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Estimates of Power Deposited Via Cesium/Barium Beta and Gamma Radiation Captured in Components of a Hanford Cesium Chloride Capsule and by Components of Overpacked Capsules Placed in an Interim Dry Storage Facility

V. E. Roetman/E. H. Randklev
Fluor Daniel Northwest Inc., Richland, WA 99352
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Abstract: This documents the Power Deposition Calculations for the Cesium Chloride Capsules and Overpacked Capsules.

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1.0 INTRODUCTION

The deposition of power in Hanford cesium chloride capsules and in the components of design concepts for overpacking and interim storage were determined as requested (Randklev, 1996a). The power deposition results from the selective capture of gamma and beta radiation coming from the decay of the ^{137}Cs isotope in the CsCl contained in the capsules. The following three cases were analyzed: a) a single CsCl capsule, b) an overpack containing eight CsCl capsules, and c) an infinite square array of such overpacks as placed in tubes of a interim dry storage facility. The power deposition was expressed as watts per gram for each of the respective physical design components in these three cases. Per the analyses request and guidance (Randklev 1996a), the primary analysis objective was to characterize, for each case, the power deposition across the radial cross-section at the expected axial position of maximum deposition. As requested, this primary part of the analysis work was done using choices for component dimension and material properties that would reasonably characterize the maximum deposition profile across the salt (CsCl) and the inner capsule barrier of the double walled metal capsule system used to construct the Hanford capsules. The secondary objective was to further evaluate the deposition behavior relative to the influence of axial position. The guidance (Randklev 1996a) also requested an analysis case that involved a lag-storage pit in a hot-cell, in which a cylindrical metal basket from a transportation cask would be used to position several capsules in the lag-storage pit. Although the basic model for the lag storage concept evaluation was essentially completed by the end of FY-96, the analysis was not run because of the need to prioritize and limit the work scope due to funding limitations for FY-97.

The specific purpose for performing the subject set of analyses (Randklev 1996a) is to obtain power deposition values (i.e., per the decay of ^{137}Cs) that can then be used as input into an analysis of the heat transfer (i.e., component temperature) response (Randklev 1996d) for such cases. The overall objective is to support the TWRS program evaluations of capsule disposal options, which could be implemented if, and when the DOE changes their current designation as "by-product" material, to "waste" material. It was found that the Hanford reference literature concerning the capsules does contain a few reports on previous Monte Carlo code determinations of the power deposition values for assemblages involving the Hanford CsCl capsules. However, in one case (Campbell, 1981) the results are now believed to be seriously in error, and the other two reported analyses (Sasmor, et al, 1988; Midgett, 1995) involve capsule + other components in assemblages that differed significantly from the subject concepts addressed in this present analysis.

The Monte Carlo N-Particle (MCNP) transport code (Breismeister, 1993 and Carter, 1995) was used to model, in three dimensions, a single capsule; eight capsules plus an overpack and a CSB tube. For these respective models, the MCNP code was then run to calculate the predicted power density deposition for the decay of ^{137}Cs. For simplicity of applying the results to specific capsules, the model assumed that only one curie of ^{137}Cs was in the salt column of each capsule as modeled.

2.0 SUMMARY

The power density deposition values predicted by the MCNP code for the given conceptual model are reported in Figures 2 through 7. Since the MCNP calculations were run on the basis of assuming an inventory of one curie of ^{137}Cs per capsule, the deposition values appropriate for a given Hanford CsCl capsule is obtained by just multiplying these MCNP predicted deposition values by the estimated number of curies of ^{137}Cs for the subject capsule.

3.0 MODEL FOR A SINGLE CESIUM CHLORIDE CAPSULE

The Randklev 1996a and 1996b references provided most of the information needed regarding capsule materials, dimensions, etc., needed for setting up the model. Each of these Hanford CsCl capsules is composed of two independent encapsulation barriers, one located inside the other, where the inner capsule contains the CsCl salt. For the Hanford CsCl capsules, both the inner and outer capsule units are made of 316 stainless steel, which for this analysis was assumed to have a density of 7.9 g/cc. Per the guidance on analysis conservatism (Randklev 1996a) regarding the upper bound for such power deposition, it was assumed that the CsCl had a density of 3.8 g/cc (Randklev 1996c). All the air gaps and void spaces were modeled as void (vacuum). Tables 1 and 2 list the dimensions of the inner and outer capsule components, respectively. For the model, the inner and outer capsules are assumed to share the same axial centerline, and are hence radially symmetrical. The inner and outer capsule were assumed to be co-centered axially, and the CsCl salt column was modeled as being in full contact with one end of the inner capsule (i.e., bottom end as melt-filled during fabrication) with a void space between the salt column and the other end of the inner capsule. As modeled, this is a very simplified representation of the void space distribution, since in an actual CsCl inner capsule the CsCl contains cooling cracks, a shrinkage void generally distributed at the top of the salt column and along the axial centerline region of the upper third or so of the salt column.

Table 1. Inner Capsule Dimensions

Outer Diameter:	2.255	inches
Wall Thickness:	0.136	inches
Inner Diameter:	1.983	inches
Overall Length:	19.725	inches
Cap Thickness:	0.400	inches
Inner Cavity Length:	18.925	inches
Density of CsCl:	3.8	g/cc
Mass of CsCl:	2.7	kg

Table 2. Outer Capsule Dimensions

Outer Diameter:	2.657	inches
Wall Thickness:	0.136	inches
Inner Diameter:	2.385	inches
Overall Length:	20.775	inches
Cap Thickness:	0.400	inches
Inner Cavity Length:	19.975	inches

The MCNP input file for a single capsule is provided in Attachment I.

Figure 2.
Specific Power Deposition in a Single CsCl Capsule in Air
Results are in Watts/gram* for 1 Curie of Cs-137

*Gamma and beta power in Watts deposited per gram of material in the specified region.

The figure is an axial cross-section of the capsule model. All results are radially symmetrical across the capsule. The reported CsCl source region deposition rates include beta power deposited at 5.61E-07 Watts/gram.

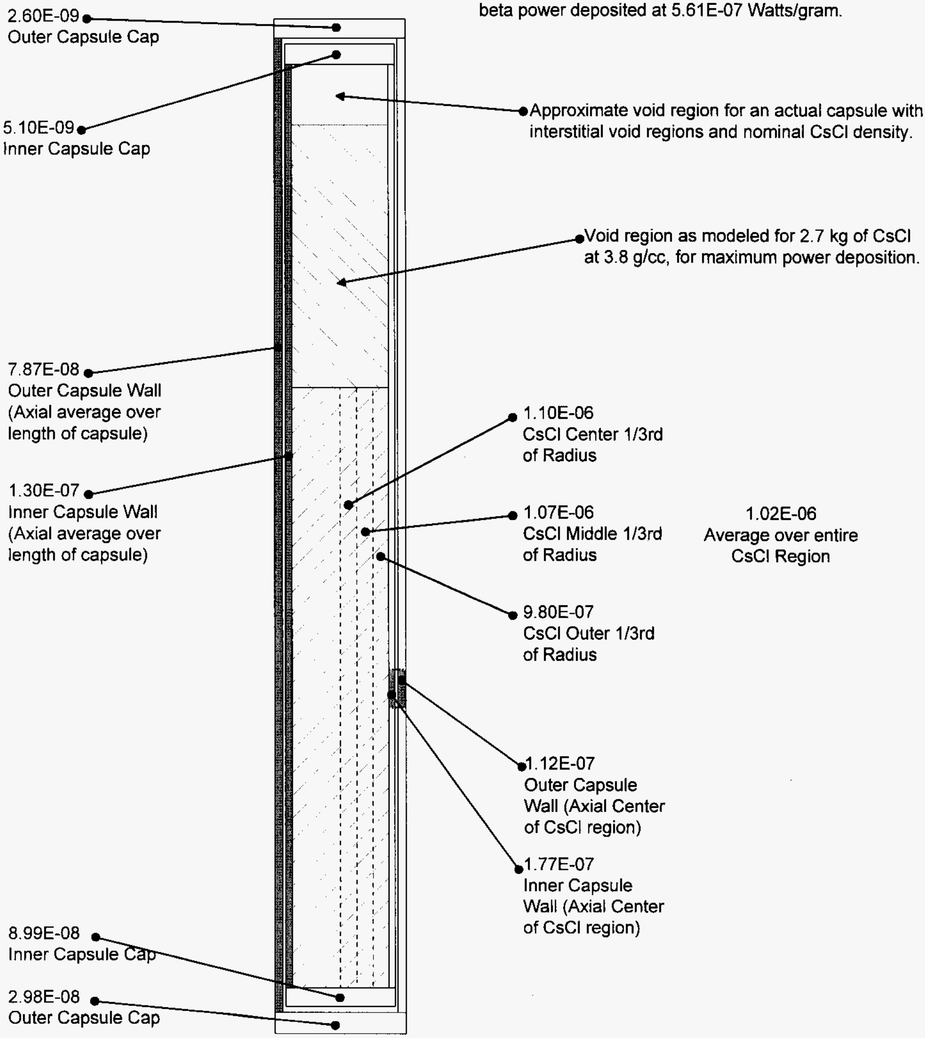


Figure 3.

Axial cross-section of the model for eight cesium chloride capsules in an overpack loaded in a storage tube in a Canister Storage Building (CSB).

The overpack is a thin-walled tube-in-tube design.
See Figure 1 for general illustration.

