SUMMARY OF ENVIRONMENTAL IMPACTS FROM THE CLASSIFIED SUPPLEMENT for the DRAFT ENVIRONMENTAL IMPACT STATEMENT DUAL AXIS RADIOGRAPHIC HYDRODYNAMIC TEST FACILITY

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SUMMARY

The U. S. Department of Energy (DOE) has issued the draft Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility Environmental Impact Statement (EIS) for public review and comment. The draft DARHT EIS analyzed six alternatives, including the DOE's preferred alternative to complete and operate the DARHT Facility at Los Alamos National Laboratory in New Mexico. The draft DARHT EIS includes a classified supplement that was not made available to the general public. To assist in the public review of the DARHT EIS, DOE has prepared this unclassified summary of the classified impact analysis and made it available for public review.

The environmental analysis in the unclassified portion of the DARHT EIS indicated that there would be very little difference in the environmental impacts among the alternatives analyzed. The impact analysis in the classified supplement analyzed the additional impacts that would be expected to occur from the Department's plans to conduct dynamic experiments with plutonium. The classified supplement to the draft DARHT EIS calculated impacts for a base case, which consisted of routine operations for conducting contained dynamic experiments with plutonium and two types of accident scenarios (breach of containment and accidental detonation of an uncontained experimental assembly, neither of which were considered to be credible). The classified supplement indicated that, in addition to the impacts discussed in the unclassified portion of the DARHT EIS, there would be some slight additional impacts, but still very little difference in the environmental impacts among the alternatives analyzed.

BACKGROUND

Release of Information

The U. S. Department of Energy (DOE) has issued the draft Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility Environmental Impact Statement (EIS) for public review and comment. The DOE approved the draft EIS for release on May 1, 1995. Formal notice of the availability of the document was given in the *Federal Register* by the Environmental Protection Agency (EPA) on May 12, 1995. The draft DARHT EIS includes a classified supplement that was not made available to the general public; the supplement segregates information pertinent to the draft EIS that has been classified as Secret Restricted Data (SRD) under the Atomic Energy Act. DOE stated in the unclassified portion of the DARHT EIS that a classified supplement was prepared which contains additional information and analysis. The classified supplement has been made available for independent review (outside of DOE) by individuals with an appropriate level of security clearance.

As indicated in the Implementation Plan (IP) prepared for the DARHT EIS and issued to the public in January 1995, DOE has undertaken a declassification review to see if any of the material included in the classified supplement could be released to the general public. As a result of that declassification review, DOE has determined that additional information pertaining to the environmental impact analysis can be made available. In the DARHT IP, DOE indicated that if additional material became available as a result of its declassification review, DOE would incorporate the information in the DARHT EIS as the next step in the process; at this time, that would be the final DARHT EIS. However, to facilitate public disclosure of this information, DOE is making available to the public the environmental impacts that are based upon a classified analysis. The information that serves as a basis for the impact analysis is classified and is not included in this information release.

Under the Atomic Energy Act, information pertaining to special nuclear material is considered to be "born classified"; that is, all such information is automatically classified unless DOE determines that it can declassify a specific piece of information. Data that would assist in the design of nuclear weapon also is classified under the Atomic Energy Act. This includes certain details associated with dynamic experiments involving plutonium. As a matter of policy, the Secretary of Energy has decided to declassify as much information as possible regarding DOE's nuclear weapons program. DOE headquarters has reviewed certain classified aspects of its hydrodynamic testing program and dynamic experiment program to determine if these can be declassified. DOE considers it unlikely that any of that material will be declassified prior to the completion of the DARHT EIS. To assist in the public review of the DARHT EIS, DOE has prepared this unclassified summary of the classified impact analysis and made it available for public review.

The DARHT EIS

DOE is preparing the DARHT EIS pursuant to the National Environmental Policy Act of 1969 (NEPA) [42 U.S.C. 4321 *et seq.*], the Council on Environmental Quality (CEQ) NEPA regulations [40 CFR 1500 to 1508] and the DOE NEPA regulations [10 CFR 1021].

The draft DARHT EIS analyzes the DOE proposal to provide enhanced high-resolution radiographic capability to perform hydrodynamic tests and dynamic experiments in support of the Department's historical mission and near-term stewardship of the nuclear weapons stockpile. The Department's Preferred Alternative for accomplishing the proposed action would be to complete and operate the DARHT Facility at Los Alamos National Laboratory (LANL) in northern New Mexico. Along with other stockpile stewardship responsibilities, DOE has assigned a hydrodynamic testing mission and dynamic experiment mission to its two nuclear weapons physics laboratories. The Pulsed High Energy Radiation Machine Emitting X-Rays (PHERMEX) is the existing radiographic hydrodynamic testing facility at LANL, and the Flash X-Ray (FXR) is the existing radiographic hydrodynamic testing facility at the Department's Lawrence Livermore National Laboratory (LLNL) in California. DOE does not perform dynamic experiments with plutonium at LLNL.

The draft DARHT EIS includes six alternatives:

- **No Action Alternative:** DOE would continue to use PHERMEX at LANL and the FXR at LLNL in support of its stockpile stewardship mission. Construction of the DARHT Facility would not be completed although the building would be completed for other uses. DOE would perform some dynamic experiments; those using plutonium would be conducted in containment vessels.

- **Preferred Alternative:** DOE would complete and operate the DARHT Facility and phase out operations at PHERMEX. DOE may delay operation of the second axis of DARHT until the accelerator equipment in the first axis is tested and proven. DOE would perform some dynamic experiments; those using plutonium would be conducted in containment vessels.

- **Upgrade PHERMEX Alternative:** Construction of the DARHT Facility would not be completed although the building would be completed and put to other uses. Major upgrades would be constructed at PHERMEX, including a second accelerator for two-axis imaging. DOE would perform some dynamic experiments; those involving plutonium would be conducted in containment vessels.

- **Enhanced Containment Alternative:** Similar to the Preferred Alternative except that most or all tests would be conducted in a containment vessel or containment structure. Most tests, including all dynamic experiments with plutonium, would be contained if containment vessels were used. All tests would be contained if a containment structure were used.

- **Plutonium Exclusion Alternative:** Similar to the Preferred Alternative except that plutonium would not be used in any of the experiments at DARHT. DOE would perform some dynamic experiments with plutonium at PHERMEX or other facilities.

- **Single-Axis Alternative:** Similar to the Preferred Alternative except that only one accelerator hall at DARHT would be completed and operated for hydrodynamic or dynamic experiments. The other

- hall would be completed for other uses. DOE would perform some dynamic experiments; those using plutonium would be conducted in containment vessels.

