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# RESPONSE TO COMMENTS (NUMBERS 78 THROUGH 105) RECEIVED AT THE PUBLIC WORKSHOP HELD ON JANUARY 12, 1993 TO DISCUSS THE EE/CA FOR REMOVAL ACTION NO. 27

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RESPONSES

# RESPONSE TO COMMENTS (NUMBERS 78 THROUGH 105) RECEIVED AT THE PUBLIC WORKSHOP HELD ON January 12, 1993 TO DISCUSS THE EE/CA FOR REMOVAL ACTION NO. 27

Reviewing the transcript of the discussions held during the above captioned portion of the public meeting, five issues emerged as having been the subjects of focus. The responses below are organized/synthesized, according to these issues rather than in a "question and answer" format since few direct questions were actually asked. The following table makes cross reference to the itemized comment numbers contained in the transcript.

| Reference | | | Issue | |
|---|---|---|---|---|
| Q. | 78<br>81<br>105 | 82<br>106 | A: | Is the use of the Industrial Source Complex model, which assumes well - developed plumes, appropriate for D&D activities? |
| Q. | 80 | 96 | B: | How were source / release rates devised? |
| Q. | 82<br>85<br>86<br>87 | 94<br>95<br>97 | C: | How were the sources modelled - individually, concurrently, cumulatively? What are the relative contributions of the various sources? |
| Q. | 78<br>79<br>83<br>84<br>85<br>88<br>89 | 90<br>91<br>92<br>93<br>95<br>96<br>97 | D: | Why does the model show two distinct areas of relatively high concentration/dose (Two "humps")? |

Repeat of Issue "A"

| Reference | | | Issue | |
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| Q. | 78<br>81<br>105 | 82<br>106 | A: | Is the use of the Industrial Source Complex model, which assumes well - developed plumes, appropriate for D&D activities? |
| Q. | 96<br>97<br>98<br>99<br>100 | 101<br>102<br>103<br>104<br>105 | B: | Demonstration of the conservatism of the approach and confirmation of the insignificance of the problem is needed. |

Response to Issues

ISSUE A: Is the use of the Industrial Source Complex model, appropriate?

The use of the Industrial Source Complex Long Term Model ISCLT2 model to assess the impact of the D&D activities proposed in the EE/CA, is considered to be appropriate since it is recommended by the EPA in the Guideline on Air Quality Models as the model of choice, for assessing long term average impacts of fine particulate matter such as that expected to result from the D&D activities and has been applied previously at the FEMP during the preparation of the Sitewide Characterization Report. EPA has conducted extensive validation studies which clearly document the conservatism of modeling studies conducted using ISCLT2.

The way in which the model was applied in the EE/CA is also very conservative. Starting assumptions are that the building will be kept under negative pressure during D&D operations using fans to draw air from the building. All exhaust will pass through HEPA filters before being vented to the atmosphere.

An air pathway analysis was conducted to quantify radiation exposure using the ISCLT2 model which allows input of multiple release points, each at a unique location. When using the ISCLT2 model the proper treatment of the vent releases is to treat them as point

sources, defined by the following input parameters:

- release height
- exhaust temperature
- exhaust velocity
- stackvent inside diameter
- location (x and y coordinates)

The building exhaust vents were conservatively assumed to have a release height of only 2 meters (the height of a man). The exhaust temperature was assumed to be equal to ambient conditions, thereby limiting the effect of thermal buoyancy. The exhaust velocity and vent diameter were set to values which eliminated momentum plume rise which would normally be expected to improve dispersion and therefore limit near-ground concentration of contaminants. The remaining model inputs for the FEMP are documented in the ISCLT2 output contained in Appendix G of the EE/CA.

The approach described above to model long term radiation levels is very conservative and will tend to overestimate actual impact for the following reasons:

1. The modeling was conducted using the EPA recommended model, ISCLT2 which has been proven to be conservative when applied in accordance with EPA protocol.

