 DST's are called non-aging waste tanks and are designed to contain wastes of lower heat generation rates, such as neutralized cladding removal waste (NCRW), complexant concentrate (CC), and plutonium finishing plant (PFP) waste. These wastes will also provide feed to the vitrification plant and have been described in Sect. 3.

The Evaporator-Crystallizer Facility plays an important part in Hanford's waste management treatment facilities. Evaporation of liquid radioactive waste and mixed waste in this facility achieve an annual waste volume reduction of 5 to 10 million gallons. This has reduced the storage space requirements for double-shell tanks by more than 100 million gallons, thus maximizing the use of available DST tanks.

At the end of 1988 there were approximately 139,000 m^3 of damp salt cake and sludge containing 134 million curies of radionuclides stored in 149 underground single-shell tanks. These tanks range in capacity from 208 to 3,785 m^3 each. The salt cake and sludge contain about 26,800 m^3 of interstitial liquor as of December 31, 1988. Pumpable liquid is being transferred to double-shell tanks; this operation, referred to as interim stabilization, is scheduled to be completed by September 1996 (HANF 1989).

3B.4.2 Treatment and Conversion to Glass

As pointed out in HANF 1989, most of the radioactive wastes in interim tank storage at Hanford are either HLW or TRU mixed with relative large quantities of inert elements such as sodium, aluminum, iron, or zirconium. Because of the volume of inert elements, virtually all of the waste in storage and that to be generated will require some form of "pretreatment" processing prior to vitrification. The pretreatment process will fractionate the waste into a high-volume, low-activity stream (for disposal in near-surface grout vaults) and a low-volume, high-activity stream suitable for vitrification and disposal in a geologic repository.

Figure 3B.4 shows a schematic flowsheet of the existing and future HLW treatment and vitrification facilities at Hanford. The current plan is that the Hanford Waste Vitrification Plant (HWVP) will have four feeds: NCAW, NCRW, CC, and PFP. According to the present plan, these feeds will be run separately, producing canistered glasses of various levels of radioactivity and thermal power. As previously indicated, the NCAW produces the highest thermal power per canister, and is the reference feed for HWVP design purposes. The CC, NCRW, and PFP wastes will produce glass of much lower thermal power. 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 1999.

3B.4.2.1 Melter Feed Preparation

The slurry receipt and adjustment tank will be used as the main feed tank for the feed waste slurries containing the high-level and TRU wastes to be vitrified. In this tank the slurry solids content will be adjusted by evaporation to 12–19 wt %. Treatment with formic acid will also take place at this point to adjust the rheology and redox state for vitrification. The treated feed will then be blended with glass frit and further concentrated by evaporation in the slurry mix evaporator to about 30–49 wt % solids. When it has been determined by sampling that the composition meets all specified requirements, the concentrated slurry will be transferred to the melter feed tank for vitrification (Jain and Barnes 1989).

3B.4.2.2 On-Site Storage of Glass-Filled Canisters

An on-site storage facility will be constructed at Hanford with sufficient capacity to store 2,000 canisters of HLW glass. At the present time, the building is planned to have a heat removal capacity of 1,000 W per canister. This is higher than the currently-planned maximum loading of about 860 W per canister and will allow for the possible future vitrification of higher-heat wastes such as might be encountered if the decision is made to vitrify the contents of the strontium and cesium capsules.

3B.4.3 Radioactivity and Thermal Power Per Canister

Hanford has provided estimated maximum and nominal radionuclide compositions of the NCAW melter feeds. These are shown in Tables 3B.17 and 3B.18 in terms of curies and grams per canister. The maximum case represents the current estimate of the maximum radioactivity and thermal power for HLW glass produced at Hanford (Mitchell and Nelson 1988). As stated in Sect. 3, the maximum case results in a glass with an activity of 298,000 Ci/canister and a thermal power of 869 W/canister at the time of filling, based on a glass load of 1,650 kg (0.62 m^3).

3B.4.4 Volume Conversion Factors to Glass

Hanford projections of glass production for NCAW are based on a waste oxides feed to vitrification of 29 kg per metric ton of uranium processed, and on the assumption of 25 wt % waste oxides loading in the glass. Given these bases, the volumetric reduction factor for NCAW to glass is about 30:1 based on feed to the pretreatment plant.

Glass production factors for the NCRW waste type are based on limiting the zirconium oxide loading in glass to 15 wt %, whereas for the PFP and CC waste types production factors are based on 25 wt % total waste oxides loading in glass (White 1986, Watrous 1991).