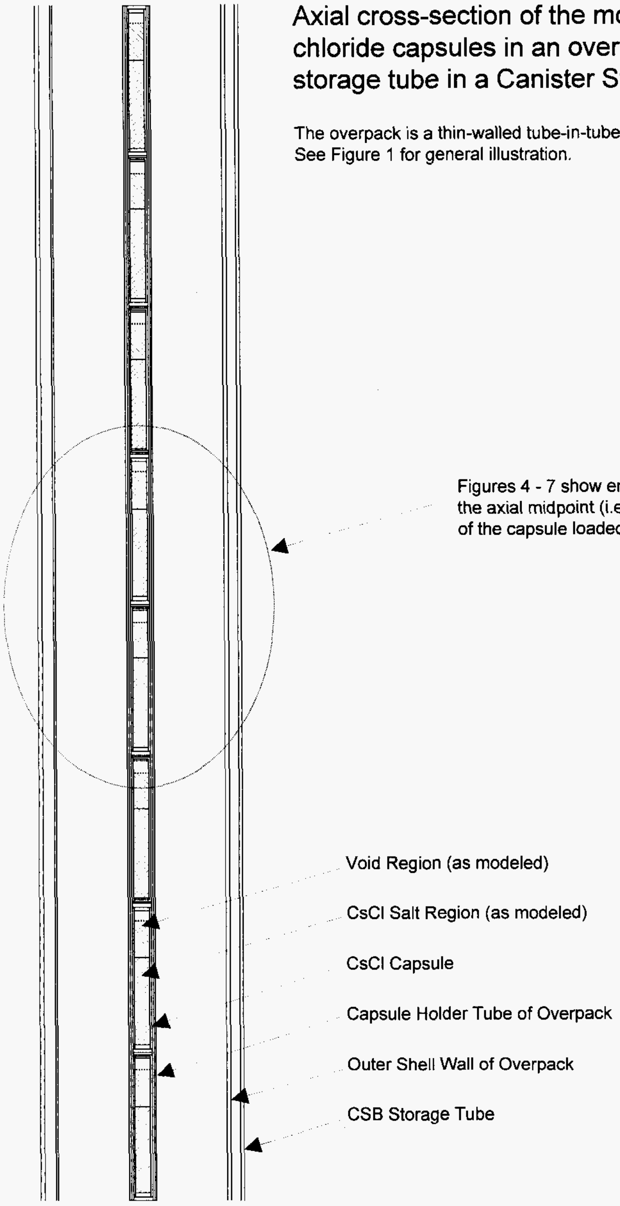


Figure 4.
Specific Power Deposition across a CsCl Capsule Loaded Overpack in one CSB Storage Tube
Results are in Watts/gram* for 1 Curie of Cs-137 in each capsule.

*Gamma and beta power deposited in Watts per gram of material in the specified region.

There are eight CsCl Capsules in each overpack.
All results are radially symmetrical.
Reported CsCl source region deposition rates include beta power deposited at 5.61E-07 Watts/gram.

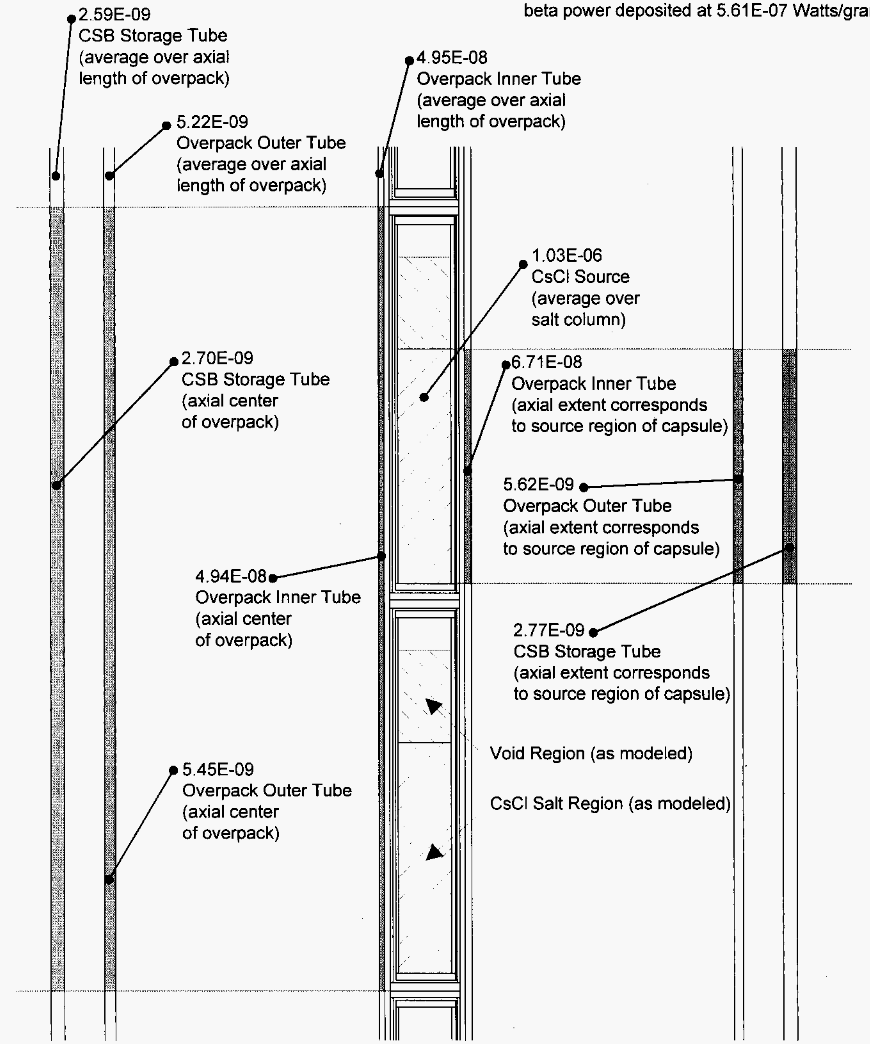


Figure 5.
Specific Power Deposition across a CsCl Capsule in a Loaded Overpack
Results are in Watts/gram* for 1 Curie of Cs-137 in each capsule.

Eight capsules per overpack.
All results are radially symmetrical across the capsule.
The reported CsCl Source region deposition rates include beta power deposited at 5.61E-07 Watts/gram.

*Gamma and beta power deposited in Watts per gram of material in the specified region.

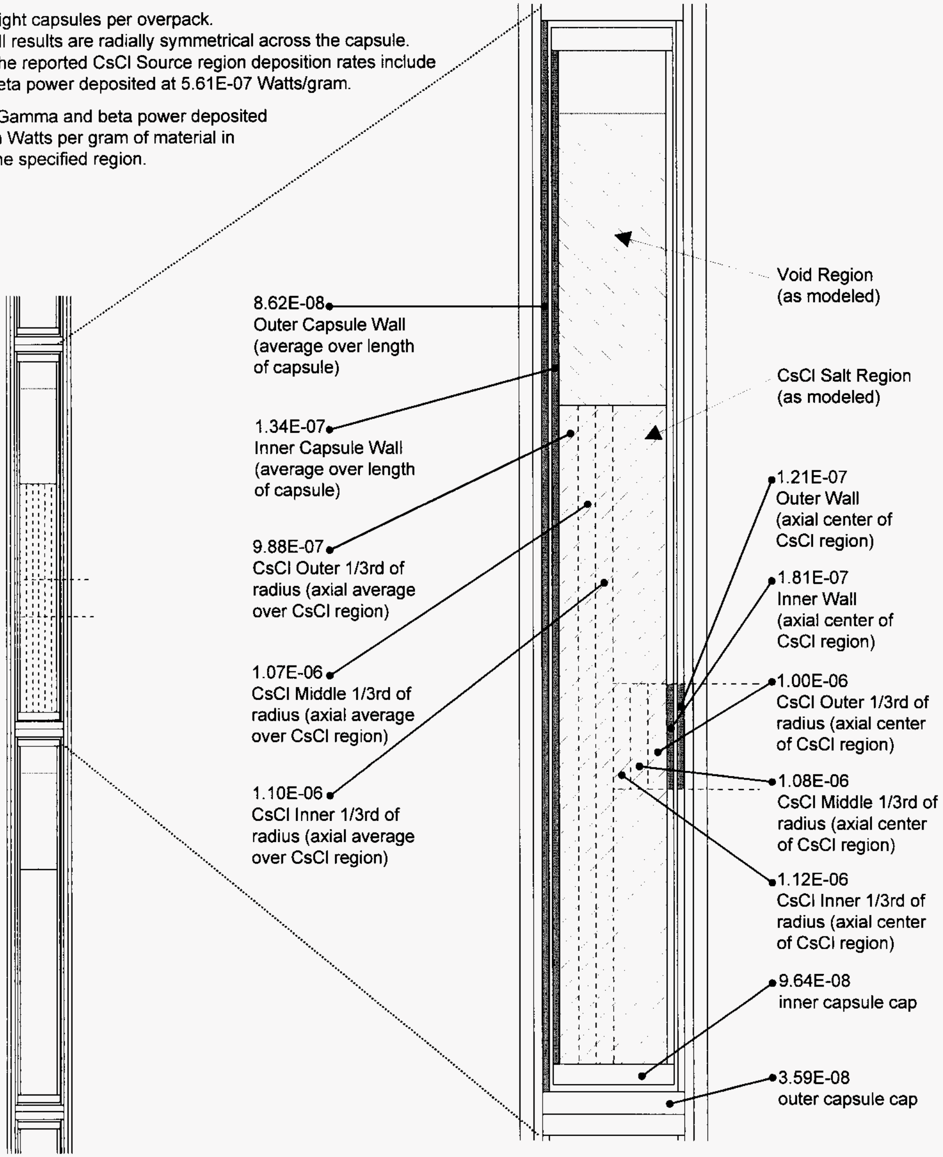


Figure 6.