2. The source parameters were deliberately selected to produce the maximum impact.

ISSUE B: How were sources / release rates derived?

Predicting the concentration of contaminants in the air rising from the resuspension of contamination on floors and surfaces is difficult. The concentration depends on the type of

contaminant, the type of surface, and the activity taking place. Direct experience with radiation protection has demonstrated however, that air samples taken in radiologically contaminated areas are higher when work is going on (no matter what kind of work) than if the area is unoccupied.

Empirical factors (based on experience rather than theory) have been developed to estimate the concentration in the air if the amount of contamination on the surface is given. The use of these factors is based on the assumption that the amount of resuspension is proportional to the amount of surface contamination. A typical formula for computing the predicted air concentration follows:

**Concentration in air ($\mu$Ci/ml ) = 4.5 E-7 x concentration on the surface ( dpm/cm$^2$ ) x F**

Here "F" is the resuspension factor (in units of cm-1), and 4.5 E-7 is a factor which converts dpm to microcuries. According to Cember[1] resuspension factors vary form 1 E-8 to 1 E-4. A value of 1 E-8 works well for Building 4A, i.e., 4.5 E-7 x 23.82 x 1 E-8 = 1.07 E-13. This compares to a measured average of 1.12 E-13. The lower value (i.e., 1 E-8) is probably due to the fact that the contamination is largely, uranium, which has a low specific activity, i.e., it takes a lot of uranium to make up a microcurie. (Note that 2382 dpm/100 cm$^2$ equals 23.82 dpm/cm$^2$).

The increase due to work activities must be compared to the work activity that was going on when the air samples were taken. The work which was taking place during sampling is estimated to be limited to light activities such as walking. During the process of D&D more vigorous activities would be expected. However, this increase would be offset somewhat because of local controls, and because areas would be cleaned up early in the D&D process. Fish[2] gives values for the resupension factor of 1 E-7 for light work such as sample collection, 4 E-7 for moderate work such as vigorous walking and 2 E-6 for work that disturbs the contamination itself, such as sweeping. On the basis of this documentation, a factor of between 4 and 20 is appropriate for the current application.

There are several common practices used to prevent generation of airborne contamination during D&D. These include the use of HEPA filtered vacuum cleaners, and the use of scabblers equipped with HEPA filtered exhaust. In addition, areas are often painted, or covered with plastic. In addition, work is sometimes done inside of a containment (plastic tent) with its own HEPA filtered ventilation system, all within the building being cleaned up.

In the EE/CA, a factor of 10 was assigned in estimating release rates. This is an assumed value that balances increased work activity against (1) local contamination controls, and (2), the knowledge that the average surface contamination now present will be systematically reduced during D&D, the emission rate being highest early in the D&D process, reducing to almost zero toward the end.

ISSUE C: How were the sources modelled? What are the relative contributions of the various sources.

The long term average spatial distribution of airborne radiation levels and dose were computed using the Industrial Source Complex Long Term (ISCLF2) model which allows input of multiple release points, each at a unique location as shown in figures 6-2 and 6-3 of the EE/CA. The contribution of each of the 25 structures addressed by the EE/CA, to the radiation levels at the points of maximum impact, are shown in Table 1 (for the southernmost "hump") and Table 2 (for the more northern "hump"). The major contributors at these locations (greater than 0.1 attocuries/m$^3$) are:

1. Plant 4, Miscellaneous Tanks
2. Old D&D Building - Building 69
3. Plant 7, Main Building
4. Plant 5, Warehouse (Thorium) - Building 65

As expected, these structures are also those having the highest release rates as shown in Table 6-6 in the EE/CA. They are also major contributors to the maximum predicted off-site concentration (Inhalation Dose) shown in Table 3.

