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Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for Maywood, New Jersey

U.S. Department of Energy

0489-0613.1

106455

Department of Energy

Oak Ridge Operations
P.O. Box 2001
Oak Ridge, Tennessee 37831— 8723

July 21, 1993

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Dear Members of the Dispute Resolution Committee:

MAYWOOD SITE -- CLEANUP CRITERIA STATEMENT OF POSITION

The purpose of this letter is to transmit the Department of Energy's (DOE) Statement of Position on the Maywood site cleanup criteria. This Statement of Position is being provided in accordance with Section XV of the Federal Facilities Agreement and is in response to the Statement of Dispute submitted by the Environmental Protection Agency (EPA) on June 21, 1993.

I am transmitting a copy of this Statement of Position to you via FAX today, July 21, 1993. Pursuant to Section XV of the Federal Facilities Agreement, the 21 day period that the Dispute Resolution Committee will have for the unanimous resolution of this dispute will commence upon your receipt of this correspondence.

In the event that you are unable to come to resolution, DOE would like to recommend that a final decision on the cleanup criteria to be implemented at the Maywood site be expedited by foregoing the time allocated to the Senior Executive Committee and moving directly to the EPA Administrator, with consultation from the Secretary of Energy.

BACKGROUND

DOE and EPA have entered into a dispute regarding the soil cleanup criteria for the Maywood site. In the Feasibility Study and Proposed Plan developed for the site, DOE has proposed to remediate soils with concentrations of thorium-232 and radium-226 greater than 5 pCi/g above background concentrations in the surface 15 centimeters of soil and 15 pCi/g in any 15 centimeter layer below the surface layer (herein termed 5/15 pCi/g criteria). These criteria have been adopted from the Uranium Mill Tailings Radiation Control Act (UMTRCA) regulations promulgated by EPA in 40 CFR 192, and are explicitly specified in DOE Order 5400.5. EPA has proposed an alternate cleanup standard of 5 pCi/g at all depths (herein termed 5/5 pCi/g criteria). DOE's position on this dispute is provided in detail in the attachment and is summarized below.

POSITION SUMMARY

- o DOE's site-specific analysis indicates that the proposed cleanup criteria are protective of human health and the environment.
  - These criteria will attain: 1) the primary dose limit of 100 millirem/year to members of the general public from exposure to residual radioactive materials and 2) the limits for radon decay product concentrations and gamma exposure rates within any buildings that might be constructed on remediated soils.
  - If the 5/15 pCi/g cleanup criteria had been determined not to be adequately protective, it would be necessary to derive a risk-based cleanup standard for the site-specific conditions.
- o EPA's assertion that the characteristics at the Maywood site differ substantially from those sites for which the 5/15 pCi/g criteria were derived is in error.
  - The contaminants, their method of migration from their source, their distribution in the soil, and impacted land use at the Maywood site is sufficiently similar to that at many of the uranium mill tailings sites, to support the determination that the cleanup standards developed for that program are relevant and appropriate to the Maywood site.
- o While the 5/15 pCi/g criteria were developed primarily for radium-226 contaminated sites, their application at the Maywood site, where the primary contaminant of concern is thorium-232, provides an extra measure of conservatism.
  - EPA's analysis indicates a potential for radon-222 concentrations to exceed current guidelines for indoor air in buildings constructed on soils containing radium-226 concentrations of 15 pCi/g. Due to its much shorter radioactive half-life (55 seconds), the radon-220 produced in the thorium-232 decay chain has a much more limited potential for emanation from the soil, and could not constitute a significant exposure pathway at the Maywood site. Radon-220 also has lower radiotoxicity relative to radon-222.
- o The difference between the 5/15 pCi/g and 5/5 pCi/g criteria does not provide an appreciable difference in risk reduction.
  - Within the current state of knowledge for predicting potential health impacts from radiation exposures, both the 5/15 pCi/g and 5/5 pCi/g criteria lie in a common risk range (i.e., within the same order of magnitude).
  - EPA formally defended the 5/15 pCi/g standard in the 40 CFR 192 rulemaking, the supporting Final Environmental Impact Statement (FEIS), and subsequent legal challenges. The FEIS specifically evaluated both the 5/15 pCi/g and the alternative 5/5 pCi/g criteria and estimated identical residual risks.

