70-3070
PDR/LPDR

LOUISIANA ENERGY

Post Office Box 1004
Charlotte, NC 28201-1004

December 30, 1992

Mr. John W. N. Hickey, Chief
Fuel Cycle Safety Branch
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Docket No.: 70-3070
Louisiana Energy Services
Claiborne Enrichment Center
Requests For Additional Information
File: MTS-6046-00-2001.01

Dear Mr. Hickey:

Enclosed are updated copies of the Claiborne Enrichment Center (CEC) Environmental Report (ER) sections 4.2, 6.1 and 6.2. The changes to these sections, highlighted by a vertical bar in the right hand margin, were prompted by the comments contained in Enclosure 2 of your letter to Louisiana Energy Services (LES) dated November 20, 1992. These comments were discussed in detail at a meeting on November 5, 1992 with members of your staff. The copies enclosed are "Information Only" copies of the ER sections. A formal update to the ER will be made in the near future.

If there are any questions concerning this, please do not hesitate to call me at (704) 373-8466.

Sincerely,

Peter G. LeRoy

050044

Peter G. LeRoy
Licensing Manager

PGL/N77.122

Enclosures

NF04 1/1

xc: (w/ enclosures)

Ms. Diane Curran, Esquire
Harmon, Curran, Gallagher, & Spielberg
2001 S Street, NW, Suite 430
Washington, DC 20009-1125

Ms. Nathalie Walker
Sierra Club Legal Defense Fund
400 Magazine Street, Suite 401
New Orleans, LA 70130

Mr. R. Wascom
Office of Air Quality and Radiation Protection
Louisiana Department of Environmental Quality
PO Box 82135
Baton Rouge, Louisiana 70884-2135

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4.2 EFFECTS OF PLANT OPERATION

This section describes the effects of plant operation on the environment surrounding the CEC facility.

4.2.1 EFFECTS OF IONIZING RADIATION

Radionuclides in the environment can be divided into four groups according to their origin: 1) nuclides that existed or were created during the formation of the earth (primordial nuclides) and have a sufficiently long half-life to be detected today; 2) nuclides created by the decay of the primordial radionuclides; 3) nuclides continually produced by natural processes other than the decay of the primordial nuclides; and 4) nuclides produced during human activities. The identities and activity levels of these radionuclides can vary extensively around the world, with variations seen between areas in close proximity. The first three groups constitute the major source of radiation exposure to man (References 1,2,3,4,5). The extent of radionuclides and radiation levels in any given area can be influenced by such factors as geology, precipitation, runoff, disturbances of the topsoil layer, solar activity, barometric pressure, and a host of other variables. Exposure to natural background radiation and radioactivity in the United States varies over a range from 200 to 350 mrem per year total effective dose equivalent (Reference 5), depending on the geographic region or locale and the prevalence of radon and its daughters.

Technological developments have added to the radiation dose received (primarily medical exposures) and to the inventory of radioactive materials, both atmospherically and terrestrially (primarily fallout). It is important that the added radioactive materials due to technological developments be monitored and limited. In order to assess the Claiborne Parish, Louisiana, site conditions prior to initiation of the preoperational radiological environmental monitoring program, an assortment of samples were taken within the site boundaries. A summary of the sample types, locations, and data obtained from the analyses is presented in a Section 6.1.5.1. This data provides an estimate of the radiological environmental characteristics prior to the initiation of the preoperational radiological environmental monitoring program.

Because public confidence in the safety of the facility is of paramount importance, the radiological environmental monitoring programs have been designed to provide comprehensive data to demonstrate that the facility is not adversely impacting the environment. Strategies have been developed to determine the most appropriate form of sampling for the specific media that will be identified in Sections 6.1.5 and 6.2.1 of this report. To provide an initial estimate the committed effective dose equivalent (CEDE) and target organ committed dose equivalents by

releases to plant environs, calculations will be performed in subsequent sections using release data from liquid and gaseous pathways. This information will permit prediction of the radiological impact of plant operation.

The comparative analyses for both the liquid and gaseous pathways will use projected release data. For the liquid pathway, the routine releases are expected to be approximately 1% of the limits in the Code of Federal Regulations, Title 10, Part 20 (Reference 6). The gaseous pathway routine release is also a small fraction (5%) of the limit found in Reference 6 and corresponds to an annual release of 30 grams of uranium. The comparisons will demonstrate sufficient protection to the general public, even when releases of radioactive materials are assumed. The term "dose" as described throughout this section will refer to a 50 year committed dose as described in References 7 and 8. Collective committed doses will be identified when appropriate. Calculated committed doses (organ, whole body, and collective) will be shown to have trivial significance.

Preoperational and operational radiological environmental monitoring programs are described in subsequent sections (6.1.5 and 6.2.1) of this report and will be performed to provide data for use in radiological committed dose calculations in order to demonstrate a negligible effect from facility releases. A program for monitoring appropriate pathways will be presented, which will ensure that the radiological impact of the facility remains negligible.

A discussion of important exposure pathways, committed dose calculations, and radiological environmental monitoring is presented in the following sections.

4.2.1.1 <u>Liquid Effluents</u>

A discussion of the liquid pathway and its associated variables is presented below. Estimates of committed dose and assumptions used are provided.

4.2.1.1.1 Critical Nuclide

Liquid effluents are expected to be a secondary mode of committed dose to the public and are anticipated to contain minute quantities of uranium compounds and uranium daughter products. Since the half-life of uranium is quite long, resulting in very limited production of daughter nuclides, the focus of liquid pathway sampling will be on uranium and its interaction with the environment. Uranium-238, uranium-235 and uranium-234 are expected to be present in effluents and will be quantified as well. Other radionuclides may be present in plant effluents and these will be quantified as they are detected. Calculations indicate that equilibrium will be reached with uranium-234 after

approximately 200 days of release of uranium-238 into the environment. Equilibrium of the uranium-235 through actinium-227 chain is achieved after approximately 40 days.

Routine releases from the facility are expected to contain minute activities of uranium-238, uranium-235, uranium-234 and their daughter products - all of which are expected to have an insignificant impact on the environment. This is substantiated by literature (Reference 3) that asserts that bioaccumulation factor for uranium nuclides approximately equals one, indicating that the uranium will remain in soil and not be absorbed by plants. Additionally, the same literature states that in more eutrophic environments, such as that found in the Claiborne Parish region, the bioaccumulation factor is even less than that found in non-eutrophic regions.

Analysis of actual environmental samples will provide information that will confirm the negligible effects on target populations.

Sections 4.2.1.1.4 and 4.2.1.2.4 encompass committed dose calculations for the most conservative situation - all activity will be attributed to uranium-234. This will provide a conservative estimate of committed dose from facility effluents.

4.2.1.1.2 Liquid Pathway Scope

The liquid pathway encompasses sample types such as ground water, surface water, and sediment which are described in subsequent sections. Virtually no transport of uranium through soils is expected, as determined by research (References 9 and 10), which indicates that the ground water pathway is of little or no radiological significance.

Surface and drinking water can be affected as the diluted effluent is transported to surface streams and lakes. Organisms dwelling in these aquatic environments will come in contact with the effluents that may or may not contain uranium. Since literature has documented that bioaccumulation values for uranium are low, the concentration of uranium in organisms is not of concern. The low quantities of released uranium coupled with the extensive dilution of the effluent by the Bluegill Pond (see Section 4.2.1.1.3) result in no significant radiological impact on any aqueous pathway.

The liquid pathway can also be impacted via airborne effluents. Gaseous releases could result in deposition of uranium on the roof and subsequent rain-induced washing of the particles into the roof drains and finally into the Hold-Up Basin. This is expected to be insignificant, but will be assessed in the environmental monitoring programs via analysis of Bluegill Pond water.

Calculations performed will focus on both the surface water and ground water pathways. Surface water, as released from Bluegill Pond will either flow towards Lake Claiborne or be incorporated into the local aquifers, of which the Sparta aquifer is the largest and also is the drinking water source for the population in the vicinity of the CEC site. Any effluent that is incorporated into the Sparta aquifer will be extensively diluted, considering that this aquifer covers a significant portion of north-central Louisiana (Figure 2.5-12). According to Figure 2.5-12, the Sparta aquifer is at least 120 square miles in area and is of varying depth. Any influx of surface water into the Sparta aquifer will result in further dilution of any effluents from the CEC facility.

4.2.1.1.3 Plant Effluents - Liquid (Routine Operation)

Normal plant liquid process effluents have been estimated to be 2,450,000 gallons/year. Under expected routine operation of the facility, effluents are expected to contain no more than 1% of the values listed in 10CFR20 Appendix B for uranium-234, uranium-235 and uranium-238. All uranic effluent normally discharged through the sewage treatment system is first processed by the on-site dryer and the dryer discharge maximum average annual activity level will be no greater than 5% of the 10CFR20 Appendix B limit (5% of limit = 1.5E-8 µCi/ml of uranium).

Using an assumption that the effluent contains a routine level corresponding to 1% of the 10CFR20 Appendix B limit for release into an unrestricted area, the total uranium activity in Bluegill Pond is estimated to be 3.0E-9 µCi/ml initially after the projected releases for one year with no dilution from the Hold-up Basin. Additionally, the dilution of the Bluegill Pond activities from the Hold-up Basin was estimated to be at least 10% at any given time, yielding a uranium-234 concentration of 3.0E-10 µCi/ml. See Table 4.2-1 for calculations. This assumes no additional dilution from other sources of water or release from Bluegill Pond. A conservative simplification can be made that all the activity is in the form of uranium-234, providing the basis for future committed dose calculations that will encompass the most restrictive dose conversion factors.

If the effluent contains 5% of the 10CFR20 Appendix B limit (the administrative limit for the facility), then the uranium concentration in the Pond would be a factor of five higher than those listed in the previous paragraph.

4.2.1.1.4 Committed Dose Calculations - Liquid Pathway (Routine)

Committed dose estimates will be performed using realistic uranium concentrations, calculated using effluent releases of uranium-234 at 1% of Appendix B. Dilution with stormwater

(runoff) from the Hold-up Basin will provide additional dilution of Bluegill Pond waters (calculated in section 4.2.1.1.3).

Since Bluegill Pond could be accessible to the public but not used as a drinking water source, reasonable assumptions have been made regarding the intake of Bluegill Pond water. To be incorporated into the drinking water supply of the residents, the contents of Bluegill Pond must first migrate into the Sparta aquifer or into Lake Claiborne. Either route will cause the waters to be extensively diluted - a dilution factor of one thousand is very conservative and will be used in subsequent calculations. The drinking water pathway will be evaluated using the dose conversion factors in References 11, 12, 13 and 14.

The Reference Man (Reference 11) annual intake of 7.3E5 ml of water will be used in the committed dose calculations performed below. Examination of the data shows that the liquid pathway does not result in any significant committed dose to members of the public.

This document uses particle size and age-specific radiological exposure models of References 12 and 13 for determining the radiation dose to man from the aquatic pathway that focusses on drinking water. Other components of the liquid pathway, such as aquatic foods, shoreline deposits, swimming, boating, and irrigated foods, will result in doses below that calculated for the drinking water pathway. Since no fishing, swimming, or boating will be done on Bluegill Pond, these pathways are not significant and will not be considered further. A minute portion of the Bluegill Pond water could be used for irrigation of gardens, but the amount used would be trivial and does not merit further discussion.

The dose conversion factors for uranium-234 are found in Reference 12 and are shown in Table 4.2-2. The Reference 12 model was used in conjunction with the age-specific dose conversion factors found in Reference 13 and the uptake/ingestion factors found in References 11 and 14. The committed doses (shown in Table 4.2-3) were calculated using the Reference Man (Reference 11) intake of 7.3E5 ml of water over a period of one year - in this case, the source of the water is Bluegill Pond at the 3.0E-10 µCi/ml activity level and a conservative dilution factor of one thousand.

Examination of the dose data (Table 4.2-3) shows that the bone is the organ with the highest committed dose for all ages. The highest calculated organ dose is to bone surfaces in all age groups with the highest committed dose attributed to the infant (7.4E-2 mrem) if the infant used Bluegill Pond as their drinking water source. Review of the data indicates that the infant will receive the highest calculate committed effective dose equivalent. All of these committed doses, organ and effective,

are trivial and are a fraction of the ambient external radiation effective dose commitment (approximately 1200 times lower than the radiation dose received from cosmic radiation alone in the Claiborne Parish area).

Doses to the kidneys, bone marrow and total body are lower than the dose received by the bone surfaces for all age groups. The committed dose equivalent (CEDE) is calculated to be approximately 2.2E-4 mrem for an adult.

Low committed doses (Table 4.2-3) calculated using very conservative assumptions clearly illustrate that the facility will have no adverse effect due to radiological discharges. Additionally, if the Bluegill Pond outfall water would be eventually used as a drinking water source, extensive dilution by ground water prior to being pumped from wells or additional dilution from surface waters as the effluent journeys towards Lake Claiborne is expected, further decreasing any activity and the resulting committed doses. The probability of ingestion of Bluegill Pond water is so remote that the liquid pathway is of essentially no consequence radiologically under expected routine operations.

The destination of Bluegill Pond outflow is Lake Claiborne, a possible drinking water source for the Claiborne Parish area. If the entire volume of Bluegill Pond were released over a short period of time (i.e., dam break) and the contents flowed into Lake Claiborne, the 99,500 acre-feet of Lake water would extensively dilute the 14 acre-feet of Bluegill Pond water. Such an event would cause the Bluegill Pond uranium level to be reduced substantially. The effect on Lake Claiborne is trivial and will not be considered further. Additionally, the surface water released from Bluegill Pond is extensively diluted by ground water prior to being pumped from wells or additional dilution from surface waters as the effluent journeys toward Lake Claiborne.

In addition to the above calculations, a comparison was made between the Lake Claiborne uranium concentration and the U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) for uranium of 20 μg/ml (corresponds to 26 pCi/liter using the EPA conversion factor) as listed in Reference 15. The Bluegill Pond concentration of 0.3 pCi/l is significantly below the EPA MCL for drinking water prior to any dilution by the Sparta aquifer or Lake Claiborne. Therefore, the uranium concentrations are well within EPA limits.

4.2.1.1.5 Maximally Exposed Resident

Calculations have been performed in Section 4.2.1.1.4 of this document to demonstrate that ingestion of Bluegill Pond water will be of trivial significance to an individual, even if that

person receives some of their drinking water from the pond. ER Section 2.2.2.4 describes that ground water is the sole source of public water for Claiborne Parish with the majority of homes within a five-mile radius of the CEC site being served by Central Claiborne Water System and other local water systems, which pull their water from the Sparta aquifer. This aquifer runs in an easterly direction and generally follows the topography of the CEC land.

Since ground water supplies will extensively dilute any Bluegill Pond water that infiltrates the Sparta aquifer, exposure of any resident using ground water as a drinking water supply will be extremely trivial (a small fraction of that calculated for surface water ingestion) and does not warrant committed dose calculations or further consideration. The concentrations found in the water meet EPA drinking water standards, even prior to further dilution in the aquifer. This is also considered by the NCRP to be a negligible individual risk level (NIRL) (Reference 16).

4.2.1.1.6 Plant Liquid Effluents - Comparison to 10CFR20 Appendix B

Reference 6 (Appendix B of 10CFR20) lists the release limits for uranium-238 as 3E-7 μCi/ml for unrestricted areas. Comparison of the 10CFR20 limit to the example uranium concentrations used in Table 4.2-1 (uranium concentration of 1% of the 10CFR20 limit) above background in Bluegill Pond after dilution shows a difference between the limit of 3E-7 μCi/ml and the estimated routine diluted effluent equilibrium concentration of 1.8E-10 μCi/ml of uranium - a safety factor of approximately 1,000 is seen.

4.2.1.1.7 Comparison to 40CFR190

Subpart B of 40CFR190 (Reference 17) states that uranium fuel cycle operations have a dose limit requiring that "the annual dose equivalent does not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials." Committed effective dose equivalents (CEDE) and committed organ dose equivalents calculated for the liquid pathway are many orders of magnitude lower than the limit of 40CFR190. Combined committed dose equivalents for the liquid and gaseous pathways will be addressed in Section 4.2.1.3.

4.2.1.1.8 Accident Scenarios - Liquid Pathway

Plausible accident scenarios are primarily concerned with the gaseous pathway and realistically would not impact liquid effluents (Reference 18). The liquid pathway could be impacted via gaseous effluents, as released from roof vents, that

precipitate on surfaces such as the roof and ground and are subsequently washed into the Hold-Up Basin or other receiving environments. For this reason, the Hold-Up Basin will also be sampled in the operational environmental radiological monitoring program. The committed doses received, if Hold-Up Basin water was ingested, are expected to be extremely low.

4.2.1.2 Airborne Effluents

4.2.1.2.1 Critical Nuclide

Uranium-238 and uranium-234 will be the critical nuclides for the gaseous pathway. The actual activity of each nuclide will depend on the equilibrium established and the enrichment attained. The influence of equilibrium on nuclide concentrations is discussed in section 4.2.1.1.1.

4.2.1.2.2 Gaseous Pathway Scope

Gaseous releases from the facility will be the primary mode for potential dose to the public. The gaseous pathway encompasses sample types such as air, soil and surface water which are described in subsequent text. Strategies have been developed to determine the most appropriate form of sampling for the proper media type in the gaseous pathway. The information will be used to confirm the negligible committed effective dose equivalents (CEDE) and target organ dose equivalents, if any, to individuals and populations due to facility operation.

4.2.1.2.3 uit Effluents - Gaseous (Routine Operation)

Release of uranium via the gaseous pathway can potentially result in a committed inhalation dose to individuals directly in the plume. If the uranium is present as uranium hexafluoride (UF_6) or as uranium oxides [UO_2F_2 and $UO_2(NO_3)_2$], then the compounds are rapidly absorbed by the lungs (Reference 15 has assigned these compounds to inhalation class D with an $f_1=0.05$). If the release is in the form of less soluble compounds (UO_3, UF_4, UCl_4) of ICRP-30 class W ($f_1=0.05$) or in the form of very insoluble compounds (UO_2, U_3O_8) of class Y ($f_1=0.002$), then the resulting uptake by the lungs will be smaller. Since any release would be in the form of UO_2F_2, class D will be assumed for all dose commitment calculations.

Annual relative effluent concentrations (CHI/Q) values and annual average relative deposition values (D/Q) were calculated for the three continuous emissions stacks at the facility using the XOQDOQ air dispersion model listed in NUREG/CR-2919R (Reference 19). The three stacks are located approximately 20 feet north of the Separations Building, along an east-west azimuth with 50 foot spacing between each stack. Input meteorological data for the XOQDOQ program was a joint frequency distribution of wind speed,

stability and wind direction recorded at the Shreveport, LA., National Weather Service (NWS) station from 1984 to 1988. The design of the plant process systems routes any radioactive effluent discharge via the east stack and the east stack data will be used for effluent and associated dose equivalent calculations. For all three stacks, the annual average values were calculated for site boundary locations, the closest residence in the prevailing wind direction, for 10 fixed distance intervals in the XOQDOQ model which extend to 50 miles from the stack in 16 azimuths. The east stack XOQDOQ values will be used for radioactivity releases. For the maximum CHI/Q value at or beyond the facility boundaries for the same 16 azimuths, Appendix A-1 contains detailed information on the XOQDOQ modeling, including the model output.

Releases are estimated to be a maximum of 30 grams of uranium per year. This value was used in the calculation for maximally exposed resident and the collective population dose commitment presented below.

4.2.1.2.4 Committed Dose Calculations - Gaseous Pathway (Routine Operation)

Release of uranium via the gaseous pathway can result in an inhalation dose commitment to residents and workers. Committed doses from the inhalation pathway can be calculated using the XOQDOQ data that has been derived for the site (Section 4.2.1.2.3). Using the Reference Man breathing rate of 8000 m3/year adult and teenager, 7300 m3/year child, and 1400 m3/yr infant, dose conversion factors (Table 4.2-4), ingestion factors (Reference 14), D/Q and CHI/Q data, committed total body and organ-specific dose values can be calculated.

Since the actual effluents will be routed through a HEPA filter prior to release, the particle size in the effluent is expected to be no larger than 0.3 µm. NUREG/CR-0150 (Reference 12) was consulted to determine the dose factors for the smaller particle size.

Presentation of the data has been divided into two sections: a) maximally exposed resident (Section 4.2.1.2.5) and b) collective dose commitments over a fifty mile radius from the site (Section 4.2.1.2.6). Both of these sets of data have separate deposition (ingestion) doses, separate inhalation doses, and a combined dose from both ingestion and inhalation. Usage factors for the ingestion pathway are given in Reference 14. All committed dose calculations are projected from an annual 30 grams of uranium released to the environment.

4.2.1.2.5 Maximally Exposed Resident

The data corresponding to the maximally exposed resident has been condensed by attributing all of the effluent to the east stack, corresponding to the actual configuration of the facility where all of the radioactive gaseous effluent is designed to be released to the environment.

For dose commitment calculations to maximally exposed resident, maximum Chi/Q values have been selected and the population of some sectors combined in order to simplify the calculation. Sector combinations are shown in Table 4.2-5. The three sectors with the highest prevailing wind directions (north, north-northeast, and south) were not combined with other sectors. The remaining sectors were combined with adjacent sectors.

Review of the site environs shows that the maximally exposed resident is located in the north sector 0.27 miles from the facility. This resident could receive, using the model in Reference 14, extremely minute dose commitments from ingestion, inhalation, and direct exposure from deposition on the ground. Committed doses have been calculated for adults, teenagers, children, and infants using the lungs, kidneys, bone surfaces, bone marrow, and whole body as targets. Data is shown in Table 4.2-6. The maximally exposed resident is the teenager primarily due to the ingestion doses to the bone surfaces, bone marrow, and kidneys. At such low dose equivalents, there is little difference between the doses received by each age group. All values have been rounded to one significant digit. These committed dose values are trivial.

Calculations were also performed for several other sectors that would be expected to yield the next highest theoretical committed doses. The data associated with these individuals is listed in Tables 4.2-7 through 4.2-13. Tables 4.2-7 through 4.2-10 are committed doses due to inhalation and Tables 4.2-11 through 4.2-13 are committed dose equivalents due to ingestion. The maximum committed dose values for each population due to inhalation and ingestion are shown in the "Max mrem" column in each table.

All of the dose commitments calculated for the maximally exposed individuals are very low and will not result in any adverse effects over the course of a lifetime. All of the values are considered to be below the Negligible Individual Risk Level as defined by the NCRP (Reference 16).

4.2.1.2.6 Collective Population Dose Commitments

The X/Q and D/Q values used were obtained from CEC SAR Volume II, Section 3.3, Appendix A-10. The maximum X/Q and D/Q values were selected for all "Max mrem" calculations as well as the "current resident". Collective population dose commitments have been

calculated using the 1990 50-mile population data found in ER Table 2.2-10. In order to simplify the calculation, populations in sectors with similar CHI/Q and D/Q were combined to determine the collective dose commitments for the 50-mile population. In all cases, the most conservative CHI/Q value was selected when sectors were combined for the calculations - this will provide a conservative number i[illegible] cases. Sector combinations were done as described in sect[illegible]2.1.2.5.

Since there was no singular value for either CHI/Q or D/Q for the 0-5 mile radius and no demographics were available that detailed the population distribution over the 0.5 mile, 1.0 mile, etc. radii; CHI/Q and D/Q increments were averaged to give realistic values for CHI/Q and D/Q for the 0-5 mile radius. The population in this radius is relatively small and the committed doses received by them do not significantly impact the collective dose commitments over 50 miles.

Tables 4.2-15 through 4.2-18 have the collective doses for four age groups in the seven selected sector groups as delineated by distance from the facility. The data was generated assuming that the entire population consisted of all adults, then an entire population consisti g of all teenagers, etc. Since an actual population has a mixture of ages, a mixture that is unknown for the population in these calculations, these calculations are very conservative for the 50 miles surrounding the facility.