3B.4.5 Sr-90 and Cs-137 Capsules

Until 1985, the defense HLW at Hanford was processed to separate the bulk of the strontium and cesium in concentrated form from the remainder of the HLW. The Sr-90 (half-life 28.5 years) and Cs-137 (half-life 30.0 years) were converted to solid forms as strontium fluoride and cesium chloride and placed in double-walled capsules for storage in water basins. Each capsule had an external diameter of about 6.7 cm and an overall length of about 53 cm. Other dimensional data are shown in Fig. 3B.5. Separation and encapsulation were completed during 1984 and resulted in a total of 640 Sr-90 capsules and 1577 Cs-137 capsules (White 1986, Turner 1990). The capsules include the short-lived daughter isotopes Y-90 and Ba-137m that are in transient equilibrium with the parent radionuclides.

A number of capsules were distributed with the intention of utilizing the contents for useful purposes, but most of the capsules have been returned to Hanford for disposal as HLW. Some of the returned capsules were dismantled for various reasons, and at the end of 1989 there were 597 Sr-90 and 1,350 Cs-137 capsules on hand for disposal (Wojtasek 1989, Turner 1990). A firm decision has been made that the contents of these capsules will go to a repository, but it has not been decided whether the capsules will be placed in overpack canisters for repository disposal or will have their contents reprocessed and disposed of as vitrified HLW.

3B.4.5.1 Radioactivity of Sr-90 and Cs-137 Capsules

The data used here for total radioactivity are from the 1990 IDB (Integrated Data Base) submittals from Hanford (Turner 1990). At the end of 1989, the 597 strontium capsules had a total radioactivity of 5.451×10^7 Ci, and the 1,350 cesium capsules had a total radioactivity of 1.187×10^8 Ci. Thus, at the end of 1989, each Sr-90 capsule had an average radioactivity of 9.13×10^4 Ci, and each Cs-137 capsule had an average radioactivity of 8.79×10^4 Ci. Total thermal outputs at the end of 1989 were 182.5 kW and 293.7 kW for all the Sr-90 and Cs-137 capsules, respectively. These were calculated from the curie quantities. The radioactivities and thermal outputs stated here include those of the daughter isotopes. Complete radioactivity and thermal power projections for the capsules through the end of year 2020 are given in Tables 3B.19 and 3B.20.

3B.4.5.2 Overpack Dimensions

As stated previously, it is not known yet whether the strontium and cesium capsules will be placed in overpack

canisters for shipment to a repository. However, Fig. 3B.6 shows two proposed designs (thin wall and cast steel) for overpack canisters for the capsules (White 1986). The design currently proposed in the Hanford reference plan is the thin-wall canister, which uses a carbon steel container with an outside diameter of 0.3 m (about 12 in.) and an overall length of 2.7 m (about 9 ft). An internal rack supports several (3 or 4) strontium or cesium capsules along the axis of the canister so that the decay heat is distributed over the entire area of the canister, thus avoiding excessive heat fluxes to the surrounding medium. This proposed canister design has not been finalized and is open to future changes.

3B.4.5.3 Number of Overpack Canisters

If overpack canisters are used, the number of canisters that will be required depends on the heat content of the capsules at the time of filling and the thermal limit, which is based on geologic repository heat load limits. The estimated thermal limits per overpack are 1.17 Kw for strontium and 0.8 kW for cesium; these figures include the daughter isotopes. The daughter isotopes Y-90 and Ba-137m account for about 83% of the heat load for a strontium capsule and about 77% of the heat load for a cesium capsule. Assuming that capsule overpacking is used and is completed at the end of the year 2010 (Turner 1990), the total thermal power of the capsules at the end of year 2010 will be 111 kW for the 597 strontium capsules and 181 kW for the 1,350 cesium capsules, including the daughter isotopes in each case.

Assuming further that the strontium and cesium capsules will not be intermingled and that a given canister must contain an integral number of capsules, then, to stay within the heat load limits stated, each overpack canister will contain four strontium or cesium capsules. This results in a total of 94 strontium canisters and 226 cesium canisters. Overpacking at a later date could result in a reduction in the total number of canisters because of decay. Also, as mentioned earlier, some capsules now on hand could be opened before disposal begins.

3B.4.6 Assessment of Data

Although Hanford's estimates of waste activity are necessarily 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 compositions of the various HLW glasses produced in the 1999–2007 period would be useful but will probably not be available until actual tankage allocations have been determined.

Quantitative data on strontium and cesium capsules are well established. Final plans for their disposal have not been made, but it has been decided that they will go to the repository in some form.

3B.5 IDAHO NATIONAL ENGINEERING LABORATORY

The HLW 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.21 and 3B.22 summarize the current and projected future volumes and radioactivities of the liquid and calcine stored at INEL, projected to the year 2020. The amount of waste generated, total waste curie content, and heat generation rate are lower than prior projections because of a projected decrease in reprocessing rate through the year 2020 (Berreth 1989, 1990). Table 3B.21 also shows the canister production schedule on which the estimates are based; immobilization is assumed to start in year 2012 at a rate of 500 canisters/year and reaches a steady rate of 1,000 canisters/year in year 2014. Production of immobilized waste is expected to continue after year 2020.