- The cost differential between DOE's proposed criteria and EPA's alternative criteria is significant yet provides only marginal risk reduction.
  - Increases costs for the Maywood site are estimated at $30 - $120 million, and impacts at other FUSRAP sites may be significantly larger.
- The 5/15 pCi/g criteria have been used effectively for remediation of more than 4500 properties, most of which were under the uranium mill tailings program where radium-226 was the primary contaminant of concern.
  - Twenty-five vicinity properties at the Maywood site have been cleaned to the 5/15 pCi/g criteria and have been released without radiological restrictions; these previous remedial actions had been demonstrated to be protective based on post-remediation monitoring data.
- The lower cleanup criteria would present practical problems in implementation, which would reduce efficiency in remediation.
  - Much greater reliance on radioanalytical laboratory analysis in place of real time measurements with field instruments would be required, with significant loss of efficiency and increased cost.
- DOE is committed to pursuing an aggressive program to ensure that radiation exposures at the Maywood site are as low as reasonably achievable.
  - Previous cleanup actions conducted by DOE at Maywood and other sites have achieved residual radionuclide concentrations well below predetermined criteria, where cost-effective.

CONCLUSION

For the conditions at the Maywood site, DOE's proposed cleanup criteria of 5 pCi/g in surface soil and 15 pCi/g in subsurface soils are protective of human health and the environment, compliant with ARARs, cost effective, and implementable. The additional costs and technical difficulties associated with EPA's proposed alternative cleanup criteria for the Maywood site are not commensurate with the marginal risk reduction benefits.

In view of this, I request that the Dispute Resolution Committee resolve this issue by accepting DOE's proposed cleanup criteria. If I can be of any assistance to you please call me at (615) 576-5724.

Sincerely,

Susan M. Cange, Site Manager
Former Sites Restoration Division

DOE STATEMENT OF POSITION

CLEANUP CRITERIA FOR THE MAYWOOD SITE
BERGEN COUNTY, NJ

July 21, 1993

1. INTRODUCTION & BACKGROUND

The U. S. Department of Energy (DOE), under its Formerly Utilized Sites Remedial Action Program (FUSRAP), has developed a Feasibility Study (DOE 1993a) and Proposed Plan (DOE 1993b) for remediation of the Maywood site, in Bergen County, New Jersey. The preferred remedy calls for a two-phased remedial action. Phase I includes excavation of all contaminated soils at residential vicinity properties, excavation of one commercial property that was once part of the former thorium processing plant, removal of the interim waste storage pile, and continuation of institutional controls at the Maywood Interim Storage Site (MISS); excavated soils would be disposed of offsite at a licensed and approved commercial disposal facility. Phase II would begin immediately upon completion of Phase I, and involves the excavation of contaminated soils at the remaining properties and treatment by soil washing. Cleaned soils would be backfilled onsite, while concentrated residuals from the treatment process would be disposed at an offsite commercial disposal facility.

The primary contaminant of concern at the Maywood site is thorium-232 and its radioactive decay products; other contaminants include lesser amounts of uranium (primarily uranium-238 and uranium-234) and its radioactive decay products, including radium-226. The soil cleanup criteria selected for the site call for excavation of soils with concentrations of thorium-232 greater than 5 picocuries per gram (pCi/g) above background concentrations averaged over the first 15 centimeters (cm) of soil below the surface, and 15 pCi/g averaged over any 15-cm layer below the surface layer, averaged over any area of 100 square meters (m^2) (herein termed "5/15 pCi/g criteria"); the same numerical criteria are specified for radium-226. These criteria are specified in the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA; PL 95-604) regulations promulgated in 40 CFR 192 for radium contaminated soils, and have been identified as relevant and appropriate standards for the Maywood site; these criteria also are specified in DOE Order 5400.5 (DOE 1990).

The draft final Feasibility Study (DOE 1993a) and Proposed Plan (DOE 1993b) for the Maywood site were submitted to the U.S. Environmental Protection Agency (EPA) for review and approval on April 20, 1993, following a lengthy development process which included extensive consultation with EPA - i.e., previous drafts of these documents were submitted to EPA for review as early as July 31, 1992, and EPA comments on these draft documents, dated September 3, 1992, and February 1, 1993, did not question the suitability of DOE's proposed cleanup criteria. On May 21, 1993, EPA submitted one substantive comment, specifically disputing the cleanup criteria selected for the site (EPA 1993a). DOE and EPA were not successful in resolving the disputed issue informally during the 30-day informal dispute resolution period. On June 21, 1993, EPA issued a formal statement of dispute (EPA 1993b) challenging the subsurface cleanup criterion and proposing an alternative cleanup standard of 5 pCi/g for thorium-232 and radium-226 at all depths (herein termed "5/5 pCi/g criteria"). In accordance with Section XV of the Federal Facility Agreement (FFA) entered into by DOE and EPA for the Maywood site, this issue is now presented to the Dispute Resolution Committee for consideration. The basis for DOE's position is summarized in Section 2.