Tables 4.2-15 through 4.2-18 contain the collective dose commitment data summed for the inhalation, ingestion, and direct exposure pathways. Ingestion pathway consists of the following categories: leafy vegetables (includes fruits, grains, and vegetables), meat (includes meat, poultry, fish, seafood), and milk. The ingestion pathway calculations considers the average individual when applying consumption variables. These variables are listed in Reference 14. All data has been rounded to one significant digit.

When reviewing ingestion and inhalation data, estimates indicate that the inhalation pathway, bone dose commitment lends to the highest dose received by the child age group. Contributing factors that influence this result are the age-specific dose conversion factors, ingestion rates and inhalation rate.

4.2.1.2.7 Plant Effluents - Gaseous Comparison to 10CFR20 Appendix B

Appendix B of Reference 6 (10CFR20) lists the release limits for uranium-234 as 3E-12 µCi/ml (UF6 form) for unrestricted areas. Comparison of this limit to the estimated gaseous effluent concentrations of 1.08E-13 µCi/ml shows a difference between the limit and the estimated concentration, as based upon the maximum estimated release of 30 grams per year of uranium and an

annualized flow rate of 52,590 cubic feet per minute (7.78E14 ml/year). Therefore, routine releases are expected to be within the 10CFR20 limit.

4.2.1.2.8 Comparison to 40CFR190

Subpart B of 40CFR190 (Reference 17) states that uranium fuel cycle operations have a limit stating that "the annual dose equivalent does not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials." Committed doses calculated for the gaseous pathway are much lower than the limit for 40CFR190. Combined committed doses for the liquid and gaseous pathways will be addressed in section 4.2.1.3.

4.2.1.2.9 Accident Scenarios

Monitoring of the environment after an accident could include soil, vegetation, and air in the vicinity of the accident to determine the amount of uranium remaining onsite and also transported offsite. It is not probable that a significant quantity of the uranium would be found in Lake Avalyn and analysis of the Lake's surface water would not be expected to yield sufficient information as to the extent of the plume due to the dilution effect of the water. Reference 18 (NUREG 1140) is quite clear in maintaining the position that realistic circumstances must be considered when examining the probability of accidents and potential exposure of uranium to the general public. By far, the most likely condition of danger will be from the exposure to chemical hazards that may be produced during accidental releases to the atmosphere. Further discussion of accident scenarios is found in Chapter 9 of the Safety Analysis Report.

4.2.1.3 <u>Summary of Radiation Dose Commitments</u>

Committed effective dose equivalent (CEDE) and target organ committed dose projections for the enrichment facility have assumed maximum release conditions during routine operation of the plant. The operating nature of this facility, based upon actual history of similar facilities in Europe, results in extremely low activities of radioactive effluents which are not likely to adversely affect the environment. As indicated with committed dose calculations derived from the liquid and gaseous pathways, the maximum effluent dose commitments are so small that no statistical significance can be shown from these most probable release paths.

The most affected individual would receive less than 0.06 mrem committed effective dose equivalent annually from routine plant operations via the gaseous pathway (includes ingestion and

inhalation). Calculations for the liquid pathway have been performed using realistic assumptions and the maximally exposed person would receive less than 0.02 mrem from the aqueous pathway. The sum of the committed doses for both pathways is no greater than 0.1 mrem with the gaseous pathway as the controlling factor. This assumes that the same person would be consistently impacted by the highest concentration of gaseous and liquid releases - a conservative assumption.

Calculated theoretical dose commitments can be compared to the 0.01 rem (10 mrem) received from a standard chest X-ray and put in terms of receiving one chest X-ray equates to being the most exposed individual from the facility for over one million years.

To briefly quantify the existing background radiation prior to the initiation of the preoperational radiological monitoring program, thirty-seven (37) thermoluminescent dosimeters (TLD's) were placed around the CEC site for a period of four months in 1990. The dose rates ranged from 0.006 to 0.015 mR/hour, with a mean of 0.010 mR/hour and a standard deviation of 0.002 mR/hour. The mean dose rate would produce an annual external dose of approximately 88 mrem which is orders of magnitude higher than the dose commitments projected from routine facility operation.

The NCRP in Reference 5 also provides a perspective as to the trivial doses attributed to facility operation by listing the mean background radiation levels in the United States and Canada. External doses are listed as 26 mrem/year from cosmic radiation, 3 mrem/year from cosmogenic radionuclides, and 28 mrem/year from terrestrial gamma radiation. Internal organ doses range from 110 mrem/year (bone surfaces) to 2400 mrem/year (bronchial epithelium). All of the dose equivalents from natural radiation are much larger than the calculated committed doses from facility operation.

If releases and/or environmental data are orders of magnitude different from the assumptions used, there would be no change in the conclusion regarding the insignificance of dose commitments due to facility effluents.

4.2.2 EFFECTS OF CHEMICAL DISCHARGES

4.2.2.1 Effects of Plant Operation on Receiving Water Quality

The design of the CEC is such that treated effluent will be discharged into Bluegill Pond. As discussed previously, outflow from the pond joins the stream from south of the property and flows off of the property to the west as a tributary to Cypress Creek and ultimately discharges into Lake Claiborne. Actual chemical discharge limits in the effluent have not yet been set by the State of Louisiana. The standards will be established

under the National Pollutant Discharge Elimination System (NPDES) and, as such, will be specific to the facility. The waste treatment process at the facility will be designed to meet the NPDES standards at the point of effluent discharge.

Preliminary limits have been established for some parameters. Of the parameters with preliminary limits, concentrations of chlorides and sulfates in surface water, shallow groundwater, and groundwater from the Sparta Sand aquifer have been measured. Total suspended solids and pH, which also have preliminary limits, have been measured in some samples. A comparison of chemical measurements (see Tables 2.5 [1, 2, 4, 5, 6, 8, 15 & 16] in Section 2.5) with the limits indicates that for all of these waters, natural concentrations are below the preliminary regulatory limit of 50 ppm for chloride. All of those analyzed for pH are within the regulatory range of 6 to 8.5. The regulatory limit of 15 ppm of sulfate was exceeded in the groundwater sample collected on August 1, 1990 from the Central Claiborne Water System Well #4 (18 ppm). This indicates that the natural concentration of sulfate in the groundwater withdrawn by the facility may be close to the discharge limit before use. Additionally, concentrations of sulfate in the unfiltered samples from onsite wells B-2, C-1, and D-1 (39 ppm, 83 ppm, and 52 ppm, respectively) exceeded the discharge limit. The regulatory limit of 65 ppm of total suspended solids was exceeded in all of the unfiltered samples from the onsite wells. Concentrations of total suspended solids in these samples range from 116 ppm to 3,690 ppm. However, it should be noted that concentrations of chemicals in unfiltered samples are not representative of concentrations that would migrate in the groundwater and no filtered samples from shallow onsite wells contained concentrations in excess of preliminary regulatory limits.

As discussed in Section 2.5.1, Cypress Creek has been shown to seasonally fluctuate between flowing and non-flowing conditions. In addition, flow in the main tributary of Cypress Creek discharging from the CEC site (the outflow from Bluegill Pond) was observed to decrease an order of magnitude between winter and summer.

Streamflow measurements along Cypress Creek are used to estimate the potential for downstream dilution of the effluent. In this analysis, the effects of dilution of the effluent discharge by Bluegill Pond are conservatively disregarded. It is projected that 3 million gallons per year (0.013 ft^3/sec) of treated effluent will be discharged from the facility. Using a simple dilution model based on the July 1990 flow measurements summarized in Table 2.5-2, which are expected to represent relative low-flow conditions, original effluent concentrations would be diluted over one order of magnitude prior to reaching the western property boundary, almost two orders of magnitude at 1.5 mi downstream, and over two orders of magnitude at 2.5 mi

downstream. During average and maximum streamflow periods, effluent concentrations could be expected to decline an additional order of magnitude at each of these locations.

As discussed in Section 2.5.1.3, during extended periods of low precipitation (most likely in July and/or August) groundwater may fail to support baseflow in Cypress Creek reducing the stream to standing pools of water isolated by reaches of dry bed. Under these conditions, effluent discharges into Bluegill Pond and subsequently out of the pond in a diluted state would be expected to eventually infiltrate to groundwater. Upon reaching groundwater, further dilution would occur and flow would continue in the subsurface of the stream's floodplain.

4.2.2.2 Effects of Chemical Discharges on Groundwater

As discussed in previous sections, there is a close interaction between surface water and shallow groundwater. Therefore, even though treated effluent from the facility is discharged to surface water, under some low flow conditions this water may seep into groundwater. Although NPDES limits have not been established, the facility will be meeting limitations on chemical discharges prior to release and Bluegill Pond will provide additional dilution. Therefore, there is not likely to be an adverse impact on the groundwater quality.

4.2.2.3 Effects on Aquatic Life

The potential for aquatic life impacts is limited to Bluegill Pond and the small surface stream that flows from it. This pond will be the discharge point for liquid effluent from the entire plant. No other onsite or offsite surface waters will receive liquid effluent from the plant.

Liquid effluent from the plant will consist of treated and non-treated waters. Treated waters will be comprised of monitored and treated waste water from the sewage treatment system, which receives effluent from sanitary drains and from the Liquid Waste Disposal System.

Non-treated waters will be comprised of:

a. yard drains from all areas inside the security fence;

b. roof drains from the Office Building;

c. roof drains from the Centrifuge Assembly Building;

d. roof drains from the Container Receipt and Dispatch Building;

e. roof drains from the Separations Buildings;

f. roof drains from Pump House; and

g. roof drains from Standby Generating Building.

Treated waters will be discharged directly to Bluegill Pond. Non-treated water (stormwater runoff only) will first be routed to the Hold-Up Basin and then released to Bluegill Pond.

Chemical compounds that are processed through the plant's Liquid Waste Disposal System may include hydrocarbon oil, decontamination system chemicals (e.g., citric acid, potassium hydroxide), solvents (e.g., Freon TF), detergents, laboratory chemicals (e.g., carbon tetrachloride), and cooling water chemicals (e.g., biocides).

Except for stormwater runoff, all liquid effluent is treated in the Liquid Waste Disposal (LWD) System and/or the Sewage Treatment System before release. Any potentially radioactive is processed through the LWD dryer to remove the radioactive compounds. Most chemical compounds are removed by the dryer as well. Dryer distillate is forwarded to the Sewage Treatment System. Sewage treatment system releases are sampled monthly and analyzed quarterly for gross alpha and beta.

Hazardous compounds are collected separately and not discharged. Trace amounts may be in the effluent stream due to laboratory procedures and glassware cleaning. The minute quantities of hazardous material that may be released are maintained within regulatory limits. Effluent water quality limits meet all federal regulations and are established in cooperation with the Louisiana Department of Environmental Quality.

The control of hazardous material at the source and the monitoring of effluent releases provides assurance that unacceptable impact to aquatic life is prevented.

4.2.2.4 Effects on Terrestrial Plants and Wildlife

The CEC release of hazardous chemical compounds to the environment is insignificant. The trace amounts released are below federal regulatory limits and the limits established by Louisiana Department of Environmental Quality. As a result, terrestrial wildlife using Bluegill Pond is unlikely to be impacted by chemical releases to surface water. Food-chain exposures resulting from the bioaccumulation of chemicals that have been released to the pond in small quantities are unlikely because, as mentioned above, none of the chemicals potentially released accumulates appreciably in aquatic life.

Because all air emissions will be maintained at or below levels established by state and federal regulatory agencies as protective of human health and the natural environment, no

impacts on terrestrial plants or wildlife are likely to result from airborne releases.

4.2.2.5 Effects on Ambient Air Quality

Two main sources of air emission have been identified for the facility. During the 18 months of construction, it is anticipated that Freon 113 vapors will be released at an estimated rate of 400 kg/year from the Centrifuge Assembly Building, where the chemical will be in use as a solvent. During operation of the facility, the Separations Building will be ventilated at a rate of 200,000 cfm. The projected uranium content of the exhausted air is less than 10 g/year. It is also likely that the process ventilation will contain a small amount of fluorine and associated compounds. Uranium is regulated as a radioactive isotope, and Freon 113 may be subject to regulations governing the emissions of chlorofluorocarbons (CFCs).

No data are available for background levels of the above noted chemicals in the ambient air in Northern Louisiana. Consequently, the incremental impact of facility air emissions on ambient air quality cannot be determined specifically for each chemical in the emissions. Ambient air quality data in northern Louisiana, however, were identified for criteria air pollutants. The data are presented and discussed in detail in 2.6.2. Examination of these data revealed that ambient levels of criteria air pollutants in Northern Louisiana have consistently met both the primary and secondary NAAQS by comfortable margins. Therefore, the air quality in Northern Louisiana can be characterized as very good.

4.2.2.6 Potential for Air Pollution in Northern Louisiana

Although the lack of background data for the chemicals emitted to the air by the facility makes it difficult to assess the impacts of plant emissions on ambient air quality, it is possible to undertake a general examination of the potential for air pollution in the region near the facility based on the potential of climatic conditions in the region for the long-term, large-scale dispersion of air pollutants. The remainder of this section is devoted to a discussion of this potential.

The potential for urban-scale air pollution events is largely governed by two meteorological variables, the height of the daytime mixing layer and wind speed. In the classic box model of urban air pollution, the mixing height is the height of the "box" through which relatively vigorous vertical mixing occurs, and the wind speed represents the rate at which pollutants are flushed from the box. For purposes of assessing the potential for urban air pollution across the contiguous United States, Holzworth calculated mixing heights and vertically averaged wind speeds from surface and upper air data collected at 62 National Weather

Service (NWS) stations (Reference 20). Average wind speeds averaged through the mixing layer and mixing heights calculated by Holzworth for the Shreveport, Louisiana station are presented in Table 4.2-6. Both annual and seasonal averages are presented for the morning and afternoon mixing layers.

The morning mixing height was calculated as the height above ground at which the dry adiabatic extension of the morning minimum surface temperature plus 5 C intersected the vertical temperature profile observed at 1200 Greenwich Median Time (GMT). The afternoon mixing height was calculated in the same manner, except that the maximum afternoon surface temperature was used in place of the minimum morning surface temperature. The "plus 5 C" was used by Holzworth to account roughly for urban heat island effects. The Homer area is more appropriately characterized as rural and therefore not subject to urban heat island effects. The urban mixing heights for Shreveport calculated by Holzworth and presented in Table 4.2-6 are likely lower than the average mixing heights found in the Homer vicinity.

Three situations existed in which mixing heights could not be calculated in the prescribed manner:

a. when cold air advection was significant enough to result in the maximum afternoon surface temperature being less than the surface temperature at 1200 GMT,

b. during periods of significant precipitation when the assumption of a dry adiabatic lapse rate is questionable, and

c. much less frequently, in cases of missing data.

These situations occur for less than 20% of the year; mixing heights during these periods were incorporated into the averages using assumptions described by Holzworth (Reference 20).

The mixing heights listed in Table 4.2-6 are fairly representative of the mixing heights found at points which are 200 to 300 mi. inland from the Gulf and Atlantic coasts. Mixing heights in these regions are intermediary between coastal regions where mixing heights are relatively constant throughout the day (with annual average morning mixing heights typically around 800 m and afternoon mixing heights around 1000 m) and regions well within the interior of the continental United States, where the afternoon mixing height can typically be greater than the morning mixing height by a factor of 10 or more. Consequently, Northern Louisiana can be somewhat buffered from radiation inversions by the moist coastal climate.

Restricted dispersion and hence high levels of air pollutants result from the combined effect of low mixing heights and light winds. Holzworth made tabulations of episodes during which

specified meteorological conditions were satisfied at each of 52 upper air NWS stations (Reference 20). Specifically, tabulations were made of episodes, over a 5-year period, lasting at least 2 days and episodes lasting at least 5 days with no precipitation cases and upper limits on mixing height and wind speed. The results for the Shreveport station are presented in matrix format in Tables 4.2-7 and 4.2-8. Holzworth reports that the relative severity of the various mixing height and wind speed limit combinations can be ranked roughly by the reciprocal of the product of the wind speed and mixing height. This is in fact the proportionality relationship of the mixing height and wind speed with the concentration in the box. Table 4.2-9 presents the ranking of mixing height and wind speed combinations using this method. Comparing Tables 4.2-7, 4.2-8, and 4.2-9 reveals that Shreveport experienced 2-day episodes in only the 5 least severe combinations and 5-day episodes in only the 2 least severe combinations. Tables 4.2-7, 4.2-8 and 4.2-9 also reveal, that relative to other areas of the United States, particularly the west coast, episodes of high meteorological potential for air pollution occur infrequently in Shreveport.

4.2.3 EFFECTS OF OPERATION OF HEAT DISSIPATION SYSTEM

All excess heat generated by the CEC facility processes and HVAC systems is rejected directly to the atmosphere via air-cooled chiller units. No waste heat will be dissipated into the environment through any of the facilities liquid effluents.

4.2.3.1 Effluent Limitations and Water Quality

The criterion for temperature in fresh water bodies established under the Louisiana Administrative Code (LAC):IX, Water Quality Regulation (Reference 21), consists of two parts, a temperature differential and a maximum temperature. The temperature differential, as stated in the regulation, represents the maximum permissible increase above ambient conditions after mixing. The numerical criteria for temperature specifies a maximum limit of 2.8 C (5 F) rise above ambient streams and rivers, or 1.7 C (3 F) rise above ambient for lakes and reservoirs. The maximum allowable temperature is 32.2 C (90 F); however, the limit can vary to allow for the effects of natural conditions, such as unusually hot, dry weather. Regional water bodies identified with numerical criteria, which would be representative of the conditions at the site, are Lake Claiborne and D'Arbonne Lake, with a maximum limit of 32 C (89.4 F). Therefore, the applicable maximum temperature limit is 32 C (89.4 F). There is expected to be no significant impact on the ambient water temperatures from the main cooling water system used during CEC plant processes. All heat generated from these closed-loop cooling water systems is rejected to the atmosphere (see SAR 6.4.6).

4.2.3.2 Physical Effects

There will be no thermal impact to either onsite or offsite receiving waters resulting from the operation of the LES facility since the process will not employ any liquid heat dissipation processes.

4.2.3.3 Biological Effects

No liquid effluent will be discharged from the facility which would increase the temperatures of receiving waters above state or federal regulations. Therefore, no thermal impacts on aquatic life will occur. Heat exchange with the atmosphere from plant air conditioning and machine cooling systems is not expected to significantly alter the local climate. Temperature changes in the atmospheric microclimate surrounding these units are unlikely to negatively affect any airborne wildlife (e.g., birds, insects) that are exposed to elevated temperatures during flight since exposure periods are likely to be very brief (e.g., a few seconds). Prolonged exposure periods which could alter physiological processes and/or behavior are unlikely because only a very small volume of air (i.e., that immediately surrounding the heat dissipation units) is likely to have elevated temperatures.

4.2.3.4 Effects of Heat Dissipation Facilities

All excess heat generated by the CEC processes and HVAC systems is either directly transferred to the atmosphere or indirectly to other closed-loop cooling water circuits. The Main Plant Cooling Water System comprises three closed-loop cooling water systems which discharge excess plant heat to the atmosphere through air-cooled chillers. Each plant unit (cascade) contains its own Main Plant Cooling Water System.

Based upon the number and size of all the facility cooling systems no on or off site meteorological changes such as fogging, icing, precipitation modifications or humidity shall occur.

The relatively small quantities of groundwater which will be used by the facility (i.e., 5-7 gpm average) will not adversely impact either groundwater levels of the Sparta Aquifer or its quality.

4.2.4 EFFECTS OF SANITARY AND OTHER WASTE DISCHARGES

The sewage treatment system for the CEC is described in Section 6.4.7 of the Safety Analysis Report (SAR). The input to the system is Liquid Waste Disposal System discharge and raw sanitary sewage from several different plant areas. The output effluent from the system is treated water that meets all state and federal regulations for release to the environment. Solid or sludge wastes which accumulate in the sewage system are monitored for

radioactivity and disposed of in a local sanitary land fill. Proper operation of the system will ensure that no adverse environmental impacts will occur.

4.2.5 OTHER EFFECTS

Inception of the facility operation shall institute no changes in water or land use in the area of the facility which have not already been abrogated during the construction period or which would otherwise adversely impact the natural environment.

No interaction between gaseous and liquid effluents from the facility with other local or regional commercial or industrial facilities shall occur. In addition, there are no other wastes from the facility known at this time to be discharged or disposed of by means other than those already presented.

The effect of groundwater withdrawal by the CEC from the Sparta Aquifer, addressed in detail in Section 2.5.2.4, does not impact the ability of current users of the aquifer to withdraw water.

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19. U.S. Nuclear Regulatory Commission, NUREG/CR-2919 R, "XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations", September 1982

20. Holzworth, G.C., Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States. Environmental Protection Agency, Office of Air Programs, Research Triangle Park, North Carolina, 1972

21. Louisiana Administrative Code. 1989. Title 33. Environmental Quality. Part IX. Water Quality Regulations. Chapter 11. Louisiana Surface Water Quality Standards. Final Rule.

TABLE 4.2-1

Calculation of Bluegill Pond Uranium Concentration

1% AND 5% OF 10CFR20 APPENDIX B LIMITS (Unrestricted Area)				
Nuclide	Limit µCi/ml	1% Limit µCi/ml	5% Limit µCi/ml	Estimated Abundance After Enrichment (fraction)
U238	3.00E-07	3.00E-09	1.50E-08	0.91
U235	3.00E-07	3.00E-09	1.50E-08	0.05
U234	3.00E-07	3.00E-09	1.50E-09	0.04

ASSUMPTIONS:
Effluent volume = 6700 gallons/day = 2.45E6 gallons/year = 9.26E9 ml/year
Releases have 1% of the 10CFR20 Appendix B Limit
Volume of Bluegill Pond = 7.8E5 cubic feet = 2.2E10 ml
Volume of Hold-Up Basin = 8.8E6 gallons = 3.33E10 ml
Water in Hold-Up Basin flows through Bluegill Pond
Hold-Up Basin input into Bluegill Pond provides dilution of activities present
Releases will conservatively assume all uranium released is in the form of U234

CALCULATIONS:

Maximum Activity Released:

Annual effluent volume x 1% 10CFR20 Limit = Maximum Activity Released:

9.26E9 ml x 3E-9 µCi/ml = 27.8 µCi

Activities in Basin and Pond:

Concentration in Pond without Basin Input:

27.8 µCi/9.26E9 ml = 3.0E-9 µCi/ml

Concentration in Pond with Basin Input:

3.0E-9 µCi/ml x 10% dilution at any given time = 3.0E-10 µCi/ml

TABLE 4.2-2
(Page 1 of 2)

Dose Conversion Factors (mRem/pCi)
Of Uranium-234 Via The Injestion Pathway

DOSE CONVERSION FACTORS FOR ADULTS BASED ON 0.3 µm PARTICLE SIZE (Ingestion Pathway)				
TARGET TISSUE	NUREG 0150 Dose Conversion Factor	NUREG 4628 Dose Conversion Factor	Organ Mass Ratio From Adult	Dose Conversion Factor Used in this Document
Total Body	9.86E-04	1.00E+00	1.00E+00	9.86E-04
Bone Surfaces	1.40E-02	1.00E+00	1.00E+00	1.40E-02
Bone Marrow	9.30E-04	1.00E+00	1.00E+00	9.30E-04
Kidneys	6.70E-03	1.00E+00	1.00E+00	6.70E-03

DOSE CONVERSION FACTORS FOR TEENAGERS BASED ON 0.3 µm PARTICLE SIZE (Ingestion Pathway)				
TARGET TISSUE	NUREG 0150 Dose Conversion Factor	NUREG 4628 Dose Conversion Factor	Organ Mass Ratio From Adult	Dose Conversion Factor Used in this Document
Total Body	9.86E-04	3.10E+00	1.00E+00	3.06E-03
Bone Surfaces	1.40E-02	4.30E+00	1.00E+00	6.02E-02
Bone Marrow	9.30E-04	2.10E+00	7.00E-01	1.37E-03
Kidneys	6.70E-03	2.50E+00	8.00E-01	1.34E-02

<u>TABLE 4.2-2</u>
(Page 2 of 2)

Dose Conversion Factors (mrem/pCi)
Of Uranium-234 Via The Ingestion Pathway

DOSE CONVERSION FACTORS FOR CHILDREN BASED ON 0.3 μm PARTICLE SIZE (Ingestion Pathway)				
TARGET TISSUE	NUREG 0150 Dose Conversion Factor	NUREG 4628 Dose Conversion Factor	Organ Mass Ratio From Adult	Dose Conversion Factor Used in this Document
Total Body	9.86E-04	4.00E+00	N/A	3.94E-03
Bone Surfaces	1.40E-02	4.30E+00	5.70E-01	3.43E-02
Bone Marrow	9.30E-04	2.40E+00	4.10E-01	9.15E-04
Kidneys	6.70E-03	3.90E+00	5.60E-01	1.46E-02

N/A = Not Applicable. No values other than 1.0 listed in NUREG 4628.