Specific Power Deposition across a CsCl Capsule Loaded Overpack in a CSB Storage Tube for an Infinite Array of such CSB Tubes.

Results are in Watts/gram* for 1 Curie of Cs-137 in each capsule.

*Gamma and beta power deposited in Watts per gram of material in the specified region.

There are eight CsCl Capsules in each overpack.
All results are radially symmetrical.
Reported CsCl source region deposition rates include beta power deposited at 5.61E-07 Watts/gram.

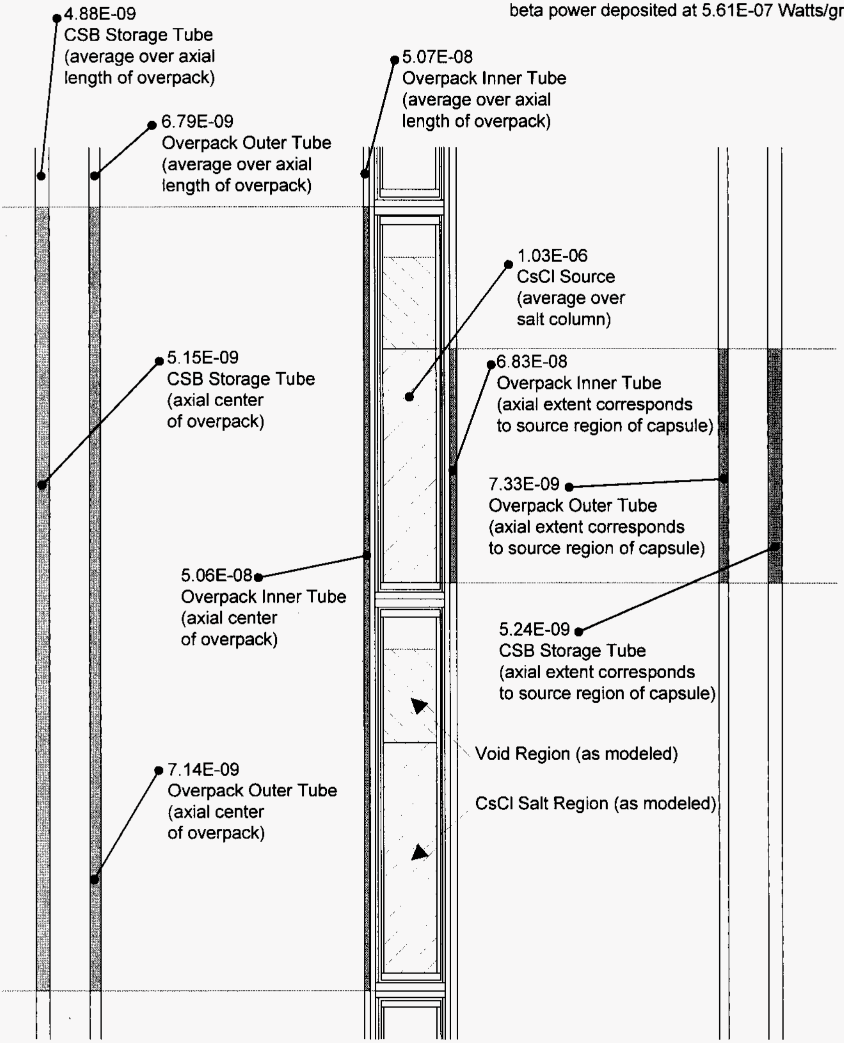
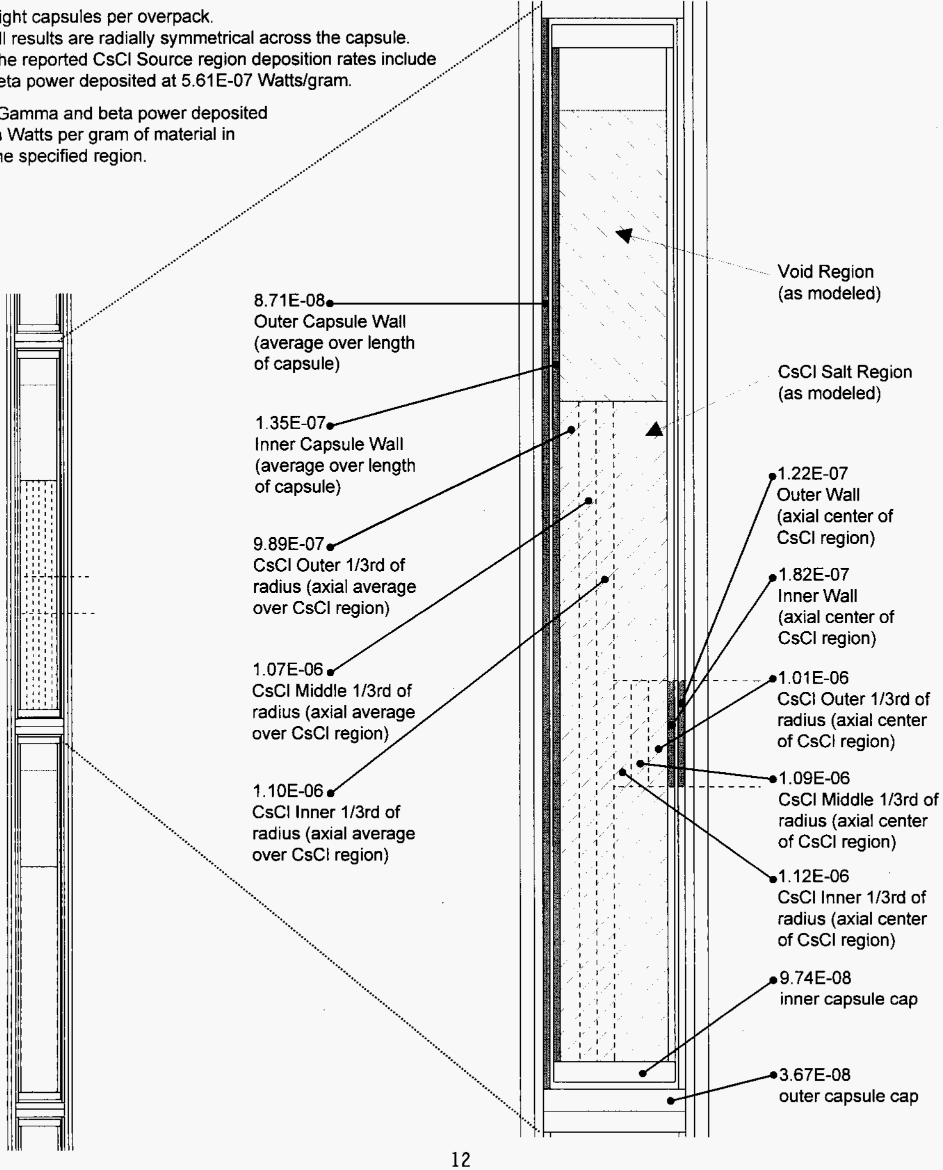


Figure 7.
Specific Power Deposition across a CsCl Capsule in a Loaded Overpack in a CSB Interim Storage Tube for an Infinite Array of such CSB Tubes. Results are in Watts/gram* for 1 Curie of Cs-137 in each capsule.

Eight capsules per overpack.
All results are radially symmetrical across the capsule.
The reported CsCl Source region deposition rates include beta power deposited at 5.61E-07 Watts/gram.

*Gamma and beta power deposited in Watts per gram of material in the specified region.



4.0 RESPECTIVE MODELS FOR AN OVERPACK CONTAINING EIGHT HANFORD CESIUM CHLORIDE CAPSULES AND FOR A CSB STORAGE TUBE CONTAINING OVERPACKED CAPSULES

The Randklev 1996a and 1996b references provided most of the information (i.e., design concept, component dimensions, materials, properties, etc.) needed to model this configuration of components. Figure 1 provides a general schematic illustration of the major components and their relative positioning for the design concept of a capsule overpack loaded with eight CsCl capsules. As the guidance notes, this overpack concept is one that is a candidate for use in the disposal option involving a federal geologic repository. Per this concept, the overpack was modeled as containing eight CsCl capsules with the eight capsules placed axially end-to-end along the axial centerline of the overpack. The capsules were assumed to be held in this position by a small diameter guide tube held in place by other fixturing (e.g., axially aligned fin plates attached perpendicular to the guide tube outer surface). The capsules were thus assumed to be radially co-centered within this guide tube, an outer tube, and then a CSB (Canister Storage Building) interim storage tube, which is a steel tube positioned in a vertical orientation within a CSB. The dimensions of the modeled overpack are listed in Table 3. The inner and outer tubes were modeled as 316 stainless steel having the same density as was assumed in Section 3.0 for the single capsule model. The CSB tube was modeled as AISI/SAE-1020 carbon steel with an assumed density of 7.86 g/cc.