The estimates shown in Table 3B.22 of radioactivity in the immobilized form were based on the assumption that the glass-ceramic produced each year would be made from calcine having the same average radionuclide composition as the average calcine inventory in storage in that year. This assumption is unlikely to hold precisely true in practice, so the estimates in Table 3B.22 should not be used for near-term estimates of the total radioactivity in the immobilized form.

Tables 3B.23 and 3B.24 show representative chemical compositions of various HLW liquids and calcines produced at INEL (IDB 1989).

3B.5.2 Treatment and Conversion to Glass-Ceramic

As already indicated, immobilization of HLW at INEL is scheduled to start in the year 2012. 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. Figure 3B.7 shows a schematic flowsheet illustrating some of the possibilities for treatment and immobilization. As the flowsheet shows, the conversion of liquid waste to glass without passing through the calciner is one of the alternatives under study. Both glass and glass-ceramic compositions are being considered as the final waste form for the calcine and liquid HLW. Previous studies have indicated that use of the glass-ceramic form could reduce the total volume of immobilized waste by as much as 60% compared to the glass form (Knecht et al. 1985, Berreth and Knecht 1986). This potential reduction in the total number of canisters of immobilized HLW is the primary reason for favoring the glass-ceramic form.

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, relying on the use of critically safe dissolvers instead. 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 glass-ceramic would be produced annually, resulting in a total production of about 1,000 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 Chapter 3 of this report were based on 1,000 canisters/year of the glass-ceramic form, since that appears currently to be the most favorable case.

3B.5.3 Radioactivity and Thermal Power Per Canister

The estimated radioactivity and thermal power per canister shown in Sect. 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.25, 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 1,277 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.26; this is the composition that was used in Sect. 3 to develop radioactivity and thermal power 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 1,277 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 about 1.6:1. The volume reduction factor for liquid HLW to calcine is about 6:1 (Mairson et al. 1986), and the overall volume reduction factor (liquid to glass-ceramic) is estimated to be about 9.6:1. Because of differences in flowsheets, this value should not be compared with those at WVDP, SRS, and HANF.

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 Sect. 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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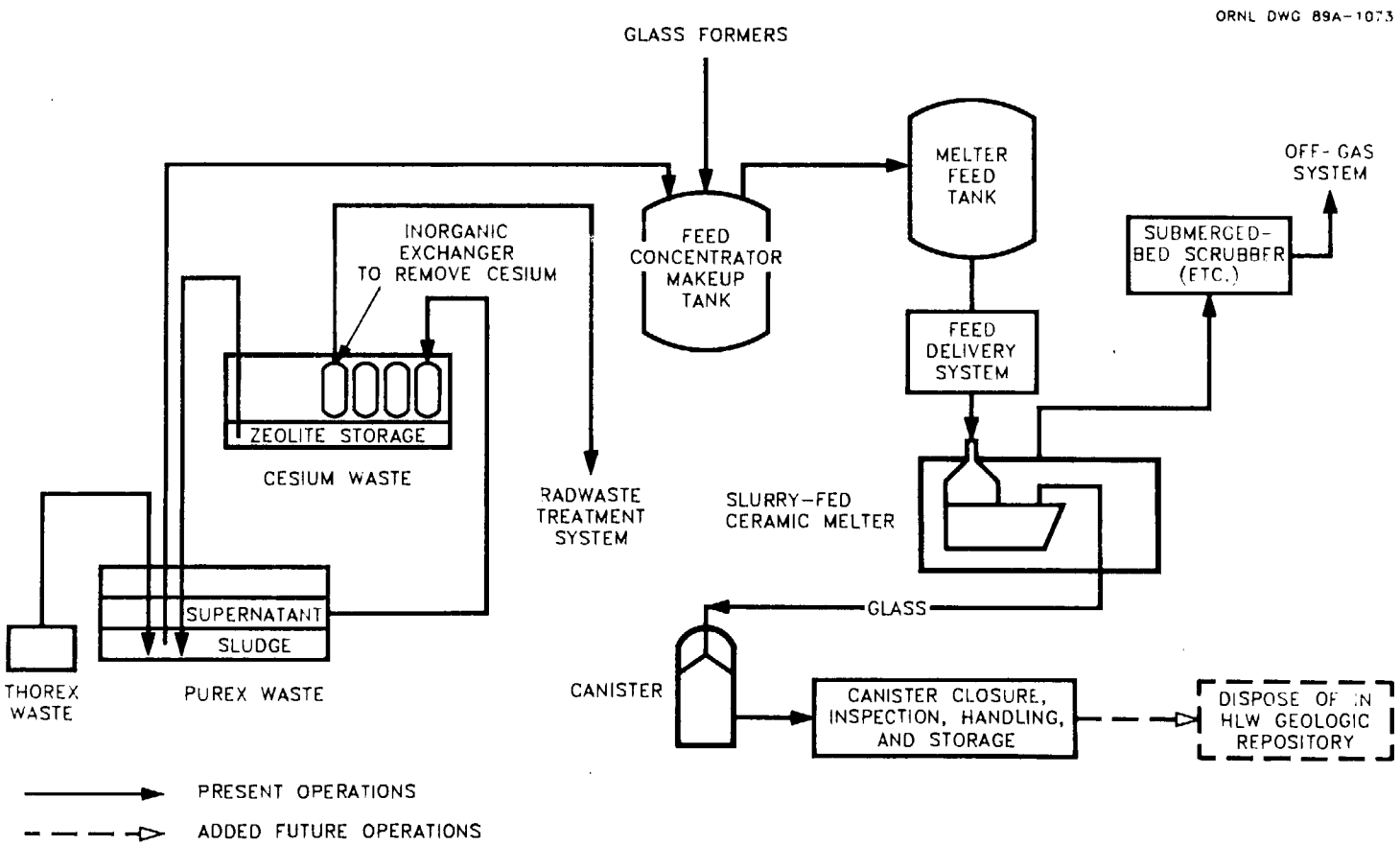