The environmental analysis in the unclassified portion of the DARHT EIS indicated that there would be very little difference in the environmental impacts among the alternatives analyzed. The impact analysis in the classified supplement indicated that, in addition to the impacts discussed in the unclassified portion of the DARHT EIS, there would be some slight additional impacts, but still very little difference in the environmental impacts among the alternatives analyzed. DOE does not believe that this information indicates that there would be substantial adverse impacts as a result of the classified analysis, nor does DOE believe that this information adds a substantial decision discriminator among the impacts of the six alternatives analyzed.

Dynamic Experiments with Plutonium

DOE has performed dynamic experiments with plutonium at LANL in the past. As part of the action analyzed in the DARHT EIS, DOE plans to perform dynamic experiments which would involve high explosive (HE) driven mixtures of plutonium isotopes and alloys, which would be chosen for the purposes of the experiment. DOE has analyzed the impacts of dynamic experiments with plutonium that would be expected to occur under all six alternatives analyzed in the DARHT EIS. All such experiments would be carried out inside double-walled steel containment vessels. All experiments would be arranged and conducted in a manner such that a nuclear explosion could not result.

Under all alternatives analyzed in the draft DARHT EIS, DOE would conduct dynamic experiments involving plutonium. To aid in the public dialogue regarding the DARHT proposal and the draft impact analysis, the following information regarding impacts associated with plutonium experiments is being made available at this time.

IMPACT ANALYSIS METHODOLOGY

Environmental Aspects Analyzed

Discussion of environmental consequences in the classified supplement were limited to those that would be different (in kind or severity) from those already described for the various alternatives in the unclassified portion of the EIS. Of the environmental aspects analyzed in the unclassified portion of the draft DARHT EIS, the classified supplement analyzed the following:

Land Resources
Socioeconomic and Community Services
Human Health
Facility Accidents
Waste Management
Transportation of Materials under Accident Conditions
Irreversible and Irretrievable Commitment of Resources

Based on the analysis in the supplement, the impacts would be the same, regardless of alternative, for Human Health, Facility Accidents, Waste Management and Transportation of Materials under Accident Conditions. Impacts on Land Resources, Socioeconomic and Community Services, and Irreversible and Irretrievable Commitment of Resources would vary slightly among the alternatives. Impacts were calculated for Area III, Technical Area (TA) 15, at LANL, which includes both the PHERMEX and DARHT sites.

The following environmental aspects were analyzed in the unclassified portion of the draft DARHT EIS but would not be expected to result in any additional impacts and were not discussed in the classified supplement:

Air Quality and Noise
Geology and Soils
Water Resources
Biotic Resources
Cultural and Paleontological Resources

- Monitoring and Mitigation
  Decontamination and Decommissioning
  Incident-free Transportation of Materials (normal operations)
  Unavoidable Adverse Impacts
  Cumulative Impacts
  Long-Term Productivity

The classified supplement analyzed impacts for a base case, and then looked to see whether or not these impacts would vary among alternatives. Of the six alternatives analyzed, the only alternative that demonstrated any variation from the base case was the Plutonium Exclusion Alternative because under that alternative, DOE would have to maintain the PHERMEX facility as well as DARHT.

Impact Modeling Approach

In general, the analysis approach in the classified supplement was the same as that described in the unclassified EIS. In some cases, the analysis approach used in the unclassified portion of the EIS was refined to better identify potential adverse impacts, as described below. The classified supplement included a discussion on the Gaussian plume modeling used in the analysis.

In an EIS analysis process, the first step is to make very conservative assumptions to determine the upper boundary of possible adverse impacts; this process tends to maximize potential adverse consequences. If potential consequences are very low or insignificant based on the initial very conservative assumptions, it can be reported with confidence that potential impacts have not been under-estimated and, in the interest of maintaining a cost effective approach to analytical evaluation, the analysis is considered complete. If the initial, conservative evaluation indicates that there is the possibility for potential adverse effects, then additional time is taken to refine the calculations to more realistically represent the postulated impact conditions. The objective of this type of environmental impact assessment is to screen for potentially adverse impacts within the conservative, bounding, approach. However, this type of coarse impact analysis calculations are different from those used for safety assessments, and should not be considered adequate to predict the actual health effects that might be observed for a specific accident scenario. Detailed, site specific models and regional scale meteorology models are better suited for dose prediction and dose reconstruction of that nature.

For the impact analysis in the classified supplement to the draft DARHT EIS, the accident analysis discussed in the supplement used more realistic plume and exposure assumptions for plutonium releases in calculating dose to the exposed population than did the accident analysis for impacts from depleted uranium releases shown in the unclassified portion of the EIS. This was done to provide a more realistic model of the expected plutonium release evaluations for acute population exposures and impacts.

Both the unclassified and classified analyses for the draft DARHT EIS used a 95th percentile meteorological condition to maximize the conservatism of the Gaussian plume model. These conditions would be the most unfavorable atmospheric condition that would be possible; in other words, weather conditions that could lead to dispersion of the most material, hence give the largest radiological dose. Atmospheric conditions actually observed at LANL would lead to lower dispersion, hence lower radiological doses, 95% of the time. The 95th percentile is considered to be the most conservative impact modeling case. In other recent EISs, DOE has used a 50th percentile weather condition to model impacts from plume dispersion; that is, the weather conditions that would be expected to occur 50% of the time (the average condition). The 50th percentile is still considered to be conservative.

The plutonium release accident analysis in the classified supplement took credit for plume depletion due to natural settling and deposition processes, and for diffusion of released material across an entire exposed sector rather than assuming all exposure took place at the plume centerline (as was done in the analysis for depleted uranium found in the unclassified portion of the EIS). These more realistic assumptions resulted in lower (by factors of 38 and 10 respectively) postulated doses and latent cancer fatalities (LCFs) for facility and transportation accidents in comparison to the more conservative assumptions that were used for the depleted uranium release analyses. The analysis approach for plutonium releases was still considered to be conservative because it used 95th percentile meteorology, reasonable maximum exposure locations and conditions, and assumed that the plume traversed the compass sector having the maximum exposed population. In order to determine the greatest possible impact (a bounding condition), the model was based on the maximum population sector that could possibly be exposed. The maximum population sector from the PHERMEX or DARHT sites would be that falling to the east-southeast, and would include both the community of White Rock (about 14% of the population in the sector) and the city of Santa Fe (about 75% of the population in the sector).