DOSE CONVERSION FACTORS FOR INFANTS BASED ON 0.3 μm PARTICLE SIZE (Ingestion Pathway)				
TARGET TISSUE	NUREG 0150 Dose Conversion Factor	NUREG 4628 Dose Conversion Factor	Organ Mass Ratio From Adult	Dose Conversion Factor Used in this Document
Total Body	9.86E-04	6.30E+01	N/A	6.21E-02
Bone Surfaces	1.40E-02	1.10E+02	2.20E-01	3.39E-01
Bone Marrow	9.30E-04	4.30E+01	1.00E-01	4.00E-03
Kidneys	6.70E-03	3.30E+01	2.00E-01	4.42E-02

N/A = Not Applicable. No values other than 1.0 listed in NUREG 4628.

Table 4.2-3

Calculated Committed Dose Equivalents (mrem)
From Uranium-234 Via The Liquid Pathway

	Adult	Teenager	Child	Infant
Total Body	2.16E-04	6.69E-04	8.64E-04	1.36E-02
Bone Surfaces	3.07E-03	1.32E-02	7.51E-03	7.42E-02
Bone Marrow	2.04E-04	2.99E-04	2.00E-04	8.76E-04
Kidneys	1.47E-03	2.93E-03	3.20E-03	9.68E-03

TABLE 4.2-4
(Page 1 of 2)

Dose Conversion Factors (mrem/pCi)
Of Uranium-234 Via The Inhalation Pathway

DOSE CONVERSION FACTORS FOR ADULTS BASED ON 0.3 μm PARTICLE SIZE (Inhalation Pathway)				
TARGET TISSUE	NUREG 0150 Dose Conversion Factor	NUREG 4628 Dose Conversion Factor	Organ Mass Ratio From Adult	Dose Conversion Factor Used in this Document
Total Body	2.92E-03	1.00E+00	1.00E+00	2.92E-03
Bone Surfaces	3.90E-02	1.00E+00	1.00E+00	3.90E-02
Bone Marrow	2.60E-03	1.00E+00	1.00E+00	2.60E-03
Lungs	1.60E-03	1.00E+00	1.00E+00	1.60E-03
Kidneys	1.90E-02	1.00E+00	1.00E+00	1.90E-02

DOSE CONVERSION FACTORS FOR TEENAGERS BASED ON 0.3 μm PARTICLE SIZE (Inhalation Pathway)				
TARGET TISSUE	NUREG 0150 Dose Conversion Factor	NUREG 4628 Dose Conversion Factor	Organ Mass Ratio From Adult	Dose Conversion Factor Used in this Document
Total Body	2.92E-03	1.00E+00	1.00E+00	2.92E-03
Bone Surfaces	3.90E-02	2.40E+00	1.00E+00	9.36E-02
Bone Marrow	2.60E-03	1.10E+00	7.00E-01	2.00E-03
Lungs	1.60E-03	1.50E+00	6.50E-01	1.56E-03
Kidneys	1.90E-02	1.40E+00	8.00E-01	2.13E-02

TABLE 4.2-4
(Page 2 of 2)

Dose Conversion Factors (mrem/pCi) Of Uranium-234 Via The Inhalation Pathway

DOSE CONVERSION FACTORS FOR CHILDREN BASED ON 0.3 μm PARTICLE SIZE (Inhalation Pathway)				
TARGET TISSUE	NUREG 0150 Dose Conversion Factor	NUREG 4628 Dose Conversion Factor	Organ Mass Ratio From Adult	Dose Conversion Factor Used in this Document
Total Body	2.92E-03	2.[illegible]0E+00	N/A	8.47E-03
Bone Surfaces	3.90E-02	3.10E+00	5.70E-01	6.89E-02
Bone Marrow	2.60E-03	1.80E+00	4.10E-01	1.92E-03
Lungs	1.60E-03	3.40E+00	4.50E-01	3.45E-03
Kidneys	1.90E-02	2.80E+00	5.60E-01	2.98E-02

N/A = Not Applicable. No values other than 1.0 listed in NUREG 4628.

DOSE CONVERSION FACTORS FOR INFANTS BASED ON 0.3 μm PARTICLE SIZE (Inhalation Pathway)				
TARGET TISSUE	NUREG 0150 Dose Conversion Factor	NUREG 4628 Dose Conversion Factor	Organ Mass Ratio From Adult	Dose Conversion Factor Used in this Document
Total Body	2.92E-03	2.20E+01	N/A	6.42E-02
Bone Surfaces	3.90E-02	3.50E+01	2.20E-01	3.00E-01
Bone Marrow	2.60E-03	1.40E+01	1.00E-01	3.64E-03
Lungs	1.60E-03	1.30E+01	1.40E-01	2.91E-03
Kidneys	1.90E-02	1.10E+01	2.00E-01	4.18E-02

N/A = Not Applicable. No values other than 1.0 listed in NUREG 4628.

TABLE 4.2-5

X/Q and D/Q Sector Indicator Groups

GROUP SECTOR INDICATOR	INCLUDED SECTORS
South	South
South Southwest	South Southwest, Southwest, West Southwest
West	West, West Northwest
Northwest	Northwest, North Northwest
North	North
North Northeast	North Northeast
Northeast	Northeast, East, East Southeast, South Southeast
Current Resident	0.27 Miles North

TABLE 4.2-6

Gaseous Pathway

Calculated Total Effective Body and (Not Effective) Organ Doses to Maximally Exposed Individuals (mrem)

CALCULATED USING 30 GRAMS PER YEAR URANIUM RELEASE					
Pathway	**Target**	**Adult**	**Teen**	**Child**	**Infant**
Inhalation	LUNG	1.0E-05	1.9E-05	6.2E-04	5.8E-06
Inhalation	KIDNEY	1.2E-04	1.0E-05	1.9E-05	2.1E-04
Inhalation	BONE SURFACE	2.5E-04	1.4E-04	7.4E-06	2.6E-05
Inhalation	BONE MARROW	1.7E-05	6.1E-04	9.0E-05	3.3E-06
Inhalation	TOTAL BODY	2.7E-04	1.3E-05	2.1E-04	4.8E-05
Ingestion	BONE SURFACE	1.2E-02	4.2E-02	2.0E-02	*
Ingestion	BONE MARROW	5.1E-04	9.6E-04	5.3E-04	*
Ingestion	KIDNEY	3.7E-03	9.4E-03	8.5E-03	*
Ingestion	TOTAL BODY	3.7E-03	2.9E-03	2.3E-03	*
External	GROUND PLANE	6.2E-08	6.2E-08	6.2E-08	
GRAND TOTAL		2.0E-02	5.6E-02	3.2E-02	3.0E-04

NOTE: * = This pathway not considered for INFANT.

TABLE 4.2-7
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Committed Dose Equivalent To INHALATION For The ADULT LUNG mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	1.3E-05	1.0E-05	6.0E-06	3.7E-06	2.6E-06	1.9E-06	1.1E-06	5.1E-07	2.8E-07	1.9E-07	1.4E-07
NNE	4.4E-06	3.4E-06	2.0E-06	1.2E-06	8.7E-07	6.7E-07	3.9E-07	1.9E-07	1.1E-07	7.4E-08	5.6E-08
NE	4.6E-06	3.2E-06	1.8E-06	1.1E-06	7.4E-07	5.5E-07	3.3E-07	1.6E-07	9.1E-08	6.2E-07	4.7E-08
S	7.8E-06	6.2E-06	3.4E-06	2.0E-06	1.3E-06	9.6E-07	5.1E-07	2.2E-07	1.2E-07	7.6E-08	5.6E-08
SW	4.1E-06	2.8E-06	1.6E-06	8.9E-07	6.0E-07	4.4E-07	2.4E-07	1.0E-07	5.6E-08	3.8E-08	2.8E-08
W	5.2E-06	4.1E-06	2.4E-06	1.5E-06	1.0E-06	7.7E-07	4.3E-07	1.9E-07	1.1E-07	7.1E-08	5.2E-08
NNW	7.0E-06	5.8E-06	3.6E-06	2.3E-06	1.7E-06	1.3E-06	8.1E-07	4.0E-07	2.3E-07	1.6E-07	1.2E-07
N 0.27 mile	1.0E-05										

Committed Dose Equivalent To INHALATION For The ADULT KIDNEY mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	1.5E-04	1.2E-04	7.2E-05	4.3E-05	3.0E-05	2.3E-05	1.3E-05	6.0E-06	3.3E-06	[illegible].3E-06	1.7E-06
U234 NNE	5.2E-05	4.1E-05	2.3E-05	1.4E-05	1.0E-05	8.0E-06	4.7E-06	2.2E-06	1.3E-06	3.8E-07	6.6E-07
U234 NE	5.5E-05	3.8E-05	2.1E-05	1.3E-05	8.8E-06	6.6E-06	4.0E-06	1.9E-06	1.1E-06	7.4E-07	5.6E-07
U234 S	9.3E-05	7.4E-05	4.1E-05	2.3E-05	1.5E-05	1.1E-05	6.1E-06	2.6E-06	1.4E-06	9.7E-07	6.7E-07
U234 SW	4.8E-05	3.4E-05	1.8E-05	1.1E-05	7.1E-06	5.3E-06	2.[illegible]E-06	1.2E-06	6.7E-07	4.5E-07	3.3E-07
U234 W	6.2E-05	4.9E-05	2.9E-05	1.7E-05	1.2E-05	9.2E-06	5.1E-06	2.3E-06	1.2E-06	8.4E-07	6.2E-07
U234 NNW	8.3E-05	6.9E-05	4.3E-05	2.8E-05	2.0E-05	1.6E-05	9.7E-06	4.7E-06	2.8E-06	1.9E-06	1.5E-06
N 0.27 mile	1.2E-04										

TABLE 4.2-7
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Committed Dose Equivalent To INHALATION For The ADULT BONE SURFACE mrem As Received Per Each Sector Location										
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	3.1E-04	2.5E-04	1.5E-04	8.9E-05	6.2E-05	4.7E-05	2.7E-05	1.2E-05	6.9E-06	4.7E-06	3.5E-06
U234 NNE	1.1E-04	8.3E-05	4.8E-05	3.0E-05	2.1E-05	1.6E-05	9.6E-06	4.6E-06	2.6E-06	1.8E-06	1.0E-06
U234 NE	1.1E-04	7.9E-05	4.3E-05	2.6E-05	1.8E-05	1.3E-05	8.1E-06	3.9E-06	2.2E-06	1.5E-06	1.1E-06
U234 S	1.9E-04	1.5E-04	8.4E-05	4.8E-05	3.2E-05	2.3E-05	1.3E-05	5.3E-06	2.8E-06	1.9E-06	1.4E-06
U234 SW	9.9E-05	6.9E-05	3.8E-05	2.2E-05	1.5E-05	1.1E-05	5.9E-06	2.6E-06	1.4E-06	9.2E-07	6.8E-07
U234 W	1.3E-04	1.0E-04	5.9E-05	3.6E-05	2.5E-05	1.9E-05	1.1E-05	4.7E-06	2.6E-06	1.7E-06	1.3E-06
U234 NNW	1.7E-04	1.4E-04	8.9E-05	5.7E-05	4.2E-05	3.3E-05	2.0E-05	9.7E-06	5.7E-06	3.9E-06	3.0E-06
N 0.27 mile	2.5E-04										

Committed Dose Equivalent To INHALATION For The ADULT BONE MARROW mrem As Received Per Each Sector Location										
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	2.1E-05	1.7E-05	9.8E-06	5.9E-06	4.2E-06	3.2E-06	1.8E-06	8.2E-07	4.6E-07	3.1E-07	2.3E-07
U234 NNE	7.1E-06	5.6E-06	3.2E-06	2.0E-06	1.4E-06	1.1E-06	6.4E-07	3.1E-07	1.7E-07	1.2E-07	9.1E-08
U234 NE	7.5E-06	5.2E-06	2.9E-06	1.7E-06	1.2E-06	9.0E-07	5.4E-07	2.6E-07	1.5E-07	1.0E-07	7.7E-08
U234 S	1.3E-05	1.0E-05	5.6E-06	3.2E-06	2.1E-06	1.6E-06	8.4E-07	3.5E-07	1.9E-07	1.2E-07	[illegible].1E-08
U234 SW	6.6E-06	4.6E-06	2.6E-06	1.4E-06	9.7E-07	7.2E-07	3.9E-07	1.7E-07	9.2E-08	6.1E-08	4.5E-08
U234 W	8.5E-06	6.7E-06	3.9E-06	2.4E-06	1.7E-06	1.3E-06	7.0E-07	3.1E-07	1.7E-07	1.1E-07	8.5E-08
U234 NNW	1.1E-05	9.5E-06	5.9E-06	3.8E-06	2.8E-06	2.2E-06	1.3E-06	6.5E-07	3.8E-07	2.6E-07	2.0E-07
N 0.27 mile	1.7E-05										

... To INHALATION For The
... As Received Per Each Sector Location

	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
				[illegible]	6.6E-05	5.0E-05	2.9E-05	1.3E-05	7.3E-06	5.0E-06	3.7E-06
				[illegible]E-05	2.3E-05	1.7E-05	1.0E-05	4.9E-06	2.8E-06	1.9E-06	1.4E-06
				2.7E-05	1.9E-05	1.4E-05	8.7E-06	4.1E-06	2.4E-06	1.6E-06	1.2E-06
			[illegible]	5.1E-05	3.4E-05	2.5E-05	1.3E-05	5.7E-06	3.0E-06	2.0E-06	1.5E-06
			[illegible]E-05	2.3E-05	1.6E-05	1.2E-05	6.3E-06	2.7E-06	1.5E-06	9.8E-07	7.2E-07
			6.3E-05	3.8E-05	2.7E-05	2.0E-05	1.1E-05	5.0E-06	2.7E-06	1.8E-06	1.4E-06
		[illegible]	9.5E-05	6.1E-05	4.5E-05	3.5E-05	2.1E-05	1.0E-05	6.0E-06	4.2E-06	3.2E-06

Committed Dose Equivalent To INHALATION For The
ADULT TOTAL BODY mrem As Received Per Each Sector Location

	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	2.3E-05	1.9E-05	1.1E-05	6.7E-06	4.7E-06	3.5E-06	2.0E-06	5.2E-07	5.1E-07	3.5E-07	2.6E-07
U234 NNE	7.9E-06	6.2E-06	3.6E-06	2.2E-06	1.6E-06	1.2E-06	7.2E-07	3.4E-07	2.0E-07	1.3E-07	1.0E-07
U234 NE	8.5E-06	5.9E-06	3.2E-06	1.9E-06	1.4E-06	1.0E-06	6.1E-07	2.9E-07	1.7E-07	1.1E-07	8.6E-08
U234 S	1.4E-05	1.1E-05	6.3E-06	3.6E-06	2.4E-06	.7E-06	9.4E-07	4.0E-07	2.1E-07	1.4E-07	1.0E-07
U234 SW	7.4E-06	5.2E-06	2.8E-06	1.6E-06	1.1E-06	8.1E-07	4.4E-07	1.9E-07	1.0E-07	6.9E-08	5.1E-0[illegible]
U234 W	9.5E-06	7.5E-06	4.4E-06	2.7E-06	1.9E-06	1.4E-06	7.9E-07	3.5E-07	1.9E-07	1.3E-07	9.6E-08
U234 NNW	1.3E-05	1.1E-05	6.7E-06	4.3E-06	3.1E-06	2.5E-06	1.5E-06	7.3E-07	4.2E-07	2.9E-07	2.2E-07
N 0.27 mile	1.9E-05										

TABLE 4.2-7
(Page 3 of 3)

Committed Dose Equivalent To INHALATION For The ADULT BONE (Marrow + Endosteal) mrem As Received Per Each Sector Location	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	3.3E-04	2.7E-04	1.6E-04	9.5E-05	6.6E-05	5.0E-05	2.9E-05	1.3E-05	7.3E-06	5.0E-06	3.7E-06
U234 NNE	1.1E-04	8.9E-05	5.1E-05	3.2E-05	2.3E-05	1.7E-05	1.0E-05	4.9E-06	2.8E-06	1.9E-06	1.4E-06
U234 NE	1.2E-04	8.4E-05	4.6E-05	2.7E-05	1.9E-05	1.4E-05	8.7E-06	4.1E-06	2.4E-06	1.6E-06	1.2E-06
U234 S	2.0E-04	1.6E-04	8.9E-05	5.1E-05	3.4E-05	2.5E-05	1.3E-05	5.7E-06	3.0E-06	2.0E-06	1.5E-06
U234 SW	1.1E-04	7.4E-05	4.0E-05	2.3E-05	1.6E-05	1.2E-05	6.3E-06	2.7E-06	1.5E-06	9.8E-07	7.2E-07
U234 W	1.4E-04	1.1E-04	6.3E-05	3.8E-05	2.7E-05	2.0E-05	1.1E-05	5.0E-06	2.7E-06	1.8E-06	1.4E-06
U234 NNW	1.8E-04	1.5E-04	9.5E-05	6.1E-05	4.5E-05	3.5E-05	2.1E-05	1.0E-05	6.0E-06	4.2E-06	3.2E-06
N 0.27 mile	2.7E-04										

Committed Dose Equivalent To INHALATION For The ADULT TOTAL BODY mrem As Received Per Each Sector Location	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	2.3E-05	1.9E-05	1.1E-05	6.7E-06	4.7E-06	3.5E-06	2.0E-06	9.2E-07	5.1E-07	3.5E-07	2.6E-07
U234 NNE	7.9E-06	6.2E-06	3.6E-06	2.2E-06	1.6E-06	1.2E-06	7.2E-07	3.4E-07	2.0E-07	1.3E-07	1.0E-07
U234 NE	8.5E-06	5.9E-06	3.2E-06	1.9E-06	1.4E-06	1.0E-06	6.1E-07	2.9E-07	1.7E-07	1.1E-07	8.6E-08
U234 S	1.4E-05	1.1E-05	6.3E-06	3.6E-06	2.4E-06	1.7E-06	9.4E-07	4.0E-07	2.1E-07	1.4E-07	1.0E-07
U234 SW	7.4E-06	5.2E-06	2.8E-06	1.6E-06	1.1E-06	8.1E-07	4.4E-07	1.9E-07	1.0E-07	6.9E-08	5.1E-08
U234 W	9.5E-06	7.5E-06	4.4E-06	2.7E-06	1.9E-06	1.4E-06	7.9E-07	3.5E-07	1.9E-07	1.3E-07	9.6E-08
U234 NNW	1.3E-05	1.1E-05	6.7E-06	4.3E-06	3.1E-06	2.5E-06	1.5E-06	7.3E-07	4.2E-07	2.9E-07	2.2E-07
N 0.27 mile	1.9E-05										

TABLE 4.2-8
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Committed Dose Equivalent To INHALATION For The TEENAGER LUNG mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	1.2E-05	1.0E-05	5.9E-06	3.6E-06	2.5E-06	1.9E-06	1.1E-06	4.9E-07	2.7E-07	1.9E-07	1.4E-07
U234 NNE	4.2E-06	3.3E-06	1.9E-06	1.2E-06	8.5E-07	6.5E-07	3.8E-07	1.8E-07	1.0E-07	7.2E-08	5.4E-08
U234 NE	4.5E-06	3.1E-06	1.7E-06	1.0E-06	7.3E-07	5.4E-07	3.3E-07	1.5E-07	8.8E-08	6.1E-08	4.6E-08
U234 S	7.6E-06	6.1E-06	3.3E-06	1.9E-06	1.3E-07	9.3E-07	5.0E-07	2.1E-07	1.1E-07	7.5E-08	5.5E-08
U234 SW	4.0E-06	2.8E-06	1.5E-06	8.7E-07	5.8E-07	4.3E-07	2.4E-07	1.0E-07	5.5E-08	3.7E-08	2.7E-08
U234 W	5.1E-06	4.0E-06	2.4E-06	1.4E-06	1.0E-06	7.5E-07	4.2E-07	1.9E-07	1.0E-07	6.9E-08	5.1E-08
U234 NNW	6.8E-06	5.7E-06	3.6E-06	2.3E-06	1.7E-06	1.3E-06	7.9E-07	3.9E-07	2.3E-07	1.6E-07	1.2E-07
N 0.27 mile	1.0E-05										

Committed Dose Equivalent To INHALATION For The TEENAGER KIDNEYS mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	1.7E-04	1.4E-04	8.0E-05	4.9E-05	3.4E-05	2.6E-05	1.5E-05	6.7E-06	3.7E-06	2.5E-06	1.9E-06
U234 NNE	5.8E-05	4.5E-05	2.6E-05	1.6E-05	1.2E-05	8.9E-06	5.2E-06	2.5E-06	1.4E-06	9.8E-07	7.4E-07
U234 NE	6.2E-05	4.3E-05	2.3E-05	1.4E-05	9.9E-06	7.4E-06	4.4E-06	2.1E-06	1.2E-06	8.3E-07	6.3E-07
U234 S	1.0E-04	8.3E-05	4.6E-05	2.6E-05	1.7E-05	1.3E-05	6.8E-06	2.9E-06	1.5E-06	1.0E-06	7.5E-07
U234 SW	5.4E-05	3.8E-05	2.1E-05	1.2E-05	8.0E-06	5.9E-06	3.2E-06	1.4E-06	7.5E-07	5.0E-07	3.7E-07
U234 W	7.0E-05	5.5E-05	3.2E-05	2.0E-05	1.4E-05	1.0E-05	5.8E-06	2.6E-06	1.4E-06	9.4E-07	7.0E-07
U234 NNW	9.3E-05	7.8E-05	4.9E-05	3.1E-05	2.3E-05	1.8E-05	1.1E-05	5.3E-06	3.1E-06	2.1E-06	1.6E-06
N 0.27 mile	1.4E-04										

Committed Dose Equivalent to INHALATION For The TEENAGER BONE SURFACE mrem As Received Per Each Sector Location

	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	7.5E-04	6.0E-04	3.5E-04	2.1E-04	1.5E-04	1.1E-04	6.5E-05	3.0E-05	1.6E-05	1.1E-05	8.4E-06
U234 NNE	2.5E-04	2.0E-04	1.2E-04	7.1E-05	5.1E-05	3.9E-05	2.3E-05	1.1E-05	6.3E-06	4.3E-06	3.3E-06
U234 NE	2.7E-04	1.9E-04	1.0E-04	6.2E-05	4.4E-05	3.2E-05	2.0E-05	9.3E-06	5.3E-06	3.6E-06	2.8E-06
U234 S	4.6E-04	3.6E-04	2.0E-04	1.1E-04	7.6E-05	5.6E-05	3.0E-05	1.3E-05	6.8E-06	4.5E-06	3.3E-06
U234 SW	2.4E-04	1.7E-04	9.1E-05	5.2E-05	3.5E-05	2.6E-05	1.4E-05	6.1E-06	3.3E-06	2.2E-06	1.6E-06
U234 W	3.1E-04	2.4E-04	1.4E-04	8.6E-05	6.0E-05	4.5E-05	2.5E-05	1.1E-05	6.2E-06	4.1E-06	3.1E-06
U234 NNW	4.1E-04	3.4E-04	2.1E-04	1.4E-04	1.0E-04	7.9E-05	4.8E-05	2.3E-05	1.4E-05	9.4E-06	7.2E-06
N 0.27 mile	6.1E-04										