Table 3. Capsule Overpack Dimensions

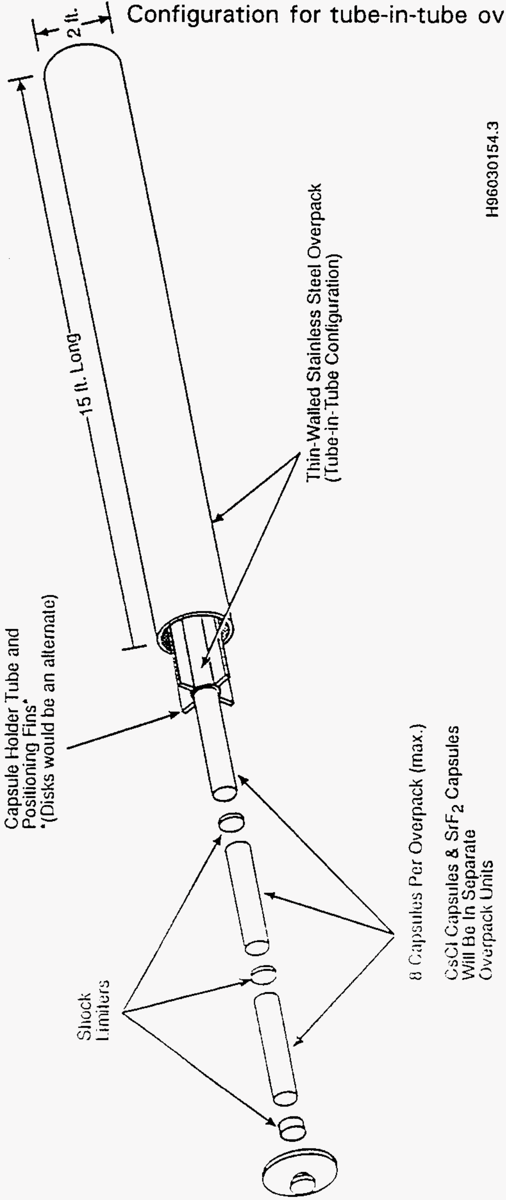
Guide Tube	3 inches ID	1/4 inch thick
Outer Case	24 inches OD	3/8 inch thick
CSB Tube	28 inches OD	½ inch thick

The MCNP input file for the an eight capsule overpack is provided in Appendix I.

5.0 MODEL FOR INFINITE ARRAY OF CSB STORAGE TUBES LOADED WITH OVERPACKED CAPSULES

The MCNP model for the single CSB storage tube, as loaded with an overpack plus capsules, was modified by inserting four reflective surfaces to simulate a close packed infinite square array (i.e., a conservative case for power deposition) of such CSB tubes loaded with overpacked capsules. The specific spacing between the tube array assumed for this model is not that important to the results since the mean free path for the gamma radiation is about 6m in air. For the capsules in overpacks in such a CSB array the power deposition profile across the radial cross-section of such a loaded CSB tube is 63% into the CsCl, 6.7% into the inner capsule wall, 5.4% into the outer capsule wall, 7.1% into the guide tube holding the capsules in the overpack unit, 8.3% into the outer shell of the overpack unit, and 9.2% into the CSB tube wall.

Figure 1.
Configuration for tube-in-tube overpack concept.



6.0 CESIUM SOURCE

The ISOSHLD code (Lourant 1990) was used to generate the gamma distribution for the decay of ^{137}Cs and the daughter product ^{137m}Ba, including the associated bremsstrahlung radiation in the CsCl source material. The gamma distribution is shown in Table 4. A photon strength of 3.626×10^{10} photons per second for one curie of ^{137}Cs was used in the MCNP input file.

Table 4. ^{137}Cs/^{137m}Ba Gamma Distribution

Energy (MeV)	Photons/Sec for 37.65 kCi ^{137}Cs
1.500E-02	3.182E+13
2.500E-02	1.547E+13
3.500E-02	1.042E+14
4.500E-02	4.919E+12
5.500E-02	3.708E+12
6.500E-02	2.547E+12
7.500E-02	1.990E+12
8.500E-02	1.434E+12
9.500E-02	1.096E+12
1.500E-01	3.636E+12
2.500E-01	7.220E+11
3.500E-01	1.841E+11
4.750E-01	7.770E+10
6.500E-01	1.187E+15
8.250E-01	2.689E+09
1.000E+00	2.362E+08

The total photon power predicted by the ISOSHLD code for the decay of ^{137}Cs was calculated to be 2.07×10^{10} MeV/s for one Ci of ^{137}Cs in equilibrium with ^{137m}Ba. This equates to 3.31×10^{-03} Watts. To estimate the amount of power deposited in the CsCl salt via beta radiation, a prediction was made for the total power released from ^{137}Cs decay (i.e., not just the contribution from photons). The total power predicted for the cesium/barium decay scheme using the ORIGEN2 code (Schmittroth 1994) was 4.82×10^{-03} Watts. Thus the difference between these two predicted values (i.e., the ORIGEN2 value for total power released minus the ISOSHLD value for the total photon power released) is 1.51×10^{-03} Watts. This difference is assumed to be the power absorbed in the CsCl source region as beta radiation. For an estimate of 2.7 kg of CsCl per capsule (Randklev 1996c), the beta deposition would be 5.61×10^{-07} Watts/g of CsCl for one Ci of ^{137}Cs. This value was added to the MCNP gamma power density results for the CsCl source regions.

7.0 PREDICTIONS OF DEPOSITION IN OTHER COMPONENTS

The power density deposition values for the other components in each of the models (i.e., the components other than the CsCl salt column, such as the inner and outer capsule metal walls, tube walls for the overpack components, etc.) were then predicted using the MCNP code. A nominal capsule loading of 2.7 kg of CsCl per capsule was used in the analysis (Randklev, 1996c). Component dimensions and the CsCl density values were taken from the Randklev, 1996b and 1996c references, respectively, and input into the MCNP code to obtain the power density values (Watts/g). The results of these calculations are reported in Figures 2 through 7, and are expressed in units of Watts/g.

8.0 REFERENCES

Breismeister, J. F., Editor, 1993, *MCNP--A General Monte Carlo Code N-Particle Transport Code*, *Version 4a*, LA-12625, Los Alamos National Laboratory, Los Alamos, New Mexico, November 1993.

Campbell, G. D., 1982, *Strontium and Cesium Capsule Heat-Transfer Analysis*, RHO-LD-167, Rev. 1, Rockwell Hanford Operations, Richland, Washington, September 1981.

Carter, L. L., 1995, *Certification of MCNP Version 4A for WHC Computer Platforms*, WHC-P-SD-300001, Rev. 5, Westinghouse Hanford Company, Richland, Washington, May 1995.

Lourant, Israel O., 1990, *Validation of ISOSHLD-PC on the IBM PC (PS-2/AT/XT)*, EDT-109878, WHC-SD-SQA-CSWD-303, Rev. 0, Westinghouse Hanford Company, Richland, Washington, February 1990.

Midgett, J. C., External Letter to J. E. Mecca (RL), *Preliminary Analysis for Cesium and Strontium Capsule Storage at the Canister Storage Building*, Letter No. 9502756b R5, Westinghouse Hanford Company, Richland Washington, September 21, 1995.

Randklev, E. H., 1996a, *Request for Radiation Decay Energy Deposition Analyses to Support Thermal Analyses of Hanford Capsules Per Hanford Processing* *for Two Disposal Path Options Being Evaluated in a TWRS Decision Analyses,"* Internal Letter 73510-96-028, to R. A. Schwarz, August 30, 1996, Westinghouse Hanford Company, Richland Washington. (See APPENDIX II for a copy.)

Randklev, E. H., 1996b, Informal memorandum to Victor E. Roetman, "Informal Notice of Analysis Priorities and Inputs," September 17, 1996, Westinghouse Hanford Company, Richland, Washington. (See APPENDIX II for a copy.)

Randklev, E. H., 1996c, Informal memorandum to Victor E. Roetman, "EHR Selection of CsCl Density Value and Salt Wt./Caps."--- supporting MCNP modeling, September 26, 1996, Westinghouse Hanford Company, Richland, Washington. (See APPENDIX II for a copy.)

Randklev, E. H., 1996d, *Request for Thermal Analyses of Hanford Processing Per Two Disposal Path Options Being Evaluated in a TWRS Decision Analysis*, Internal Letter 73510-96-030 to E. R. Cramer, September 30, 1996, Westinghouse Hanford Company, Richland, Washington. (See APPENDIX II for a copy.)

Sasmor, D. J., J. D. Pierce, G. L. Tingey, H. E. Kjarmo, J. Tills and D. C. McKeon, 1988, *Characterization of Two WESF Capsules After Five Years of Service*, Sandia National Laboratories, Albuquerque, New Mexico, April 1988.

Schmittroth, F. A., *Conversion of ORIGEN2 to the Sun Workstations*, WHC-SD-SWD-006, Rev. 1, Westinghouse Hanford Company, Richland, Washington, August 1994.

APPENDIX I

MCNP INPUT FILES

Consisting of 11 pages,
including cover page.

