Agenda August 13, 2003 Meeting with NRC

Topic: Dose Modeling

Meeting Goals:

1. Obtain feedback on Staff review of Soil DCGL Calculation and establish mechanism for a response process

2. Apprise Staff on development of dose modeling approach for Building Occupancy and Concrete scenarios

Meeting Topics:

I. Approach to Derive Soil DCGL Values / Impact on Sensitivity Analysis for BO and Concrete

1. Summary of approach to derive Soil DCGL values using Peak of the Mean Dose
2. Results of Resident Farmer Scenario Runs
   a. Nuclide specific PMD Conversion Factor for unit activity concentration of 1 pCi/gm
   b. PMD precision in 3 repetitions
   c. DCGL values
3. " Forward" run results using the DCGL value as the initial nuclide concentration
4. Requirement for Sensitivity Analysis for Building Occupancy and Concrete Scenarios

II. Building Occupancy Scenario

1. Summary of Scenario and approach to derive Building Occupancy DCGL values
2. Results of Building Occupancy Runs
   a. Determination of the year in which maximum dose occurs
   b. Nuclide specific "analogous" PMD Conversion Factor and Standard Deviation for unit activity concentration of 1 pCi/m^2
   c. DCGL values
3 " Forward" run results using the DCGL value as the initial nuclide concentration

III. Subsurface Concrete

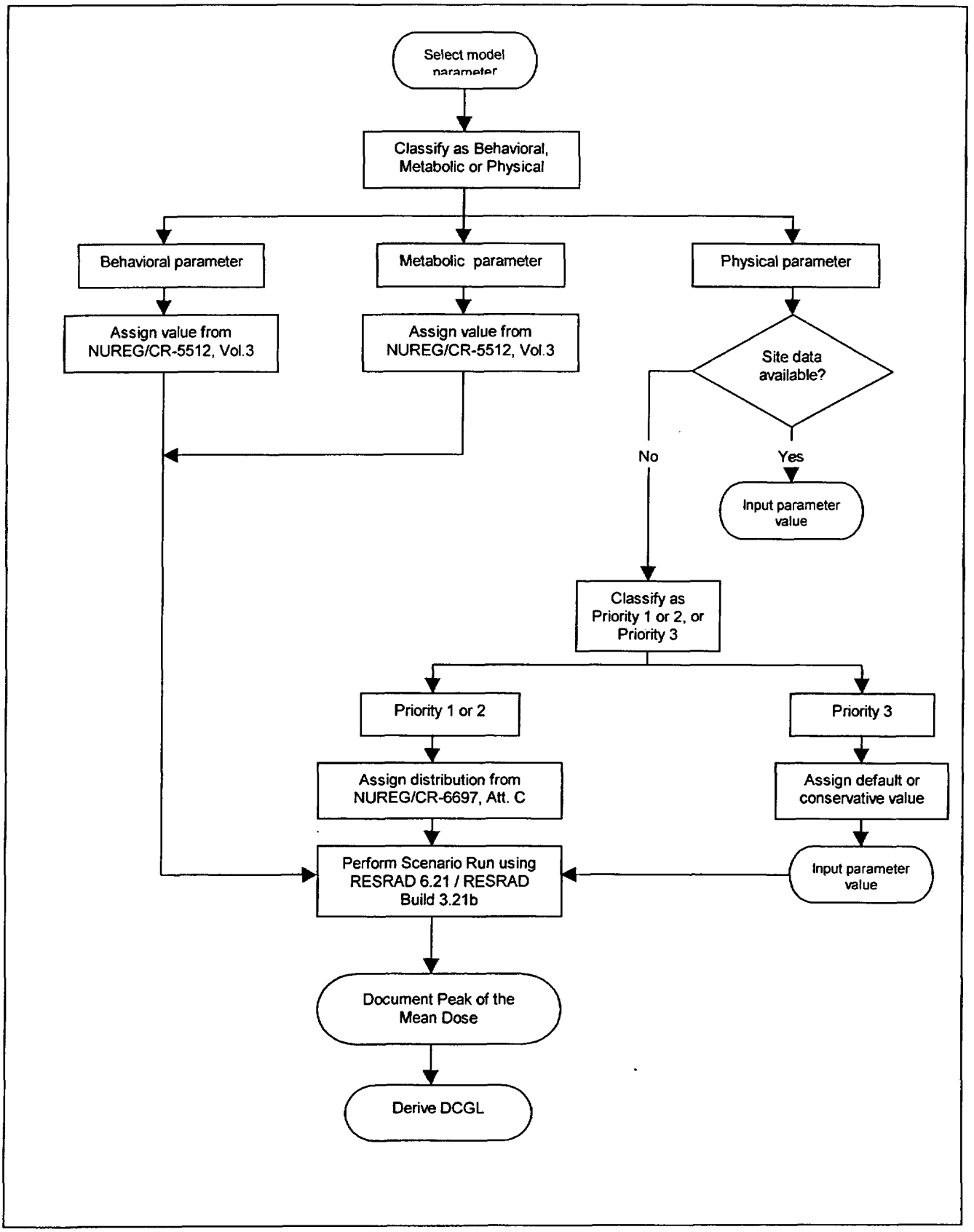
1. Preliminary Outline of Scenario including:
   a. Modified Resident Farmer Scenario using external exposure and water dependent pathways
   b. Contaminated Zone Area
   c. Well location and water model
   d. Kd
2. Soil "Forward" runs have confirmed DCGL derived in this manner will not exceed dose limit, therefore will not be repeated for RESRAD Concrete runs