Committed Dose Equivalent To INHALATION For The TEENAGER BONE MARROW mrem As Received Per Each Sector Location

	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	1.6E-05	1.3E-05	7.5E-06	4.6E-06	3.2E-06	2.4E-06	1.4E-06	6.3E-07	3.5E-07	2.4E-07	1.8E-07
U234 NNE	5.4E-06	4.3E-06	2.5E-06	1.5E-06	1.1E-06	8.4E-07	4.9E-07	2.3E-07	1.3E-07	9.2E-08	7.0E-08
U234 NE	5.8E-06	4.0E-06	2.2E-06	1.3E-06	9.3E-07	6.9E-07	4.2E-07	2.0E-07	1.1E-07	7.8E-08	5.9E-08
U234 S	9.8E-06	7.8E-06	4.3E-06	2.4E-06	1.6E-06	1.2E-06	6.4E-07	2.7E-07	1.4E-07	9.6E-08	7.0E-08
U234 SW	5.1E-06	3.5E-06	1.9E-06	1.1E-06	7.5E-07	5.6E-07	3.0E-07	1.3E-07	7.0E-08	4.7E-08	3.5E-08
U234 W	6.5E-06	5.1E-06	3.0E-06	1.8E-06	1.3E-06	9.7E-07	5.4E-07	2.4E-07	1.3E-07	8.8E-08	6.6E-08
U234 NNW	8.7E-06	7.3E-06	4.6E-06	2.9E-06	2.1E-06	1.7E-06	1.0E-06	5.0E-07	2.9E-07	2.0E-07	1.5E-07
N 0.27 mile	1.3E-05										

TABLE 4.2-8
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Committed Dose Equivalent To INHALATION For The TEENAGER BONE (Marrow + Endosteal) mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	7.6E-04	6.1E-04	3.6E-04	2.2E-04	1.5E-04	1.2E-04	6.6E-05	3.0E-05	1.7E-05	1.1E-05	8.5E-06
U234 NNE	2.6E-04	2.0E-04	1.2E-04	7.3E-05	5.2E-05	4.0E-05	2.4E-05	1.1E-05	6.4E-06	4.4E-06	3.3E-06
U234 NE	2.8E-04	1.9E-04	1.0E-04	6.3E-05	4.4E-05	3.3E-05	2.0E-05	9.5E-06	5.4E-06	3.7E-06	2.8E-06
U234 S	4.7E-04	3.7E-04	2.1E-04	1.2E-04	7.8E-05	5.7E-05	3.1E-05	1.3E-05	6.9E-06	4.6E-06	3.4E-06
U234 SW	2.4E-04	1.7E-04	9.3E-05	5.3E-05	3.6E-05	2.7E-05	1.4E-05	6.3E-06	3.4E-06	2.2E-06	1.7E-06
U234 W	3.1E-04	2.5E-04	1.4E-04	8.8E-05	6.1E-05	4.6E-05	2.6E-05	1.2E-05	6.3E-06	4.2E-06	3.1E-06
U234 NNW	4.2E-04	3.5E-04	2.2E-04	1.4E-04	1.0E-04	8.1E-05	4.9E-05	2 4E-05	1.4E-05	9.6E-06	7.3E-06
N 0.27 mile	6.2E-04										

Committed Dose Equivalent To INHALATION For The TEENAGER TOTAL BODY mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	2.3E-05	1.9E-05	1.1E-05	6.7E-06	4.7E-06	3.5E-06	2.0E-06	9.2E-07	5.1E-07	3.5E-07	2.6E-07
U234 NNE	7.9E-06	6.2E-06	3.6E-06	2.2E-06	1.6E-06	1.2E-06	7.2E-07	3.4E-07	2.0E-07	1.3E-07	1.0E-07
U234 NE	8.5E-06	5.9E-06	3.2E-06	1.9E-06	1.4E-06	1.0E-06	6.1E-07	2.9E-07	1.7E-07	1.1E-07	8.6E-08
U234 S	1.4E-05	1.1E-05	6.3E-06	3.6E-06	2.4E-06	1.7E-06	9.4E-07	4.0E-07	2.1E-07	1.4E-07	1.0E-07
U234 SW	7.4E-06	5.2E-06	2.8E-06	1.6E-06	1.1E-06	8.1E-07	4.4E-07	1.9E-07	1.0E-07	6.9E-08	5.1E-08
U234 W	9.5E-06	7.5E-06	4.4E-06	2.7E-06	1.9E-06	1.4E-06	7.9E-07	3.5E-07	1.9E-07	1.3E-07	9.6E-08
U234 NNW	1.3E-05	1.1E-05	6.7E-06	4.3E-06	3.1E-06	2.5E-06	1.5E-06	7.3E-07	4.2E-07	2.9E-07	2.2E-07
N 0.27 mile	1.9E-05										

TABLE 4.2-9
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Committed Dose Equivalent To INHALATION For The CHILD LUNG mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	9.0E-06	7.3E-06	4.3E-06	2.6E-06	1.8E-06	1.4E-06	7.8E-07	3.6E-07	2.0E-07	1.4E-07	1.0E-07
U234 NNE	2.1E-06	2.4E-06	1.4E-06	8.6E-07	6.1E-07	4.7E-07	2.8E-07	1.3E-07	7.6E-08	5.2E-08	3.9E-08
U234 NE	3.3E-06	2.3E-06	1.2E-06	7.5E-07	5.3E-07	3.9E-07	2.4E-07	1.1E-07	6.4E-08	4.4E-08	3.3E-08
U234 S	5.5E-06	4.4E-06	2.4E-06	1.4E-06	9.2E-07	6.8E-07	3.6E-07	1.5E-07	8.2E-08	5.4E-08	4.0E-08
U234 SW	2.9E-06	2.0E-06	1.1E-06	6.3E-07	4.2E-07	3.1E-07	1.7E-07	7.4E-08	4.0E-08	2.7E-08	2.0E-08
U234 W	3.7E-06	2.9E-06	1.7E-06	1.0E-06	7.2E-07	5.5E-07	3.1E-07	1.4E-07	7.4E-08	5.0E-08	3.7E-08
U234 NNW	4.9E-06	4.1E-06	2.6E-06	1.7E-06	1.2E-06	9.5E-07	5.8E-07	2.8E-07	1.6E-07	1.1E-07	8.7E-08
N 0.27 mile	7.4E-06										

Committed Dose Equivalent To INHALATION For The CHILD KIDNEY mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	1.1E-04	8.9E-05	5.2E-05	3.1E-05	2.2E-05	1.7E-05	9.5E-06	4.4E-06	2.4E-06	1.6E-06	1.2E-06
U234 NNE	3.8E-05	2.9E-05	1.7E-05	1.0E-05	7.5E-06	5.8E-06	3.4E-06	1.6E-06	9.2E-07	6.4E-07	4.8E-07
U234 NE	4.0E-05	2.8E-05	1.5E-05	9.1E-06	6.4E-06	4.8E-06	2.9E-06	1.4E-06	7.8E-07	5.4E-07	4.1E-07
U234 S	6.8E-05	5.4E-05	3.0E-05	1.7E-05	1.1E-05	8.2E-06	4.4E-06	1.9E-06	1.0E-06	6.6E-07	4.8E-07
U234 SW	3.5E-05	2.4E-05	1.3E-05	7.7E-06	5.2E-06	3.8E-06	2.1E-06	9.0E-07	4.9E-07	3.2E-07	2.4E-07
U234 W	4.5E-05	3.5E-05	2.1E-05	1.3E-05	8.8E-06	6.7E-06	3.7E-06	1.7E-06	9.1E-07	6.1E-07	4.5E-07
U234 NNW	6.0E-05	5.0E-05	3.1E-05	2.0E-05	1.5E-05	1.2E-05	7.0E-06	3.4E-06	2.0E-06	1.4E-06	1.1E-06
N 0.27 mile	9.0E-05										

TABLE 4.2-9
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Committed Dose Equivalent To INHALATION For The CHILD BONE SURFACE mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	2.5E-04	2.0E-04	1.2E-04	7.3E-05	5.1E-05	3.9E-05	2.2E-05	1.0E-05	5.6E-06	3.8E-06	2.8E-06
U234 NNE	8.7E-05	6.8E-05	3.9E-05	2.4E-05	1.7E-05	1.3E-05	7.9E-06	3.7E-06	2.1E-06	1.5E-06	1.1E-06
U234 NE	9.3E-05	6.4E-05	3.5E-05	2.1E-05	1.5E-05	1.1E-05	6.7E-06	3.2E-06	1.8E-06	1.2E-06	9.4E-07
U234 S	1.6E-04	1.2E-04	6.8E-05	3.9E-05	2.6E-05	1.9E-05	1.0E-05	4.3E-06	2.3E-06	1.5E-06	1.1E-06
U234 SW	8.1E-05	5.6E-05	3.1E-05	1.8E-05	1.2E-05	8.8E-06	4.8E-06	2.1E-06	1.1E-06	7.5E-07	5.5E-07
U234 W	1.0E-04	8.2E-05	4.8E-05	2.9E-05	2.0E-05	1.5E-05	8.6E-06	3.8E-06	2.1E-06	1.4E-06	1.0E-06
U234 NNW	1.4E-04	1.2E-04	7.3E-05	4.7E-05	3.4E-05	2.7E-05	1.6E-05	8.0E-07	4.6E-06	3.2E-06	2.4E-06
N 0.27 mile	2.1E-04										

Committed Dose Equivalent To INHALATION For The CHILD BONE MARROW mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	7.1E-06	5.7E-06	3.3E-06	2.0E-06	1.4E-06	1.1E-06	6.1E-07	2.8E-07	1.6E-07	1.1E-07	7.9E-08
U234 NNE	2.4E-06	1.9E-06	1.1E-06	6.7E-07	4.8E-07	3.7E-07	2.2E-07	1.0E-07	5.9E-08	4.1E-08	3.1E-08
U234 NE	2.6E-06	1.8E-06	9.7E-07	5.9E-07	4.1E-07	3.1E-07	1.9E-07	8.8E-08	5.0E-08	3.5E-08	2.6E-08
U234 S	4.3E-06	3.5E-06	1.9E-06	1.1E-06	7.2E-07	5.3E-07	2.9E-07	1.2E-07	6.4E-08	4.2E-08	3.1E-08
U234 SW	2.3E-06	1.6E-06	8.6E-07	4.9E-07	3.3E-07	2.5E-07	1.3E-07	5.8E-08	3.1E-08	2.1E-08	1.5E-08
U234 W	2.9E-06	2.3E-06	1.3E-06	8.2E-07	5.7E-07	4.3E-07	2.4E-07	1.1E-07	5.8E-08	3.9E-08	2.9E-08
U234 NNW	3.9E-06	3.2E-06	2.0E-06	1.3E-06	9.5E-07	7.5E-07	4.5E-07	2.2E-07	1.3E-07	8.9E-08	6.8E-08
N 0.27 mile	5.8E-06										

Committed Dose Equivalent To INHALATION For The CHILD BONE (Marrow + Endosteal) mrem As Received Per Each Sector Location

	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	2.6E-04	2.1E-04	1.2E-04	7.5E-05	5.2E-05	4.0E-05	2.3E-05	1.0E-05	5.8E-06	3.9E-06	2.9E-06
U234 NNE	8.9E-05	7.0E-05	4.0E-05	2.5E-05	1.8E-05	1.4E-05	8.1E-06	3.8E-06	2.2E-06	1.5E-06	1.1E-06
U234 NE	9.5E-05	6.6E-05	3.6E-05	2.2E-05	1.5E-05	1.1E-05	6.8E-06	3.2E-06	1.9E-06	1.3E-06	9.6E-07
U234 S	1.6E-04	1.3E-04	7.0E-05	4.0E-05	2.7E-05	2.0E-05	1.1E-05	4.5E-06	2.4E-06	1.6E-06	1.2E-06
U234 SW	8.3E-05	5.8E-05	3.2E-05	1.8E-05	1.2E-05	9.1E-06	5.0E-06	2.1E-06	1.2E-06	7.7E-07	5.7E-07
U234 W	1.1E-04	8.4E-05	5.0E-05	3.0E-05	2.1E-05	1.6E-05	8.9E-06	3.9E-06	2.2E-06	1.4E-06	1.1E-06
U234 NNW	1.4E-04	1.2E-04	7.5E-05	4.8E-05	3.5E-05	2.8E-05	1.7E-05	8.2E-06	4.8E-06	3.3E-06	2.5E-06
N 0.27 mile	2.1E-04										

Committed Dose Equivalent To INHALATION For The CHILD TOTAL BODY mrem As Received Per Each Sector Location

	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	3.1E-05	2.5E-05	1.5E-05	8.9E-06	6.3E-06	4.8E-06	2.7E-06	1.2E-06	6.9E-07	4.7E-07	3.5E-07
U234 NNE	1.1E-05	8.4E-06	4.8E-06	3.0E-06	2.1E-06	1.6E-06	9.7E-07	4.6E-07	2.6E-07	1.8E-07	1.4E-07
U234 NE	1.1E-05	7.9E-06	4.3E-06	2.6E-06	1.8E-06	1.4E-06	8.2E-07	3.9E-07	2.2E-07	1.5E-07	1.2E-07
U234 S	1.9E-05	1.5E-05	8.4E-06	4.8E-06	3.2E-06	2.3E-06	1.3E-06	5.3E-07	2.8E-07	1.9E-07	1.4E-07
U234 SW	9.9E-06	6.9E-06	3.8E-06	2.2E-06	1.5E-06	1.1E-06	5.9E-07	2.6E-07	1.4E-07	9.2E-08	6.8E-08
U234 W	1.3E-05	1.0E-05	5.9E-06	3.6E-06	2.5E-06	1.9E-06	1.1E-06	4.7E-07	2.6E-07	1.7E-07	1.3E-07
U234 NNW	1.7E-05	1.4E-05	8.9E-06	5.7E-06	4.2E-06	3.3E-06	2.0E-06	9.8E-07	5.7E-07	3.9E-07	3.0E-07
N 0.27 mile	2.6E-05										

TABLE 4.2-10
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Committed Dose Equivalent To INHALATION For The INFANT LUNG mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	4.1E-06	3.3E-06	1.9E-06	1.2E-06	8.1E-07	6.2E-07	3.5E-07	1.6E-07	9.0E-08	6.1E-08	4.5E-08
U234 NNE	1.4E-06	1.1E-06	6.3E-07	3.9E-07	2.8E-07	2.1E-07	1.3E-07	6.0E-08	3.4E-08	2.4E-08	1.8E-08
U234 NE	1.5E-06	1.0E-06	5.6E-07	3.4E-07	2.4E-07	1.8E-07	1.1E-07	5.0E-08	2.9E-08	2.0E-08	1.5E-08
U234 S	2.5E-06	2.0E-06	1.1E-06	6.2E-07	4.1E-07	3.0E-07	1.6E-07	6.9E-08	3.7E-08	2.4E-08	1.8E-08
U234 SW	1.3E-06	9.0E-07	5.0E-07	2.8E-07	1.9E-07	1.4E-07	7.7E-08	3.3E-08	1.8E-08	1.2E-08	8.8E-09
U234 W	1.7E-06	1.3E-06	7.7E-07	4.7E-07	3.3E-07	2.5E-07	1.4E-07	6.1E-08	3.4E-08	2.2E-08	1.7E-08
U234 NNW	2.2E-06	1.9E-06	1.2E-06	7.5E-07	5.5E-07	4.3E-07	2.6E-07	1.3E-07	7.4E-08	5.1E-08	3.9E-08
N 0.27 mile	3.3E-06										

Committed Dose Equivalent To INHALATION For The INFANT KIDNEY mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	5.8E-05	4.7E-05	2.8E-05	1.7E-05	1.2E-05	8.9E-06	5.1E-06	2.3E-06	1.3E-06	8.7E-07	6.5E-07
U234 NNE	2.0E-05	1.6E-05	9.0E-06	5.6E-06	4.0E-06	3.1E-06	1.8E-06	8.6E-07	4.9E-07	3.4E-07	2.5E-07
U234 NE	2.1E-05	1.5E-05	8.0E-06	4.8E-06	3.4E-06	2.5E-06	1.5E-06	7.2E-07	4.1E-07	2.9E-07	2.2E-07
U234 S	3.6E-05	2.9E-05	1.6E-05	8.9E-06	6.0E-06	4.4E-06	2.3E-06	1.0E-06	5.3E-07	3.5E-07	2.6E-07
U234 SW	1.9E-05	1.3E-05	7.1E-06	4.1E-06	2.7E-06	2.0E-06	1.1E-06	4.8E-07	2.6E-07	1.7E-07	1.3E-07
U234 W	2.4E-05	1.9E-05	1.1E-05	6.7E-06	4.7E-06	3.5E-06	2.0E-06	8.8E-07	4.8E-07	3.2E-07	2.4E-07
U234 NNW	3.2E-05	2.7E-05	1.7E-05	1.1E-05	7.8E-06	6.2E-06	3.7E-06	1.8E-06	1.1E-06	7.4E-07	5.6E-07
N 0.27 mile	4.8E-05										

TABLE 4.2-10
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Committed Dose Equivalent To INHALATION For The INFANT BONE SURFACE mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	4.2E-04	3.4E-04	2.0E-04	1.2E-04	8.4E-05	6.4E-05	3.6E-05	1.7E-05	9.2E-06	6.3E-06	4.7E-06
U234 NNE	1.4E-04	1.1E-04	6.5E-05	4.0E-05	2.8E-05	2.2E-05	1.3E-05	6.2E-06	3.5E-06	2.4E-06	1.8E-06
U234 NE	1.5E-04	1.1E-04	5.8E-05	3.5E-05	2.4E-05	1.8E-05	1.1E-05	5.2E-06	3.0E-06	2.0E-06	1.5E-06
U234 S	2.6E-04	2.0E-04	1.1E-04	6.4E-05	4.3E-05	3.1E-05	1.7E-05	7.2E-06	3.8E-06	2.5E-06	1.8E-06
U234 SW	1.3E-04	9.3E-05	5.1E-05	2.9E-05	2.0E-05	1.5E-05	7.9E-06	3.4E-06	1.8E-06	1.2E-06	9.1E-07
U234 W	1.7E-04	1.4E-04	8.0E-05	4.8E-05	3.4E-05	2.5E-05	1.4E-05	6.3E-06	3.5E-06	2.3E-06	1.7E-06
U234 NNW	2.3E-04	1.9E-04	1.2E-04	7.7E-05	5.6E-05	4.4E-05	2.7E-05	1.3E-05	7.6E-06	5.3E-06	4.0E-06
N 0.27 mile	3.4E-04										

Committed Dose Equivalent To INHALATION For The INFANT BONE MARROW mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	5.1E-06	4.1E-06	2.4E-06	1.5E-06	1.0E-06	7.7E-07	4.4E-07	2.0E-07	1.1E-07	7.6E-08	5.7E-08
U234 NNE	1.7E-06	1.4E-06	7.8E-07	4.8E-07	3.5E-07	2.7E-07	1.6E-07	7.5E-08	4.3E-08	2.9E-08	2.2E-08
U234 NE	1.8E-06	1.3E-06	7.0E-07	4.2E-07	3.0E-07	2.2E-07	1.3E-07	6.3E-08	3.6E-08	2.5E-08	1.9E-08
U234 S	3.1E-06	2.5E-06	1.4E-06	7.8E-07	5.2E-07	3.8E-07	2.0E-07	8.7E-08	4.6E-08	3.0E-08	2.2E-08
U234 SW	1.6E-06	1.1E-06	6.2E-07	3.5E-07	2.4E-07	1.8E-07	9.6E-08	4.2E-08	2.2E-08	1.5E-08	1.1E-08
U234 W	2.1E-06	1.6E-06	9.6E-07	5.9E-07	4.1E-07	3.1E-07	1.7E-07	7.7E-08	4.2E-08	2.8E-08	2.1E-08
U234 NNW	2.8E-06	2.3E-06	1.5E-06	9.3E-07	6.8E-07	5.4E-07	3.2E-07	1.6E-07	9.2E-08	6.4E-08	4.9E-08
N 0.27 mile	4.2E-06										

TABLE 4.2-10
(Page 3 of 3)

Committed Dose Equivalent To INHALATION For The INFANT BONE (Marrow + Endosteal) mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	4.2E-04	3.4E-04	2.0E-04	1.2E-04	8.5E-05	6.5E-05	3.7E-05	1.7E-05	9.4E-06	6.3E-06	4.7E-06
U234 NNE	1.4E-04	1.1E-04	6.5E-05	4.0E-05	2.9E-05	2.2E-05	1.3E-05	6.2E-06	3.6E-06	2.5E-06	1.9E-06
U234 NE	1.5E-04	1.1E-04	5.8E-05	3.5E-05	2.5E-05	1.8E-05	1.1E-05	5.3E-06	3.0E-06	2.1E-06	1.6E-06
U234 S	2.6E-04	2.1E-04	1.1E-04	6.5E-05	4.3E-05	3.2E-05	1.7E-05	7.2E-06	3.8E-06	2.5E-06	1.9E-06
U234 SW	1.4E-04	9.4E-05	5.2E-05	3.0E-05	2.0E-05	1.5E-05	8.0E-06	3.5E-06	1.9E-06	1.2E-06	9.2E-07
U234 W	1.7E-04	1.4E-04	8.0E-05	4.9E-05	3.4E-05	2.6E-05	1.4E-05	6.4E-06	3.5E-06	2.3E-06	1.7E-06
U234 NNW	2.3E-04	1.9E-04	1.2E-04	7.8E-05	5.7E-05	4.5E-05	2.7E-05	1.3E-05	7.7E-06	5.4E-06	4.1E-06
N 0.27 mile	3.5E-04										

Committed Dose Equivalent To INHALATION For The INFANT TOTAL BODY mrem As Received Per Each Sector Location											
	Max mrem	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
U234 N	9.0E-05	7.2E-05	4.2E-05	2.6E-05	1.8E-05	1.4E-05	7.8E-06	3.6E-06	2.0E-06	1.3E-06	1.0E-06
U234 NNE	3.1E-05	2.4E-05	1.4E-05	8.5E-06	6.1E-06	4.7E-06	2.8E-06	1.3E-06	7.5E-07	5.2E-07	3.9E-07
U234 NE	3.3E-05	2.3E-05	1.2E-05	7.4E-06	5.2E-06	3.9E-06	2.3E-06	1.1E-06	6.4E-07	4.4E-07	3.3E-07
U234 S	5.5E-05	4.4E-05	2.4E-05	1.4E-05	9.1E-06	6.7E-06	3.6E-06	1.5E-06	8.1E-07	5.4E-07	3.9E-07
U234 SW	2.9E-05	2.0E-05	1.1E-05	6.3E-06	4.2E-06	3.1E-06	1.7E-06	7.4E-07	4.0E-07	2.6E-07	2.0E-07
U234 W	3.7E-05	2.9E-05	1.7E-05	1.0E-05	7.2E-06	5.4E-06	3.0E-06	1.4E-06	7.4E-07	5.0E-07	3.7E-07
U234 NNW	4.9E-05	4.1E-05	2.6E-05	1.6E-05	1.2E-05	9.5E-06	5.7E-06	2.8E-06	1.6E-06	1.1E-06	8.6E-07
N 0.27 mile	7.3E-05										