MCNP INPUT FILE FOR SINGLE CAPSULE WITH ONE CURIE OF ^{137}Cs.

```
CsCl Capsule 1 Ci
c     0001111111111222222222223333333333444444444455555555556666666666677777777

c     7890123456789012345678901234567890123456789012345678901234567890123456 7

c  #1  CsCl source
   1     1 -3.8   -1 6 -13                      imp:p=1
c  #2  inner capsule
   2     2 -7.9   -2 1 -5 6                     imp:p=1
c  #3  inner capsule top plug
   3     2 -7.9   -7 5 -2                       imp:p=1
c  #4  inner capsule bottom plug
   4     2 -7.9   -6 8 -2                       imp:p=1
c  #5  air gap between capsules (void)
   5     0        (-3 -9 10 )(2 :7 :-8 )        imp:p=1
c  #6  outer capsule
   6     2 -7.9   -4 3 -9 10                    imp:p=1
c  #7  outer capsule top plug
   7     2 -7.9   -11 9 -4                      imp:p=1
c  #8  outer capsule bottom plug
   8     2 -7.9   12 -4 -10                     imp:p=1
c  #9  outside world
   9     0        4 :11 :-12                    imp:p=0
c  #10 void space above CsCl
   10    0        -1 13 -5                      imp:p=1

   1         cz       2.5180000
   2         cz       2.8640000
   3         cz       3.0290000
   4         cz       3.3740000
   5         pz       48.070000
   6         pz       0.0000000
   7         pz       49.086000
   8         pz      -1.0160000
   9         pz       49.403000
  10         pz      -1.3335000
  11         pz       50.419000
  12         pz      -2.3495000
  13         pz       31.245500
  14         pz       14.620000
  15         pz       16.620000
  16         cz       0.8390000
  17         cz       1.6790000

mode   p
c      ---------------
```

```
c     -- materials --
c     ---------------
c     material one CsCl density 3.80 g/cc
m1    55000 0.50      $Cesium 50%
      17000 0.50      $Chlorine 50%
c     material two 316-L Stainless Steel density 7.90 g/cc @ 200C
m2    26000 -0.65395   $Iron
       6000 -0.0003    $Carbon
      25000 -0.02      $Manganese
      15000 -0.00045   $Phosphorus
      16000 -0.00030   $Sulfer
      14000 -0.01      $Silicon
      28000 -0.12      $Nickle
      24000 -0.17      $Chromium
      42000 -0.025     $Molybdenum
c     material three Air density 0.00122 g/cc
me     7000 -0.765    $Nitrogen
       8000 -0.235    $Oxygen
c     ---------------
c     --- source ----
c     --- One Ci ----
c     ---------------
c     NOTE SOURCE IS FOR ONE CURIE
sdef erg d1 rad d2 ext d3 axs 0 0 1 wgt 3.626E+10
#     si1          sp1
      l            d
      1.500E-02    3.182E+13
      2.500E-02    1.547E+13
      3.500E-02    1.042E+14
      4.500E-02    4.919E+12
      5.500E-02    3.708E+12
      6.500E-02    2.547E+12
      7.500E-02    1.990E+12
      8.500E-02    1.434E+12
      9.500E-02    1.096E+12
      1.500E-01    3.636E+12
      2.500E-01    7.220E+11
      3.500E-01    1.841E+11
      4.750E-01    7.770E+10
      6.500E-01    1.187E+15
      8.250E-01    2.689E+09
      1.000E+00    2.362E+08
si2  2.518
si3  0.00 31.2455
c     ---------------
c     ---- tally ----
c     ---------------
fc6   energy deposited per gram in Watts in end caps
f6:p  3 4 7 8
```

```
fm6   1.602E-13
c     ---------------
fc16   energy deposited per gram in Watts in CsCl
f16:p  1
fs16   -16 -17 t
fm16   1.602E-13
c     ---------------
fc26   energy deposited per gram in Watts in Inner Wall
f26:p  2
fs26   -14 -15 -13 t
fm26   1.602E-13
c     ---------------
fc36   energy deposited per gram in Watts in Outer Wall
f36:p  6
fs36   -14 -15 -13 t
fm36   1.602E-13
c     ---------------
c     ---------------
nps   3000000
```