2. RATIONALE FOR PROPOSED CLEANUP CRITERIA

2.1 Protectiveness

The proposed cleanup criteria of 5 pCi/g for surface soils and 15 pCi/g for subsurface soils are protective of human health and the environment at the Maywood site. These criteria were originally developed through formal rulemaking and deemed protective by EPA. In the 40 CFR 192 rulemaking (48 FR 590), the supporting "Final Environmental Impact Statement for Remedial Action Standards for Inactive Uranium Processing Sites" (EPA 1982) and subsequent legal challenges (U.S.Court of Appeals for the Tenth Circuit 1985), EPA formally defended the protectiveness of this standard, and independent analyses by DOE have confirmed this evaluation. The Final Environmental Impact Statement specifically evaluated both the 5/15 pCi/g final standard and the alternative of 5 pCi/g at all depths, and estimated identical residual risks (EPA 1982, pp 110-111).

While the 40 CFR 192 Subpart B standards are directly applicable only to the inactive uranium processing sites specifically designated under Title I of UMTRCA, they are relevant and appropriate for the Maywood site. EPA's assertion that the contamination situation at Maywood "differ[s] substantially from those for which [the standard] was derived" is erroneous. Conditions at the Maywood site are not significantly different from those at the uranium mill sites for which the 40 CFR 192 standards were developed. Both Maywood and the sites managed under the Uranium Mill Tailings Remedial Action Program (UMTRAP) are the result of radioactive ore processing activities, and include numerous "vicinity properties" contaminated by relocation of contaminants by erosion, use of contaminated materials as fill material, and spillage during transportation. Both programs address identical contaminants of concern at sites characterized by large volumes of contaminated soil, widely ranging soil contaminant concentrations, and land use ranging from residential to industrial. The distribution of radioactive contamination at the Maywood site is very similar to that at uranium mill tailings sites. Radioactive materials which eroded from the site are spread in thin layers, much the same as the windblown tailings at some uranium mill sites. Radioactive materials that were removed from the site were used as a soil conditioner and for other purposes, again much the same as at the uranium mill sites. The tailings that were removed at the uranium mill sites were the sand fractions which typically have radium concentrations of less than 100 pCi/g, also similar to the removed contaminated materials at Maywood.

EPA also promulgated standards for radium-228 contaminated soils at licensed commercial thorium processing sites in 40 CFR 192 Subpart E, "Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended." The standards for radium-228 at thorium processing sites in Subpart E are numerically the same as those specified for radium-226 in Subparts B and D. These standards apply to the management of thorium byproduct materials, such as those at the Maywood site, during and following processing of thorium ores, and to the restoration of disposal sites.

EPA's assertion that the 15 pCi/g standard for subsurface soil is not adequately protective is not supported by site-specific analysis. As part of the detailed evaluation of remedial action alternatives for the Maywood site in the Feasibility Study (DOE 1993a), DOE conducted an assessment of the risks to current and potential future receptors from residual contaminants remaining after remediation. Results of this analysis (summarized in Attachment A) indicate the maximum reasonable exposure estimate of residual risk to be at the upper end of EPA's target risk range of 10^{-4} to 10^{-6} specified in the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300) and CERCLA risk assessment guidance. If the 40 CFR 192 standards had been determined not to be adequately protective, it would be necessary to derive a risk-based cleanup standard for the site-specific conditions, rather than arbitrarily adopting the 5 pCi/g standard for surface soil; however, based on the site-specific analysis, the 5/15 pCi/g standards are adequately protective for the Maywood site.

In the preamble to the 40 CFR 192 final rule (48 FR 600-601) and the Final Environmental Impact Statement (EPA 1982, p 111, 134), potential exposure to radon-222 decay products within buildings constructed on contaminated lands is stated to be the primary health risk at offsite properties contaminated with uranium tailings, and limitation of such exposure to no more than 0.02 working levels (WL) is indicated to be the primary basis for the selected cleanup standard; external gamma exposure, inhalation of airborne particulates, and waterborne exposure pathways were indicated to be generally of lesser concern for these sites (e.g, EPA 1982 p 134), although gamma exposures can be significant in some cases. For sites such as Maywood, where the principal contaminant is thorium-232, many of these considerations would not apply. For the thorium-232 contamination at Maywood, external gamma radiation is the primary exposure pathway of concern; the effective dose equivalent due to external gamma exposure is approximately equivalent for thorium-232 concentrations of 5 pCi/g in surface soils and 15 pCi/g in subsurface soils.