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem ADULT BONE SURFACE

	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	7.7E-03	4.8E-03	1.8E-03	7.9E-04	4.5E-04	3.0E-04	1.4E-04	4.8E-05	2.1E-05	1.2E-05	3.4E-06
NNE	2.5E-03	1.5E-03	5.5E-04	2.4E-04	1.4E-04	9.3E-05	4.4E-05	1.5E-05	7.0E-06	4.2E-06	2.9E-06
NE	4.2E-03	1.4E-03	5.3E-04	2.3E-04	1.3E-04	8.9E-05	4.1E-05	1.4E-05	6.4E-06	3.9E-06	2.7E-06
S	4.8E-03	2.9E-03	1.1E-03	4.9E-04	2.8E-04	1.9E-04	8.6E-05	2.9E-05	1.3E-05	7.4E-06	5.0E-06
SW	2.2E-03	1.2E-03	4.6E-04	2.1E-04	1.2E-04	8.1E-05	3.7E-05	1.3E-05	5.6E-06	3.3E-06	2.2E-06
W	2.5E-03	1.5E-03	6.0E-04	2.7E-04	1.6E-04	1.1E-04	4.9E-05	1.7E-05	7.5E-06	4.5E-06	3.1E-06
NNW	3.9E-03	2.3E-03	9.4E-04	4.2E-04	2.4E-04	1.6E-04	7.4E-05	2.5E-05	1.1E-05	6.5E-06	4.5E-06
N 0.27 mile	1.2E-02										

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem ADULT BONE MARROW

	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	3.4E-04	2.1E-04	8.0E-05	3.5E-05	2.0E-05	1.3E-05	6.2E-06	2.1E-06	9.3E-07	5.5E-07	3.7E-07
NNE	1.1E-04	6.4E-05	2.4E-05	1.1E-05	6.2E-06	4.1E-06	2.0E-06	6.9E-07	3.1E-07	1.9E-07	1.3E-07
NE	1.8E-04	6.4E-05	2.4E-05	1.0E-05	5.9E-06	3.9E-06	1.8E-06	6.2E-07	2.8E-07	1.7E-07	1.2E-07
S	2.1E-04	1.3E-04	4.9E-05	2.2E-05	1.2E-05	8.2E-06	3.8E-06	1.3E-06	5.7E-07	3.3E-07	2.2E-07
SW	9.6E-05	5.2E-05	2.1E-05	9.3E-06	5.4E-06	3.6E-06	1.7E-06	5.6E-07	2.5E-07	1.5E-07	9.9E-08
W	1.1E-04	6.7E-05	2.7E-05	1.2E-05	7.1E-06	4.7E-06	2.2E-06	7.4E-07	3.3E-07	2.0E-07	1.4E-07
NNW	1.7E-04	1.0E-04	4.2E-05	1.9E-05	1.1E-05	7.2E-06	3.3E-06	1.1E-06	4.8E-07	2.9E-07	2.0E-07
N 0.27 mile	5.1E-04										

TABLE 4.2-11
(Page 2 of 3)

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem ADULT BONE (Marrow + Endosteal)											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	8.1E-03	5.0E-03	1.9E-03	8.3E-04	4.7E-04	3.1E-04	1.5E-04	5.0E-05	2.2E-05	1.3E-05	8.8E-06
NNE	2.6E-03	1.5E-03	5.7E-04	2.5E-04	1.5E-04	9.7E-05	4.6E-05	1.6E-05	7.3E-06	4.4E-06	3.0E-06
NE	4.4E-03	1.5E-03	5.5E-04	2.4E-04	1.4E-04	9.3E-05	4.3E-05	1.5E-05	6.6E-06	4.1E-06	2.8E-06
S	5.0E-03	3.0E-03	1.1E-03	5.1E-04	2.9E-04	1.9E-04	9.0E-05	3.0E-05	1.3E-05	7.8E-06	5.2E-06
SW	2.3E-03	1.2E-03	4.8E-04	2.2E-04	1.3E-04	8.4E-05	3.9E-05	1 3E-05	5.8E-06	3.4E-06	2.3E-06
W	2.6E-03	1.6E-03	6.3E-04	2.9E-04	1.7E-04	1.1E-04	5.1E-05	1.7E-05	7.8E-06	4.7E-06	3.3E-06
NNW	4.0E-03	2.4E-03	9.8E-04	4.4E-04	2.6E-04	1.7E-04	7.8E-05	2.6E-05	1.1E-05	6.8E-06	4.7E-06
N 0.27 mile	1.2E-02										

Ingestion Committed Dose Equivalent Contributed From Vegetaton, Milk, and Meat, in mrem ADULT KIDNEYS											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	2.5E-03	1.5E-03	5.7E-04	2.5E-04	1.4E-04	9.6E-05	4.5E-05	1.5E-05	6.7E-06	3.9E-06	2.7E-06
NNE	7.9E-04	4.6E-04	1.7E-04	7.7E-05	4.5E-05	3.0E-05	1.4E-05	4.9E-06	2.2E-06	1.3E-06	9.3E-07
NE	1.3E-03	4.6E-04	1.7E-04	7.4E-05	4.3E-05	2.8E-05	1.3E-05	4.5E-06	2.0E-06	1.2E-06	8.7E-07
S	1.5E-03	9.1E-04	3.5E-04	1.6E-04	8.9E-05	5.9E-05	2.7E-05	9.3E-06	4.1E-06	2.4E-06	1.6E-06
SW	6.9E-04	3.7E-04	1.5E-04	6.7E-05	3.9E-05	2.6E-05	1.2E-05	4.0E-06	1.8E-06	1.0E-06	7.1E-07
W	7.9E-04	4.8E-04	1.9E-04	8.8E-05	5.1E-05	3.4E-05	1.6E-05	5.3E-06	2.4E-06	1.4E-06	1.0E-06
NNW	1.2E-03	7.5E-04	3.0E-04	1.4E-04	7.8E-05	5.2E-05	2.4E-05	7.9E-06	3.5E-06	2.1E-06	1.5E-06
N 0.27 mile	3.7E-03										

TABLE 4.2-11
(Page 3 of 3)

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem ADULT TOTAL BODY											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	2.5E-03	1.5E-03	5.7E-04	2.5E-04	1.4E-04	9.6E-05	4.5E-05	1.5E-05	6.7E-06	3.9E-06	2.7E-06
NNE	7.9E-04	4.6E-04	1.7E-04	7.7E-05	4.5E-05	3.0E-05	1.4E-05	4.9E-06	2.2E-06	1.3E-06	9.3E-07
NE	1.3E-03	4.6E-04	1.7E-04	7.4E-05	4.3E-05	2.8E-05	1.3E-05	4.5E-06	2.0E-06	1.2E-06	8.7E-07
S	1.5E-03	9.1E-04	3.5E-04	1.6E-04	8.9E-05	5.9E-05	2.7E-05	9.3E-06	4.1E-06	2.4E-06	1.6E-06
SW	6.9E-04	3.7E-04	1.5E-04	6.7E-05	3.9E-05	2.6E-05	1.2E-05	4.0E-06	1.8E-06	1.0E-06	7.1E-07
W	7.9E-04	4.8E-04	1.9E-04	8.8E-05	5.1E-05	3.4E-05	1.6E-05	5.3E-06	2.4E-06	1.4E-06	1.0E-06
NNW	1.2E-03	7.5E-04	3.0E-04	1.4E-04	7.8E-05	5.2E-05	2.4E-05	7.9E-06	3.5E-06	2.1E-06	1.5E-06
N 0.27 mile	3.7E-03										

TABLE 4.2-12
(Page 1 of 3)

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem TEEN BONE SURFACE											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	2.8E-02	1.7E-02	6.5E-03	2.9E-03	1.6E-03	1.1E-03	5.1E-04	1.7E-04	7.7E-05	4.5E-05	3.1E-05
NNE	9.0E-03	5.3E-03	2.0E-03	8.8E-04	5.1E-04	3.4E-04	1.6E-04	5.6E-05	2.5E-05	1.5E-05	1.1E-05
NE	1.5E-02	5.3E-03	1.9E-03	8.5E-04	4.9E-04	3.2E-04	1.5E-04	5.1E-05	2.3E-05	1.4E-05	9.9E-06
S	1.7E-02	1.0E-02	4.0E-03	1.8E-03	1.0E-03	6.8E-04	3.1E-04	1.1E-04	4.6E-05	2.7E-05	1.8E-05
SW	7.9E-03	4.3E-03	1.7E-03	7.6E-04	4.4E-04	2.9E-04	1.4E-04	4.6E-05	2.0E-05	1.2E-05	8.1E-06
W	9.0E-03	5.5E-03	2.2E-03	1.0E-03	5.8E-04	3.9E-04	1.8E-04	6.1E-05	2.7E-05	1.6E-05	1.1E-05
NNW	1.4E-02	8.5E-03	3.4E-03	1.5E-03	8.9E-04	5.9E-04	2.7E-04	9.0E-05	3.9E-05	2.4E-05	1.7E-05
N 0.27 mile	4.2E-02										

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem TEEN BONE MARROW											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	6.4E-04	3.9E-04	1.5E-04	6.5E-05	3.7E-05	2.5E-05	1.2E-05	4.0E-06	1.7E-06	1.0E-06	7.0E-07
NNE	2.0E-04	1.2E-04	4.5E-05	2.0E-05	1.2E-05	7.7E-06	3.6E-06	1.3E-06	5.7E-07	3.5E-07	2.4E-07
NE	3.4E-04	1.2E-04	4.4E-05	1.9E-05	1.1E-05	7.3E-06	3.4E-06	1.2E-06	5.3E-07	3.2E-07	2.3E-07
S	4.0E-04	2.4E-04	9.1E-05	4.0E-05	2.3E-05	1.5E-05	7.1E-06	2.4E-06	1.1E-06	6.2E-07	4.1E-07
SW	1.8E-04	9.7E-05	3.8E-05	1.7E-05	1.0E-05	6.7E-06	3.1E-06	1.0E-06	4.6E-07	2.7E-07	1.8E-07
W	2.0E-04	1.2E-04	5.0E-05	2.3E-05	1.3E-05	8.8E-06	4.1E-06	1.4E-06	6.2E-07	3.7E-07	2.6E-07
NNW	3.2E-04	1.9E-04	7.8E-05	3.5E-05	2.0E-05	1.3E-05	6.1E-06	2.1E-06	9.0E-07	5.4E-07	3.8E-07
N 0.27 mile	9.6E-04										

TABLE 4.2-12
(Page 2 of 3)

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem TEEN BONE (Marrow + Endosteal)											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	2.9E-02	1.8E-02	6.7E-03	2.9E-03	1.7E-03	1.1E-03	5.2E-04	1.8E-04	7.8E-05	4.6E-05	3.1E-05
NNE	9.2E-03	5.4E-03	2.0E-03	9.2E-04	5.2E-04	3.5E-04	1.6E-04	5.8E-05	2.6E-05	1.6E-05	1.1E-05
NE	1.6E-02	5.4E-03	2.0E-03	8.7E-04	5.0E-04	3.3E-04	1.5E-04	5.2E-05	2.4E-05	1.4E-05	1.0E-05
S	1.8E-02	1.1E-02	4.1E-03	1.8E-03	1.0E-03	6.9E-04	3.2E-04	1.1E-04	4.8E-05	2.8E-05	1.9E-05
SW	8.0E-03	4.4E-03	1.7E-03	7.8E-04	4.5E-04	3.0E-04	1.4E-04	4.7E-05	2.1E-05	1.2E-05	8.3E-06
W	9.2E-03	5.6E-03	2.2E-03	1.0E-03	5.9E-04	4.0E-04	1.8E-04	6.2E-05	2.8E-05	1.7E-05	1.2E-05
NNW	1.4E-02	8.7E-03	3.5E-03	1.6E-03	9.1E-04	6.0E-04	2.8E-04	9.3E-05	4.0E-05	2.4E-05	1.7E-05
N 0.27 mile	4.3E-02										

Ingestion Committed Dose Equivalent Contributed From Vegetaton, Milk, and Meat, in mrem TEEN KIDNEYS											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	6.3E-03	3.9E-03	1.5E-03	6.4E-04	3.7E-04	2.4E-04	1.1E-04	3.9E-05	1.7E-05	1.0E-05	6.8E-06
NNE	2.0E-03	1.2E-03	4.4E-04	2.0E-04	1.1E-04	7.6E-05	3.6E-05	1.3E-05	5.6E-06	3.4E-06	2.4E-06
NE	3.4E-03	1.2E-03	4.3E-04	1.9E-04	1.1E-04	7.2E-05	3.3E-05	1.1E-05	5.1E-06	3.2E-06	2.2E-06
S	3.9E-03	2.3E-03	8.9E-04	4.0E-04	2.3E-04	1.5E-04	7.0E-05	2.4E-05	1.0E-05	6.0E-06	4.1E-06
SW	1.8E-03	9.5E-04	3.8E-04	1.7E-04	9.8E-05	6.5E-05	3.0E-05	1.0E-05	4.5E-06	2.7E-06	1.8E-06
W	2.0E-03	1.2E-03	4.9E-04	2.2E-04	1.3E-04	8.6E-05	4.0E-05	1.4E-05	6.1E-06	3.6E-06	2.5E-06
NNW	3.1E-03	1.9E-03	7.6E-04	3.4E-04	2.0E-04	1.3E-04	6.0E-05	2.0E-05	8.8E-06	5.3E-06	3.7E-06
N 0.27 mile	9.4E-03										

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem TEEN TOTAL BODY										
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	1.9E-03	1.2E-03	4.4E-04	2.0E-04	1.1E-04	7.4E-05	3.4E-05	1.2E-05	5.2E-06	3.0E-06	2.1E-06
NNE	6.1E-04	3.6E-04	1.3E-04	6.0E-05	3.4E-05	2.3E-05	1.1E-05	3.8E-06	1.7E-06	1.0E-06	7.2E-07
NE	1.0E-03	3.6E-04	1.3E-04	5.7E-05	3 3E-05	2.2E-05	1.0E-05	3.4E-05	1.6E-06	9.6E-07	6.7E-07
S	1.2E-03	7.1E-04	2.7E-04	1.2E-04	6.9E-05	4.6E-05	2.1E-05	7.2E-06	3.1E-06	1.8E-06	1.2E-06
SW	5.3E-04	2.9E-04	1.1E-04	5.2E-06	3.0E-05	2.0E-05	9.2E-06	3.1E-06	1.4E-06	8.1E-07	5.5E-07
W	6.1E-04	3.7E-04	1.5E-04	6.8E-05	3.9E-05	2.6E-05	1.2E-05	4.1E-06	1.8E-06	1.1E-06	7.7E-07
NNW	9.5E-04	5.8E-04	2.3E-04	1.0E-04	6.0E-05	4.0E-05	1.8E-05	6.1E-06	2.7E-06	1.6E-06	1.1E-06
N 0.27 mile	2.9E-03										

TABLE 4.2-13
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Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem CHILD BONE SURFACE											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	1.3E-02	8.2E-03	3.1E-03	[illegible]-03	7.8E-04	5.2E-04	2.4E-04	6.3E-05	3.6E-05	2.1E-05	1.5E-05
NNE	4.3E-03	2.5E-03	9.4E-04	4.2E-04	2.4E-04	1.6E-04	7.6E-05	2.7E-05	1.2E-05	7.2E-06	5.0E-06
NE	7.2E-03	2.5E-03	9.1E-04	4.0E-04	2.3E-04	1.5E-04	7.0E-05	2.4E-05	1.1E-05	6.7E-06	4.7E-06
S	8.3E-03	4.9E-03	1.9E-03	8.4E-04	4.8E-04	3.2E-04	1.5E-04	5.0E-05	2.2E-05	1.3E-05	8.7E-06
SW	3.7E-03	2.0E-03	8.0E-04	3.6E-04	2.1E-04	1.4E-04	6.4E-05	2.2E-05	9.6E-06	5.7E-06	3.8E-06
W	4.3E-03	2.6E-03	1.0E-03	4.7E-04	2.7E-04	1.8E-04	8.5E-05	2.9E-05	1.3E-05	7.8E-06	5.4E-06
NNW	6.7E-03	4.0E-03	1.6E-03	7.3E-04	4.2E-04	2.8E-04	1.3E-04	4.3E-05	1.9E-05	1.1E-05	7.8E-06
N 0.27 mile	2.0E-02										

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem CHILD BONE MARROW											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	3.6E-04	2.2E-04	8.3E-05	3.6E-05	2.1E-05	1.4E-05	6.4E-06	2.2E-06	9.7E-07	5.7E-07	3.9E-07
NNE	1.1E-04	6.7E-05	2.5E-05	1.1E-05	6.4E-06	4.3E-06	2.0E-06	7.1E-07	3.2E-07	1.9E-07	1.3E-07
NE	1.9E-04	6.7E-05	2.4E-05	1.1E-05	6.2E-06	4.1E-06	1.9E-06	6.4E-07	2.9E-07	1.8E-07	1.3E-07
S	2.2E-04	1.3E-04	5.1E-05	2.2E-05	1.3E-05	8.5E-06	4.0E-06	1.3E-06	5.9E-07	3.4E-07	2.3E-07
SW	9.9E-05	5.4E-05	2.1E-05	9.6E-06	5.6E-06	3.7E-06	1.7E-06	5.8E-07	2.6E-07	1.5E-07	1.0E-07
W	1.1E-04	7.0E-05	2.8E-05	1.3E-05	7.3E-06	4.9E-06	2.3E-06	7.7E-07	3.4E-07	2.1E-07	1.4E-07
NNW	1.8E-04	1.1E-04	4.3E-05	2.0E-05	1.1E-05	7.5E-06	3.4E-06	1.1E-06	5.0E-07	3.0E-07	2.1E-07
N 0.27 mile	5.3E-04										

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem
TEEN BONE (Marrow + Endosteal)

	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	1.4E-02	8.4E-03	3.2E-03	1.4E-03	8.0E-04	5.3E-04	2.5E-04	8.5E-05	3.7E-05	2.2E-05	1.5E-05
NNE	4.4E-03	2.6E-03	9.7E-04	4.3E-04	2.5E-04	1.7E-04	7.8E-05	2.7E-05	1.2E-05	7.4E-06	5.1E-06
NE	7.4E-03	2.6E-03	9.4E-04	4.1E-04	2.4E-04	1.6E-04	7.2E-05	2.5E-05	1.1E-05	6.9E-06	4.8E-06
S	8.5E-03	5.1E-03	1.9E-03	8.6E-04	5.0E-04	3.3E-04	1.5E-04	5.2E-05	2.3E-05	1.3E-05	8.9E-06
SW	3.8E-03	2.1E-03	8.2E-04	3.7E-04	2.1E-04	1.4E-04	6.6E-05	2.2E-05	9.9E-06	5.8E-06	4.0E-06
W	4.4E-03	2.7E-03	1.1E-03	4.9E-04	2.8E-04	1.9E-04	8.7E-05	3.0E-05	1.3E-05	8.0E-06	5.5E-06
NNW	6.8E-03	4.2E-03	1.7E-03	7.5E-04	4.3E-04	2.9E-04	1.3E-04	4.4E-05	1.9E-05	1.2E-05	8.1E-06
N 0.27 mile	2.1E-02										

Ingestion Committed Dose Equivalent Contributed From Vegetaton, Milk, and Meat, in mrem
CHILD KIDNEYS

	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	5.7E-03	3.5E-03	1.3E-03	5.8E-04	3.3E-04	2.2E-04	1.0E-04	3.5E-05	1.5E-05	9.1E-06	6.2E-06
NNE	1.8E-03	1.1E-03	4.0E-04	1.8E-04	1.0E-04	6.9E-05	3.2E-05	1.1E-05	5.1E-06	3.1E-06	2.1E-06
NE	3.1E-03	1.1E-03	3.9E-04	1.7E-04	9.9E-05	6.5E-05	3.0E-05	1.0E-05	4.7E-06	2.9E-06	2.0E-06
S	3.5E-03	2.1E-03	8.1E-04	3.6E-04	2.1E-04	1.4E-04	6.3E-05	2.1E-05	9.4E-06	5.5E-06	3.7E-06
SW	1.6E-03	8.6E-04	3.4E-04	1.5E-04	8.9E-05	5.9E-05	2.7E-05	9.3E-06	4.1E-06	2.4E-06	1.6E-06
W	1.8E-03	1.1E-03	4.4E-04	2.0E-04	1.2E-04	7.8E-05	3.6E-05	1.2E-05	5.5E-06	3.3E-06	2.3E-06
NNW	2.8E-03	1.7E-03	6.9E-04	3.1E-04	1.8E-04	1.2E-04	5.5E-05	1.8E-05	8.0E-06	4.8E-06	3.3E-06
N 0.27 mile	8.5E-03										

TABLE 4.2-13
(Page 3 of 3)

Ingestion Committed Dose Equivalent Contributed From Vegetation, Milk, and Meat, in mrem CHILD TOTAL BODY											
	Max mrem/Yr	0.5-1 Miles	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles
N	1.5E-03	9.4E-04	3.6E-04	1.6E-04	9.0E-05	6.0E-05	2.8E-05	9.5E-06	4.2E-06	2.5E-06	1.7E-06
NNE	4.9E-04	2.9E-04	1.1E-04	4.8E-05	2.8E-05	1.9E-05	8.7E-06	3.1E-06	1.4E-06	8.3E-07	5.8E-07
NE	8.3E-04	2.9E-04	1.1E-04	4.6E-05	2.7E-05	1.8E-05	8.1E-06	2.8E-06	1.3E-06	7.7E-07	5.4E-07
S	9.5E-04	5.7E-04	2.2E-04	9.7E-05	5.6E-05	3.7E-05	1.7E-05	5.8E-06	2.5E-06	1.5E-06	9.9E-07
SW	4.3E-04	2.3E-04	9.2E-05	4.1E-05	2.4E-05	1.6E-05	7.4E-06	2.5E-06	1.1E-06	6.5E-07	4.4E-07
W	4.9E-04	3.0E-04	1.2E-04	5.4E-05	3.2E-05	2.1E-05	9.7E-06	3.3E-06	1.5E-06	8.9E-07	6.2E-07
NNW	7.7E-04	4.7E-04	1.9E-04	8.4E-05	4.9E-05	3.2E-05	1.5E-05	4.9E-06	2.2E-06	1.3E-06	9.0E-07
N 0.27 mile	2.3E-03										

<u>TABLE 4.2-14</u>

GASEOUS PATHWAY
Collective Total Effective Body and Organ Doses Equivalents
Calculated For
Exposed Individuals Within 50 Miles, mrem

CALCULATED USING 30 GRAMS PER YEAR URANIUM RELEASE					
		ADULT	TEEN	CHILD	INFANT
Inhalation	Lung	3.1E-02	3.1E-02	2.2E-02	1.0E-02
Inhalation	Kidney	3.7E-01	4.2E-01	2.7E-01	1.4E-01
Inhalation	Bone Surface	7.7E-01	1.8E+00	6.3E-01	1.0E+00
Inhalation	Bone Marrow	5.1E-02	3.9E-02	1.7E-02	1.3E-02
Inhalation	Total Body	5.7E-02	5.7E-02	7.7E-02	1.3E-02
Ingestion	Bone Surface	6.4E+01	2.3E+02	1.1E+02	*
Ingestion	Bone Marrow	2.8E+00	1.5E+01	7.5E+00	*
Ingestion	Kidney	2.0E+01	5.9E+01	5.0E+01	*
Ingestion	Total Body	2.0E+01	1.7E+01	1.4E+01	*
External	Ground Plane	2.4E-05			
GRAND TOTAL		1.1E+02	3.3E+02	1.8E+02	1.2E+00

NOTE: Ground Plane considers all population for each age specific category equalling the entire population.

NOTE: * = This pathway not considered for INFANT.