IV. Area Factor Calculations

1. Will use probabilistic modules of codes
2. Reduce Time Integrations to improve run times
3. Effect of Time Integration reduction on Dose

V. Address Questions on Soil Calculations

Figure 1
Approach to DCGL using the Peak of the Mean Dose



RESRAD Resident Farmer Scenario Results

Soil Peak of the Mean Dose per unit pCi/gm

Radionuclide	Peak of the Mean Dose* Repetition 1	Peak of the Mean Dose* Repetition 2	Peak of the Mean Dose* Repetition 3	% precision among Repetitions
H-3	2.932E-02	2.913E-02	2.947E-02	0.58
C-14	2.229E+00	2.219E+00	2.227E+00	0.24
Mn-54	1.153E+00	1.154E+00	1.156E+00	0.13
Fe-55	6.907E-04	6.923E-04	6.904E-04	0.15
Ni-59	6.010E-03	6.023E-03	6.550E-03	4.97
1000 obs.	6.222E-03	6.239E-03	6.267E-03	0.36
Ni-63	1.645E-02	1.649E-02	1.793E-02	4.95
1000 obs.	1.703E-02	1.708E-02	1.716E-02	0.38
Co-60	5.172E+00	5.154E+00	5.167E+00	0.18
Sr-90	9.270E+00	9.330E+00	9.653E+00	2.19
Nb-94	2.927E+00	2.931E+00	2.930E+00	0.07
Tc-99	9.883E-01	9.891E-01	1.027E+00	2.21
Ru-106	3.665E-01	3.668E-01	3.655E-01	0.19
Ag-108m	2.934E+00	2.932E+00	2.934E+00	0.04
Sb-125	6.619E-01	6.627E-01	6.626E-01	0.07
Cs-134	3.751E+00	3.688E+00	3.728E+00	0.86
Cs-137	2.042E+00	2.037E+00	2.052E+00	0.37
Eu-152	2.073E+00	2.074E+00	2.073E+00	0.03
Eu-154	2.246E+00	2.247E+00	2.248E+00	0.04
Eu-155	5.348E-02	5.353E-02	5.354E-02	0.06
Pu-238	4.714E-01	4.952E-01	4.839E-01	2.46
Pu-239	5.462E-01	5.445E-01	5.275E-01	1.92
Pu-241	1.578E-02	1.581E-02	1.624E-02	1.61
Am-241	5.637E-01	5.639E-01	5.496E-01	1.47
Cm-243	5.493E-01	5.445E-01	5.582E-01	1.26

* Unit in mrem/yr per pCi/gm

RESRAD Resident Farmer Scenario Results

Median Peak of the Mean Dose and Calculated DCGL

Nuclide	Median DCF mrem/yr per pCi/gm	DCGL pCi/gm
H-3	2.932E-02	8.527E+02
C-14	2.227E+00	1.123E+01
Mn-54	1.154E+00	2.166E+01
Fe-55	6.907E-04	3.620E+04
Ni-59	6.239E-03	4.007E+03
Ni-63	1.708E-02	1.464E+03
Co-60	5.167E+00	4.838E+00
Sr-90	9.330E+00	2.680E+00
Nb-94	2.930E+00	8.532E+00
Tc-99	9.891E-01	2.528E+01
Ru-106	3.665E-01	6.821E+01
Ag-108m	2.934E+00	8.521E+00
Sb-125	6.626E-01	3.773E+01
Cs-134	3.728E+00	6.706E+00
Cs-137	2.042E+00	1.224E+01
Eu-152	2.073E+00	1.206E+01
Eu-154	2.247E+00	1.113E+01
Eu-155	5.353E-02	4.670E+02
Pu-238	4.839E-01	5.166E+01
Pu-239	5.445E-01	4.591E+01
Pu-241	1.581E-02	1.581E+03
Am-241	5.637E-01	4.435E+01
Cm-243	5.493E-01	4.551E+01