TABLE 1
Location of Highest On-Site Impact
Receptor (699500,4352300)

| Source | Predicted Radiation Level (attocuries/m3) | Predicted Dose (rems) |
|---|---|---|
| Plant 4, Miscellaneous Tanks | 5.966073 | 1.36E-06 |
| Plant 7 Main Building | 0.257873 | 5.88E-08 |
| Old D&D Building | 0.051614 | 1.18E-08 |
| Plant 5 Warehouse (Thorium) | 0.009568 | 2.00E-08 |
| PP Sump House | 0.004798 | 1.09E-09 |
| Plant 4 Maintenance | 0.004572 | 1.04E-09 |
| Harshaw Tower | 0.004565 | 1.04E-09 |
| Warehouse for Integrated Demolition | 0.003762 | 8.58E-10 |
| Thorium Warehouse | 0.003036 | 6.35E-09 |
| Incinerator Building | 0.002730 | 6.22E-10 |
| Thorium Warehouse | 0.002426 | 5.07E-09 |
| West Tank Farm | 0.001390 | 3.17E-10 |
| Magnesium Warehouse | 0.001085 | 2.47E-10 |
| PP Maintenance | 0.000643 | 1.47E-10 |
| Refrigeration Building | 0.000527 | 1.20E-10 |
| Incinerator at STP | 0.000127 | 2.90E-11 |
| Fire Training Area | 0.000085 | 1.94E-11 |

TABLE 2
Location of Second-Highest On-Site Impact
Receptor (699700,4352600)

| Source | Predicted Radiation Level (attocuries/m3) | Predicted Dose (rems) |
|---|---|---|
| Old D&D Building | 3.562840 | 8.12E-07 |
| Plant 4, Miscellaneous Tanks | 0.201369 | 4.59E-08 |
| Plant 5 Warehouse (Thorium) | 0.176305 | 3.68E-07 |
| Magnesium Warehouse | 0.051982 | 1.19E-08 |
| Plant 7 Main Building | 0.029813 | 6.80E-09 |
| PP Sump House | 0.001650 | 3.76E-10 |
| Warehouse for Integrated Demolition | 0.001406 | 3.21E-10 |
| Thorium Warehouse | 0.001188 | 2.48E-09 |
| Harshaw Tower | 0.001090 | 2.49E-10 |
| Thorium Warehouse | 0.001054 | 2.20E-09 |
| Incinerator Building | 0.000691 | 1.58E-10 |
| West Tank Farm | 0.000471 | 1.07E-10 |
| Fire Training Area | 0.000437 | 9.96E-11 |
| Plant 4 Maintenance | 0.000345 | 7.87E-11 |
| PP Maintenance | 0.000210 | 4.79E-11 |
| Refrigeration Building | 0.000131 | 2.99E-11 |
| Incinerator at STP | 0.000081 | 1.85E-11 |

TABLE 3
Location of Highest Off-Site Impact
Receptor (699500,4352300)

| Source | Predicted Radiation Level (attocuries/m3) | Predicted Dose (rems) |
|---|---|---|
| Old D&D Building | 0.098442 | 9.83E-08 |
| Plant 4, Miscellaneous Tanks | 0.075819 | 7.57E-08 |
| Plant 7 Main Building | 0.015414 | 1.54E-08 |
| Plant 5 Warehouse (Thorium) | 0.009145 | 8.37E-08 |
| Magnesium Warehouse | 0.002686 | 2.68E-09 |
| PP Sump House | 0.000908 | 9.07E-10 |
| Thorium Warehouse | 0.000667 | 6.11E-09 |
| Warehouse for Integrated Demolition | 0.000464 | 4.63E-10 |
| Harshaw Tower | 0.000461 | 4.60E-10 |
| Thorium Warehouse | 0.000416 | 3.81E-09 |
| Incinerator at STP | 0.000307 | 3.07E-10 |
| Incinerator Building | 0.000282 | 2.82E-10 |
| West Tank Farm | 0.000255 | 2.55E-10 |
| Fire Training Area | 0.000188 | 1.88E-10 |
| Plant 4 Maintenance | 0.000163 | 1.63E-10 |
| PP Maintenance | 0.000109 | 1.09E-10 |
| Refrigeration Building | 0.000056 | 5.59E-11 |

ISSUE D: Why does the model show two distinct areas of relatively high concentration / dose (two "humps)?