TABLE 4.2-15

GASEOUS PATHWAY

Collective Committed Dose Equivalent mrem As Received Per Each Sector Location For The Summation Of The INHALATION and INGESTION Pathways With Total Population Equalling ADULT								
	Max mrem/Yr Avg.	0.5-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	0-50 Miles
N	2.70E-01	6.08E-01	1.24E+00	1.12E+00	1.51E+00	1.25E+00	1.42E+00	7.41E+00
NNE	7.37E-02	1.56E-01	5.00E-01	1.07E+00	2.45E+00	3.31E-01	1.17E+00	5.75E+00
NE	8.64E-02	7.58E-01	8.22E+00	1.68E+01	8.56E+00	4.90+001	8.48E+00	4.78E+01
S	5.02E-02	3.30E-01	4.37E+00	2.09E+00	6.31E-01	6.78E-01	1.25E+00	9.40E+00
SW	0.00E+00	2.82E+00	2.79E+00	8.05E+00	3.41E+00	1.14E+01	8.33E+00	3.69E+01
W	5.24E-02	9.84E-01	2.43E+00	4.22E+00	2.27E+00	1.34E+00	7.05E-01	1.20E+01
NNW	1.02E-01	4.01E-01	5.43E+00	3.99E+00	7.36E+00	2.34E+00	2.26E+00	2.19E+01
N 0.27 mile	5.97E-02							5.97E-02

TABLE 4.2-16

GASEOUS PATHWAY

Collective Committed Dose Equivalent mrem As Received Per Each Sector Location For The Summation Of The INHALATION and INGESTION Pathways With Total Population Equalling TEENAGER								
	Max mrem/Yr Avg.	0.5-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	0-50 Miles
N	7.57E-01	4.20E+00	3.52E+00	3.17E+00	4.29E+00	3.52E+00	4.01E+00	2.35E+01
NNE	2.06E-01	1.07E+00	1.42E+00	3.04E+00	6.94E+00	9.09E-01	3.31E+00	1.69E+01
NE	2.43E-01	5.23E+00	2.33E+01	4.76E+01	2.42E+01	1.38E+01	2.40E+01	1.38E+02
S	1.41E-01	2.29E+00	1.24E+01	5.92E+00	1.78E+00	1.92E+00	3.54E+00	2.80E+01
SW	0.00E+00	1.97E+01	7.89E+00	2.28E+01	9.63E+00	3.25E+01	2.36E+01	1.16E+02
W	1.46E-01	6.83E+00	6.88E+00	1.20E+01	6.42E+00	3.79E+00	1.99E+00	3.80E+01
NNW	2.85E-01	2.71E+00	1.54E+01	1.13E+01	2.09E+01	6.53E+00	6.39E+00	6.34E+01
N 0.27 mile	1.68E-01							1.68E-01

TABLE 4.2-17

GASEOUS PATHWAY

Collective Committed Dose Equivalent mrem As Received per Each Sector Location For The Summation Of The INHALATION and INGESTION Pathways With Total Population Equalling CHILD								
	Max mrem/Yr Avg.	**0.5-5 Miles**	**5-10 Miles**	**10-20 Miles**	**20-30 Miles**	**30-40 Miles**	**40-50 Miles**	**0-50 Miles**
N	4.26E-01	1.59E+00	1.99E+00	1.79E+00	2.43E+00	1.99E+00	2.26E+00	1.25E+01
NNE	1.16E-01	4.07E-01	8.02E-01	1.72E+00	3.93E+00	5.06E-01	1.87E+00	9.35E+00
NE	1.37E-01	1.99E+00	1.32E+01	2.69E+01	1.36E+01	7.81E+00	1.36E+01	7.73E+01
S	7.92E-02	8.68E-01	7.03E+00	3.35E+00	1.01E+00	1.09E+00	2.00E+00	1.54E+01
SW	0.00E+00	7.48E+00	4.46E+00	1.29E+01	5.44E+00	1.84E+01	1.33E+01	6.20E+01
W	8.22E-02	2.59E+00	3.89E+00	6.76E+00	3.62E+00	2.14E+00	1.12E+00	2.02E+01
NNW	1.60E-01	1.03E+00	8.73E+00	6.36E+00	1.18E+01	3.67E+00	3.61E+00	3.54E+01
N 0.27 mile	9.50E-02							9.50E-02

TABLE 4.2-18

GASEOUS PATHWAY

Collective Committed Dose Equivalent mrem As Received Per Each Sector Location For the Summation Of The INHALATION and Pathway With Total Population Equalling INFANT								
	Max mrem/Yr Avg.	0.5-5 Miles	5-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	0-50 Miles
N	9.84E-03	1.32E-02	9.29E-03	7.94E-03	9.03E-03	1.45E-02	1.34E-02	7.72E-02
NNE	2.85E-03	3.83E-03	2.76E-03	3.91E-03	1.08E-02	2.95E-02	4.09E-03	5.78E-02
NE	2.15E-03	1.50E-02	1.17E-02	5.62E-02	1.49E-01	8.97E-02	5.84E-02	3.82E-01
S	1.81E-03	5.35E-03	3.88E-03	1.98E-02	1.12E-02	3.87E-03	4.67E-03	5.07E-02
SW	0.00E+00	1.81E-02	3.79E-02	1.42E-02	4.96E-02	2.39E-02	9.02E-02	2.34E-01
W	2.42E-03	1.48E-02	1.81E-02	1.76E-02	3.69E-02	2.27E-02	1.49E-02	1.27E-01
NNW	4.03E-02	2.01E-02	8.59E-03	5.26E-02	4.92E-02	1.10E-01	3.84E-02	2.83E-01
N 0.27 mile	1.21E-03							1.21E-03

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6.1 APPLICANT'S PREOPERATIONAL ENVIRONMENTAL PROGRAMS

The purpose of the pre-operational program was to identify the physical, chemical and biological variables which were likely to affect, or be affected by, the construction or operation of the CEC.

6.1.1 WATER

6.1.1.1 <u>Onsite Lakes and Ponds</u>

Physicochemical data were obtained from the centers of both Lake Avalyn and Bluegill Pond during two sampling rounds (January 20, 1990 and May 23, 1990). Dissolved oxygen concentrations were measured at 1-ft intervals using a Yellow Springs Instrument (YSI) polarographic oxygen probe and meter (Model 54). Conductivity and temperature also were obtained at 1-foot intervals with a YSI S-C-T meter (Model 33). Water samples for all other measurements were obtained from the surface only. Total alkalinity was determined by titration with a weak acid (Reference 1), pH was measured with an Orion portable pH meter, and turbidity with a Hach ratio turbidimeter. During the first sampling event, total hardness was measured with a Hach portable hardness kit. During the second sampling event a 25 cm Secchi Disk was used to determine water transparency, and surface and bottom samples were collected and analyzed for additional inorganic water chemistry parameters. The bottom samples were collected using an acid-washed polypropylene horizontal water sampler. With the exception of the samples which were to be analyzed for nutrient and mineral content, all of the water samples were treated with 5% acid solutions (either nitric or sulfuric acid) for preservation. The samples were subsequently analyzed using standard methods.

For the purpose of qualitative analysis, four sediment samples were collected from both Lake Avalyn and Bluegill Pond. These were obtained from evenly spaced locations down the centers of the ponds using a Ponar Sediment Sampler. Each sample was described and photographed.

Bathymetric surveys were performed on Lake Avalyn and Bluegill Pond in order to obtain volume estimates of these bodies of water. Prior to the surveys, aerial photographs were studied and significant bank features were identified. These features were used as guides in establishing transects at approximately 200- and 100-ft intervals across the width of Lake Avalyn and Bluegill Pond, respectively. These transects were run using a Lawrence Model X15 depth recorder device attached to a boat. In addition, one length-wise transect was run along the center of both Lake Avalyn and the Bluegill Pond. Volume estimates were made between adjacent transects by averaging the cross sectional areas of the transects and then multiplying that by their

distance apart. The volume of the individual segments were then added to obtain a total volume estimate.

Measurements of specific conductance, temperature, dissolved oxygen, pH, alkalinity and water level will be made on a quarterly schedule of Lake Avalyn amd Bluegill Pond to document seasonal fluctuations prior to plant operation.

6.1.1.2 Streams

Two rounds of stream monitoring were performed on and in the vicinity of the site (May 23, 1990 and July 25, 1990). After measuring the total width of and depth at regularly spaced intervals across the streams, the equal-width increment (EWI) method was used to calculate the cross-sectional areas. Where sufficient flow existed, a Mead Flow Meter was used to obtain velocity measurements also following the guidelines of the EWI method. However, at a majority of the locations (all of the onsite locations) flow was insufficient to obtain reliable velocity measurements with the flow meter. In these instances a velocity estimate was obtained by timing the uninhibited movement of a small stick across a relatively uniform 3-ft section of the stream.

6.1.1.3 Groundwater

Shallow groudwater beneath the LES property was investigated by installing monitoring wells on the property between July 24 and 31, 1990 (reference Section 2.5.2.3.1 and Figure 2.5-11). The wells are 2 inch diameter and were drilled using a 6-1/4-in hollow stem auger (3-1/4-in auger for the deep well). Geologic logs for each of the wells were produced based on split-spoon samples collected at 5-ft intervals. In addition, undisturbed samples of the stratigraphic unit screened in each well were collected using 2-1/2-ft Shelby Tubes. These samples were analyzed for particle size distribution, bulk density, porosity, and total organic carbon using standard methods. When undisturbed samples could not be obtained using a Shelby Tube (as was the case for some of the particularly wet sands), a split-spoon sample was collected for particle size distribution and total organ carbon analysis.

After completion, most of the wells were air-developed. A compressor was used to force air down the well at approximately 140 psia until the turbidity of the water stabilized. The remaining wells (A-1, B-1, and B-2) were developed using a bladder pump. After development samples were collected from all of the wells. Prior to the collection of samples, three to five well volumes were purged using disposable polypropylene bailers and measurements of pH, temperature, and specific conductivity were taken. After these parameters stabilized, samples were collected for analyses using standard methods and Quality

Assurance procedures which meet US Environmental Protection Agency guidelines.

On August 13, 1990 slug tests were performed on each of the seven onsite wells. The tests were performed in order to obtain hydraulic conductivity estimates. The test involved the measurement of the initial water level in the well using an electronic water level indicator marked in hundredths of a foot. A slug of water was then evacuated from the well using a teflon bailer, and the water levels were measured at time intervals using the electronic water level indicator. These data (water level recovery vs. time) were analyzed using a BASIC program which statistically fits a line (by least squares) to the plotted points. Based on these plots and well configuration data, the hydraulic conductivity is calculated. While not precise, this method allows for an order of magnitude estimate to be made for hydraulic conductivity.

Both 2- and 3-dimensional contouring of shallow groundwater levels on site were performed using the Surfer graphics package. The average of the water levels measured August 1 and 13, 1990 were used for contouring, and the statistical inverse-distance method was applied to the data. This method was selected over the linear kriging approach because the highly variable geology and topography (and hence groundwater levels) are not expected to conform to a linear approximation. The extreme variability is most recognized between the central ridge on the property (wells A-1, E-1, and F-1) and the southwest drainage basin (well C-1).

Deep groundwater beneath the LES property was evaluated by means of the Theis equation (Reference 2) to evaluate the possible effects of anticipated water withdrawals from the Sparta Aquifer by the CEC (see Section 2.5.2.4). The Theis equation is applicable to confined aquifer conditions and is used for the prediction of drawdown at any distance from a pumping well for any time. The solution ignores recharge to the aquifer and, therefore, is considered to be conservative. Known aquifer transmissivity and storativity values and a range of pumping rates were used to estimate these drawdowns. In addition, the effects of withdrawals from the Central Claiborne Water System Well #4 were assessed individually and coupled with the withdrawals by the facility.

Prior to facility operations, measurement of water levels in all existing preoperational survey wells will continue on a quarterly schedule to document the seasonal range of groundwater fluctuations at the site.

6.1.2 AIR

No onsite monitoring of meteorological or air quality conditions at the CEC has been conducted; therefore, all data used in this

report to characterize such conditions necessarily have been collected at offsite locations by independent agencies and institutions. The data were obtained through either literature searches or through direct contact with the agency or institution responsible for maintaining the data.

6.1.2.1 Meteorological Data

Meteorological conditions at the facility location were evaluated and summarized in Section 2.6.1 of this report in order to characterize the LES site climatology and provide a basis for predicting the dispersion of gaseous effluents. The primary source of these data was the National Oceanic and Atmospheric Agency (NOAA) Local Climatological Data (LCD) station located at the Shreveport Regional Airport approximately 56 mi. west-southwest of the site. Data collected at the Shreveport LCD station and used in the analysis include that for winds, precipitation, and temperature. Printed copies of these data were obtained directly from the NOAA (Reference 3). In general, average values reported in the NOAA data were based on a 30-year period of record (1951 to 1980), while extremes were based on a 36-year record ending in 1988.

A detailed justification for using the Shreveport data and a discussion of the extent it may be considered representative of the meteorology and climatology at the location of the facility are presented in Section 2.6.1. Part of this analysis involved comparing data from the Shreveport LCD station with data collected at other weather stations near the site. For example, temperature and precipitation data are collected at an observation station located approximately 6 mi. southwest of the site. The station is operated by the Louisiana State Agricultural Center which reports data on a monthly basis to the Shreveport LCD station. As with the Shreveport data, printed copies of the summary of the 1951 to 1980 Homer data were received directly from the NOAA (Reference 4).

Wind data are not collected at the Homer station. Wind data, however, are available from the Shreveport LCD station and two Federal Aviation Authority (FAA) weather stations at airports in Monroe, Louisiana and El Dorado, Arkansas, which are, respectively, about 60 mi. east-southeast and 40 mi. northeast of the site (see Figure 2.6-3). Printed copies of data were obtained from the NOAA which summarize joint frequencies of wind speeds and directions for a 9-year period (1950 to 1958) in Monroe and 5-year period (1949 to 1954) in El Dorado (Reference 4). These data were used to make a comparison of the means and extremes of wind speed at these two stations with the wind speed data from the Shreveport LCD station. Summaries of joint frequencies of wind speeds and directions at the Shreveport LCD station were obtained from the NOAA for a 5-year period (1984 to 1988). These data were used in the χ/Q dispersion analysis

required for Sections 4.2.1.2 and 5.1 of this report. In addition to the 5-year joint frequency data, summary statistics for the Shreveport station (e.g., peak gusts, mean wind speed, and minimum and maximum monthly average wind speeds) were available from the NOAA for a 36-year period ending in 1988 (Reference 3).

The effect of the difference in winds between the site location and the Shreveport LCD station on the χ/Q analysis was assessed in Section 2.6.1.3 via an air dispersion modeling exercise. The analysis, as described in that section, essentially consisted of comparing the output from a computer air dispersion model using the 1984 to 1988 Shreveport meteorological data with the output obtained using a composite meteorological data set based on meteorological data from the Shreveport station and the two FAA stations in Monroe and El Dorado. The source of the composite data was the Personal Computer Graphical Exposure Modeling System (PCGEMS), which has been developed by the EPA as a database and modeling system for the performance of exposure assessment studies (Reference 5). The meteorological data contained in PCGEMS for the Shreveport, Monroe and El Dorado Stations are based on 5-year records (i.e., 1970 to 1974, 1954 to 1958 and 1950 to 1954, respectively).

A discussion of storms and other forms of severe weather as they have occurred in Northern Louisiana is presented in Section 2.6.1.4. The information and data reported in this section were obtained primarily from the Tornado and Straight Wind Speed Study for the Proposed Uranium Enrichment Plant Site prepared for Fluor Daniel, Inc. by McDonald-Mehta Engineers (Reference 6). Additional information was obtained from Violent Tornado Climatography (Reference 7), the NOAA annual summary of data from the Shreveport LCD station (Reference 3), and a letter from the Claiborne Parish Civil Defense (Reference 8), which describes a tornado sighting in 1986.

6.1.2.2 Air Quality Data

Only air quality data for existing levels of Clean Air Act Criteria Pollutants are available for Northern Louisiana. These data were presented and compared to the National Ambient Air Quality Standards (NAAQS) in Section 2.6.2 of this report. The primary source of the data was the Louisiana Division of Air Quality (LDAQ), which supplied printed copies of the data from their database. Data were obtained from a total of four LDAQ stations in Northern Louisiana. The stations are:

a. the Keel Radio Station in Dixie, a small town about 15 mi. north of Shreveport,

b. the Claiborne Public Health Unit in Homer,

c. the Shreveport Downtown Airport, and

d. the airport in Monroe.

Based on availability and relevance to the site, TSP data from Homer and Dixie, sulfur dioxide data from Shreveport and Monroe, and ozone data from Dixie, Shreveport, and Monroe are presented and discussed in Section 2.6.2. All of these data were from a 5-year record (1984 to 1988), with the exception of ozone, which was examined for the entire available record of 8 years (1981 to 1988) for reasons noted in Section 2.6.1. For two criteria pollutants, not measured at any of the above LDAQ sites, the EPA's 1985 Annual Statistics on Air Quality (Reference 9) reports on measurements conducted in Shreveport and Monroe. The minimum, median, and maximum lead levels in 1985 in Shreveport and the mean and maximum nitrogen dioxide levels in 1985 in Monroe and Shreveport are identified in Section 2.6.2 as reported in this reference.

A general examination of the potential for air pollution in the region near the facility is presented in Section 4.2.2.6. This examination is based on seasonal and annual mixing height and wind speed data presented by Holzworth (Reference 10) explicitly for this purpose.

6.1.3 LAND

6.1.3.1 Geology and Soils

Geological and soils studies have been performed at the site to determine the nature of surface and subsurface conditions. A description of sample collection sites and the methodologies utilized to evaluate soil and rock materials is presented in Section 3.6 of the Safety Analysis Report. Geology and soils studies at the site have included: test borings, test pits, insitu permability tests, refraction profiling, static and dynamic laboratory tests, and analysis of bearing capacity and settlement. The principle objective in conducting geology and soils studies was to evaluate the structural integrity of the site for engineering purposes and to characterize certain physico-chemical aspects related to surficial groundwaters.

6.1.3.2 Land Use and Demographic Surveys

An inspection of the 5-mi. radius surrounding the site was conducted to locate households and any historic, scenic, cultural, or natural landmarks. Land use patterns for this area were also identified. This information was plotted and evaluated by radial sector as discussed in Section 2.2 of this document.

To estimate projected populations of the 5-mi. radius surrounding the site, Mr. Vincent Maruggi, with the Division of Business and

Economic Research of the University of New Orleans, was first contacted to obtain the estimated population of Claiborne Parish for 1988. This estimated population was compared with 1990 population estimates for Claiborne Parish, also furnished by Mr. Vincent Maruggi, to determine projected growth of the area within a 5-mi. radius of the site. Demographic information also was obtained for Claiborne Parish from the Woods and Poole Economic Database. Demographic information from this database can be requested from Woods & Poole Economics, Inc., Washington, D.C. Projected populations for Claiborne Parish were reported by Mr. Maruggi through the year 2000. To determine projected populations through the year 2035, it was assumed that the percentage of the population contributed from a single radial sector remained constant with time.

6.1.4 BIOTA

Preoperational monitoring programs were conducted at the site. The initial monitoring was designed to characterize the ecological community as it existed at the site prior to and after extensive clearcutting had occurred (see Section 2.7). This consisted of field surveys of the plant, avian, and aquatic communities at the site and qualitative analyses of the likely composition and distribution of the site's mammalian, reptile, and amphibian communities. The latter analyses were based on knowledge of existing habitat at the site and of species-specific distribution and habitat preferences. These analyses were supplemented by information provided by personnel from the Louisiana Department of Wildlife and Fisheries (References 12, 13, 14), the Louisiana Natural Heritage Program (Reference 15), the Louisiana Department of Forestry (Reference 16), and the U.S. Fish and Wildlife Service (Reference 17). Additional information was obtained from field guides (References 18, 19), and other summary sources (References 20, 21, 22) and from an inventory of Louisiana wildlife (Reference 23). This information is summarized in Section 2.7.

As discussed in Section 2.7, clearcutting at the CEC site has resulted in an alteration of the ecological community of the site. For example, the successional stages of several of the forest communities at the site have been altered significantly, moving towards earlier stages of succession. Such changes in the plant communities also result in changes in the associated wildlife community. However, over time, the plant and wildlife communities will continue to change as natural successional processes result in a movement of the communities toward pretimbering conditions. Because of this continual change, the baseline plant and animal communities used to evaluate potential impacts of the facility will be changing constantly. When site operational monitoring programs are instituted in accordance with compliance permit requirements, the extent of the ecological changes that have occurred since the baseline studies will be

documented.

The procedures and methodologies for preoperational monitoring are described below for each of the communities.

6.1.4.1 Preoperational Programs--Vegetation

A botanical assessment was conducted on June 16, 17, and 23, 1990. The purpose of the study was to develop a general vegetative map of the property. Further, because large-scale timbering had occurred recently at the site, the successional trends for each vegetative community were noted.

To conduct the botanical survey, the entire site was first flagged each 0.1 mi. This survey divided the property into 100 increments, each 0.01 mi^2. Then, a visual ground survey of the vegetation was conducted and the dominant vegetative community for each square was recorded on a map. Five distinct terrestrial plant communities were identified. These are:

a. upland mixed forest--recent harvest,
b. upland mixed forest--several years since harvest,
c. upland forest--pine dominated,
d. upland mixed forest--mature, and
e. bottomland hardwood forest

The plant species that occurred in each survey area were identified, and their relative abundance within the surveyed unit was estimated. The following qualitative terms were used to describe the relative abundance of plant species on the site.

Dominant: the most prevalent species within a given vegetative community based on considerations of biomass (qualitatively determined by number and size of individuals). A community may have one or more dominant species or no dominant species.

Common: a species that may be noted at any random point within a specific vegetative community.

Moderate: a species that may or may not be noted at any random point but that may be located with a limited amount of searching.

Scattered: a species that occurs only a few times within a given vegetative community or a species that is abundant in only one or two localized areas.

Macrophytic vegetation in and around Lake Avalyn and Bluegill Pond was surveyed. Survey grids were not established for the pond vegetative survey, but rather the plant species that occurred in three distinct areas along the perimeter of the Lake

and pond were recorded. The areas surveyed were as follows:

a. In the water:
this included free-floating species and species rooted within the mud and emergent above the surface of the water.

b. Immediate bank:
this included species that occupied a strip usually only a few feet wide which is generally inundated during periods of heavy rain and runoff.

c. Upper bank:
this included species that occupied a strip extending from the immediate bank to the top of the bank.

The relative abundance categories that were used for terrestrial plant communities also were used to describe abundance for the macrophyte community associated with the lake and pond.

The results of the botanical survey are summarized in Section 2.7.1 for terrestrial plant communities and in Section 2.7.3 for aquatic plant communities.

6.1.4.2 Preoperational Program--Birds

Site-specific avian surveys were conducted by Goertz in January (three days) and April (one day) 1990 to verify the presence of particular bird species at the site. The January survey was conducted before the clearcutting occurred in the spring and early summer of 1990. The winter and spring survey was designed to characterize in general terms the members of the avian community.

For the winter survey, the distinct habitats at the site were first characterized (see Table 6.1-1) and then the bird species composition within each of these habitats was noted. Transects 100 m in length were established within each distinct homogenous habitat, and data were collected at every 5 m transect interval. Species composition and relative abundance were determined based on visual observations, call counts, and nest identification.

In addition to verifying species presence, the spring survey was designed to determine the nesting and migratory status of the species observed and (as a measure of the nesting potential of the site) to determine the occurrence and number of territories of singing males and/or exposed, visible posturing males. The area was censused for breeding birds by spot mapping using the procedures described by the International Bird Census Committee (Reference 24). Spot mapping is a common technique for censusing passerine breeding birds (Reference 25). Censusing was conducted in the three major habitats of the area listed in Table 6.1-1.

The results of the avian survey are summarized in Section 2.7.2.

6.1.4.3 Preoperational Programs--Mammals

No on-site surveys have been conducted to characterize the preoperational mammalian communities of the site. The mammals likely to be present were inferred from knowledge of existing habitat and of species-specific distribution and habitat preferences. Literature sources and State and Federal wildlife officials were contacted for information to support the analysis (see Section 6.1.4).