DOE's primary radiation protection standard applicable to the Maywood site requires that the effective dose equivalent to any member of the public from exposure to residual radioactive materials (excluding radon) shall not exceed 100 millirem/year (mrem/year) above background for all plausible land uses (DOE Order 5400.5, DOE 1990); DOE further requires that all radiation doses should be reduced as low as reasonably achievable (ALARA) below this primary dose limit. The 100 mrem/year dose limit is a consensus standard, recommended by national and international radiation protection organizations, including the International Commission on Radiological Protection (ICRP 1991), the National Council on Radiation Protection and Measurements (NCRP 1993), and the U.S. Nuclear Regulatory Commission (NRC 1991). Additional limits in DOE Order 5400.5 (DOE 1990) specify that, within any occupied or habitable building, gamma radiation shall not exceed background by more than 20 microroentgens/hour (μR/hr), and radon decay product concentrations (including background) shall not exceed 0.02 WL where reasonably achievable and 0.03 WL in any case; these requirements are adopted from 40 CFR 192 Subpart B. Based on discussions with EPA staff, both DOE and EPA are in agreement that these dose limits are appropriate for the Maywood site, and DOE is committed to attaining these dose limits. The 5/15 pCi/g soil cleanup standards specified in 40 CFR 192 are concentration limits derived to achieve the primary dose limits and

radon progeny concentration limits; DOE's analysis confirms that the 5/15 pCi/g cleanup criteria would attain these limits at the Maywood site.

EPA has presented no information to indicate that the 5/15 pCi/g criteria are not fully protective of human health and the environment for the conditions at the Maywood site. With regard to the two Attachments submitted by EPA in support of the statement of dispute, DOE notes the following:

1) Russell and Richardson (1992) identified the potential to exceed a radon-222 concentration of 2 pCi/liter in indoor air in buildings constructed on soils with radium-226 concentrations approaching 15 pCi/g (i.e., a radon concentration of 4 pCi/liter is assumed, at 50 % equilibrium with radon decay products, to equate to the radon daughter concentration limit of 0.02 WL specified in 40 CFR 192, and this value is reduced by half to allow for other sources of radon), based solely upon mathematical modeling; this analysis may be overly conservative in allowing only one-half of the 0.02 WL limit from radium contaminated soils, as the standard makes no such provision, but specifies only that the annual average radon decay product concentration shall not exceed 0.02 WL where reasonably achievable and 0.03 WL in any case, in both cases "including background" - the relative contribution of background is not specified. The EPA analysis also estimates indoor gamma exposure rate to be "very close to" the limit specified in 40 CFR 192 (20 μR/hour) for soil concentrations approaching 15 pCi/g. These concerns may be valid for sites where the primary contaminant of concern is radium-226, although the underlying models of radon migration into structures from soils contain large uncertainties and may be a questionable basis for risk management decisions involving large expenditures of public funds.

Such concerns are not valid, however, for thorium-232 contamination at the Maywood site. The radioactive decay series for radium-226 and thorium-232 include the noble gases radon-222 (radon) and radon-220 (thoron), respectively. However, the radioactive half-life of radon-220 (55.6 seconds) is very short relative to the half-life of radon-222 (3.8 days), which precludes significant migration of radon-220 from subsurface soils. EPA estimates that the potential for release of radon gas from contaminated soils is 25 times lower for radon-220 than for radon-222 (EPA 1991). Thus, the potential for accumulation of radon-220 in indoor air in buildings constructed on soils containing thorium-232 is much lower than that for radon-222 in radium-226 contaminated soils, and the analysis of Russell and Richardson (1992) is not directly applicable to the Maywood site. Furthermore, the health risk from radon-220 decay products has been estimated to be lower than that for radon-222 decay products by a factor of three for an equal concentration of inhaled alpha energy (ICRP 1981). The application of the 5/15 pCi/g standards derived for radium-226 contaminated soils to the Maywood site, where thorium-232 is the primary contaminant of concern, therefore is highly conservative.

2) The Health Physics Society's "Position Statement on Radiation Standards for Site Cleanup and Restoration" (HPS 1993) was developed as input to the NRC's enhanced

participatory rulemaking to establish radiological criteria for decommissioning of NRC-licensed facilities and DOE's proposed 10 CFR 834. This position statement endorses the primary dose limit of 100 mrem/year and the reduction of all radiation exposures as low as reasonably achievable, consistent with DOE policy noted above as well as current recommendations of the International Commission on Radiological Protection (ICRP 1991) and the National Council on Radiation Protection and Measurements (NCRP 1993). A soil concentration limit of 5 pCi/g above background is also proposed, again based on limiting radon concentrations in indoor air; however, this criterion is suggested only for application to near surface soils, with a depth limit of "no less than 0.5 and no greater than 1 meter". As noted above, DOE's analysis for the Maywood site indicates that compliance with both the radon concentration limit and primary dose limit will be achieved by the 5/15 pCi/g cleanup criteria.

The Health Physics Society's primary recommendation cautions, however, that "standards for site cleanup and restoration should be based on the principle of balancing the societal costs and risks of cleanup against the societal benefits of actual radiological risk reduction, to assure that the net benefit to society is maximized." Further, as part of its considerations, the position statement concurs with the ICRP recommendation that "the proposed intervention should do more good than harm, i.e., the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including social costs, of the intervention." Reduction of the cleanup criteria for the Maywood site would impose very significant additional costs to achieve marginal risk reduction, in direct conflict with this recommendation.