Fig. 3B.1. HLW treatment and vitrification at WVDP. Source: IDB 1989.

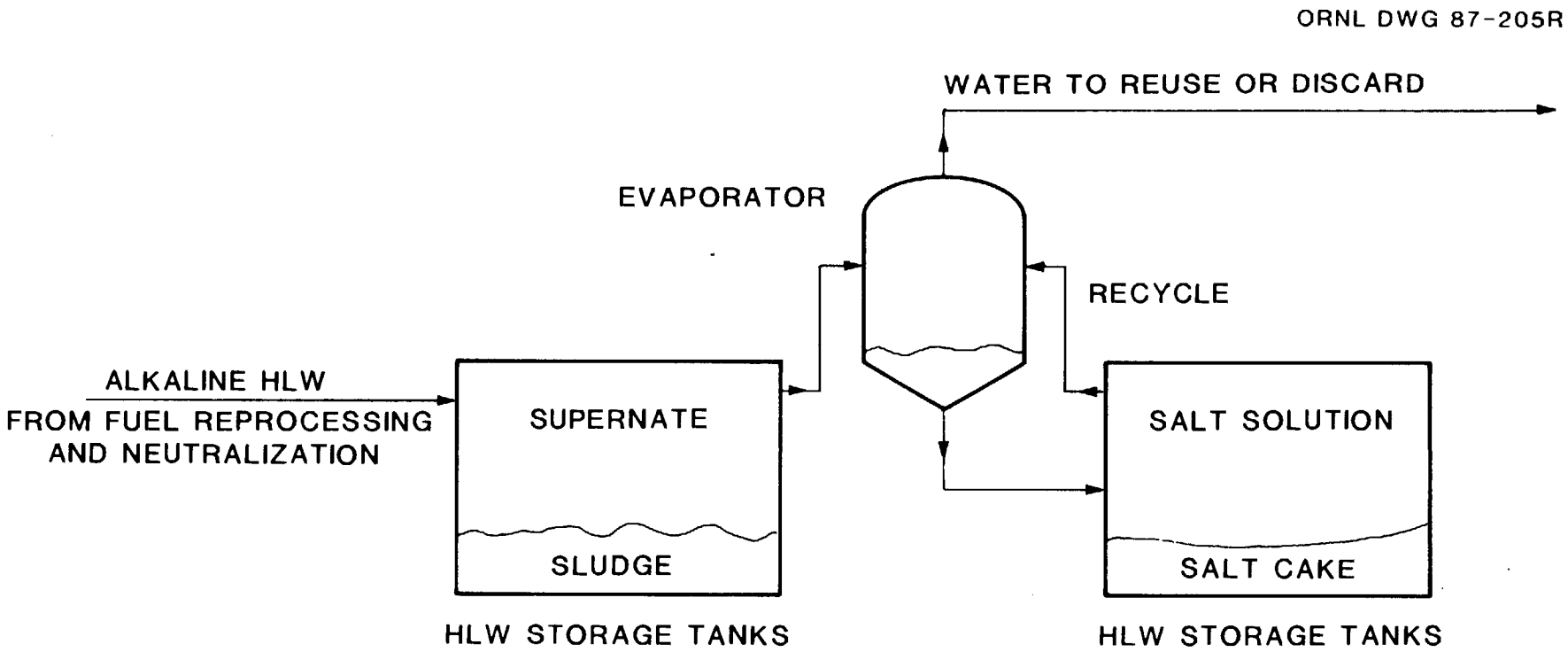


Fig. 3B.2. Simplified representation of primary HLW operations at Savannah River Site.