MCNP INPUT FILE FOR 8 CAPSULE OVERPACK - ONE CI PER CAPSULE

```
CsCl Capsule 1 Ci per capsule
c      0001111111111222222222233333333334444444444555555555566666666667777777
c      78901234567890123456789012345678901234567890123456789012345678901234567

c    #1 source
     1      1       -3.80000 -1 6 -13
c    #2 steel
     2      2       -7.90000 -2 1 -5 6
c    #3 steel
     3      2       -7.90000 -7 5 -2
c    #4 steel
     4      2       -7.90000 -6 8 -2
c    #5 void
     5      0   (-3 -9 10 )(2 :7 :-8 )
c    #6 steel
     6      2       -7.90000 -4 3 -9 10
c    #7 steel
     7      2       -7.90000 -11 9 -4
c    #8 steel
     8      2       -7.90000 12 -4 -10
c    #10 void
    10      0   -1 13 -5
c    #11 steel
    11      2       -7.90000  -22 11 -4
c    #12 steel
    12      2       -7.90000  -20 21 -2
c    #13 steel
    13      2       -7.90000  22 -16 -4 3
c    #14 steel
    14      2       -7.90000  18 -17 -2
c    #15 steel
    15      2       -7.90000  16 -15 -4
c    #16 steel
    16      2       -7.90000  -4 -30 15
c    #17 steel
    17      2       -7.90000  -2 -28 29
c    #18 steel
    18      2       -7.90000  -2 26 -25
c    #19 steel
    19      2       -7.90000  -4 -23 24
c    #20 steel
    20      2       -7.90000  -4 -38 23
c    #21 steel
    21      2       -7.90000  -2 -36 37
c    #22 steel
    22      2       -7.90000  -2 -33 34
c    #23 steel
    23      2       -7.90000  -2 -44 45
c    #24 steel
    24      2       -7.90000  -4 32 -31
```

```
c   #25 steel
   25     2      -7.90000  -4 -46 31
c   #26 steel
   26     2      -7.90000  -2 42 -41
c   #27 steel
   27     2      -7.90000  -2 53 -52
c   #28 steel
   28     2      -7.90000  -4 40 -39
c   #29 steel
   29     2      -7.90000  -4 -54 39
c   #30 steel
   30     2      -7.90000  -2 -49 50
c   #31 steel
   31     2      -7.90000  -2 -60 61
c   #32 steel
   32     2      -7.90000  -4 48 -47
c   #33 steel
   33     2      -7.90000  -4 47 -62
c   #34 steel
   34     2      -7.90000  -2 -57 58
c   #35 steel
   35     2      -7.90000  -2 69 -68
c   #36 steel
   36     2      -7.90000  -4 -55 56
c   #37 steel
   37     2      -7.90000  -4 55 -70
c   #38 steel
   38     2      -7.90000  -2 -65 66
c   #39 steel
   39     2      -7.90000  -4 64 -63
c   #40 steel
   40     2      -7.90000  -2 1 20 -18
c   #41 void
   41     0  (-16 -3 22 )(-21 :17 :2 )
c   #42 source
   42     1      -3.8000  -1 20 -19
c   #43 void
   43     0  -18 19 -1
c   #44 steel
   44     2      -7.90000  -4 3 30 -24
c   #45 steel
   45     2      -7.90000  1 -2 28 -26
c   #46 void
   46     0  (-3 -24 30 )(25 :-29 :2 )
c   #47 source
   47     1      -3.8000  28 -1 -27
c   #48 void
   48     0  -26 -1 27
c   #49 steel
   49     2      -7.90000  3 -4 38 -32
c   #50 steel
   50     2      -7.90000  1 -2 -34 36
c   #51 void
   51     0  (-32 38 -3 )(33 :-37 :2 )
```

```
c   #52 source
   52     1      -3.8000  36 -35 -1
c   #53 void
   53     0  -34 -1 35
c   #54 steel
   54     2      -7.90000  3 -4 46 -40
c   #55 steel
   55     2      -7.90000  -2 1 -42 44
c   #56 void
   56     0  (-3 -40 46 )(41 :-45 :2 )
c   #57 source
   57     1      -3.8000  44 -43 -1
c   #58 void
   58     0  -42 -1 43
c   #59 steel
   59     2      -7.90000  -4 3 54 -48
c   #60 steel
   60     2      -7.90000  1 -2 52 -50
c   #61 void
   61     0  (-48 -3 54 )(49 :2 :-53 )
c   #62 source
   62     1      -3.8000  52 -1 -51
c   #63 void
   63     0  -50 -1 51
c   #64 steel
   64     2      -7.90000  -4 3 62 -56
c   #65 steel
   65     2      -7.90000  -2 1 60 -58
c   #66 void
   66     0  (62 -56 -3 )(57 :-61 :2 )
c   #67 source
   67     1      -3.8000  60 -59 -1
c   #68 void
   68     0  -58 -1 59
c   #69 steel
   69     2      -7.90000  -64 70 -4 3
c   #70 steel
   70     2      -7.90000  -2 1 68 -66
c   #71 void
   71     0  (-64 -3 70 )(65 :-69 :2 )
c   #72 source
   72     1      -3.8000  68 -67 -1
c   #73 void
   73     0  -66 67 -1
c   #74 steel
   74     2      -7.90000  63 -78 -72
c   #75 steel
   75     2      -7.90000  12 -72 71 -63
c   #76 void
   76     0  -71 4 -63 12
c   #77 steel
   77     2      -7.90000  -12 80 -72
c   #78 steel
   78     2      -7.90000  74 -73 80 -78
```

```
c   #79 steel
   79     2      -7.90000  -73 78 -79
c   #80 void
   80     0  -78 -74 72 80
c   #81 steel
   81     2      -7.90000  -80 81 -73
c   #82 carbon steel
   82     4      -7.86000  -79 76 -75 81
c   #83 carbon steel
   83     4      -7.86000  -75 -81 82
c   #84 void
   84     0  81 -79 73 -76
c   #85 carbon stel
   85     4      -7.86000  79 -75 -77
c   #86 outside world
   86     0  77 :75 :-82

    1        cz      2.5180000
    2        cz      2.8640000
    3        cz      3.0290000
    4        cz      3.3740000
    5        pz      48.070000
    6        pz      0.0000000
    7        pz      49.086000
    8        pz     -1.0160000
    9        pz      49.403000
   10        pz     -1.3335000
   11        pz      50.419000
   12        pz     -2.3495000
   13        pz      31.245500
c       capsule 2

   15        pz      103.18800
   16        pz      102.17200
   17        pz      101.85500
   18        pz      100.83900
   19        pz      84.014500
   20        pz      52.769000
   21        pz      51.753000
   22        pz      51.435500
c       capsule 3

   23        pz      155.95700
   24        pz      154.94100
   25        pz      154.62400
   26        pz      153.60800
   27        pz      136.78350
   28        pz      105.53800
   29        pz      104.52200
   30        pz      104.20450
c       capsule 4

   31        pz      208.72600
   32        pz      207.71000
```

```
   33       pz     207.39300
   34       pz     206.37700
   35       pz     189.55250
   36       pz     158.30700
   37       pz     157.29100
   38       pz     156.97350
c     capsule 5

   39       pz     261.49500
   40       pz     260.47900
   41       pz     260.16200
   42       pz     259.14600
   43       pz     242.32150
   44       pz     211.07600
   45       pz     210.06000
   46       pz     209.74250
c     capsule 6

   47       pz     314.26400
   48       pz     313.24800
   49       pz     312.93100
   50       pz     311.91500
   51       pz     295.09050
   52       pz     263.84500
   53       pz     262.82900
   54       pz     262.51150
c     capsule 7

   55       pz     367.03300
   56       pz     366.01700
   57       pz     365.70000
   58       pz     364.68400
   59       pz     347.85950
   60       pz     316.61400
   61       pz     315.59800
   62       pz     315.28050
c     capsule 8

   63       pz     419.80200
   64       pz     418.78600
   65       pz     418.46900
   66       pz     417.45300
   67       pz     400.62850
   68       pz     369.38300
   69       pz     368.36700
   70       pz     368.04950
   71       cz     3.8100000
   72       cz     4.4450000
   73       cz     30.480000
   74       cz     29.527500
   75       cz     35.560000
   76       cz     34.290000
   77       pz     422.65950
   78       pz     420.43700
```

```
   79        pz      421.38950
   80        pz     -2.9845000
   81        pz     -3.9370000
   82        pz     -5.2070000
  100        cz      0.839
  101        cz      1.679
  102        pz      171.4298
  103        pz      176.4298
  104        pz      224.1988
  105        pz      229.1988

mode   p
imp:p  1 83r 0
c      --------------
c      -- materials --
c      ---------------
c      material one CsCl density 3.80 g/cc
m1     55000 0.50      $Cesium 50%
       17000 0.50      $Chlorine 50%
c      material two 316-L Stainless Steel density 7.90 g/cc @ 200C
m2     26000 -0.65395   $Iron
        6000 -0.0003    $Carbon
       25000 -0.02      $Manganese
       15000 -0.00045   $Phosphorus
       16000 -0.00030   $Sulfer
       14000 -0.01      $Silicon
       28000 -0.12      $Nickle
       24000 -0.17      $Chromium
       42000 -0.025     $Molybdenum
c      material three Air density 0.00122 g/cc
c      m3      7000 -0.765    $Nitrogen
c              8000 -0.235    $Oxygen
c      material four Carbon Steel AISI-SAE 1020 density 7.86 g/cc
m4     26000 -0.9926     $Iron
        6000 -0.0020    $Carbon
       25000 -0.0045    $Manganese
       15000 -0.0004    $Phosphorus
       16000 -0.0005    $Sulfer
c      ---------------
c      --- source ----
c      --- One Ci ----
c      ---------------
c      NOTE SOURCE IS FOR ONE CURIE, EIGHT SOURCES!
sdef erg d1 rad d2 ext d3 cel d5 pos fcel d4 axs 0 0 1 wgt 2.901E+11
si5    L 1 42 47 52 57 62 67 72
sp5    D 1 1  1  1  1  1  1  1
#      si1          sp1
       L            D
       1.500E-02    3.182E+13
       2.500E-02    1.547E+13
       3.500E-02    1.042E+14
       4.500E-02    4.919E+12
       5.500E-02    3.708E+12
       6.500E-02    2.547E+12
```

```
       7.500E-02    1.990E+12
       8.500E-02    1.434E+12
       9.500E-02    1.096E+12
       1.500E-01    3.636E+12
       2.500E-01    7.220E+11
       3.500E-01    1.841E+11
       4.750E-01    7.770E+10
       6.500E-01    1.187E+15
       8.250E-01    2.689E+09
       1.000E+00    2.362E+08
si2  2.518
si3  0.00 31.2455
ds4  L 0 0 0.00
       0 0 52.769
       0 0 105.538
       0 0 158.307
       0 0 211.076
       0 0 263.845
       0 0 316.614
       0 0 369.383
c     ---------------
c     ---- tally ----
c     ---------------
fc6   energy deposited per gram in Watts in end caps
f6:p  25 23 83 81 77
fm6   1.602E-13
c     ---------------
fc16   energy deposited per gram in Watts in CsCl
f16:p  57 52
fs16   -100 -101 t
fm16   1.602E-13
c     ---------------
fc26   energy deposited per gram in Watts in Overpack Walls large
f26:p  82 78 75
fs26   -23 -39 t
fm26   1.602E-13
c     ---------------
fc36   energy deposited per gram in Watts in Overpack Walls small
f36:p  82 78 75
fs36   -36 -35 -44 -43 t
fm36   1.602E-13
c     ---------------
fc46   energy deposited per gram in Watts in upper canister walls
f46:p  54 55
fs46   -104 -105 -43 t
fm46   1.602E-13
c     ---------------
fc56   energy deposited per gram in Watts in lower canister walls
f56:p  49 50
fs56   -102 -103 -35 t
fm56   1.602E-13
c     ---------------
fc66   energy deposited per gram in Watts in axial,radial center of CsCl upper
f66:p  57
```

```
fs66   100 -104 -105
fm66   1.602E-13
c     ---------------
fc76   energy deposited per gram in Watts in axial,radial center of CsCl lower
f76:p  52
fs76   100 -102 -103
fm76   1.602E-13
c     ---------------
fc86   energy deposited(W) per g in axial ctr radial mid of CsCl upper
f86:p  57
fs86   -100 101 -104 -105
fm86   1.602E-13
c     ---------------
fc96   energy deposited(W) per g in axial ctr radial mid of CsCl lower
f96:p  52
fs96   -100 101 -102 -103
fm96   1.602E-13
c     ---------------
fc106   energy deposited(W) per g in axial ctr radial out of CsCl upper
f106:p  57
fs106   -101 -104 -105
fm106   1.602E-13
c     ---------------
fc116   energy deposited(W) per g in axial ctr radial out of CsCl lower
f116:p  52
fs116   -101 -102 -103
fm116   1.602E-13
c     ---------------
c     ---------------
ctme  360
```

APPENDIX II

COPIES OF GUIDANCE LETTERS AND MEMORANDUMS

WHC-SD-WM-TI-791, Rev.0

KN

**Westinghouse
Hanford Company**

**Internal
Memo**

From: Process Technology
Phone: 376-1456 H5-27
Date: August 30, 1996
Subject: REQUEST FOR RADIATION DECAY ENERGY DEPOSITION ANALYSES TO SUPPORT THERMAL ANALYSES OF HANFORD CESIUM CHLORIDE CAPSULES PER HANFORD PROCESSING FOR TWO DISPOSAL PATH OPTIONS BEING EVALUATED IN A TWRS DECISION ANALYSES

73510-96-028

To: R. A. Schwarz H0-35

cc: T. R. Beaver H0-34
R. D. Claghorn H5-49
~~E. R. Cramer H0-34~~
R. L. Gibby H5-27
J. Greenborg H0-35
D. M. Ogden H0-34
D. J. Washenfelder H5-27
73510 File/LB H5-27

The purpose of this letter is to document the basic scope of the analysis assignment you are to perform. You were identified by your manager (J. Greenborg) as the lead for conducting this analysis assignment, and the following workscope description is in part based on the meeting that Mr. E. R. Cramer, of Process Engineering Analysis, and myself had with you on August 26, 1996 to discuss this matter. Your time charges for this work should be made to the **TPCN D5222**.

The basic assignment is to provide radiation decay (Cs-137) energy deposition analysis to estimate the specific energy deposition amongst the fabrication components of a capsule and the surrounding components associated with the following design cases:

a) a single capsule surrounded by air;
b) a BUSS cask basket holding 16 capsules (fewer capsules optional) with the basket located in a lag storage pit (high-density concrete lined with stainless steel plate);
c) a set of overpacked capsules surrounded by air, in which a set of 8 capsules are positioned end-to-end along the axial centerline of a right-circular cylinder overpack design (i.e., a stainless steel tube-in-tube overpack configuration where the innermost tube (i.e., holding the capsules) is positioned using four plate-type fins aligned axially along the outer surface of this inner-most tube;
d) two capsule overpacks positioned end-to-end within a given storage tube (vertical orientation) in a Canister Storage Building (CSB) for high-level waste disposal products.