RESRAD Resident Farmer Scenario Results

Soil DCGL values and DCGL Dose Verification Results

Nuclide	Median DCF mrem/yr per pCi/gm	DCGL pCi/gm	DCGL Dose Calculation mrem/yr
H-3	2.932E-02	8.527E+02	**25.00** 24.84 25.13
C-14	2.227E+00	1.123E+01	25.03 24.91 **25.01**
Mn-54	1.154E+00	2.166E+01	24.97 **24.99** 25.03
Fe-55	6.907E-04	3.620E+04	**25.00** 25.06 24.99
Ni-59	6.239E03	4.007E+03	24.93 **25.00** 25.11
Ni-63	1.708E-02	1.464E+03	24.94 **25.01** 25.12
Co-60	5.167E+00	4.838E+00	25.02 24.94 **25.00**
Sr-90	9.330E+00	2.680E+00	24.84 **25.01** 25.87
Nb-94	2.930E+00	8.532E+00	24.97 25.01 **25.00**
Tc-99	9.891E-01	2.528E+01	24.98 **25.00** 25.96
Ru-106	3.665E-01	6.821E+01	**25.00** 25.02 24.93
Ag-108m	2.934E+00	8.521E+00	**25.00** 24.98 25.00
Sb-125	6.626E-01	3.773E+01	24.97 25.01 **25.00**
Cs-134	3.728E+00	6.706E+00	25.16 24.73 **25.00**

RESRAD Resident Farmer Scenario Results

Soil DCGL values and DCGL Dose Verification Results

Nuclide	Median DCF mrem/yr per pCi/gm	DCGL pCi/gm	DCGL Dose Calculation mrem/yr
Cs-137	2.042E+00	1.224E+01	**25.00** 24.94 25.12
Eu-152	2.073E+00	1.206E+01	**25.00** 25.01 25.00
Eu-154	2.247E+00	1.113E+01	25.00 **25.01** 25.02
Eu-155	5.353E-02	4.670E+02	24.98 **25.00** 25.00
Pu-238	4.839E-01	5.166E+01	24.35 25.58 **25.00**
Pu-239	5.445E-01	4.591E+01	25.08 **25.00** 24.22
Pu-241	1.581E-02	1.581E+03	24.95 **25.00** 25.68
Am-241	5.637E-01	4.435E+01	**25.00** 25.01 24.38
Cm-243	5.493E-01	4.551E+01	**25.00** 24.78 25.40

Building Occupancy Scenario

Metabolic and Behavioral Parameter values obtained from NUREG-5512 vol3 and NUREG-6697.

Scenario defined:

1. Direct Ingestion:

   Base on the methodology in NUREG-5512 using a default ingestion rate 1.1E-4m2/hr and dividing by the source area.

Physical Parameters

Scenario defined:

1. Room Dimension:

   An inventory of the rooms and partial rooms that would remain on site following the DEMCO demolition project was used as the starting point in determining room dimensions. Wall dimensions were determined from Site Drawings showing the building locations, building elevations and dimensions. Ceilings are not included in the model, as partial rooms/rooms remaining at the time of Final Status Survey (FSS) will either have no ceiling or will be covered with a ceiling constructed of new uncontaminated building materials.

   Room area: 19.7 meters^2

   Room Height: 3.5 meters

   Sources: Floor and four wall

   Source area: Floor = 19.7 meters^2 and Walls = 15.6 meters^2

2. Source and Receptor location

   Receptor location is defined as the middle of the room at a height of 1 meter. Coordinates for the source centers are defined by the source areas listed above.

Physical Parameter assigned distributions from NUREG-6697:

1. Deposition Velocity
2. Resuspension Rate
3. Time for Source Removal

Input correlations assigned between Deposition Velocity and Resuspension Rate, and between Sources for Time for Source Removal

RESRAD Build Building Occupancy Results
Surface Area Mean Dose at T_{max} and Building Area Surface DCGL