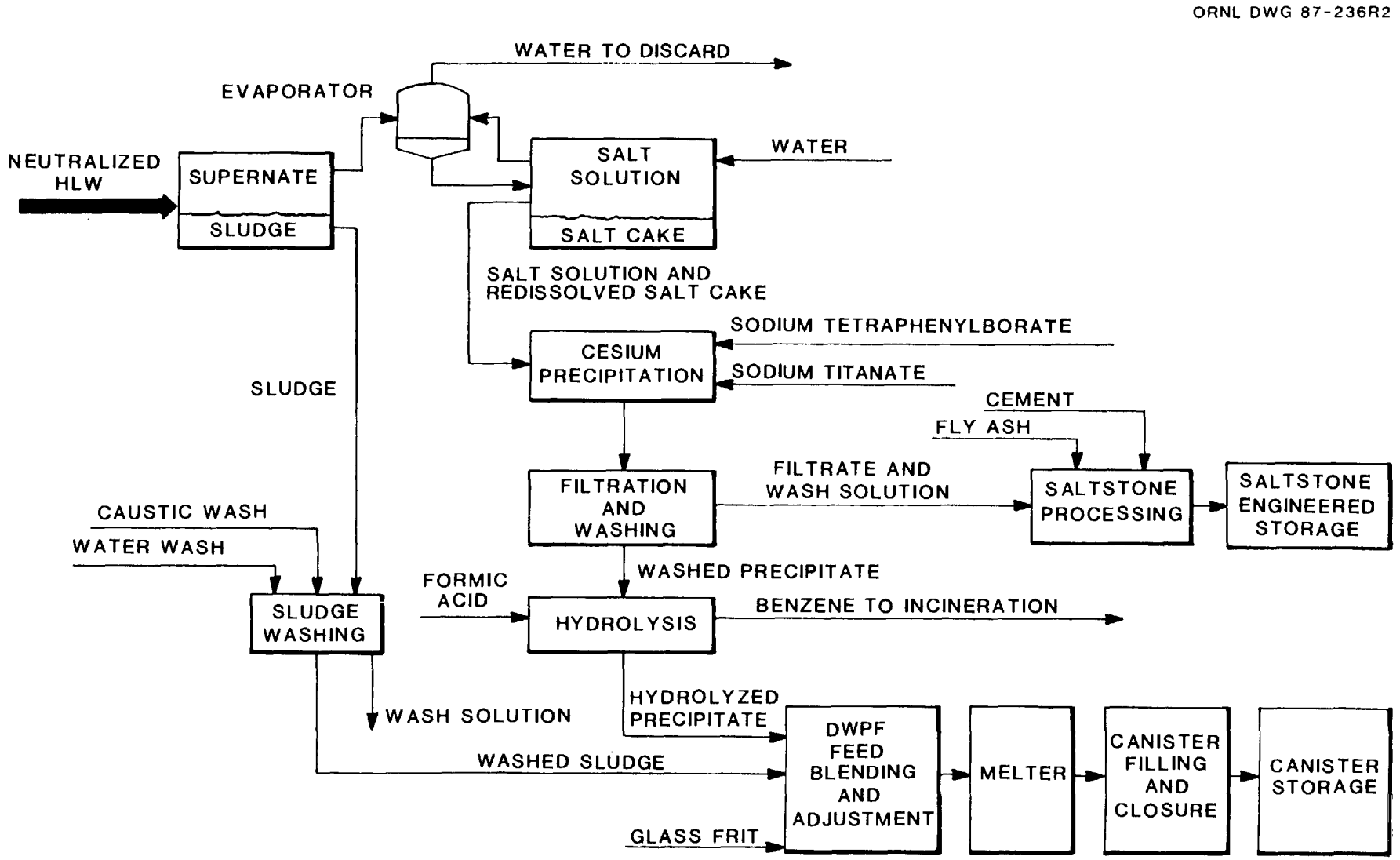


Fig. 3B.3. HLW processing at Savannah River Site after startup of DWPF.