Prediction of potential health impacts from radiation exposures is subject to very large uncertainties, based on numerous assumptions and extrapolations upon which knowledgeable scientists disagree (e.g., NAS 1990). Therefore, it is not possible to draw such clear lines of demarcation to indicate that a subsurface soil concentration of 15 pCi/g of radium or thorium is "unsafe" whereas a concentration of 5 pCi/g is "safe"; rather, both values must be considered to lie in a common risk range (i.e., a common order of magnitude). Depending on the site-specific exposure conditions, both values may fall either within or outside the EPA's target risk range of 10^{-4} to 10^{-6}; however, in either case, the predicted radiation dose and health risk would be within the range of that from natural background radiation. In the Final Environmental Impact Statement for the 40 CFR 192 rulemaking (EPA 1982, pp 110-111), EPA acknowledged this situation in estimating identical residual risks for the 5/15 pCi/g standards and 5/5 pCi/g alternative, both outside the 10^{-4} to 10^{-6} target risk range.

It should also be noted that the primary dose limit of 100 mrem/year for members of the public, which represents a consensus of the radiation protection community, yields an excess cancer risk estimate of approximately 6×10^{-5} per year of exposure (or 4×10^{-3} for a 70-year lifetime). The average natural background radiation in the United States results in an annual effective dose equivalent of approximately 300 mrem/year (NCRP 1987), with a lifetime excess cancer risk of 10^{-2} (EPA 1989). Natural background radiation levels much higher than this average occur in many areas underlain by uranium-rich granites and shales; for example, indoor

radon concentrations exceeding 200 pCi/liter (i.e., 50 times EPA's 4 pCi/liter guideline) in indoor air have been attributed to natural sources in areas such as Pennsylvania's Reading Prong (NCRP 1984). The excess cancer risk to a person exposed to the 4 pCi/liter concentration guideline for radon-222 in indoor air over a lifetime is estimated to exceed 10^{-2}. The risk from residual radioactive materials at the Maywood site is a small increment to these background radiation risks, comparable to the variability in natural background risks.

In response to EPA's concern (EPA 1993c) that 15 pCi/g may not be suitable as a criterion for replacement of treated soils at the Maywood site, DOE has reevaluated the proposed replacement criterion. An important consideration in the selection of criteria for replacement of treated soils is the large volume of soils proposed for treatment at the Maywood site; replacement of treated soils which meet the selected criteria as subsurface backfill at selected properties could provide a large, relatively homogenous layer of soils with residual contaminant concentrations approaching the selected limit. This situation would be in marked contrast to the implementation of the same criteria as cleanup standards, where only small localized areas of contamination approaching the specified limits would remain after remediation. Concentration limits for thorium-232 in treated soils have been derived to achieve the primary dose limit of 100 mrem/year effective dose equivalent to current and future receptors under the Maywood site-specific conditions; the derived concentration limits range from 8 pCi/g for residential land use conditions to 20 pCi/g for commercial/industrial land use conditions. (Note that treated soils would be used as backfill only at the Maywood Interim Storage Site, the Stepan Company property, and adjacent commercial/industrial properties, and would be covered by 15 cm of clean fill; residential use of any of the affected properties is not considered plausible as specified in the Baseline Risk Assessment (DOE 1993c); only clean backfill from an offsite borrow area will be used at properties where residential use is considered plausible.) The derived concentration limits may be further reduced on the basis of ALARA considerations. The Proposed Plan will be revised to specify such a performance-based criterion for replacement of treated soils, such that the post-remediation conditions at the site will meet pertinent dose limits.

2.2 Precedent

The 5/15 pCi/g cleanup criteria have been successfully used for remediation of more than 4500 properties under UMTRAP, FUSRAP, and other programs. In each case these criteria have been determined to be protective of human health and the environment. Selection of the alternative criteria proposed by EPA could bring into question the previous remedial activities at the Maywood site (where 25 vicinity properties have been previously remediated and certified for unrestricted release using the 5/15 pCi/g criteria) and at numerous other sites. At a minimum, implementation of dissimilar cleanup criteria at neighboring properties would raise significant, and unnecessary, equity concerns. Alternatively, it might become necessary to undertake additional site characterization and/or remedial actions at previously remediated properties to attain the revised cleanup criteria.

The 5/15 pCi/g cleanup criteria also have been specified in the Records of Decision (RODs) signed by EPA for several other CERCLA sites containing radium and/or thorium as contaminants of concern - e.g., Denver Radium Site, Monticello Mill Tailings Site, Maxey Flats Disposal Site; in each case, the 40 CFR 192 Subpart B standards (including the 15 pCi/g subsurface concentration limit) are explicitly stated to be relevant and appropriate requirements, and determined to be protective of human health and the environment. Thus, the recent assertion by EPA that only the surface concentration limit is appropriate for consideration as an ARAR is inconsistent with these previous determinations.