As in Appendix H and I of the unclassified portion of the EIS, the GENII computer code was used for the classified supplement to model air dispersion in order to calculate potential impacts to human health. Gaussian plume models such as GENII are generally used in impact analyses of this type because these models are quick and convenient; carry numerous field studies and historical documentation; and because most practitioners are familiar with and understand the parameters of this type of analysis. However, it is important to understand the applicability of information that Gaussian dispersion models provide when interpreting dose estimates. Plume models are not always appropriate to accurately model long-range dispersion and transport in complex terrain, such as is found around Los Alamos.

Almost all Gaussian plume models, including GENII, use meteorological conditions near the ground at the point of release to model air transport of released material. The models simply assume that atmospheric conditions are constant and remain so indefinitely, with the result that the model assumes that a plume travels in a straight path and expands at a constant, predictable rate. Errors in concentration estimates can result when a straight-line Gaussian model is used in situations that involve complex terrain or changing wind conditions. Complex terrain and wind changes tend to reduce plume concentrations, resulting in conservative estimates of potential dose compared to the actual doses which might be received. Even when site conditions closely match the assumptions of the model, estimates of air concentration at any given point may only agree with field measurements within a factor of 3 to 5. Another limitation of this type of model is that its validity has not been tested at distances greater than about 6 mi (10 km) from any source. However, for lack of any other convenient tools, it is standard practice in environmental impact modeling to apply Gaussian plume models out to distances between 50 and 60 mi (80 and 100 km). This methodology has been found to be acceptable for bounding analyses such as those used in EISs; more accurate analysis techniques would be used in safety studies to evaluate expected doses from accident scenarios.

Under the model used for the draft DARHT EIS, total population dose was determined by the time-integrated air concentration and by the population density, both of which change with radial distance from the source. Table H-6 in Appendix H of the unclassified portion of the draft DARHT EIS shows the population distribution within a 50 mi (80 km) radius of TA-15. The air concentration decreases steadily with increasing distance, at a rate that depends on the atmospheric stability class. Within the east-southeast sector, which was determined to be the maximally exposed population sector for the accident analysis in the classified supplement, two population spikes are apparent, representing the community of White Rock between 3 and 5 miles (5 and 9 km) from the PHERMEX or DARHT sites, and the city of Santa Fe between 20 and 30 miles (37 and 55 km) from the sites. For the containment breach scenario, these population centers would contribute 23% and 60%, respectively, of the total person-rem (the product of the number of persons in the area and the average calculated dose), and for the detonation scenario, they would contribute 14% and 75%.

These percentages illustrate two points. First, a comparison of the White Rock contribution between the two scenarios shows the sensitivity of near-range dose estimates to the source elevation and release geometry. Some portion of the elevated plume would be expected to pass high over the community, reducing its actual contribution to the total dose. No credit was taken for this reduction. Second, it is clear that over half of the estimated population dose would be related to persons residing beyond 25 mi (40 km) from the postulated release (in Santa Fe). Although Santa Fe and White Rock sit at approximately the same elevation, the intervening Rio Grande Valley does not satisfy the uniform terrain condition required for confident extrapolation of the Gaussian model. Actual exposures at Santa Fe would be reduced by increased dispersion during travel of the plume through the Rio Grande Valley. No credit was taken for this reduction.

Because of these considerations, concentration estimates using a Gaussian plume model as a function of radial distance from the source are expected to be conservatively high for the vast majority of initial meteorological conditions. Sufficient conservatism was left in the impact assessment in the classified supplement to offset any uncertainties introduced by limitations of the physical transport description. Under these conditions, the Gaussian plume model used was deemed to be an appropriate screening tool for the purpose of identifying ranges of potential consequences from hypothetical release scenarios.

ENVIRONMENTAL CONSEQUENCES FROM DYNAMIC EXPERIMENTS WITH PLUTONIUM

Summary of Environmental Consequences

The classified supplement to the draft DARHT EIS calculated impacts for a base case, which consisted of routine operations for conducting contained-dynamic experiments with plutonium and two types of accident scenarios (breach of containment and accidental detonation of an uncontained experimental assembly). DOE does not believe that either accident scenario analyzed would be likely to occur (the probability would be less than 1×10^{-6} per year); however, the CEQ NEPA regulations require discussion of low probability, high consequence events. For the DARHT EIS, in both the unclassified and classified portions, accident scenarios were evaluated using a conservative "what-if?" approach; that is, the analysis did not make any attempt to identify any specific physical or human error mechanism as being capable of producing or likely to produce the release.

Based on the analyses presented in the classified supplement, conducting dynamic experiments with plutonium would be expected to have negligible potential for environmental impacts under any of the alternatives analyzed. Impacts would be the same regardless of whether the dynamic experiments were conducted at the PHERMEX site or the DARHT site. The analysis indicated that there would be no disproportionate adverse impact among minority or low-income groups from routine operations or accidental release of plutonium.

The environmental impact analysis in the classified supplement indicated that the consequences that would be expected from conducting dynamic experiments with plutonium would be negligible. The impact analysis identified some potential impacts from accident scenarios, but related DOE studies indicate that these accident events would not be considered to be credible. The environmental consequences resulting from release of plutonium from postulated accidents would be the same for all alternatives analyzed, but would be expected to be higher than those calculated for accidental release of depleted uranium analyzed in the unclassified portion of the EIS. The consequences of an accidental release of plutonium, if by some unknown mechanism it were to occur, were calculated to be zero (0.3) LCFs for a breach of containment accident and to range from five to 12 LCFs for an unconfined detonation accident (slightly above the existing baseline cancer fatality rate); consequences from accidental release of depleted uranium from these types of accidents was calculated to be zero LCFs. The classified analysis did not identify any adverse impacts on the public as a whole from performing dynamic experiments with plutonium; accordingly there would be no basis for a finding of disproportionate adverse impacts among minority or low-income groups.

Table 1 summarizes the additional environmental consequences that would be expected to occur from dynamic experiments involving plutonium.

Base Case Impact Analysis

Under all alternatives analyzed, routine operations with plutonium would be conducted in double-walled containment vessels to minimize the possibility of release of radioactive material to the environment and to assist in clean-up operations. Multiple levels of physical and administrative processes (including two-person independent check-off of experimental setup and detonation procedures and sequences) would assure that the highest levels of safety for workers and the public would be maintained, and safety procedures would be rigorously reviewed following DOE guidelines.

The base case in the classified supplement looked at impacts to environmental resources, workers and the general public from routine operations, and from two types of accidents: breach of the double containment vessel, and unconfined detonation. Neither accident was considered to be credible (less than 10^{-6} annual probability), but both were analyzed using the "what if?" approach described in the unclassified portion of the EIS.