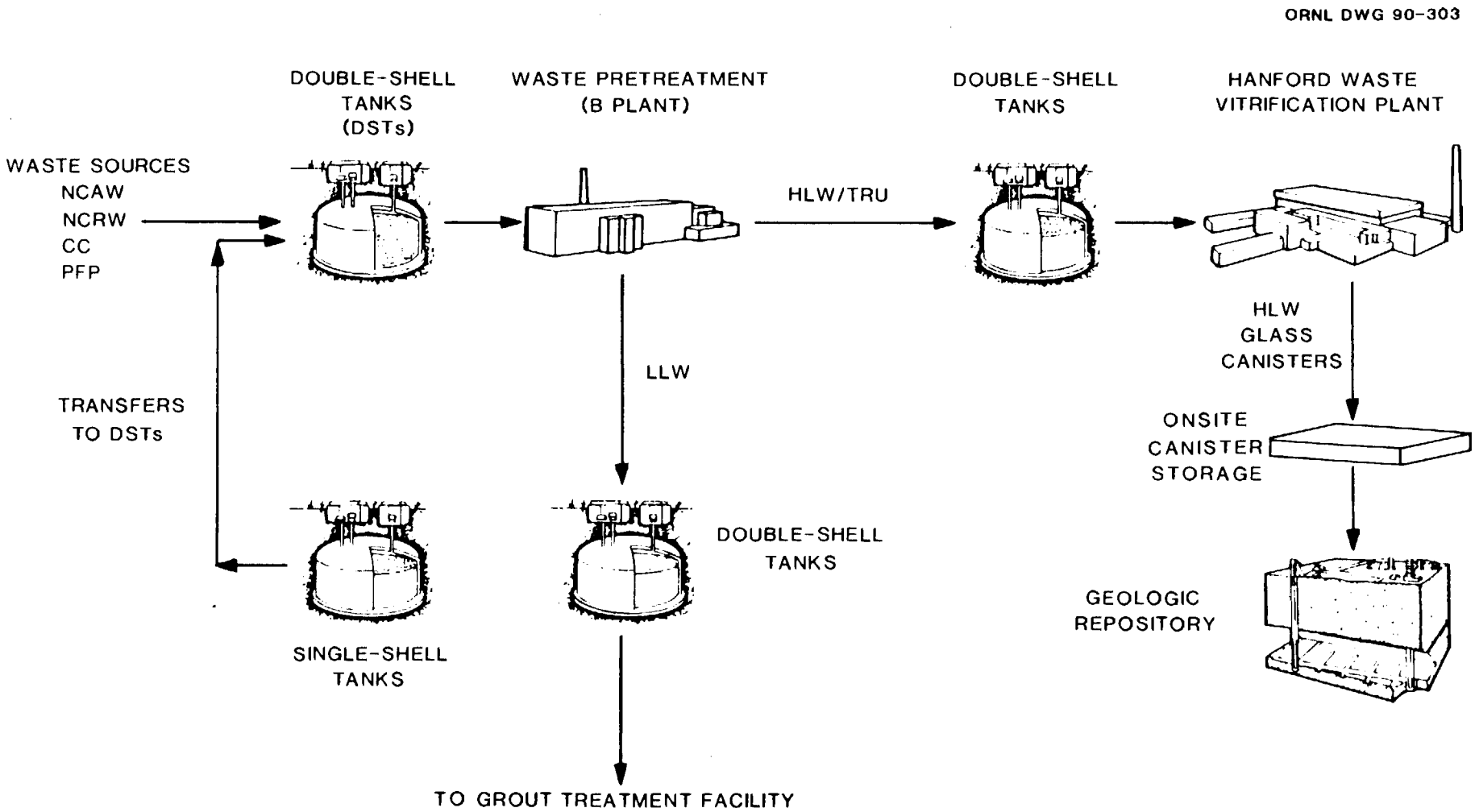
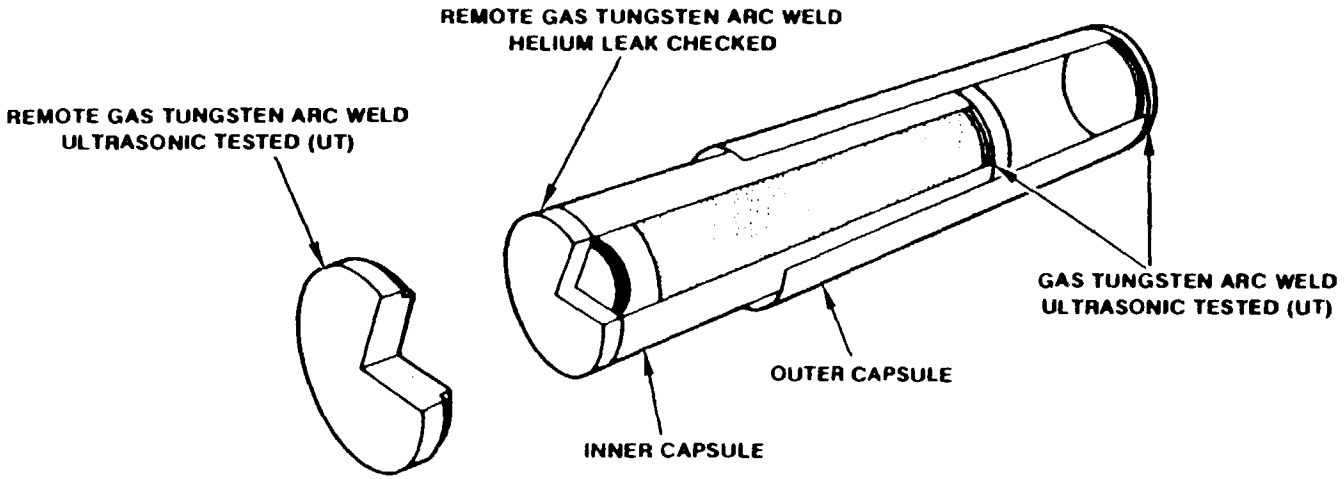