2.3 Cost Effectiveness

Lowering the cleanup criteria would have significant impacts on the cost and schedule for remedial actions at the Maywood site and other FUSRAP sites. The 5/15 pCi/g criteria have been used for designation of radioactively contaminated properties at the Maywood site for consideration under FUSRAP, for characterization of radioactive contamination at designated properties, and for verification of completed remedial actions. Consequently, the sampling and analysis protocols used at the site and throughout the FUSRAP program have been designed primarily to identify and characterize the contamination exceeding these concentration limits. The Work Plan for the site (DOE 1992a) and the Remedial Investigation Report (DOE 1992b), which were reviewed and approved by EPA, specifically identify the 5/15 pCi/g criteria used in the current DOE guidelines for acceptable concentrations of residual contamination in soils. Selection of lower criteria for remediation of these properties would necessitate reevaluation of the designation process, and potentially would require additional radiological survey activities at some previously undesignated properties, as well as additional site characterization at previously characterized and any newly designated properties. These additional characterization activities would have significant cost impacts, and ongoing and planned remediation activities might need to be suspended or delayed, pending the additional characterization data. Revision of the cleanup criteria might also alter the range and relative ranking of alternatives considered for remediation, which would require revision of the Feasibility Study analyses, adding further schedule delays and increased costs.

Because the remedial investigation for the Maywood site was not designed to delineate areas of contamination below 15 pCi/g in subsurface soils, it is not possible to accurately estimate incremental waste volumes and costs which would result from the 5/5 pCi/g cleanup criteria with current information. Based upon the available data, incremental costs at Maywood have been estimated to range from $30,000,0000 to $120,000,000, or 20% to 80% over current cost estimates for the preferred alternative. The lower estimate assumes that waste volumes will increase by only 20% and the costs for the preferred alternative will increase linearly with the waste volume; however, it is possible that the cost growth will be greater than this estimate due to factors such as increased treatment costs to achieve the lower performance objective and reduced efficiency in excavating more diffuse residual contamination. The upper cost estimate could be realized if either (a) the waste volume increases by 80% over baseline volume estimates and costs increase linearly, or (b) the proposed treatment technology fails to achieve the 5 pCi/g

performance criterion, in which case a more costly disposal alternative might be required. Costs for additional remedial investigation activities at the site to better define the extent of contamination between 15 pCi/g and 5 pCi/g in the subsurface soils would be in addition to this estimate, but are not currently defined.

The cost impact throughout the FUSRAP program from implementation of the lower criteria is estimated to be $1,000,000,000 to $4,000,000,000, again assuming an increase of 20% to 80% over baseline cost estimates. The additional volume of contaminated materials requiring management under the revised criteria is estimated at 400,000 yd^3 to 1,500,000 yd^3 across FUSRAP. This additional cost would impact the schedule for remediation of the Maywood site and other FUSRAP sites.

EPA's analysis in the Final Environmental Impact Statement identifies the 5/15 standard as the "optimized cost-benefit standards", whereas the 5/5 pCi/g alternative "approaches a high-cost nondegradation alternative" below which compliance cannot be readily measured with field instrumentation (EPA 1982, p 107); it further notes that this proposed alternative "would require more skill and training of personnel, and greater use of more expensive measuring techniques, but cleanup would only be marginally more complete" (EPA 1982, p 136). DOE agrees with the EPA analysis in the Final Environmental Impact Statement that the 5/15 pCi/g cleanup criteria represent sensible risk management, and the expenditure of large additional costs for marginal risk reduction benefit is clearly unwarranted.

2.4 Implementability

Lowering the subsurface cleanup criterion from 15 pCi/g to 5 pCi/g would significantly reduce the utility of field screening techniques, requiring much more costly and less efficient measurement techniques - i.e., greater reliance on radioanalytical laboratory measurements would be required in place of real-time field measurements, with resultant loss of efficiency in remediation. Also, use of modern remote-data-logging systems, such as the Ultrasonic Ranging and Detection System (USRADS), would not be feasible at the reduced concentration limit. These practical limitations were acknowledged by EPA in the 40 CFR 192 rulemaking and Final Environmental Impact Statement, and contributed to the selection of the 15 pCi/g criterion for subsurface contamination. Both the Final Environmental Impact Statement and preamble to the final rule note that "these standards will result in essentially the same health protection, but will be much easier to implement."