- **Land Resources**

Under the base case, impacts on land resources would be essentially the same as those described in section 5.1.1. of the unclassified portion of the EIS.

Table 1 - *Summary of the Additional Potential Environmental Impacts for Dynamic Experiments with Plutonium*

Summary of the Additional Potential Environmental Impacts for Dynamic Experiments with Plutonuium[1]

Factor/Measure	No Action	Preferred Alternative	Upgrade PHERMEX Alternative	Enhanced Containment Alternative[5]	Plutonium Exclusion Alternative	Single-Axis Alternative
Land Resources						
Acerage committed	No change	No change	No change	No change	11 ac additional	No change
Human Health						
Routine Operations						
Maximally Exposed Individual (MEI)						
most conservative case[2]	No Latent Cancer Fatality (LCF) Increase	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase
conservative[3]	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase
background cancer rate	16.6 % Cancer Fatality (CF)	16.6 % CF	16.6 % CF	16.6 % CF	16.6 % CF	16.6 % CF
Population[4]						
most conservative case	No LCF	No LCF	No LCF	No LCF	No LCF	No LCF
conservative	No LCF	No LCF	No LCF	No LCF	No LCF	No LCF
Facility Accident						
MEI						
most conservative case	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase
conservative	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase	No LCF Increase
Population						
most conservative case	No LCF	No LCF	No LCF	No LCF	No LCF	No LCF
conservative	No LCF	No LCF	No LCF	No LCF	No LCF	No LCF
Transportation						
MEI						
most conservative case	4% LCF Increase	4% LCF Increase	4% LCF Increase	4% LCF Increase	4% LCF Increase	4% LCF Increase
conservative	1.5% LCF Increase	1.5% LCF Increase	1.5% LCF Increase	1.5% LCF Increase	1.5% LCF Increase	1.5% LCF Increase
Population						
most conservative case	12 LCF	12 LCF	12 LCF	12 LCF	12 LCF	12 LCF
conservative	5 LCF	5 LCF	5 LCF	5 LCF	5 LCF	5 LCF
background	7500 Cancer Fatalities (CF)	7500 CF	7500 CF	7500 CF	7500 CF	7500 CF

Summary of the Additional Potential Environmental Impacts for Dynamic Experiments with Plutonium(1)

Factor/Measure	No Action	Preferred Alternative	Upgrade PHERMEX Alternative	Enhanced Containment Alternative	Plutonium Exclusion Alternative	Single-Axis Alternative
Worker Impacts Routine Operations	0.5% LCF Increase	0.5% LCF Increase	0.5% LCF Increase	0.5% LCF Increase	0.5% LCF Increase	0.5% LCF Increase
Facility Accident Line personnel	Explosive Hazard Dominates	Explosive Hazard Dominates	Explosive Hazard Dominates	Explosive Hazard Dominates	Explosive Hazard Dominates	Explosive Hazard Dominates
400 m. non-involved most conservative case conservative	2% LCF Increase 1% LCF Increase	2% LCF Increase 1% LCF Increase	2% LCF Increase 1% LCF Increase	2% LCF Increase 1% LCF Increase	2% LCF Increase 1% LCF Increase	2% LCF Increase 1% LCF Increase
750 m. non-involved most conservative case conservative	1% LCF Increase 0.4% LCF Increase	1% LCF Increase 0.4% LCF Increase	1% LCF Increase 0.4% LCF Increase	1% LCF Increase 0.4% LCF Increase	1% LCF Increase 0.4% LCF Increase	1% LCF Increase 0.4% LCF Increase
Transportation Accident Line personnel	Explosive Hazard Dominates	Explosive Hazard Dominates	Explosive Hazard Dominates	Explosive Hazard Dominates	Explosive Hazard Dominates	Explosive Hazard Dominates
Socioeconomics	No change	No change	No change	No change	$2.1 million annual operating cost	No change
Resources Material Replacement Resource Commitments	10% per year No change	10% per year No change	10% per year No change	10% per year No changge	10% per year Slight increase	10% per year No change
Waste Management TRU waste	100 nCi/year	100 nCi/year	100 nCi/year	100 nCi/year	100 nCi/year	100 nCi/year

(1) Table lists only additional potential environmental impacts for dynamic experiments with plutonium. See Table 3.3 of the unclassified draft DARHT EIS for other impacts.

(2) Most conservative case assumes weather conditions leading to unfavorable atmospheric dispersion; for this case atmospheric dispersion conditions observed at Los Alamos lead to lower doses 95% of the time.

(3) Conservative case calculations use weather conditions which represent the atmospheric dispersion parameters observed for the Los Alamos area 50% of the time.

(4) Wind direction is assumed to be towards the sector (ESE) with the largest population: White Rock and Santa Fe.

(5) Dynamic experiments with plutonium would be conducted inside double walled containment essels. For the Enhanced Containment Alternatiuve, under the containment building option, the releases would be expected to be even lower. However, the analysis in the classified supplemnt did not take building containment into account.

- **Human Health**

Potential radiological impacts on human health from dynamic experiments using plutonium were analyzed under the base case. Non-radiological impacts were determined to be essentially the same as described in section 5.1.8. of the unclassified portion of the EIS. Radiological impacts that might result from dynamic experiments using plutonium were analyzed. The classified supplement identified some impacts that could occur in addition to the impacts described in section 5.1.8 of the unclassified portion of the EIS. Unless otherwise stated, the term "dose" means "effective dose equivalent." For comparison, the existing baseline cancer fatality rate is about 16.6%, which would translate to an expected occurrence of about 7,500 cancer fatalities in the affected population as discussed in the draft DARHT EIS over 50 years. Again for comparison, a dose of 2×10^{-10} rem is the dose that would be received in northern New Mexico from an exposure to natural background radiation of about one-fiftieth of a second.

- *Radiological Impacts on the Public - Routine Operations*

Routine operations for plutonium experiments were assumed to be conducted in a double containment vessel with high efficiency particulate air (HEPA) filters having particulate retention efficiencies of 99% to 99.9% (gases would not be impeded) and an effluent monitor with a detection limit of 6×10^{-10} Ci. Under routine operating conditions, a doubly contained plutonium experiment would not be expected to release any gases or particulates to the atmosphere. However, to conservatively model the consequences from potential releases associated with routine operations during plutonium experiments, the release for each experiment was assumed to equal the detection limit of the monitoring instrument. Thus, a maximum of 6×10^{-10} Ci of plutonium was assumed to be released to the atmosphere during each experiment. Using the methods described in *Appendix H, Human Health* in the unclassified portion of this EIS, the 50-year committed dose to the maximally exposed individual among the general public over the 30-year life of the project would be 2×10^{-10} rem. This would be the same whether the tests were conducted at the PHERMEX site or the DARHT site. This would relate to a maximum probability of 8×10^{-14} of contracting a latent fatal cancer. The collective population dose over the life of the project would amount to about 3×10^{-7} person-rem; for this dose, no LCFs would be expected (1×10^{-10} LCFs).