As described in addressing Issue C, the plots in figures 6-2 and 6-3 of the EE/CA showing two "humps", superimpose the outputs for all of the 25 modelled sources. The "humps" correspond with the combined influence of the four largest sources. Their physical occurrence on the site is the result of a) the locations and magnitudes of the sources b) the dispersion assumptions - the orientation of the buildings, their height, proximity to each other etc. and c) the meteorological conditions (the prevailing wind direction is from the southwest and the centers of concentration appear downwind from the major sources). The southern focus reflects the contributions made by building 4a and 7, the more northerly, those of building 65 and 69.

ISSUE E: Demonstration of conservatism in the approach and confirmation of the insignificance of the problem.

The calculated exposure to radiological and other contaminants, of both onsite and offsite individuals during the D&D operations is extremely small. This is attributable to the many protective measures that will be taken to ensure that this is the case.

The greatest hazard from dust-like (fine particulate matter) contamination distributed on building and equipment surfaces at the FEMP arises if it becomes airborne and is inhaled. Since most of this material is in the buildings it is essential to prevent its release during D&D and several methods and engineering controls were described in the EE/CA to prevent the release of the contaminants from any given structure. The first, was the reduction of atmospheric pressure within the structure through the use of ventilation fans. Each fan is exhausted through a high efficiency particulate filter (HEPA filter), designed to remove 99.97 percent of the particles of the size which is most likely to be retained in the lung if inhaled. DOE requires that each HEPA be tested in place prior to first use to demonstrate that it meets or exceeds the percent removal requirement. There is also a requirement to monitor the performance of a HEPA filter during operation.

Secondly, with the building maintained under negative pressure, workers remove the loose contamination on accessible surfaces using cleanup equipment each equipped with its own HEPA filter, or by working inside a plastic tent with its own filtered exhaust. Then the process equipment is taken down, again with the air removed from the process equipment, passing through a HEPA filter before even being exhausted to the inside of the building. This pre-filtered air is again HEPA filtered before exhausting to the exterior. As a result of this rigorous filtered ventilation, the air leaving a building is 99.97 percent cleaner than the air inside. At a distance, following mixing with the ambient air, the concentration of radioactive contaminants is decreased even further.

All emissions simultaneously.

To further exercise conservatism in assessing the impact of such exhausts, the modelling analysis described in Issues B and C was undertaken, in which it was assumed that all 25 structures would undergo simultaneous D&D. This established the worst case concentrations that could be seen at the various locations within the FEMP. To establish the significance of these concentrations, the dose from breathing them (Inhalation dose)was calculated by assuming that a person stood at the point of highest concentration for 2000 hours per year directly inhaling. His dose (total effective dose equivalent) is 0.011 mrem per year. In perspective, this dose is very small since the NCRP (National Council on Radiation Protection) reports that the average person in the United States receives an annual dose from all natural sources, of 300 mrem just from living on the earth.[3] The worst-case annual dose to a Fernald worker is some 27,000 times lower than this, and that to the most heavily exposed person offsite, several orders of magnitude lower yet.

good explanation

## REFERENCES


1) Comber, Herman, Introduction to Health Physics, Pergamon Press, New York, NY, 1969, p321

2) Fish, B.R., et al, "Redispersion of "Settled Particulates", in Surface Contamination, Pergamon Press, New York, NY, 1964

3) NCRP 93, Ionizing Radiation Exposure of the Population of the United States, National Council on Radiation Protection Measurement, September 1, 1987, Bathesda, Maryland.