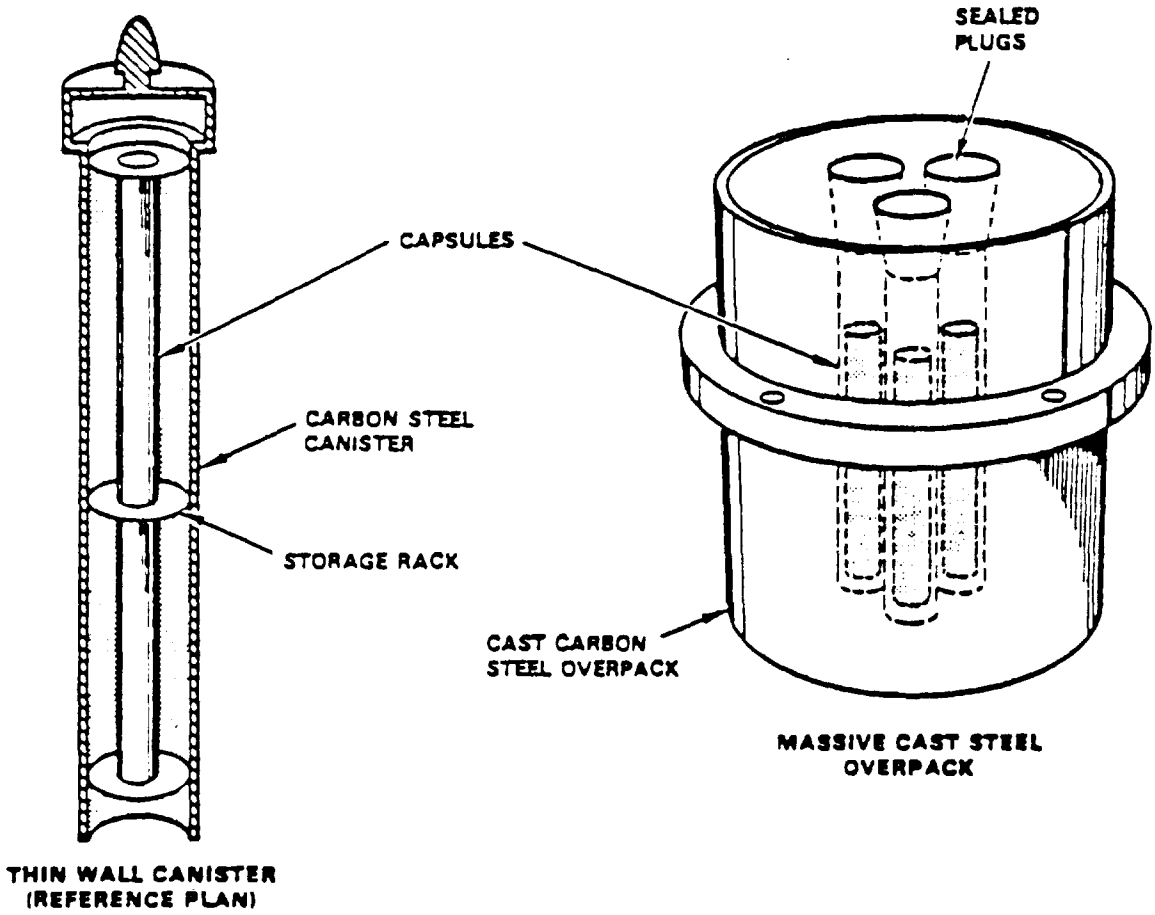
Fig. 3B.4. Hanford site: schematic flowsheet of existing and future HLW processing facilities. Adapted from HANF 1989.

	FORM	LOADING	PERCENT OF THEORETICAL DENSITY BASED ON TOTAL VOID SPACE OF CAPSULE	TEMPERATURE			
				AIR		WATER	
				CENTER LINE	SURFACE	CENTER LINE	SURFACE
STRONTIUM FLUORIDE	COMPACTED POWDER	150 kCi (MAX)	68	860°C	430°C	660°C	71°C
CESIUM CHLORIDE	MELT CAST	70 kCi	65	450°C	200°C	327°C	58°C



	CAPSULE									
	INNER					OUTER				
	MATERIAL	WALL THICKNESS	OUTSIDE DIAMETER	TOTAL LENGTH	TOTAL CAP THICKNESS	MATERIAL	WALL THICKNESS	OUTSIDE DIAMETER	TOTAL LENGTH	TOTAL CAP THICKNESS
STRONTIUM FLUORIDE	HASTELLOY C-276 (UT)	0.305 (UT)	5.72	48.39	1.02	STAINLESS STEEL 316-L (UT)	0.277 (UT)	6.67	51.05	1.02
CESIUM CHLORIDE	STAINLESS STEEL 316-L (UT)	0.241 (UT)	5.72	50.10	1.02	STAINLESS STEEL 316-L (UT)	0.277 (UT)	6.67	52.77	1.02
NOTE ALL DIMENSIONS ARE IN cm										

Fig. 3B.5. Dimensional data for strontium and cesium capsules. Source: White 1986.