- *Radiological Impacts on the Public - Breach of Containment Accident*

The bounding accident assumed for facility accidents was a hypothetical breach of the inner vessel container and breach to the atmosphere via a one-inch hole in the secondary container following detonation. The impacts would be the same regardless of whether this accident took place at the PHERMEX site or the DARHT site. In this case it was assumed that a small fraction of the plutonium was released to the atmosphere at ground level, was volatilized, and was respirable. The remainder was assumed to be confined to the vessel. Such an accident has never happened nor has any mechanism been identified that would initiate such an event, hence it was examined only as a "what if?" accident.

The 50-year committed dose from such an accident, if it were to occur, to the maximally exposed individual among the general public (assumed to be an individual on State Road 4, the closest LANL boundary to the PHERMEX or DARHT sites) was calculated to be 14 rem, which, using a dose to latent cancer fatality conversion of 5×10^{-4} LCFs per rem, would relate to a maximum probability of 0.007 of contracting a latent fatal cancer. The collective 50-year committed population dose within the east-southeast sector (the sector of the general population assumed to be receiving the dose, in the general direction of Santa Fe) was calculated to amount to about 560 person-rem for which no actual (0.3) latent cancer fatalities would be inferred.

- *Radiological Impacts on the Public - Uncontained Detonation Accident*

The bounding accident for accidents during transportation of materials was assumed to be a hypothetical detonation of a plutonium experiment while outside of its double containment vessel. The impacts were calculated as if the event took place at the PHERMEX or DARHT site (rather than at some other location within LANL where the experimental device might be handled) because these sites are closest to the LANL boundary; the impacts would be the same regardless of whether this accident took place at the PHERMEX site or the DARHT site. Such an accident has never happened nor has any mechanism been identified that would initiate such an event, hence it was examined only as a "what if?" accident. Related DOE safety studies indicate that the probability of an accidental uncontained detonation of the type analyzed would be less than 10^{-6} per year, which is considered to be an incredible event.

Because under this scenario detonation of the explosive would take place in open air, the release was modeled as explosive, lofting to 99 m before encountering atmospheric dispersion. The 50-year committed dose from such an accident, if it were to occur, to the maximally exposed individual among the general public (an individual located on State Road 4 at the LANL boundary) was calculated to be 76 rem which would relate to a maximum probability of 0.04 of contracting a latent fatal cancer. Using the most-conservative 95th percentile meteorological condition, the collective 50-year committed population dose within the east-southeast sector (sector population receiving the dose) was calculated to amount to about 24,000 person-rem for which about 12 latent cancer fatalities would be inferred. In other recent EISs DOE has used a somewhat-less-conservative 50th percentile meteorological condition; in this case, the dose calculation would be about 0.37 times the more-conservative amount, for which five additional LCFs would be inferred. The inferred range of impacts, then, from this incredible accident scenario would be from five to 12 additional LCFs above background conditions. DOE may choose to further examine and refine this estimate of LCFs for the final EIS.

- *Radiological Impacts on Workers - Routine Operations*

Radiological impacts on workers from the baseline case would be essentially the same as reported in section 5.1.8 of the unclassified portion of the EIS, namely 0.3 rem to the maximally exposed worker over the 30-year life of the project and a collective worker dose of 9 person-rem. For the individual, the maximum probability of contracting a fatal radiation induced cancer, using a dose to latent cancer fatalities of 4×10^{-4} LCFs per rem for low dose rates, would be about 1×10^{-5}. Over the life of the project no radiation-related latent fatal cancers would be expected among workers (5×10^{-3} LCFs). This would include a contribution from plutonium experiments. The 50-year committed dose to noninvolved workers would relate to a maximum probability of 2×10^{-13} of contracting a latent fatal cancer. The collective worker dose over the life of the project would amount to about 9×10^{-9} person-rem for which no latent cancer fatalities would be expected (3×10^{-12} LCFs).

- *Radiological Impacts on Workers - Breach of Containment Accident*

The 50-year dose to a noninvolved worker 400 m from the firing point (see section 5.1.9 of the unclassified portion of the EIS) was calculated to be 60 rem for which, using a dose to latent cancer fatality conversion factor of 4×10^{-4} LCFs per rem, the maximum probability of contracting a latent fatal cancer would be about 0.02. The 50-year dose to the noninvolved worker at a 750 m distance (see section 5.1.9 of the unclassified portion of the EIS) was calculated to be about 20 rem for which the maximum probability of contracting a latent fatal cancer would be about 0.009.

- *Radiological Impacts on Workers - Uncontained Detonation Accident*

As was the case analyzed in the unclassified portion of the EIS, blast injuries associated with the hypothetical uncontained experimental device explosion were assumed to be fatal to all workers who might be close to the experimental assembly (which was not considered to be an incremental addition to the impacts identified in the unclassified accident analysis). As a consequence, radiological impacts to these individuals were not investigated.

- **Socioeconomics**

Under the base case analyzed in the classified supplement, socioeconomic considerations would be essentially the same as those described in section 5.1.7. of the unclassified portion of the EIS.

DOE used the same analysis techniques described in the unclassified section of the EIS to determine whether any disproportionately high or adverse health or environmental impact would occur on minority and low-income populations due to the impacts analyzed in the classified portion of the draft EIS. DOE determined that the uncontained detonation accident scenario was the only impact which indicated a potential impact over 50 years of greater than zero; this incredible accident inferred about five to 12 potential LCFs over 50 years, assuming, with the impact model used, that those impacts would occur in the east-southeast sector. Figure 1 shows this sector plotted over the distribution of minority population with the ten, twenty and thirty mile sectors shown; figure 2 shows the sector plotted over the distribution of low-income population. This sector includes both the population of White Rock, within ten miles, and Santa Fe, within thirty miles. The figures indicate that the impacts would occur within areas that generally have a population with fewer minorities and higher incomes; therefore the potential for adverse impact would not be expected to occur disproportionately among minority or low-income populations.