Nuclide	Mean DCF (mrem / yr per pCi / m^2)	Std Dev. In the Mean DCF	Relative Std Dev.	DCGL (pCi / m^2)	DCGL (dpm / 100 cm^2)
H-3	8.07E-09	1.51E-14	< 0.01%	3.10E+09	6.88E+07
C-14	2.69E-07	5.65E-12	< 0.01%	9.29E+07	2.06E+06
Mn-54	7.94E-06	1.17E-11	< 0.01%	3.15E+06	6.99E+04
Fe-55	6.89E-08	1.03E-12	< 0.01%	3.63E+08	8.06E+06
Ni-59	2.71E-08	1.50E-13	< 0.01%	9.23E+08	2.05E+07
Ni-63	7.42E-08	7.39E-13	< 0.01%	3.37E+08	7.48E+06
Co-60	3.32E-05	7.41E-11	< 0.01%	7.53E+05	1.67E+04
Sr-90	1.96E-05	2.36E-10	< 0.01%	1.28E+06	2.83E+04
Nb-94	2.21E-05	5.20E-11	< 0.01%	1.13E+06	2.51E+04
Tc-99	1.89E-07	2.92E-12	< 0.01%	1.32E+08	2.94E+06
Ru-106	4.67E-06	1.64E-11	< 0.01%	5.35E+06	1.19E+05
Ag-108m	2.30E-05	2.15E-11	< 0.01%	1.09E+06	2.41E+04
Sb-125	5.84E-06	1.70E-11	< 0.01%	4.28E+06	9.50E+04
Cs-134	2.58E-05	1.75E-10	< 0.01%	9.69E+05	2.15E+04
Cs-137	1.39E-05	1.58E-10	< 0.01%	1.80E+06	3.99E+04
Eu-152	1.58E-05	2.39E-11	< 0.01%	1.58E+06	3.51E+04
Eu-154	1.70E-05	1.81E-11	< 0.01%	1.47E+06	3.26E+04
Eu-155	9.97E-07	4.60E-13	< 0.01%	2.51E+07	5.57E+05
Pu-238	4.35E-04	5.39E-08	0.01%	5.75E+04	1.28E+03
Pu-239	4.82E-04	6.12E-08	0.01%	5.19E+04	1.15E+03
Pu-241	1.02E-05	2.31E-09	0.02%	2.45E+06	5.44E+04
Am-241	4.96E-04	6.25E-08	0.01%	5.04E+04	1.12E+03
Cm-243	3.40E-04	3.87E-08	0.01%	7.35E+04	1.63E+03

RESRAD Build - Building Occupancy Results
Surface Area Mean Dose at T_{max} and Building Area Surface DCGL

Nuclide	DCGL pCi / m2	Mean Dose from DCGL	Nuclide	DCGL pCi / m2	Mean Dose from DCGL
H-3	3.10E+09	25.0	Ag-108m	1.09E+06	25.1
C-14	9.29E+07	24.9	Sb-125	4.28E+06	25.0
Mn-54	3.15E+06	25.0	Cs-134	9.69E+05	25.0
Fe-55	3.63E+08	25.0	Cs-137	1.80E+06	25.0
Ni-59	9.23E+08	25.0	Eu-152	1.58E+06	25.0
Ni-63	3.37E+08	25.0	Eu-154	1.47E+06	25.0
Co-60	7.53E+05	25.0	Eu-155	2.51E+07	25.0
Sr-90	1.28E+06	25.0	Pu-238	5.75E+04	25.0
Nb-94	1.13E+06	25.0	Pu-239	5.19E+04	25.0
Tc-99	1.32E+08	24.9	Pu-241	2.45E+06	24.9
Ru-106	5.35E+06	25.0	Am-241	5.04E+04	25.0
			Cm-243	7.35E+04	25.0

Subsurface Concrete DCGL using RESRAD Resident Farmer Scenario

1. Consider intact concrete in contact with the water table
2. Modified Resident Farmer Scenario to consider the following pathways:
   a. external exposure
   b. water dependent pathways
3. Parameter Considerations:
   a. Concrete (Contaminated Zone Area) area and thickness determined by reviewing concrete structures to remain after demolition and site grading and also which of those structures are in contact with the water table.
      Area: ~ 450m2
      Thickness: 0.3m - 2 m
   b. Kd value options: Kd values from CY Kd analysis and soil Kd distributions from NUREG 6697. We will also be considering the results of a literature study on Kd in concrete to be conducted by BNL.
   c. Water Transport Model.
   d. Contaminated zone parameters for concrete to be evaluated by team hydrogeologist/chemist
4. Peak of the Mean approach to derive DCGL values
5. Forward runs with DCGL values have been confirmed with the RESRAD soil scenario and will not be repeated for concrete runs

Area Factor Calculations

1. Testing with RESRAD Build probabilistic code and Pu-241 indicates that a reduction in the Time Integrations (from the default value =17) will reduce run times and NOT effect the dose value at Tmax. This will allow use of Building Occupancy results to develop Area Factor relationship. Assume same is true RESRAD.
2. Plan to use the probabilistic code to develop nuclide specific Area Factors.
3. The number of observations and repetitions will not change from DCGL runs

Questions on Soil Calculation