	OVERPACK DIMENSIONS		
	OVERALL LENGTH (m)	OUTSIDE DIAMETER (m)	APPROXIMATE REQUIRED
THIN WALL CANISTER	2.7	0.3	513
MASSIVE CAST STEEL OVERPACK	1.2	0.6	1300

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Fig. 3B.6. Overpack concepts for strontium and cesium capsules. Source: White 1986.

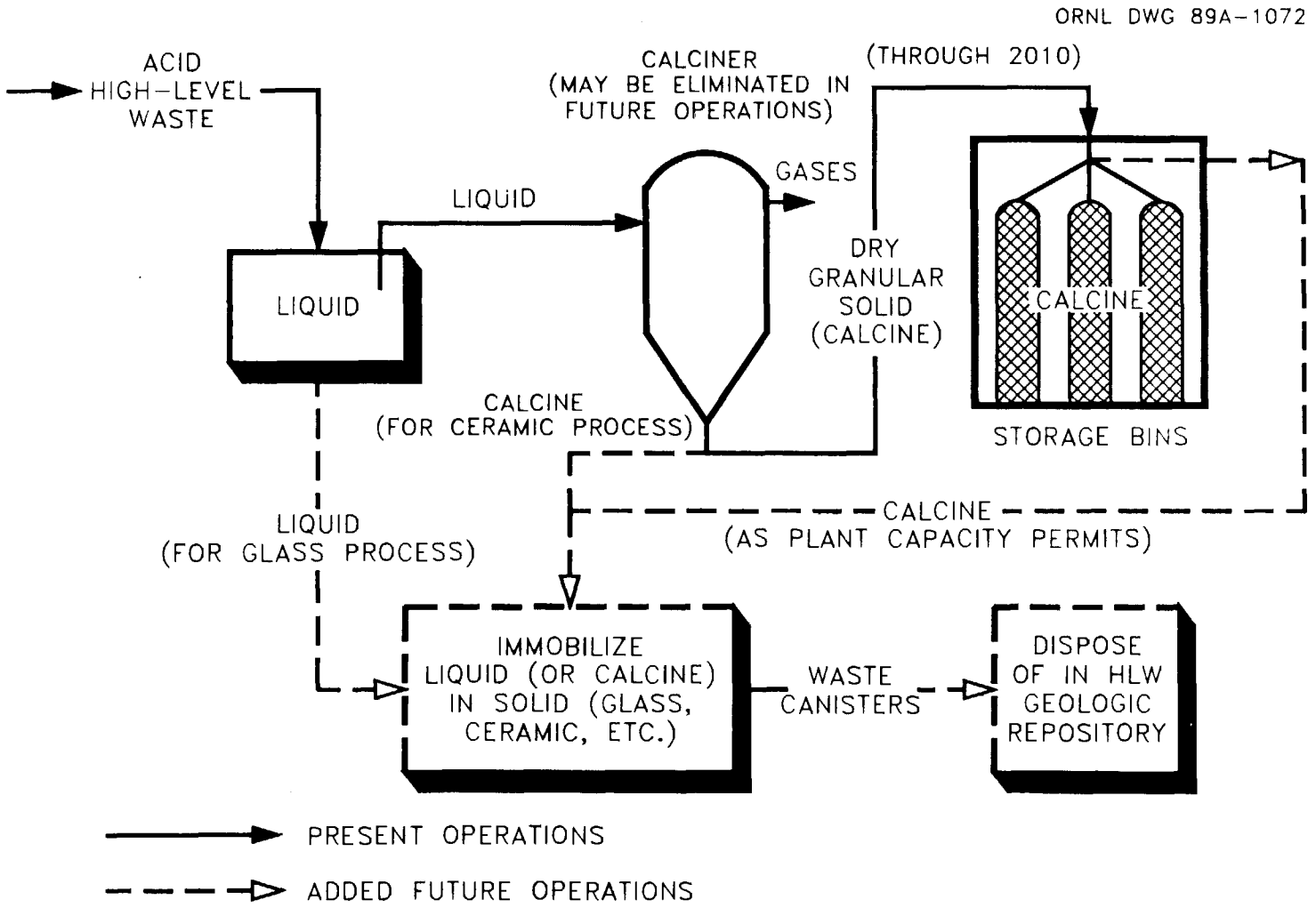

Fig. 3B.7. HLW treatment and vitrification at INEL. Source: IDB 1989.