- **Resource Commitments**

Under the base case analyzed in the classified supplement, in addition to the resource commitments cited in section 5.8 of the unclassified portion of the EIS for the six alternatives, there would be a commitment of small quantities of resources (e.g., supplies, chemicals and electricity) that would be consumed for each dynamic experiment.

- **Waste Management**

Under the base case, in addition to waste management considerations cited in section 5.1.12 of the unclassified portion of the EIS, other wastes would be expected to result from dynamic experiments with plutonium. The inner containment vessel itself could be considered waste (the inner vessel would be used only once) and would be treated as transuranic (TRU) waste (waste that is 100 nCi TRU elements or more per gram of waste) and stored pending ultimate disposition. Ultimate disposition would probably be in a deep geologic repository. There would probably also be small quantities (perhaps up to 0.3 m^3) of other wastes which would also be treated as TRU wastes.

Plutonium Exclusion Alternative

Of the six alternatives analyzed in the draft DARHT EIS, the impacts analyzed in the classified supplement under the base case described above would vary slightly only under the Plutonium Exclusion Alternative. Under the Plutonium Exclusion Alternative plutonium experiments would not be conducted at the DARHT facility; however DOE would use PHERMEX or other facilities at LANL for dynamic experiments using plutonium. In addition to the impacts discussed under the base case, under the Plutonium Exclusion Alternative there would be some additional impacts to land use, socioeconomic and resource commitment considerations.

- **Land Resources**

Under the Plutonium Exclusion Alternative, land would be committed for both the PHERMEX and DARHT facilities. However, continued commitment of such use for both facilities would be within established land use patterns at LANL.

- **Socioeconomics**

The principal socioeconomic consideration associated with operation of DARHT plus use of PHERMEX for dynamic experiments with plutonium would be an additional operating cost of an average of 2.1 million dollars per year for 30 years, over and above the 6.2 million dollars per year cost of operating the DARHT facility.

- **Resource Commitments**

Under the Plutonium Exclusion Alternative additional resource commitments and small additional quantities of resources would be required to maintain PHERMEX as well as DARHT.

INCREMENTAL IMPACTS

The environmental impacts discussed in the classified supplement would be incremental, or in addition, to those discussed in the unclassified portion of the draft DARHT EIS. Table 2 shows the incremental addition to the impacts in the unclassified portion of the EIS, and the resultant total impact from the six alternatives analyzed.

Figure 1 – *East-Southeast Population Sector Overlain on Distribution of Minority Population within a 30-mi (50 km) Radius of the PHERMEX and DARHT Sites*

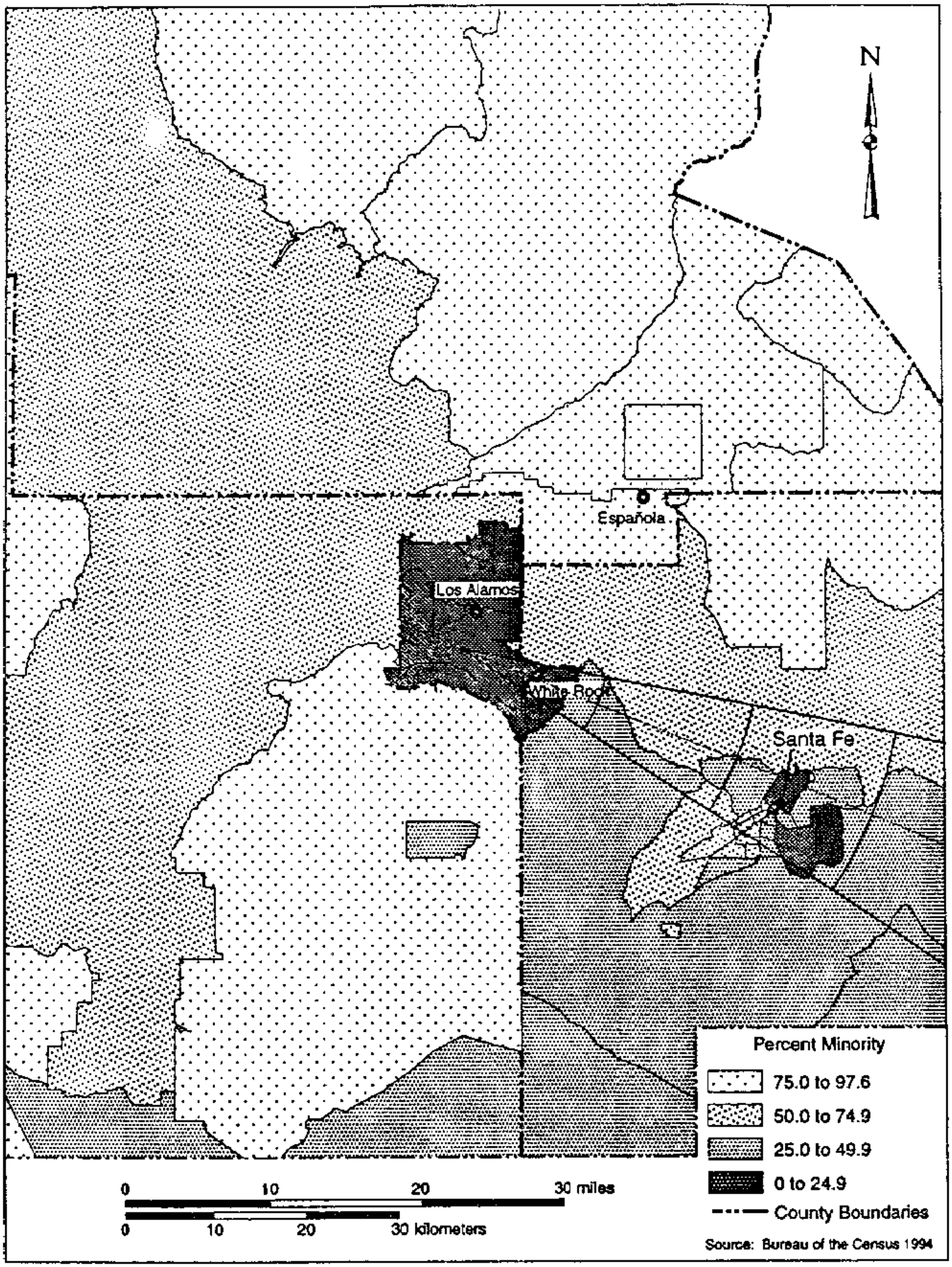

Figure 2 – *East-Southeast Population Sector Overlain on Distribution of Low-Income Population within a 30-mi (50 km) Radius of the PHERMEX and DARHT Sites*