The mammalian communities are described in Section 2.7.2.

6.1.4.4 Preoperational Programs--Reptiles and Amphibians

As was the case with mammals, no onsite surveys were conducted to characterize the preoperational reptile and amphibian communities of the site. The species likely to be present were inferred from knowledge of existing habitat and of species-specific distribution and habitat preferences. Literature sources and State and Federal wildlife officials were contacted for information to support the analysis (see Section 6.1.4).

The reptile and amphibian communities are described in Section 2.7.2.

6.1.4.5 Preoperational Programs--Aquatics

An aquatic survey was conducted in Lake Avalyn and Bluegill Pond on January 20, 1990. The waters were surveyed for plankton (phytoplankton and zooplankton), benthic organisms, and fish.

Plankton were surveyed by collecting a 100 L sample of water from the center of the lake and the pond. Samples were dipped with a calibrated, wide-mouth plastic pail and poured through a Wisconsin straining net (80 μm mesh), concentrated into glass-stoppered graduated cylinders, fixed with Lugol's solution and transferred into 4-oz. wide-mouth bottles.

Zooplankton were identified only as miscellaneous Protozoa, Rotataria or Copepoda (adult or nauplius). Specimens were identified and enumerated in a Sedgewick-Rafter counting cell following the method of Lind (Reference 26) using a combination of slide counts and strip counts at 100X magnification. Data were reported as number of organisms/L of lake water.

Phytoplankton were identified and enumerated using a Palmer counting cell at 400X magnification. In some cases all of the 0.05 ml counting cell was observed and in other cases 50 random fields were observed. Organisms were identified as dinoflagellates, filamentous green algae, single cell green

algae, yellow-green algae, desmids, and diatoms. Data were recorded as the number of cells/L of lake water. Classification followed that of Prescott (Reference 27).

Benthic samples for quantitative analysis were collected from four locations in the pond and the lake using a Ponar dredge. The four benthic samples from each water body were taken by starting near the shoreline and progressively moving into deeper water (sampling depths were 1-1/2 ft., 4 ft., 8 ft., and 12 ft. to 14 ft respectively). Shoreline samples were collected from areas with beds of rooted vegetation in an attempt to maximize the number of habitat types in order to obtain a more representative sample of the actual benthic diversity as a reflection of water quality and not a function of substrate conditions only. In addition, a random sample to be used in qualitative analysis was collected from the lake and the pond using a D-frame aquatic sweep net. The random sweep net sample was collected to supplement the dredge sample by capturing organisms capable of escaping capture by the Ponar dredge and those that would not normally be captured by the dredge due to particular habitat preferences.

All benthic samples were sieved through a #30 field screen, placed in liter bottles, preserved with 10% formalin in the field, stained with Biebrich Scarlet and Eosin B, and hand picked under illuminated magnification. Specimens from the quantitative samples were identified to the family level with exception of annelid worms, which were identified to the Class level (Oligochaeta). Specimens from qualitative samples were identified in a like manner but were not counted because only their presence was considered as important to the study. Nomenclature of the benthos followed Ward and Whipple (Reference 28).

Fish were collected using a 6 mm mesh net, 8 ft. by 20 ft. in size, along the shoreline up to a depth of approximately 4 ft. The lake and pond were sampled for approximately 30 min. each. Representative fish were preserved in a 10% formalin solution for later reference or voucher. Nomenclature for the fish and identification characteristics followed Douglas (Reference 29).

The results of the aquatic survey are summarized in Section 2.7.3.

6.1.5 PREOPERATIONAL RADIOLOGICAL MONITORING

6.1.5.1 Summary of Baseline Radiological Data

Samples were taken at the facility site in order to assess its pre-existing radiological conditions. The types, numbers, and locations of the samples taken are presented in Table 6.1-2 along with a brief synopsis of the radionuclides and activities found. The data presented here is not intended to be a substitute for a sound preoperational monitoring program, but to briefly characterize the site conditions prior to construction and initiation of the preoperational program.

6.1.5.2 Overview of the Preoperational Radiological Monitoring Program

Regulatory Guide 4.9 (Reference 1), "Preparation of Environmental Reports for Commercial Uranium Enrichment Facilities" was used as the primary reference for the development and implementation of the program. In accordance with Reference 1, the preoperational radiological monitoring program is described with the appropriate detail in the following text. The preoperational program will focus on collecting needed data to perform critical pathway analyses, including selection of nuclide/media combinations to be encompassed into the operational surveillance program. Identification of radionuclides will be performed using accurate and sensitive analytical equipment, as is technically appropriate. Data collection during this period will be planned to provide information for evaluating any future changes in environmental conditions, which might be caused by facility operation. This is essential for proper assessment of doses due to facility operation after onset of enrichment.

The preoperational program is designed to be more extensive than the operational program in order to provide this base of knowledge and also to anticipate changing conditions around the site as the facility is built, operated and eventually decommissioned. Environmental surveillance at the Louisiana Energy Services CEC is a major part of the radiological program in order to provide data to provide reasonable assurance of containment and effluent controls, to assess radiological impacts on site environs, to estimate potential impact on members of the public, and to determine compliance with applicable radiation protection standards. Surveillance will be initiated prior to the operation of the facility in order to provide preoperational (baseline) data and to adequately define the extent of site-specific terrestrial radioactivity.

6.1.5.3 Preoperational Radiological Monitoring Program

The Preoperational Radiological Monitoring Program will be initiated at least two years prior to the operation of the

enrichment facility to provide a sufficient database for comparison with the Operational Radiological Monitoring Program, and to provide experience that will improve the efficiency and quality of the Operational Radiological Monitoring Program.

Table 6.1-3 describes the Preoperational Radiological Monitoring Program. Table 6.1-4 lists the detection capabilities for environmental sample analysis. Program enhancements can be initiated and documented during the preoperational program or during the operational program.

Sections 6.1.5.3.1 through 6.1.5.3.3 describe the rationale behind the sample types chosen. The rationale presented is based on the data available at the time of this report. The rationale is subject to change as additional knowledge is discovered which would allow for improved and more efficient environmental monitoring, at a reasonable cost, so that the environment surrounding the facility is maintained in a safe and acceptable manner. During the implementation of the preoperational program, some samples may be unavailable or may be collected differently than specified. Additionally, some desired sampling sites may be on private property that facility personnel have not attained permission to use for sampling purposes. Under these circumstances, documentation shall be created to describe the rationale and actions behind the decisions. If a sampling location has frequent unavailable sample or deviations from the schedule, then one of the following shall be performed and documented: another location to be selected as its replacement, sampler repair/replacement or other appropriate actions shall be taken.

6.1.5.3.1 Atmospheric Radioactivity Monitoring

The air monitoring program will use the meteorological data from the Shreveport Meteorological Station from 1984 through 1988 (more recent meteorological data may be used as it becomes available). Plant design data, geographical data, Chi/Q values, D/Q values, land use data, radioactive inventory data, and projected radioactive effluent data are parameters that will be used to determine the expected deposition of airborne radioactivity to the environment around the facility as a result of operation. The background data will then be used to determine the committed effective dose equivalent (CEDE) attributed to facility operation.

The primary radioactive material that may be released is uranium, which has a short term for dispersal to the environment. The majority of the air monitoring sites are in the prevailing wind direction, based on historical data of frequency of wind speed and direction, and located within 1.0 mile of the facility. The sampling filters will entrain radioactive particles that may be deposited in the environment. The fraction of particles caught

by the filter will depend upon meteorological conditions that exist during the sampling period.

Air monitoring sites will be located as described in Table 6.1-3 and Table 6.2-1, for the preoperational and operational monitoring programs, respectively.

6.1.5.3.2 Hydrospheric Radioactivity Monitoring

Trace amounts of radioactive materials may be contained on the site within Bluegill Pond. Additionally, the Hold-Up Basin may contain small amounts of radioactivity from roof drains and other releases. In order to assess the amount of radioactivity released into the liquid pathway, surface water will be sampled from Bluegill Pond and the Hold-Up Basin on the site.

Ground water sampling will be based on available hydrology data. Although uranium has very low transport properties in soils and clays, sampling will be performed in order to assure protection of ground water aquifers and to document changes, if any, in natural background characteristics. Ground water will be sampled from at least one well on the site and at one residence/business (if available) less than two miles from the facility in a location where ground water could be potentially affected by operation of the facility.

6.1.5.3.3 Geospheric Radioactivity Monitoring

Soil sampling will be performed in the same prevailing wind directions (geographical sectors) as the air monitoring site locations and in areas that may be impacted by effluents. The areas impacted by effluents will be identified, as appropriate, as the program progresses and the operating characteristics of the facility are documented. This sampling will determine the amount of any trace amounts of radioactive material that may be deposited to the ground from plumes or other effluent streams from the facility that may contain radioactive material.

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TABLE 6.1-2

SUMMARY OF RADIOLOGICAL CONDITIONS FOUND AT THE CLAIBORNE PARISH ENRICHMENT SITE WHEN SCREENING MEASUREMENTS WERE PERFORMED PRIOR TO THE PREOPERATIONAL RADIOLOGICAL MONITORING PROGRAM

Sample Type Collected	# Samples Collected	Nuclides Identified	Activity Range	Activity Mean
Airborne Radioiodines	4	none (a)	(b)	(b)
Airborne Particulates	4	none (a)	(b)	(b)
Broad Leaf Vegetation	12	Cs-137 (a)	(c)	115 pCi/kg
Surface Water	21	none (a)	(b)	(b)
Ground Water	15	none (a)	(b)	(b)
Sediment	16	Cs-137 (a,d)	64-4534	1044 pCi/kg
Soil	38	Cs-137 (a,e)	133-1123	698 pCi/kg
Direct Radiation (f)	37	none	0.006-0.015	0.010

Footnotes to Table 6.1-2:

(a) Gamma spectroscopy analysis only.

(b) No nuclides identified, therefore no activity ranges or means exist.

(c) No range exists because only one sample was determined to have activity.

(d) Positive identification of Cs-137 was made in 16 of 16 samples.

(e) Positive identification of Cs-137 was made in 24 of 38 samples.

(f) Direct radiation measured with thermoluminescent dosimeters. Data in mR/hour.

TABLE 6.1-3

PREOPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Pathway/ Sample type (a)	Samples and Locations	Sampling and collections (b,c)
Airborne Particulate (d)	AP1 - One sample located in the sector with the highest prevailing wind direction. To be located in the area with the highest Chi/Q for that sector near the site boundary.	Air sampler with a particulate filter, operating continuously and collected weekly.
	AP2 - One sample located in the sector with the second highest prevailing wind direction. To be located in the area with the highest Chi/Q for that sector near the site boundary.	
	AP3 - One sample located near the resident who is maximally exposed from the gaseous pathway.	
	AP4 - One sample located in the west sector. To be located near the site boundary corresponding to the highest Chi/Q in that sector.	
	AP5 - One sample located in the east sector near the site boundary corresponding to the highest Chi/Q in that sector.	
	AP6 - One sample located in the south sector near the site boundary, corresponding to the highest Chi/Q in that sector. If this sector is already represented by another air sampling site corresponding to the AP1 through AP4 sites above, then site AP7 is not needed.	

TABLE 6.1-3 (CONTINUED)

PREOPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Pathway/ Sample type (a)	Samples and Locations	Sampling and collections (b,c)
	AP7 - One sample located in the north sector near the site boundary, corresponding to the highest Chi/Q in that sector. If this sector is already represented by another air sampling site corresponding to the AP1 through AP4 sites above, then site AP8 is not needed.	
Airborne/ Soil (e,f)	S1-S16 - Samples to be collected near the site boundary in each sector. One sample per site.	Collected quarterly. Combine samples from sixteen sectors into four composites as described in footnote f.
Airborne/ Vegetation (f,g)	V1-V16 - Samples to be collected near the site boundary in each sector. One sample per site.	Collected quarterly. Combine samples from sixteen sectors into four composites as described in footnote f.
Liquid/ Ground Water (h)	GW1 - Same as chemistry well # A1.	Grab samples to be collected quarterly.
	GW2 - Same as chemistry well # B1.	
	GW3 - Same as chemistry well # C1.	
	GW4 - Same as chemistry well # D1.	
	GW5 - Same as chemistry well # E1.	

TABLE 6.1-3 (CONTINUED)

PREOPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Pathway/ Sample type (a)	Samples and Locations	Sampling and collections (b,c)
	GW6 - Same as chemistry well # F1.	
Liquid/ Shoreline Sediment (i)	SS1 - To be collected near the outflow of Bluegill Pond.	Grab samples to be collected quarterly. Combine samples from sixteen sectors into four composites as described in footnote f.
	SS2 - To be collected near the inflow of Bluegill Pond from the Hold-Up Basin.	
	SS3 - To be collected near the south shore of Bluegill Pond.	
	SS4 - To be collected near the north shore of Bluegill Pond.	
	SS5 - To be collected near surface water site SW12 at Lake Claiborne.	
Liquid/ Bottom Sediment (i)	BS1 - To be collected from the east end of Bluegill Pond.	Grab samples to be collected quarterly. Combine samples from sixteen sectors into four composites as described in footnote f.
	BS2 - To be collected from the center of Bluegill Pond.	
	BS3 - To be collected from the west end of Bluegill Pond.	
	BS4 - To be collected from the center of the Hold-Up Basin.	
	BS5 - To be collected near surface water site SW12 at Lake Claiborne.	

TABLE 6.1-3 (CONTINUED)

PREOPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Pathway/ Sample type (a)	Samples and Locations	Sampling and collections (b,c)
Liquid/ Surface Water (h)	SW1 - Inflow to Lake Avalyn. Same location as chemistry surface water location #1. This is the control location. SW5 - Inflow to Bluegill Pond. Same location as chemistry surface water location #5. SW6 - Bluegill Pond, near the center. Same as chemistry surface water location #6a. SW7 - Outflow from Bluegill Pond. Same as chemistry surface water location #7. SW8 - Site drainage stream. Same as chemistry surface water location #8. SW9 - Outflow at the western property boundary. Same chemistry surface water location #9. SW11 - Hold-Up Basin. Take sample from center of basin. No corresponding chemistry location. SW12 - Lake Claiborne. Take sample at inflow point of Cypress Creek. No corresponding chemistry surface water location.	Grab samples collected quarterly. Locations correspond to those shown on Figure 2.5-10 for chemistry surface water collections. Note that some chemistry sites are not needed in the radiological sampling.

TABLE 6.1-3 (continued)

PREOPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM footnotes

(a) This table presents an acceptable minimum program for a site at which each entry is applicable. The program may be enhanced at any time. The code letters in parenthesis (i.e., AP1, SW2) provide one way of defining generic sample locations and can be used to identify the specific locations during the designation of each sample site.

(b) Sufficient volumes of samples will be collected when available, using accurate sample collection methods to ensure the attainment of Lower Limits of Detecting as specified in Table 6.1-4.

(c) Samples collected will be sent to an appropriate laboratory for analysis via a reliable shipping organization. A sample transmittal form will accompany the samples. Samples will be packaged in a manner to ensure the integrity of each during transit. Perishable samples shall be refrigerated as soon as possible by the receiving laboratory. Samples requiring analysis as a composite will be stored in a manner to ensure the integrity of the sample until the composite analysis has been performed.

(d) Air particulate samples will be collected on filters attached to continuously operating air samplers. To be analyzed for gross alpha, gross beta, and isotopic uranium as detailed here. Gross alpha and gross beta analyses shall be performed weekly on each sample. Isotopic uranium analyses shall be performed on quarterly composites of the filters from each site - the composites shall be done on a by-site basis (i.e., all AP1 sites together, all AP4 sites together, etc.). Sites AP1 and AP2 require more stringent lower limits of detection as shown in Table 6.1-4.

(e) Soil samples will be collected using scoops, shovels, etc. as appropriate. Collect the top surface of the soil, not to reasonably exceed a depth of two to four inches.

(f) Sectors shall be combined thusly:

Composite 1 = sectors N, NNE, NE
Composite 2 = sectors E, SSE, SE
Composite 3 = sectors S, SSW, SW
Composite 4 = sectors W, NNW, NW

TABLE 6.1-3 (continued)

PREOPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
footnotes

(g) Representative vegetation samples will be obtained as they are available (seasonal variations may occur). If no vegetation sample is available, obtain the sample at a location as near as possible (within the same sector) to the designated site. To be analyzed for gross alpha and gross beta. Isotopic uranium analyses to be performed on quarterly composites of vegetation from the same site. Vegetation maintained for the quarterly composites shall be preserved to preserve the integrity of the sample (i.e., frozen).

(h) Water samples will be collected using water collection buckets, bottles, pumps, etc. and stored in clean containers. To be analyzed for gross alpha and gross beta. Isotopic uranium analyses to be performed on annual composites of waters from the same site.

(i) Sediments will be collected using a device that will gather the top surface of the sediment, not to reasonably exceed a depth of six to eight inches. To be analyzed for gross alpha and gross beta. Isotopic uranium analyses to be performed on annual composites of sediment from the same site.

NOTE: The number, media, frequency, and location of samples may be enhanced to reflect the facility's operating history and other information. Any modifications to the program shall be documented.

TABLE 6.1-4

LOWER LIMITS OF DETECTION (LLD) FOR RADIOLOGICAL ENVIRONMENTAL MONITORING ANALYSES

NUCLIDE	WATER (µCi/ml) (a)	AIR (µCi/ml) (b)	SOIL/ SEDIMENT (µCi/g) (c)	VEGETATION (µCi/g) (d)
gross alpha (e,f)	1.0E-12	1.0E-18	3.0E-7	1.0E-10
gross beta (g)	1.0E-12	1.0E-18	3.0E-7	1.0E-10
U-total (h)	1.0E-12	1.0E-18	3.0E-7	1.0E-10

(a) Uranium LLD's for water are based upon a fraction of the 10CFR20 Appendix B Table 2, Column 2 limit for D compounds (3E-7 µCi/ml) and also upon the expected effluent concentration encountered in the environment. The LLD is designed to be low enough to allow detection of very minute amounts of radioactivity to provide information on both background levels during the preoperational program and also to assess the operation of the facility. The limit in Appendix B is based upon ingestion of water of 7.3E7 ml per year at the listed concentration - this would result in a committed dose of 50 mrem. The LLD is 1/3E5 of the limit for each nuclide. Therefore if the water ingested contained each of the above uranium nuclides at 1.0E-9 µCi/ml, the CEDE received would be no greater than 1/E5 of the limit.

(b) Uranium LLD's for air are based upon a fraction of the 10CFR20 Appendix B Table 2, Column 1 limit for D compounds (3E-12 µCi/ml) and also upon the expected effluent concentration encountered in the environment. The LLD is designed to be low enough to allow detecting of very minute amounts of radioactivity to provide information on both background levels during the preoperational program and also to assess the operation of the facility. The limit in Appendix B is based upon continuous breathing of air with the listed concentration - this would result in a committed dose of 50 mrem. The LLD is 1/3E5 of the limit for each nuclide. Therefore if the air breathed contained each of the above uranium nuclides at 1.0E-17 µCi/ml, the CEDE received would be no greater than 1/1E5 of the limit.

TABLE 6.1-4 (continued)

LOWER LIMITS OF DETECTION (LLD)
FOR RADIOLOGICAL ENVIRONMENTAL MONITORING ANALYSES

(c) Uranium LLD's for soil/sediment are based upon a fraction of the 30 pCi/g uranium above background decommissioning limit for facilities. The LLD listed above corresponds to 1/100 of the 30 pCi/g limit and provides reasonable assurance that activities deposited in the environment due to facility operation can be detected and trended. Soil and sediment are to be analyzed on a dry weight basis.

(d) Uranium LLD's for vegetation are based upon ingestion of 190 kg/year vegetation (Regulatory Guide 1.109) containing 1 pCi/kg uranium yielding approximately 2.5E-2 mrem to adult bone. This is the most restrictive of the ingestion pathway - committed dose equivalents to other organs and to all other age groups are less than the estimated 2.5E-2 mrem above. Vegetation is to be analyzed on a wet weight basis.

(e) Gross alpha LLD for air is based upon a fraction of the 10CFR20 Appendix B Table 2, Column 1 limit given for mixtures if Ac-227-D,W,Y, Th-229-W,Y, Th-232-W,Y, Pa-231-W,Y, Cm-248-W, and Cm-250-W are not present. The gross alpha LLD is also based upon projected release data as described in footnote (a). The limit in Appendix B (1.0E-14 µCi/ml) is based upon continuous breathing of air with the listed concentration - this would result in a committed dose of 50 mrem. The LLD is based upon the limit for the mixture of nuclides listed in this footnote. Therefore if the air breathed contained activity at the activity of 1.0E-17 µCi/ml, the CEDE received would be no greater than 1/1E5 of the limit or 5E-4 mrem.

(f) Gross alpha LLD for water is based upon a fraction (1/100) of the 10CFR20 Appendix B Table 2 limit given for uranium-238, -235, and -234 nuclides. The gross alpha LLD is also based upon projected release data as described in footnote (a). No limit is given for mixtures of uranium nuclides in a liquid in Appendix B, therefore the most restrictive value (3E-7 µCi/ml) has been selected as the basis for the LLD. If the water ingested contained a mixture of the above uranium nuclides that totaled 1.0E-12 µCi/ml, the committed dose received would be no greater than 1.1E5 of the limit or 5E-4 mrem.

(g) Gross beta LLD's for air and water have similar bases as described in footnotes (e) and (f) of this table.

TABLE 6.1-4 (continued)

LOWER LIMITS OF DETECTION (LLD) FOR RADIOLOGICAL ENVIRONMENTAL MONITORING ANALYSES

(h) The uranium LLD is based upon assuming all uranium in the sample is uranium-234. If isotopic uranium analyses is desired instead of total uranium, then the LLD for each uranium compound would equal those listed for the total uranium. The LLD is based upon both a fraction of the 10CFR20 Appendix B Table 2 limit given for the uranium-238, -235, and -234 nuclides and on the calculated effluent concentrations expected at the sampling sites. The LLD will allow the analyses to be sensitive enough to detect small changes in the radiological characteristics of the site.

NOTE: These values apply for UF6 originating from non-reprocessed fuel.

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6.2 OPERATIONAL MONITORING

The baseline studies discussed in Section 6.1 provide initial data necessary to determine the physical, chemical, and biological variables which are likely to be affected by CEC construction and operation.

The proposed monitoring program for CEC operation is outlined in this section.

6.2.1 OPERATIONAL RADIOLOGICAL MONITORING PROGRAM

6.2.1.1 Effluent Monitoring Systems

Comparisons of effluent data to environmental data will be performed as determined by release data. Under routine operating conditions, no significant activity should be released from the facility and this should be confirmed by environmental data. If an accidental release of uranium should occur, then the environmental data can be used to help assess the extent of the release.

6.2.1.2 Environmental Monitoring Program

The Preoperational Radiological Monitoring Program (Section 6.1.5) will be superseded by the Operational Radiological Monitoring Program (outlined in Table 6.2-1) at the time the facility receives its first shipment of uranium hexafluoride.

The rationale for the operational radiological monitoring program is similar to the preoperational monitoring program (see Sections 6.1.5.3.1 through 6.1.5.3.3). The frequency of some types of samples will be reduced as compared to the preoperational program since the goal of establishing a significant baseline will have been accomplished. The operational program is designed to use the same Lower Limits of Detection (LLD's) as the preoperational program. The operational sampling program may be enhanced as it is implemented so that monitoring data will be reliable without incurring unnecessary work.

Action and reporting levels for radioactivity in environmental samples have been established. These values are listed in Tables 6.2-2 and 6.2-3.

As construction work at the uranium enrichment plant proceeds, changing conditions (e.g., regulatory, site characteristics - both radiological and non-radiological, technology, etc.) and new knowledge may require that the operational monitoring program be reviewed and updated. Such review would be performed when environmental data indicate a positive significant trend with respect to radionuclide activities. Minute increases and/or decreases in activity are indicative of background fluctuations

and would not initiate an investigation.