Specific design details to be assumed for component materials, component dimensions, etc., will basically correspond to values for such component designs as used during the radiation dose rate analyses that you did for us during May and June of 1995 in support of an earlier stage of this work.

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A major exception to that information is that the diameter of the capsule overpack design concept has been reduced from 27 inches in diameter (1995 basis) to a value of 24 inches in diameter (1996 basis). During our August 26, 1996 meeting, you indicated that you still had the models for those earlier determinations and that you also had a model for the BUSS cask basket per past work on a safety analysis report for the BUSS cask. Please take advantage of any existing models that are appropriate.

I propose that we handle the remaining parameter value choices by less formal written communication. Such choices, however, should be guided by our interest in establishing a conservative envelope for such radiation decay deposition (i.e., maximum levels achievable starting from the salt axial centerline, inner capsule wall, outer capsule wall, overpack walls, etc.) for given capsule curie loadings and capsule design, overpack design, etc.. The reason for this is that one of the primary interests relative to the follow-on thermal analysis work is to estimate the maximum salt:metal (inner capsule) interface temperatures that could result from such configurations. We will be looking to your expert technical judgement to help guide us in making those remaining parameter value choices.

Please use the following estimated decayed values for the maximum and average Curie (kCi) loadings per capsule for the CsCl capsule population as decayed to the calendar years 2010, 2020, and 2035 (Per a disposal population of 1328 capsules -- WHC/WESF estimates provided to me in FY 1995).

Year	Maximum	Average
2010	37.65 kCi	27.77 kCi
2020	(Estimates pending--will be provided later)	
2035	21.20 kCi	15.63 kCi

The lag storage (BUSS cask basket) case should be analyzed using the estimated values for the maximum and the average capsule inventory for the calendar years 2010 and 2020. The first priority for all the requested analysis cases is to run the maximum estimated inventory value first. The analysis case involving overpacked capsules placed in a CSB storage tube should be similarly run for the calendar years of 2010, 2020, and 2035, preferably in that sequence.

As I noted during our August 26, 1996 meeting, my review work on the reports of past Monte Carlo analyses of the Cs-137 decay energy deposition across these Hanford capsules has revealed major differences between such predictions. Please be advised of the need to carefully conduct these analyses so that we can successfully resolve such controversy.
Dr. Gregory Spriggs, of LANL, who did such an analysis (MCNP code), in support of another WHC task during FY 1995, has been reviewing reports that I sent him regarding other such analyses, and he has initiated a new MCNP analysis for a single capsule to help resolve this matter. I will keep you informed on these supporting efforts.

The goal is to try and complete the work in FY 1996. Mr. E. R. Cramer and myself will work with you next week to develop a more detailed and prioritized schedule regarding when you will be able to provide him with the input he will need for his follow-on thermal analysis work. The Cost

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Account Manager (R. D. Claghorn) and myself recognize that in trying to resume such detailed analysis work so late in the fiscal year there will likely be some challenges in trying to complete the work in FY 1996. You indicated during our August 26, 1996 meeting that you might have as much as half-time to devote to this effort.

It may be possible to accommodate some workscope carryover into the first quarter of FY 1997 but that is not our preferred plan. Please keep me informed (376-1456) as soon as any potential delays or complications arise.

Edward H Randklev

E. H. Randklev, Principal Engineer
Process Technology

ehr

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[475] From: Edward H (Ed) Randklev at ~WHC133 9/17/96 5:34PM (5661 bytes: 87 ln)
To: Randolph A Schwarz at ~HANFORD07A, Eldon R Cramer at ~WHC304
cc: Victor E Roetman at ~HANFORD07A, Edward H (Ed) Randklev
Subject: Informal Notice of Analysis Priorities and Inputs

------------------------------ Message Contents ------------------------------

Randy,

Please do the decay energy deposition work according to the following list, which is arranged in descending priority:

a. single capsule case
b. capsules in an overpack, which is loaded in a Canister Storage Bldg. storage tube.
   NOTE: My 8/30/96 letter [73510-96-028] to you was not explicit enough about this priority. We also are essentially only interested in the axial midpoint condition (i.e., worst case), unless the end-effects thought to be so large that they must be considered.
c. capsules loaded in basket (i.e., the same type as used in a BUSS cask) that is placed in a lag storage pit.

Eldon and I spoke to Victor Roetman this afternoon, and I realized that I needed to issue some clarification about both the prioritization and the dimensions for some of the cases.

Regarding the dimensions, please use the following:

1. For all analysis cases, use the third generation of wall thicknesses for the inner and outer capsules, respectively. This should be 0.136 inches in wall thickness for both capsules. Inner caps. OUTER dia. is 2.255ins. (i.e., 2 1/4 ins. nominal) and the Outer caps. had an INNER dia. of 2.385ins, which with the 0.136in. wall thickness yields a 2.657 ~~2.521~~in. OD (i.e., 2 5/8in. nominal with tolerances). Use the decimal values for finalizing the dimensions. These came from WHC-SD-WM-D1C-004 Rev.0, page 103D by D.F. Washburn, Sr. ~~(Values seem odd but use as is)~~ The capsules are 316 austenitic stainless steel.
2. The overpack should be assumed to be 316 austenitic stainless steel. The outer case of the overpack is nominally 2ft. OD and would be 3/8ins. thick. The "guide or positioning tube", which holds the capsules along the axial centerline of the overpack tube, is nominally 3ins. I.D. ~~OD~~ and 1/4ins. thick.
3. The Canister Storage Bldg. will use a steel tube for positioning the overpacks, and this steel tube is to be 28ins. OD and 1/2ins. thick. carbon steel. This would leave quite a large radial gap between the overpack OD and CSB tube ID, but for now assume that overpack is held in place to share the same axial centerline. It may turn out that the design will use some form of "sleeve" (steel, etc.) to take up some of space, but for these first analyses do not include any such sleeve. (THIS CSB CASE IS THE MOST IMPORTANT)
4. For the "basket in a pit", assume that a plate

   (same material as the basket) will be

set on the top of the basket to ensure that the capsules do not protrude above the top of this overall structure (hence will be radially shielded).

5. The basket will set in a stainless steel lined pit (rt. cir. config.). Assume the 316 stainless steel is 1/2ins. thick and behind it is high-temperature (high density) concrete--very thick.

I think the above information will fill in most of the missing pieces for your current modeling needs, and the prioritization guidance will further help focus the efforts.

I will confirm all this with a WHC internal ltr. to you for your referencing in preparing the letter report back to me.

I called Gregg Spriggs/LANL today, and he will not
get the U of NM MCNP results for a single capsule case for
about a month---the fellow is in Europe on business.
I will compare your results to Sprigg's reporting
(will get you a copy of his report tomorrow) for our
initial cross-check. Gregg thought your group's idea of just assuming the beta was all deposited in the salt was fine for this analysis--i.e., conservative relative to my concern for salt/metal interface temperatures and not a significant factor anyway. Gregg still figures that if he did make an error in his MCNP analysis, it will turn out to be that he misinterpreted a piece of the codes output. We can discuss further once we make the comparison---and can call him and also discuss it further as needed.

Later,

Ed R.

KN

[525] From: Edward H (Ed) Randklev at ~WHC133 9/26/96 5:43PM (1429 bytes: 25 ln)
To: Victor E Roetman at ~HANFORD07A, Randolph A Schwarz at ~HANFORD07A
cc: Edward H (Ed) Randklev, Eldon R Cramer at ~WHC304
Subject: EHR Selection of CsCl Density Value and Salt Wt./Caps.

------------------------------- Message Contents --------------------------------

This message is to provide a copy of the values I provided Victor via our phone discussion about 11AM this morning for use in the MCNP analysis case for the CsCl capsules.

Density of Cesium Chloride (CsCl)
Use a value of 3.8 gms/cc
(Eldon and I derived this from values in PNL-5517 that given for a set of elevated temperatures and which could be converted to density. The 3.8 value is a value rounded off from the value attributed to CsCl at 370C. In my view this is an appropriately conservative value to use for our MCNP work.)

Weight of CsCl per capsule:

Use a value of 2.7kg of CsCl per capsule.
(I got this from my draft of a Capsule Description Report Summary)

Let's settle on the strontium fluoride input values tomorrow.

Later,

Ed R.

WHC-SD-WM-TI-791, Rev. 0
KN

Westinghouse Hanford Company **Internal Memo**

From: Process Technology 73510-96-030
Phone: 376-1456 H5-27
Date: September 30, 1996
Subject: REQUEST FOR THERMAL ANALYSES OF HANFORD PROCESSING PER TWO DISPOSAL PATH OPTIONS BEING EVALUATED IN A TWRS DECISION ANALYSIS

To:	E. R. Cramer	H0-34
cc:	D.M. Ogden	H0-34
	D.J. Washenfelder	H5-27
	R.A. Schwarz	H0-35
	V.E. Roetman	H0-35
	R.P. Claghorn	H5-49
	73510 File/LB	H5-27

Reference: Letter, E. H. Randklev to R. A. Schwarz, "Request for Radiation Decay Energy Deposition Analyses to Support Thermal Analyses of Hanford Cesium Chloride Capsules Per Hanford Processing for Two Disposal Path Options Being Evaluated in a TWRS Decision Analysis," 73510-96-028, dated August 30, 1996.