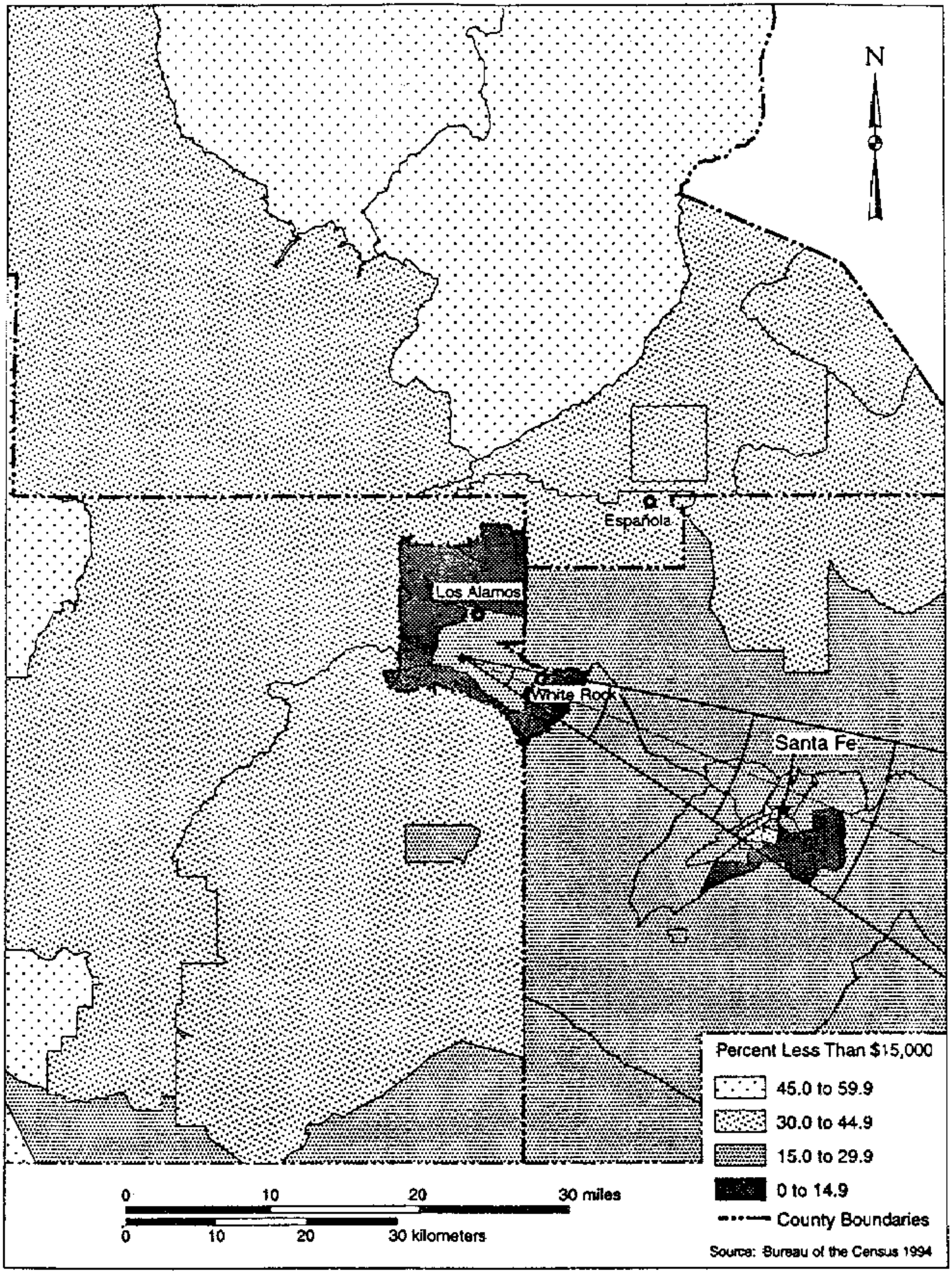

Table 2 - *Incremental Change and Total Environmental Impacts, Draft DARHT EIS*[1]

Factor/Measure	No Action	Preferred Alternative	Upgrade PHERMEX Alternative	Enhanced Containment Alternative[2]	Plutonium Exclusion Alternative[3]	Single-Axis Alternative
Land Resources						
DARHT Draft EIS						
Acreage Committed						
PHERMEX	11 ac	11 ac	11 ac	11 ac	11 ac	11 ac
DARHT (including RSL[4])	8 ac	8 ac	8 ac	9 ac	8 ac	8 ac
Incremental Change						
Acreage committed	No change	No change	No change	No change	11 ac additional (Both PHERMEX and DARHT)	No change
Total Impact						
Acreage Committed						
PHERMEX	11 ac	11 ac	11 ac	11 ac	11 ac	11 ac
DARHT (including RSL)	8 ac	8 ac	8 ac	8 ac	8 ac	8 ac
Socioeconomics						
DARHT Draft EIS						
various	various	various	various	various	various	various
Incremental Change						
cost of operation	No change	No change	No change	No change	$2.1 million additional annual operating cost (DARHT and PHERMEX)	No change
Total Impact						
various	various	various	various	various	various	various
Human Health - Public (30-yr life of project)						
DARHT Draft EIS						
MEI[5] Dose	$7x10^{-4}$ rem	$7x10^{-4}$ rem	$7x10^{-4}$ rem	$5x10^{-4}$ rem	$7x10^{-4}$ rem	$7x10^{-4}$ rem
Population Dose	30 person-rem	30 person-rem	30 person-rem	13 person-rem (V) 8 person-rem (B)	30 person-rem	30 person-rem
Latent Cancer Fatalities	None	None	None	None	None	None

Table 2 - *Incremental Change and Total Environmental Impacts, Draft DARHT EIS*[1]

Table 2 (contd) - *Incremental Change and Total Environmental Impacts, Draft DARHT EIS*