During the implementation of the operational program, some samples may be collected differently than specified. Under these circumstances, documentation shall be created to describe what was done and the rationale behind the decisions. If a sampling location has frequent unavailable samples or deviations from the schedule, then another location can be selected or other appropriate actions taken.

Each year, the licensee will submit a summary of the environmental sampling program and the associated data (e.g., data required by 10CFR70.59) to the proper regulatory authorities. This summary will include the types, numbers, and frequencies of samples collected and the identities and activities of nuclides found in the samples that can be reasonably attributed to facility operation.

6.2.2 PHYSICAL AND CHEMICAL MONITORING

6.2.2.1 Effluent Monitoring System

Specific information regarding the source and characteristics of all non-radiological plant wastes that will be collected and disposed of offsite, or discharged in various effluent streams is provided in Section 7.2 of the Safety Analysis Report (SAR). Chemical constituent quantities which will be discharged to the natural environment in facility effluents will be below concentrations which have been established by State and Federal regulatory agencies as protective of human health and the natural environment.

6.2.2.1.1 Surface Water Monitoring Program

Surface water samples have been collected at several locations within and outside the plant site and analyzed to establish site "baseline" water quality conditions. Baseline sample collection locations and tabulated physiochemical data are presented in Section 2.5.

Prior to initiation of facility operation, and continuing on a quarterly basis thereafter throughout the life of the plant, additional water samples will be collected, analyzed and compared to the baseline data to monitor any impact the facility operations might have on surface water quality. Locations where surface water samples will be collected on a quarterly basis during facility operation are shown in Figure 6.2-1. A list of the physiochemical parameters which will be analyzed along with the analytical methodologies for each is presented in Table 6.2-3.

6.2.2.1.2 Groundwater Monitoring Program

Chemical measurements of the shallow onsite groundwaters and the deep sparta aquifer zone underlying the site have been made to establish "baseline" groundwater quality conditions of the facility site. Collection locations and tabulations of this baseline information are presented in Section 2.5.

Prior to facility operation and continuing on a quarterly basis thereafter throughout the life of the plant; additional groundwater samples will be collected, analyzed and compared to the baseline data to monitor any impact facility operations might have on groundwater quality. Locations where both shallow groundwater and Sparta Aquifer groundwater samples will be collected on a quarterly basis during operation are shown in Figure 6.2-2. A list of parameters which will be analyzed in groundwater samples plus the analytical methodologies for each is presented in Table 6.2-5.

6.2.2.1.3 Stormwater Monitoring Program

The stormwater monitoring program will be initiated during construction of the facility. Stormwater monitoring during facility construction will be conducted annually and used to evaluate the effectiveness of measures taken to prevent the contamination of stormwater and to retain sediments within property boundaries. The hold-up basin will be used as a sediment detention basin during construction and the construction phase stormwater monitoring will be conducted at the discharge from the hold-up basin to Bluegill Pond.

Stormwater monitoring will continue with monitoring frequency increased to quarterly upon initiation of facility operation. Operational phase monitoring will be conducted upstream of the hold-up basin in order to demonstrate that runoff does not contain pollutants which would result in the creation of contaminated sediments in the hold-up basin. A list of parameters to be monitored and monitoring frequencies are presented in Table 6.2-6. This monitoring program is based upon the requirements contained in EPA's proposed rule, NPDES General Permits and Reporting Requirements for Storm Water Discharges Associated With Industrial Activity, published in the Federal Register August 16, 1991.

6.2.2.2 Environmental Monitoring

The purpose of this Section is to describe the operational surveillance monitoring program which will be employed by the Claiborne Enrichment Center (CEC) to measure non-radiological chemical impacts upon the natural environment.

The ability of both regulatory agencies and CEC operational personnel to detect as well as correct any potentially adverse chemical releases from the facility to the environment will rely on chemistry data which will be collected as part of the monitoring programs described in the preceding Section 6.2.2.1. Data acquisition from these programs encompasses both on and off-site sample collection locations and chemical element/compound analyses commonly mandated by Federal and State National Pollution Discharge Elimination System (NPDES) compliance programs.

The range of chemical surveillance and analytical sensitivity incorporated into all the planned effluent monitoring programs for the facility should be sufficient to predict any relevant chemical interactions in the environment related to plant operations. In addition, to insure the facilities operation will have no environmental impact, the CEC intends to limit chemicals in all facility effluents to levels below those prescribed by State of Louisiana and the USEPA, as being protective of human health and the natural environment.

6.2.3 METEOROLOGICAL MONITORING

This Section provides details of the program designed to monitor meteorological phenomena during plant operation, in accordance with the specifications listed in Regulatory Guide 1.23 for onsite meteorological programs (Reference 1). This monitoring network will be adequate to evaluate the atmospheric dispersion at the site for both normal and accident conditions.

The terrain in and around the facility is relatively flat which makes it possible to obtain characteristic meteorological information for the entire site from a single instrument tower. Based on site inspections and facility plot plans, the tower location which provides the most accurate and representative measurements of required meteorological data is to the south of the plant (see Figure 6.2-3). This location was selected so that the tower would be far enough from facility structures to minimize their impacts on the wind distribution. In addition, the meteorological characterization for the site area presented in Section 2.6 indicates that the wind blows predominantly from the south, therefore, the building structures will have no significant impact on the predominant winds. The tower base will be located at approximately the same elevation as the finish grade for the facility structures.

All instruments selected for use in the meteorological monitoring program will meet or exceed the performance specifications outlined in Regulatory Guide 1.23 (Reference 1). The instruments listed in the following discussion may be replaced by other models, but the replacements will have equal or better performance specifications.

Wind speed will be measured using the Met One 014A Wind Speed Sensor. This instrument records wind speeds in the 0 to 100 mph range with a starting threshold of 1 mph. It is accurate to ±0.25 mph or 1.5% and has a standard distance constant of less than 15 ft. and an optional fast response distance constant of less than 5 ft. Wind direction will be measured using the Met One 024A Wind Direction Sensor. This 3-cup anemometer has a starting threshold of 1 mph and an accuracy of ±0.5 mph. Both sensors will operate in temperatures from -50 C to +70 C.

Onsite temperature will be monitored using the Met One 060A Ambient Temperature Sensor (Dash No -2). Temperature difference (which will be used to estimate atmospheric stability) will be measured using the Met One 062A Air Temperature Difference Sensor. Both sensors operate in the ambient range of -50 C to +50 C to an accuracy of 0.1 C. There is no self heating of the sensors and the time constant is 10 sec. in still air. Both the air temperature sensor and the air temperature difference sensor will be shielded from solar radiation effects using the Met One 076B model radiation shield. This shield operates in temperatures ranging from -50 C to +85 C. Radiation error is less than 0.05 F under a maximum solar radiation of 1.6 gm-cal/cm^2/min.

The monitoring instruments listed above will be connected to the Met One 451L data recorder via a Met One model 104 translator for signal conditioning. The 451L model is an intelligent datalogger designed for environmental monitoring. Data are sampled once every 10 sec., and averages are built upon the individual samples. Built-in firmware provides for vector/scalar averaging, which is then recorded on a removable magnetic cartridge. The datalogger output also will be directed to digital display units, which will provide real-time displays of ambient temperature, wind speed, and direction. In addition, analog recorders will also be used for temperature difference and wind speed and direction as backup to the digital equipment.

The monitored data will be transferred from the magnetic cartridge to a computer for data manipulation. Hourly averages of wind speed, direction, ambient temperature, and temperature difference will be compiled and then used to produce joint frequency distributions of wind speed and direction as a function of atmospheric stability on a monthly basis. The monthly data will be used to construct an annual joint frequency distribution at the end of each calendar year.

The accuracy of the meteorological monitoring program will be insured through the use of scheduled instrument calibrations and servicing. Instrument calibrations will be accomplished at least semiannually using precision internal reference sources. The servicing schedule will be in accordance with the manufacturers recommendations, or as needed for unscheduled maintenance due to

equipment failure. The program for instrument maintenance and servicing combined with the redundant data recorders will assure at least a 90% data recovery.

6.2.4 BIOTA

The procedures used to characterize the plant, bird, aquatic, mammalian, and amphibian/reptilian communities of the proposed site during preoperational monitoring are regarded as appropriate for the operational monitoring program. Operational monitoring surveys also will be conducted quarterly (except annually for amphibians/reptiles) using the same sampling sites established during the preoperational monitoring program.

These surveys should be sufficient to characterize gross changes in the composition of the vegetation or avian, aquatic, mammalian, and amphibian/reptilian communities of the site associated with operation of the facility plant. Interpretation of operational monitoring results, however, must consider those changes that would be expected at the proposed site as a result of natural successional processes. Plant communities at the site, particularly those that were clearcut in 1990, will continue to change as forests regenerate and begin to mature. Changes in the bird community are likely to occur concomitantly in response to the changing habitat.

REFERENCES FOR SECTION 6.2

1. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.23, On-site Meteorological Programs (Safety Guide 23), February 1972.

TABLE 6.2-1

SUMMARY OF ENVIRONMENTAL RADIOLOGICAL MONITORING SAMPLING SITES - OPERATIONAL PROGRAM

Pathway/ Sample type (a)	Samples and Locations	Sampling and collections (b,c)
Airborne Particulate (d)	AP1 - One sample located in the sector with the highest prevailing wind direction. To be located in the area with the highest Chi/Q for that sector near the site boundary.	Air sampler with a particulate filter, operating continuously and collected weekly.
	AP2 - One sample located in the sector with the second highest prevailing wind direction. To be located in the area with the highest Chi/Q for that sector near the site boundary.	
	AP3 - One sample located near the resident who is maximally exposed from the gaseous pathway.	
	AP4 - One sample located in the west sector. To be located near the site boundary corresponding to the highest Chi/Q in that sector.	
	AP5 - One sample located in the east sector near the site boundary, corresponding to the highest Chi/Q in that sector.	
	AP6 - One sample located in the south sector near the site boundary, corresponding to the highest Chi/Q in that sector. If this sector is already represented by another air sampling site corresponding to the AP1 through AP4 sites above, then site AP7 is not needed.	

TABLE 6.2-1 (continued)

SUMMARY OF RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLING SITES - OPERATIONAL PROGRAM

Pathway/ Sample type (a)	Samples and Locations	Sampling and collections (b,c)
	AP7 - One sample located in the north sector near the site boundary, corresponding to the highest Chi/Q in that sector. If this sector is already represented by another air sampling site corresponding to the AP1 through AP4 sites above, then site AP8 is not needed.	
Airborne/ Soil (e,f)	S1-S16 - Samples to be collected near the air boundary in each sector. One sample per site.	Collected semi-annually. Combine samples from sixteen sectors into four composites as described in footnote f.
Airborne/ Vegetation (f,g)	V1-V16 - Samples to be collected near the site boundary in each sector. One sample per site.	Collected semi-annually at the same time as soil sample collection. Combine samples from sixteen sectors into four composites as described in footnote f.
Liquid/ Ground Water (h)	GW1 - Same as chemistry well # A1. GW2 - Same as chemistry well # B1. GW3 - Same as chemistry well # C1. GW4 - Same as chemistry well # D1. GW5 - Same as chemistry well # E1.	Grab samples to be collected semi-annually.

TABLE 6.2-1 (continued)

SUMMARY OF RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLING SITES - OPERATIONAL PROGRAM

Pathway/ Sample type (a)	Samples and Locations	Sampling and collections (b,c)
	GW6 - Same as chemistry well # F1.	
Liquid/ Shoreline Sediment (i)	SS1 - To be collected near the outflow of Bluegill Pond. SS2 - To be collected near the inflow of Bluegill Pond from the Hold-Up Basin. SS3 - To be collected near the south shore of Bluegill Pond. SS4 - To be collected near the north shore of Bluegill Pond. SS5 - To be collected near surface water site SW12 at Lake Claiborne.	Grab samples to be collected semi-annually. Combine samples from sixteen sectors into four composites as described in footnote f.
Liquid/ Bottom Sediment (i)	BS1 - To be collected from the east end of Bluegill Pond. BS2 - To be collected from the center of Bluegill Pond. BS3 - To be collected from the west end of Bluegill Pond. BS4 - To be collected from the center of the Hold-Up Basin. BS5 - To be collected near surface water location SW12 at Lake Claiborne.	Grab samples to be collected semi-annually. Combine samples from sixteen sectors into four composites as described in footnote f.

TABLE 6.2-1 (continued)

SUMMARY OF RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLING SITES - OPERATIONAL PROGRAM

Pathway/ Sample type (a)	Samples and Locations	Sampling and collections (b,c)
Liquid/ Surface Water (h)	SW1 - Inflow to Lake Avalyn. Same location as chemistry surface water location #1. This is the control location. SW5 - Inflow to Bluegill Pond. Same location as chemistry surface water location #5. SW6 - Bluegill Pond, near the center. Same as chemistry surface water location #6a. SW7 - Outflow from Bluegill Pond. Same as chemistry surface water location #7. SW8 - Site drainage stream. Same as chemistry surface water location #8. SW9 - Outflow at the western property boundary. Same chemistry surface water location #9. SW11 - Hold-Up Basin. Take sample from center of basin. No corresponding chemistry location. SW12 - Lake Claiborne. Take sample at inflow point of Cypress Creek. No corresponding chemistry surface water location.	Collected continuously via integrating water sampling equipment. Obtain monthly composites of integral water samples. Locations correspond to those shown on Figure 2.5-10 for chemistry surface water collections. Note that some chemistry sites are not needed in the radiological sampling.

TABLE 6.2-1 (continued)

SUMMARY OF RADIOLOGICAL ENVIRONMENTAL MONITORING
SAMPLING SITES - OPERATIONAL PROGRAM
footnotes

(a) This table presents an acceptable minimum program for a site at which each entry is applicable. The program may be enhanced at any time. The code letters in parenthesis (i.e., AP1, SW2) provide one way of defining generic sample locations and can be used to identify the specific locations during the designation of each sample site.

(b) Sufficient volumes of samples will be collected when available, using accurate sample collection methods to ensure the attainment of Lower Limits of Detecting as specified in Table 6.1-4.

(c) Samples collected will be sent to an appropriate laboratory for analysis via a reliable shipping organization. A sample transmittal form will accompany the samples. Samples will be packaged in a manner to ensure the integrity of each during transit. Perishable samples shall be refrigerated as soon as possible by the receiving laboratory. Samples requiring analysis as a composite will be stored in a manner to ensure the integrity of the sample until the composite analysis has been performed.

(d) Air particulate samples will be collected on filters attached to continuously operating air samplers. To be analyzed for gross alpha, gross beta, and isotopic uranium as detailed here. Gross alpha and gross beta analyses shall be performed weekly on each sample. Isotopic uranium analyses shall be performed on quarterly composites of the filters from each site - the composites shall be done on a by-site basis (i.e., all AP1 sites together, all AP4 sites together, etc.). Sites AP1 and AP2 require more stringent lower limits of detection as shown in Table 6.1-4.

(e) Soil samples will be collected using scoops, shovels, etc. as appropriate. Collect the top surface of the soil, not to reasonably exceed a depth of two to four inches.

(f) Sectors shall be combined thusly:

Composite 1 = sectors N, NNE, NE
Composite 2 = sectors E, SSE, SE
Composite 3 = sectors S, SSW, SW
Composite 4 = sectors W, NNW, NW

TABLE 6.2-1 (continued)

SUMMARY OF RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLING SITES - OPERATIONAL PROGRAM footnotes

(g) Representative vegetation samples will be obtained as they are available (seasonal variations may occur). If no vegetation sample is available, obtain the sample at a location as near as possible (within the same sector) to the designated site. To be analyzed for gross alpha and gross beta. Isotopic uranium analyses to be performed on quarterly composites of vegetation from the same site. Vegetation maintained for the quarterly composites shall be preserved to preserve the integrity of the sample (i.e., frozen).

(h) Water samples will be collected using water collection buckets, bottles, pumps, etc. and stored in clean containers. To be analyzed for gross alpha and gross beta. Isotopic uranium analyses to be performed on annual composites of waters from the same site.

(i) Sediments will be collected using a device that will gather the top surface of the sediment, not to reasonably exceed a depth of six to eight inches. To be analyzed for gross alpha and gross beta. Isotopic uranium analyses to be performed on annual composites of sediment from the same site.

NOTE: The number, media, frequency, and location of samples may be enhanced to reflect the facility's operating history and other information. Any modifications to the program shall be documented.

TABLE 6.2-2

ACTION LEVELS FOR RADIOLOGICAL ENVIRONMENTAL ANALYSES (a,b)

NUCLIDE	WATER (μCi/ml)	AIR (μCi/ml)	SOIL/SEDIMENT (μCi/g)	VEGETATION (μCi/g)
gross alpha	3.0E-10	3.0E-15	5.0E-6	1.0E-8
gross beta	3.0E-10	3.0E-15	5.0E-6	1.0E-8
U234 (c)	3.0E-10	3.0E-15	5.0E-6	1.0E-8

(a) Activity above background levels for the CEC site. Background levels will be established during the preoperational program. If no background data exists, then steps should be taken to obtain data either by analyzing additional samples or other appropriate mechanisms.

(b) If an action level has been exceeded, then an investigation should be conducted by facility personnel or their designees. If a gross alpha action level has been exceeded, then isotopic analysis of that sample is warranted. This investigation shall be documented and maintained in the facility's permanent files associated with the radiological environmental monitoring program. No reporting to regulatory authorities is required.

(c) The action level for uranium (total) is the same as for uranium-234.

NOTE 1: A gross alpha activity that exceeds the action level for gross alpha indicates the need for isotopic analysis of that sample.

NOTE 2: These values apply for UF6 originating from non-reprocessed fuel.

TABLE 6.2-3

REPORTING LEVELS FOR RADIOLOGICAL ENVIRONMENTAL ANALYSES (a,b)

NUCLIDE	WATER (μCi/ml)	AIR (μCi/ml)	SOIL/SEDIMENT (μCi/g)	VEGETATION (μCi/g)
gross alpha	3.0E-9	3.0E-14	5.0E-05	5.0E-7
gross beta	3.0E-9	3.0E-14	5.0E-5	5.0E-7
U234 (c)	3.0E-9	3.0E-14	5.0E-5	5.0E-7

(a) Activity above background levels for the CEC site. Background levels will be established during the preoperational program. If no background data exists, then steps should be taken to obtain data either by analyzing additional samples or other appropriate mechanisms.

(b) Reporting levels are based upon a CEDE being no greater than 1/100 of the 10 CFR 20 dose equivalent limit (50 mrem), 1/50 the EPA dose equivalent limit (25 mrem), and 1/30 the EPA drinking water activity limit for uranium (30 pCi/l). If water or air is ingested/inhaled for one year at these concentrations, the corresponding CEDE is 0.5 mrem. Attainment of a reporting level does not indicate a violation of regulations or any adverse effects attributable to the population or the environment, but is a warning that processing systems in the facility may need review and/or modification. If activity in a sample is equal to or greater than the listed reporting level, a summary of the event and corrective action shall be made in the annual environmental operating report. Implementation of corrective actions and all supporting documentation shall be retained on file for the life of the facility.

(c) Reporting levels are based upon the decommissioning limit of 30 pCi/g of uranium above background. The reporting level listed here is a fraction (1/10) of the limit in order to provide the CEC facility with a warning and action level with regard to uranium concentration in the soil. To be done on a dry weight basis.

TABLE 6.2-3 (continued)

REPORTING LEVELS FOR RADIOLOGICAL ENVIRONMENTAL ANALYSES (a,b)

(d) Reporting levels for vegetation are based upon ingestion of 190 kg/year vegetation (Regulatory Guide 1.109) containing 10 pCi/kg uranium yielding approximately 2.5E-1 mrem to adult bone. This is the most restrictive of the ingestion pathway - dose equivalents to other organs and the CEDE to all other age groups are less than the estimated 2.5E-1 mrem above. To be done on a wet weight basis.

NOTE 1: A gross alpha activity that exceeds the action level for gross alpha indicates the need for isotopic anlaysis of that sample.

NOTE 2: These values apply for UF6 originating from non-reprocessed fuel.

TABLE 6.2-4

SURFACE WATER CHEMISTRY MONITORING PROGRAM

Physiochemical Measurement	Analytical Methodology
pH	Electrode
Conductivity	Electrical Conductance
Transparency	Secchi Disk
Turbidity	Nephelometric
Total Suspended Solids	Gravimetric
Dissolved Oxygen	Probe
Alkalinity	Potentiometric Titration
Calcium	AA/ICP
Magnesium	AA/ICP
Potassium	AA/ICP
Sodium	AA/ICP
Chloride	Colorimetric
Fluoride	Colorimetric
Hardness ($CaCo_3$)	Equivalency Calculation
Silver	AA/ICP
Beryllium	AA/ICP
Antimony	AA/ICP
Zinc	Cold Vapor AA
Thallium	AA/ICP
Arsenic	AA/ICP
Selenium	Colorimetric
Cadmium	AA/ICP
Chromium	AA/ICP
Copper	AA/ICP
Nickel	AA/ICP
Lead	AA/ICP
Sulfate	Turbidometric
Total Organic Carbon	TOC Analyzer
Nitrite & Nitrate Nitrogen	Colorimetric
Ammonia Nitrogen	Colorimetric
Total Phosphorus	Colorimetric

Abbreviations - AA = Atomic Absorption Spectrophotometry
- ICP = Inductively Coupled Plasma - Atomic Emission Spectroscopy
- Probe = Specific Ion Probe

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TABLE 6.2-5

GROUNDWATER WATER CHEMISTRY MONITORING PROGRAM

Physiochemical Measurement	Analytical Methodology
Temperature	Thermistor Thermometer
pH	Electrode
Conductivity	Electrical Conductance
Total Suspended Solids	Gravimetric
Total Solids	Gravimetric
Total Alkalinity	Potentiometric Titration
Calcium	AA/ICP
Magnesium	AA/ICP
Potassium	AA/ICP
Sodium	AA/ICP
Chloride	Colorimetric
Fluoride	Colorimetric
Hardness ($CaCo_3$)	Equivalency Calculation
Silver	AA/ICP
Beryllium	AA/ICP
Antimony	AA/ICP
Zinc	Cold Vapor AA
Thallium	AA/ICP
Arsenic	AA/ICP
Selenium	Colorimetric
Cadmium	AA/ICP
Chromium	AA/ICP
Copper	AA/ICP
Nickel	AA/ICP
Lead	AA/ICP
Sulfate	Turbidometric
Total Organic Carbon	TOC Analyzer
Nitrite & Nitrate Nitrogen	Colorimetric

Abbreviations - AA = Atomic Absorption Spectrophotometry
- ICP = Inductively Coupled Plasma - Atomic Emission Spectroscopy
- Probe = Specific Ion Probe

TABLE 6.2-6

STORMWATER MONITORING PROGRAM

A. Construction Phase Stormwater Monitoring Program

Monitored Parameter	Monitoring Frequency	Sample Type
Oil & Grease	Annual	Grab
Total Suspended Solids	Annual	Grab
BOD5	Annual	Grab
COD	Annual	Grab
Total Phosphorus	Annual	Grab
Total Kjeldahl Nitrogen	Annual	Grab
pH	Annual	Grab
Nitrate plus Nitrite Nitrogen	Annual	Grab

B. Operational Phase Stormwater Monitoring Program

Monitored Parameter	Monitoring Frequency	Sample Type
Oil & Grease	Quarterly	Grab
Total Suspended Solids	Quarterly	Grab
BOD5	Quarterly	Grab
COD	Quarterly	Grab
Total Phosphorus	Quarterly	Grab
Total Kjeldahl Nitrogen	Quarterly	Grab
pH	Quarterly	Grab
Nitrate plus Nitrite Nitrogen	Quarterly	Grab
Uranium	Quarterly	Grab