In practice, the actual cleanup levels achieved during remedial actions at FUSRAP sites are generally well below the 5/15 target levels - i.e., due to the imprecise nature of field excavation equipment relative to the typical configuration of contaminated materials in thin discrete layers, and to allow for uncertainties in field measurements, excavation of contaminated soils continues until concentrations clearly below the target levels are achieved. Such practices reduce the need for remobilization to excavate additional soils at a later time. Historical cleanup activities conducted by DOE have resulted in residual concentrations well below predetermined

criteria, and in many cases near background levels. Review of the post-remedial action data for the previous removal actions at the Maywood site, for example, indicates that the cleanup levels actually achieved at most of the remediated properties already meet the 5 pCi/g level; of 1105 soil samples collected following completion of the remedial action at these properties, 1053 (92%) were determined to be within 5 pCi/g above background. However, the site characterization program and independent verification program were designed primarily to provide assurance that the 5/15 pCi/g cleanup criteria were attained, and data were not collected specifically to evaluate residual concentrations below 15 pCi/g in subsurface soils.

It is DOE's policy that all radiation exposures should be kept as low as reasonably achievable (ALARA). In the context of DOE's ALARA program, the cleanup criteria specified for a remedial action are considered as upper limits only, and the actual level of remediation attained may be significantly greater, such as that noted above for the previous remedial actions at the Maywood site. DOE is committed to pursuing an aggressive ALARA program throughout the remediation of the Maywood site, which may include removal of contaminated soils below target cleanup criteria in situations where implementation costs are reasonable and incremental risks to remedial action personnel are low. The combination of DOE's proposed 5/15 pCi/g soil cleanup criteria in concert with this ALARA program will provide a level of protection approximately equivalent to EPA's proposed alternative criteria of 5 pCi/g at all depths, but allows for recognition of technological limitations and provides opportunities for greater cost effectiveness.

3. CONCLUSION

The cleanup criteria proposed by DOE for remediation of radioactive contamination at the Maywood site specify that concentrations of thorium-232 and radium-226 shall not exceed 5 pCi/g above background concentrations averaged over the surface 15 cm layer of soil and 15 pCi/g averaged over any 15-cm layer below the surface layer. Selection of these criteria is based on thorough analysis of site-specific conditions, which has determined the criteria to be protective of human health and the environment, compliant with all regulatory requirements, implementable, and cost effective. The proposed criteria are specified in 40 CFR 192 regulations and DOE Order 5400.5.

In the 40 CFR 192 rulemaking and the supporting Final Environmental Impact Statement, EPA determined that the 5/15 pCi/g standards were protective of human health for uranium mill tailings sites. The situation at the Maywood site is not significantly different from that at uranium mill sites, and site-specific analyses have confirmed the protectiveness of these criteria under current and future site conditions. The 40 CFR 192 standards are considered relevant and appropriate for the Maywood site because the site characteristics and distribution of radioactive contaminants at the site are substantially similar to that for which the standards were developed. In fact, use of these standards at the Maywood site, where the primary contaminant of concern is thorium-232, provides a greater degree of protectiveness than at uranium mill sites, where radon-222 contributes significantly to the potential radiation risk.

EPA has indicated concerns that the 15 pCi/g criterion specified in the draft Feasibility Study and Proposed Plan may not be appropriate for determining onsite replacement of treated soils during Phase II of the proposed remedy, due to the potentially large quantities of such treated soils. To address this concern, DOE has derived a concentration limit for replacement of treated soils, based on the primary dose limit of 100 mrem/year effective dose equivalent and site-specific conditions. The proposed remedy will be revised to specify this performance-based criterion for replacement of treated soils, such that the site conditions following completion of the remedial action will meet all pertinent dose limits and ALARA considerations. With this modification, DOE continues to feel that the proposed remedy and cleanup criteria represent the optimal alternative for remediation of the Maywood site, based upon evaluation criteria specified in the National Contingency Plan and EPA CERCLA guidance, as documented in the Feasibility Study and Proposed Plan.

The additional costs and technical difficulties imposed by EPA's proposed alternative criteria, as well as the inconsistency with previous actions at Maywood and similar radioactively contaminated sites, are not commensurate with the marginal risk reduction benefits. **Therefore, it is DOE's position that the 40 CFR 192 cleanup criteria of 5 pCi/g for surface soils and 15 pCi/g for subsurface soils, as proposed in the Feasibility Study and Proposed Plan, are appropriate for the Maywood site.**

4. REFERENCES

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ATTACHMENT A

Assessment for Residual Radioactive Contamination at the Maywood Site

This Attachment presents estimates of radiation dose and incremental cancer risk to potential receptors following remediation of the Maywood site to the cleanup criteria proposed in the "Feasibility Study-Environmental Impact Statement for the Maywood Site" (DOE 1993a) and the "Proposed Plan for the Maywood Site" (DOE 1993b). These dose and risk estimates were computed using the RESRAD computer code (Gilbert et al. 1989, Yu et al. 1993), which has been developed to implement the DOE guidelines for residual radioactive material as specified in DOE Order 5400.5 (DOE 1990). Parameter values and assumptions conform with those in the "Baseline Risk Assessment for the Maywood Site" (DOE 1993c), which has been formally approved by EPA, and in the Feasibility Study.