Factor/Measure	No Action	Preferred Alternative	Upgrade PHERMEX Alternative	Enhanced Containment Alternative(2)	Plutonium Exclusion Alternative(3)	Single-Axis Alternative
Incremental Change						
MEI Dose	$2x10^{-10}$ rem	$2x10^{-10}$ rem	$2x10^{-10}$ rem	$2x10^{-10}$ rem	$2x10^{-10}$ rem	$2x10^{-10}$ rem
Population Dose	$3x10^{-7}$ rem	$3x10^{-7}$ rem	$3x10^{-7}$ rem	$3x10^{-7}$ rem	$3x10^{-7}$ rem	$3x10^{-7}$ rem
Latent Cancer Fatalities	None	None	None	None	None	None
Total Impact						
MEI Dose	$7x10^{-4}$ rem	$7x10^{-4}$ rem	$7x10^{-4}$ rem	$5x10^{-4}$ rem	$7x10^{-4}$ rem	$7x10^{-4}$ rem
Population Dose	30 person-rem	30 person-rem	30 person-rem	13 person-rem (V) 8 person-rem (B)	30 person-rem	30 person-rem
Latent Cancer Fatalities	None	None	None	None	None	None
Human Health - Workers (30-yr life of project)						
DARHT Draft EIS						
Average Dose	0.3 rem	0.3 rem	0.3 rem	0.3 rem	0.6 rem	0.3 rem
Collective Dose	9 person-rem	9 person-rem	9 person-rem	60 person-rem	9 person-rem	9 person-rem
Latent Cancer Fatalities	None	None	None	None	None	None
Incremental Change						
Average Dose	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium
Collective Dose	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium	Indistinguishable from depleted uranium
Latent Cancer Fatalities	None	None	None	None	None	None
Total Impact						
Average Dose	0.3 rem	0.3 rem	0.3 rem	0.3 rem	0.6 rem	0.3 rem
Collective Dose	9 person-rem	9 person-rem	9 person-rem	60 person-rem	9 person-rem	9 person-rem
Latent Cancer Fatalities	None	None	None	None	None	None

Table 2 (contd) - *Incremental Change and Total Environmental Impacts, Draft DARHT EIS*

Factor/Measure	No Action	Preferred Alternative	Upgrade PHERMEX Alternative	Enhanced Containment Alternative(2)	Plutonium Exclusion Alternative(3)	Single-Axis Alternative
Facility Accident						
DARHT Draft EIS						
Involved Workers, worst case (explosion related fatalities)	15	15	15	15	15	15
Public dose, MEI	6×10^{-4} rem	6×10^{-4} rem	6×10^{-4} rem	1×10^{-2} rem (V) 1×10^{-3} rem (B)	6×10^{-4} rem	6×10^{-4} rem
Latent Cancer Fatalities	None	None	None	None	None	None
Population dose	13 person-rem	13 person-rem	13 person-rem	17 person-rem (V) 1.7 person-rem (B)	13 person-rem	13 person-rem
Latent Cancer Fatalities	None	None	None	None	None	None
Incremental Change						
Involved Workers, (explosion related fatalities)	15 (not incremental)	15 (not incremental)	15 (not incremental)	15 (not incremental)	15 (not incremental)	15 (not incremental)
Public dose, MEI	76 rem	76 rem	76 rem	76 rem	76 rem	76 rem
Latent Cancer Fatalities, maximum probability	0.04	0.04	0.04	0.04	0.04	0.04
Population dose	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem
Latent Cancer Fatalities	5 - 12	5 - 12	5 - 12	5 - 12	5 - 12	5 - 12
Total Impact						
Involved Workers, worst case (explosion related fatalities)	15	15	15	15	15	15
Public dose, MEI	76 rem	76 rem	76 rem	76 rem	76 rem	76 rem
Latent Cancer Fatalities, maximum probability	0.04	0.04	0.04	0.04	0.04	0.04
Population dose	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem	9,000 - 24,000 person-rem
Latent Cancer Fatalities	5 - 12	5 - 12	5 - 12	5 - 12	5 - 12	5 - 12
Transportation						
DARHT Draft EIS						
30-yr worker dose	0.004 rem	0.004 rem	0.004 rem	0.004 rem	0.004 rem	0.004 rem
30-yr public dose	3×10^{-9} person-rem	3×10^{-9} person-rem	3×10^{-9} person-rem	3×10^{-9} person-rem	3×10^{-9} person-rem	3×10^{-9} person-rem
30-yr latent cancer fatalities	None	None	None	None	None	None
Incremental Change						
30-yr worker dose	about 0.0004 rem	about 0.0004 rem	about 0.0004 rem	about 0.0004 rem	about 0.0004 rem	about 0.0004 rem
30-yr public dose	about 3×10^{-10} person-rem	about 3×10^{-10} person-rem	about 3×10^{-10} person-rem	about 3×10^{-10} person-rem	about 3×10^{-10} person-rem	about 3×10^{-10} person-rem
30-yr latent cancer fatalities	None	None	None	None	None	None

Table 2 (contd) - ***Incremental Change and Total Environmental Impacts, Draft DARHT EIS***

Factor/Measure	No Action	Preferred Alternative	Upgrade PHERMEX Alternative	Enhanced Containment Alternative(2)	Plutonium Exclusion Alternative(3)	Single-Axis Alternative
Total Impact						
30-yr worker dose	0.004 rem	0.004 rem	0.004 rem	0.004 rem	0.004 rem	0.004 rem
30-yr public dose	$3x10^{-9}$ person-rem	$3x10^{-9}$ person-rem	$3x10^{-9}$ person-rem	$3x10^{-9}$ person-rem	$3x10^{-9}$ person-rem	$3x10^{-9}$ person-rem
30-yr latent cancer fatalities	None	None	None	None	None	None
Irreversible and/or Irretrievable Commitment of Resources						
DARHT Draft EIS						
various	various	various	various	various	various	various
Incremental Change						
various	slight increase	slight increase	slight increase	slight increase	slightly larger increase (operate DARHT and PHERMEX)	slight increase
Total Impact						
various	various	various	various	various	various	various

(1) For environmental aspects that would be affected, this table lists the environmental impacts from Table 3.3 of the unclassified draft DARHT EIS , the incremental change from the impact analysis in the classified supplement, and the total impact that would be expected from the six alternatives analyzed. See Table 3.3 of the unclassified draft DARHT EIS for other environmental impacts that would not be affected by the impacts in the classified supplement.

(2) The Enhanced Containment Alternative examined two options: a containment vessel approach (V) and a containment building approach (B). Dynamic experiments with plutonium would be conducted inside double walled containment vessels under either option. Most conservative case assumes weather conditions leading to unfavorable atmospheric dispersion; for this case atmospheric dispersion conditions observed at Los Alamos lead to lower doses 95% of the time.

(3) Under the Plutonium Exclusion Alternative, dynamic experiments using plutonium would not be conducted at DARHT, but would be conducted at PHERMEX or other locations.

(4) RSL is the Radiographic Support Laboratory at TA-15, Los Alamos NAtional Laboratory, built in 1990 as the first phase of the DARHT project.

(5) MEI is the maximally-exposed individual, assumed to be loacted on State Route 4 adjacent to the Los Alamos National Laboratory boundary.