The purpose of this letter is to formally outline the basic scope of a thermal analysis assignment involving Hanford cesium chloride capsules and strontium fluoride capsules relative to two candidate schemes for Hanford preparations to support final disposal. This information is needed to support a TWRS program decision analysis of Hanford preparation options, preferred disposal path recommendation and then selection of a new TWRS program baseline for capsule disposal.

Most of this information was informally provided to you earlier this month, following your Team Leader (D.M. Ogden) having identified you as the lead for doing this assignment. The circumstances of trying to expedite the restart of FY-96 work on these analyses tasks has necessitated that most of the initial instructions had to be handled informally. Since Mr. T. R. Beaver of your group did similar thermal analyses for us in FY-95 and early FY-96 (i.e., regarding the Hanford capsules of CsCl and those of SrF_2 relative to potential disposal processing situations), we will expect your analyses efforts to utilize Mr. Beaver's models, reference files and technical perspective to the maximum extent practical. Your time for this work should be charged to the TPCN D5222, until the end of FY-96, at which time a new number will be provided.

The basic assignment is to provide us with thermal analyses results and interpretation relative to several proposed design concepts associated with handling and storing these capsules during Hanford preparations for final disposal (off-site) of either the whole capsules or at least their radioisotopic contents.

For the analyses cases concerning the Hanford CsCl capsules, you are to use as input the results of radiation decay (Cs-137, etc.) energy deposition analyses (i.e., Monte Carlo code work) that will be provided by Mr. R. A. Schwarz/WHC and Mr. V. E. Roetman/WHC of the radiation analysis group (Mr. Jess Greenborg/Mgr.). As you know the past thermal analyses cases (CsCl capsules), which Mr. Tom Beaver did for us, used radiation decay energy values (i.e., % of energy deposited) from literature references.

Mr. Beaver's FY-95 analyses used values from RHO-LD-167, Rev.1 by G. D. Campbell/RHO, 1981, and his FY-96 analyses work for us used values from Monte Carlo code work done in the last quarter of FY-95 by Dr. G. A. Spriggs/LANL in support of a Stone and Webster Corp. report on thermal analysis of dry storing the capsules. However, my continued review of the literature has surprisingly revealed even further controversy regarding the estimation of such energy deposition for the CsCl (Cs-137 decay) capsules. To resolve this situation, we have recently arranged (Ref.) for WHC radiation analysts to perform Monte Carlo code determinations of these energy deposition values for use as input to your thermal analyses. If time and funding permit, this radiation analysis work will also provide such input values to support your thermal analysis work on cases involving the strontium fluoride capsules.

The requested thermal analyses work involves several different design configurations and additional components other than the capsules. Except for the Hanford capsules, most of the components (e.g., overpack, interim storage tube, lag-storage pit, etc.) are merely design concepts at this time. Hence, I will not be able to give you summary reporting references for configurations, dimensions and material selection and properties. Instead I will provide such detail via several written communications to the analysis teams.

The <u>primary</u> objective for the requested analyses cases is to obtain an estimate of the highest valued radial thermal profile for each set of unique conditions. The analyses cases for the cesium chloride capsules are the first priority, and those for the strontium fluoride capsules are second in priority. The following set of cases are to be done for both the cesium chloride capsules and the strontium fluoride capsules, and the cases outlined in Items a) and b) are considered as precursor analyses cases for the two storage design cases noted in Items c) and d), with Item c) being the highest priority overall:

<u>Cesium Chloride Capsules</u>

a) Do a thermal analysis for a single Hanford CsCl production capsule, in 80°F air, for both the maximum and average estimated kCi/capsule inventories as decayed to calendar year 2000 (i.e., Dec. 31, 2000). Follow this by doing the same analyses for a decay date of 2010. Supplement as appropriate Mr. Beaver's documented technical perspective as to the general parametric response of increasing the air temperature.

b) Do a thermal analysis for a set of overpacked capsules, in 80°F air, for the same conditions as noted in Item a) above. The basic overpack design consists of 8 capsules positioned end-to-end along the axial centerline of a metal right-circular cylinder, which is capped at both ends. Assume that the overpack is composed of stainless steel (e.g., 316) that is 3/8 inches thick, 24 inches O.D., and 15 feet long. The capsules will be held in place along the overpack axial centerline by a similar stainless steel guide tube that is nominally 3 inches I.D. and 1/4 inches thick. A small spacer/shock-limiter disk will separate each capsules. The capsule guide (holder) tube is, for now, assumed to be held in position by four fin-like plates positioned at 90 degrees to the tube surface and 90 degrees between the respective fin plates around the cross-section of the tube.

c) Do a thermal analysis for the case where two overpacks, each containing 8 capsules, are aligned vertically (i.e., end-to-end one over the other) in a steel storage tube of a Canister Storage Building that would be designed for storing such overpacked capsules in preparation for final disposal. Assume that the design for the steel storage tube is the same as currently listed for the vitrified HLW from Phase 1; namely, the each tube will a right-circular cylinder of carbon steel that has an inner diameter of 27 inches and is 1/2 inches thick. Each such storage tube is sealed at the bottom, contains a shock-limiter/overpack holding fixture at the bottom of the first overpack and between the two overpacks and that the top of the tube is sealed with a shielded plug. For now assume that the gap between the outer surface of the overpack and the inner surface of this storage tube is just filled air at atmospheric pressure (i.e., no forced circulation).

d) Do a thermal analysis for a lag-storage holding pit that uses the BUSS cask internal basket holding 16 capsules. (NOTE: Depending the results for the 16 capsule design other basket loadings using fewer capsules, e.g., 8 capsules, may be considered for analysis.) The lag-storage pit concept consists of a right-circular cylinder cavity, which would be constructed of thick-walled structural concrete faced with a layer of refractory concrete and then an outer surface layer of stainless steel (e.g., assume it is 3/8 ins. thick) for decontamination control. Assume that the gap between the O.D. of the BUSS cask basket and the I.D. of the pit is nominally 3 inches. Also assume that all gaps (e.g., capsules to BUSS cask basket walls, basket to pit wall, etc.) are filled with air. For the first analysis of this case, assume that there is not a lid over the pit. This assumption will be reviewed after the radiation analysis (R. A. Schwarz/WHC, et.al) work provides some perspective as to the strength of the gamma field coming off the top of such a basket-capsule configuration. Obviously a lid on the lag-storage pit would have significant implications for the thermal conditions of a storage environment.

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Strontium Fluoride Capsules

Do the same set of analyses for the strontium fluoride capsules as detailed in Items a) through d) for the cesium chloride capsules. The BUSS cask basket loading of capsules will be adjusted as needed to match what Hanford has used as the maximum loading per cask for shipping such capsules off-site in the past.

I have already informally provided you with considerable input information, and will formally transmit the key elements of such material for report referencing purposes in the next week or so.

The Cost Account Manager (R. D. Claghorn) and myself recognize that trying to resume such analysis activity so near the end of the fiscal year has presented challenges in trying to get most of the work done during FY-96. What with the uncertainties about FY-97 funding levels and the reassignment of personnel to other contractors, we will no doubt have to do some adjustments of the scope and scheduling to better match the yet to be provided details of the FY-97 funding.

Please keep me informed (376-1456) as to your progress and any potentially significant delays or complications that come up.

Edward H Randklev

Dr. E. H. Randklev, Principal Engineer
Process Technology

CHECKLIST FOR INDEPENDENT TECHNICAL REVIEW
NUMBER: WHC-SD-TI-791 Rev 0
DOCUMENT REVIEWED
Estimates of Power Deposited Via Cesium Barium Beta and Gamma Radiation Captured in Components of a Hanford Cesium Chloride Capsule and by Components of Overpacked Capsules Places in an Interim Dry Storage Facility
AUTHOR(s) Victor Roetman

I. Method(s) of Review

(X) Input data checked for accuracy
(   ) Independent calculation performed
    (   ) Hand calculation
    (   ) Alternate computer code: MICROSHIELD
(   ) Comparison to experiment or previous results
(   ) Alternate method (define)________________________

II. Checklist (either check or enter NA if not applied)

(X) Task completely defined
(X) Activity consistent with task specification
(X) Necessary assumptions explicitly stated and supported
(X) Resources properly identified and referenced
(X) Resource documentation appropriate for this application
(X) Input data explicitly stated
(X) Input data verified to be consistent with original source
(X) Geometric model adequate representation of actual geometry
(X) Material properties appropriate and reasonable
(NA) Mathematical derivations checked including dimensional consistency
(NA) Hand calculations checked for errors
(X) Assumptions explicitly stated and justified
(X) Computer software appropriate for task and used within range of validity
(NA) Use of resource outside range of established validity is justified
(X) Software runstreams correct and consistent with results
(X) Software output consistent with input
(X) Results consistent with applicable previous experimental or analytical findings
(X) Results and conclusions address all points and are consistent with task requirements and/or established limits or criteria
(X) Conclusions consistent with analytical results and established limits
(NA) Uncertainty assesment appropriate and reasonable
(   ) Other (define)

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III. Comments:

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IV. REVIEWER: R. A. Schwarz R A Schwarz DATE: 12/5/86

DISTRIBUTION SHEET

To Distribution	From Criticality and Shielding	Page 1 of 1
		Date November 13, 1996
Project Title/Work Order Estimates of Power Deposited Via Cesium/Barium Beta and Gamma Radiation Captured in Components of a Hanford Cesium Chloride Capsule and by Components of Overpacked Capsules Placed in an Interim Dry Storage Facility		EDT No. 619220
		ECN No.

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E. R. Cramer	H0-34	X			
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