Under the proposed cleanup criteria, concentrations of thorium-232 and radium-226 (and their respective decay products) would not exceed 5 pCi/g above background in the surface 15-cm layer of soil or 15 pCi/g above background in any 15-cm layer below the surface layer. For the purpose of this evaluation, these limits are allocated as indicated in Table A-1.

Table A-1. Assumed Residual Soil Concentrations

Radionuclide	Assumed Residual Soil Concentration (pCi/g)	
	Surface	Subsurface
Th-232 + Progeny	4	12
Ra-226 + Progeny	1	3
U-238 + Progeny, U-234	1	1

This relative allocation is based on the relative magnitude of thorium-232, radium-226, and uranium-234/238 concentrations in soils at the Maywood site. The 5 pCi/g and 15 pCi/g limits are not applicable to uranium, for which a site-specific concentration limit is derived; however, the sum-of-the-fractions rule is applied, such that the sum of the ratios of the radionuclides to the respective concentration limit does not exceed unity. Since thorium-232 is the primary radioactive contaminant of concern at the site, it is expected to be the predominant residual radionuclide.

Estimates of total effective dose equivalent and lifetime excess cancer risk to potential receptors at the site following completion of remedial action are summarized in Table A-2. Results of this analysis indicate that the total effective dose equivalent from the residual soil contamination will not exceed the primary dose limit of 100 mrem/year (DOE 1990), under reasonable maximum exposure (RME) conditions. All exposure assumptions are consistent with those previously approved in the Baseline Risk Assessment (DOE 1993c), and are summarized

Table A-2. Estimated Dose and Risk from Residual Soil Contamination		
Receptor Scenario	Effective Dose Equivalent (mrem/year)	Lifetime Excess Cancer Risk
Employee		
Mean	31	8×10^{-5}
RME	31	3×10^{-4}
Resident		
Mean	49	2×10^{-4}
RME	49	5×10^{-4}

in Table A-3. These exposure assumptions are considered to be conservative, such that actual doses and risks are expected to be much lower.

In all cases, direct external gamma irradiation from contaminated soils is estimated to be the predominant exposure pathway, contributing > 95% of the effective dose equivalent. Since the exposure parameters impacting the external dose estimates do not differ for the mean and RME conditions, the mean and RME estimates of effective dose equivalent are not significantly different; differences in mean and RME estimates of excess cancer risk are more pronounced due to the different exposure durations.

As noted above, and discussed at length in the Baseline Risk Assessment, the exposure assumptions used to predict these potential radiation doses are considered highly conservative. In addition to the parameters addressed in the Baseline Risk Assessment, the characteristics of the residual contaminated zone assumed for this analysis are considered to be very conservative - i.e., a subsurface layer 1-meter thick with soil contaminated at the upper bound of the residual concentration limit; in reality, such a thick layer of soil contaminated at this level is highly unlikely, based on a review of site-specific borehole data and results of previous remedial actions at this and similar sites. Similarly, the assumed lateral extent of the contaminated zone is considered to be conservative; at most properties, residual contamination would be much more localized. Despite this conservatism, doses are not predicted to exceed the 100 mrem/year limit, and lifetime excess cancer risks are estimated at the upper boundary of the target risk range.

For purposes of comparison, radiation exposure from natural sources of radioactivity results in an annual effective dose equivalent of approximately 300 mrem/year (NCRP 1987). Radiation from medical procedures and from consumer products contribute another 60 mrem/year (NAS 1990). The radiation dose associated with potential exposures to residual contaminants at the Maywood site should be considered in the context of, and compared to, this natural background radiation exposure.

Table A-3. Exposure Parameter Assumptions*

Parameter	Units	Mean Worker	RME Worker	Mean Resident	RME Resident
Exposure Time Indoors	h/d	7	7	16.4	16.4
Exposure Time Outdoors	h/d	1.75	1.75	0.44	0.44
Exposure Frequency	d/yr	250	250	350	350
Exposure Duration	yr	7	25	9	30
Area of Exposure Unit	m^2	1000	1000	100	100
Contaminated Zone Thickness	m	1	1	1	1
Indoor gamma shielding factor	-	0.8	0.8	0.8	0.8
Inhalation Rate	m^3/hr	1.875	2.5	0.62	0.83
Dust loading	ug/m^3	100	200	100	200
Dust from soil origin	%	50	50	50	50
Dust respirable fraction	%	30	30	30	30
Amount of outdoor dust present indoors	%	40	40	40	40
Soil Ingestion Rate	mg/d	30	50	60	100
Water Ingestion Rate	l/d	0.7	1.0	1.4	2.0
Ingestion of Home-grown Produce	g/d	-	-	80	80

*The basis for assumed parameter values is discussed in the Baseline Risk Assessment (DOE 1993c).

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