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OAK RIDGE GASEOUS DIFFUSION PLANT

MARTIN MARIETTA

Data Analysis Approach Report for K-1407-B Holding Pond and K-1407-C Retention Basin

APPROVAL FOR RELEASE

Document: # K/ER-23/D0 ; Date 3/90 ;

Title/Subject Data Analysis Approach Report for K-1407-B Holding Pond and K-1407-C Retention Basin

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MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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K/ER-23/D0

Environmental Restoration Division
K-25 Environmental Restoration Program

Data Analysis Approach Report for K-1407-B Holding Pond and K-1407-C Retention Basin

March 1990

Prepared for
U.S. Department of Energy
Office of Waste Management and Environmental Restoration
under budget and reporting code CD 10 72 and GF 72

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U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

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CONTENTS

1. INTRODUCTION 1
   1.1 REGULATORY AND HISTORICAL INFORMATION 1
   1.2 PURPOSE OF THE REPORT 2

2. DATA EVALUATION 3
   2.1 EVALUATION OF ANALYTICAL METHODS 4
   2.2 SAMPLE QUANTITATION LIMITS 4
      2.2.1 SQLs Greater Than Reference Concentrations 6
      2.2.2 High Detection Limits 6
      2.2.3 Only Some Samples Tested Positive 6
      2.2.4 Chemicals for Which SQLs Are Not Available 7
   2.3 QUALIFIERS AND CODES 7
   2.4 BLANKS 10
   2.5 TENTATIVELY IDENTIFIED COMPOUNDS 10
   2.6 BACKGROUND CONCENTRATIONS 11
   2.7 POTENTIAL CONTAMINANTS OF CONCERN 11

3. PRELIMINARY SCREENING OF POTENTIAL CONTAMINANTS OF CONCERN 12
   3.1 DERIVATION OF GUIDELINE VALUES 12
   3.2 DE MINIMUS LEVELS FOR RADIONUCLIDES 15

4. SUMMARY 17

REFERENCES 18

1. INTRODUCTION

1.1 REGULATORY AND HISTORICAL INFORMATION

The K-1407-C Retention Basin and the K-1407-B Holding Pond are surface impoundments at the Oak Ridge Gaseous Diffusion Plant (ORGDP), which were used as settling basins for effluent from various facilities. These areas are Resource Conservation and Recovery Act (RCRA) Interim Status units, and a closure plan was previously submitted to the Tennessee Department of Health and the Environment (TDHE) for each of the impoundments. These closure plans are *Closure Plan for the K-1407-B Holding Pond*, K/HS-216,[1] and *Closure Plan for the K-1407-C Holding Pond*, K/HS-221.[2] Once the closure plans were approved in 1988, all water was discharged to a treatment facility, and the sludge was removed and stored or fixed in concrete according to the provisions set forth in each of the plans. Verification samples were taken and were submitted for analysis to ensure that all RCRA hazardous materials had been removed from the ponds. No RCRA hazardous constituents were detected, but elevated levels of radionuclides were found in all samples. Because radionuclides fall under the jurisdiction of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the appropriate plant personnel were notified, and site RCRA closure activities (e.g., capping) were halted in 1989.

Working in conjunction with the Environmental Protection Agency (EPA), TDHE, and the Department of Energy (DOE), ORGDP has proposed a strategy to determine the nature and extent of the radionuclide contamination. Closure of the K-1407-C Retention Basin and the K-1407-B Holding Pond will be postponed until a remedial investigation in accordance with CERCLA can be conducted and the threat (if any) posed by radioactive

contamination to human health or the environment can be determined. A risk assessment will be performed subsequent to the receipt of the analytical data, and the assessment will dictate the necessity and selection of a remedial alternative. The closure plans have been modified to include the proposed strategy; these plans will be submitted for approval to EPA, TDHE, and DOE.

1.2 PURPOSE OF THE REPORT

The purpose of the data analysis approach report is to describe the methodology used to evaluate the analytical data from the remedial investigation of both the K-1407-C Retention Basin and the K-1407-B Holding Pond. Upon receipt of the data from the data base manager, personnel from the Office of Risk Analysis, Oak Ridge National Laboratory (ORNL) and from the ORGDP Quality and Technical Services Division will evaluate the data and determine the threat (if any) posed by these sites to human health and the environment.

A data evaluation as described in Sect. 2 of this report will be conducted to determine the appropriateness and validity of the data for use in a quantitative risk assessment. If the data evaluation results in a list of potential contaminants of concern, those contaminants will be compared with existing state and federal standards and with the guideline values contained in the *RCRA Facility Investigation Guidance Document*, Vol. I (ref. 3), and Table 2.2 of the *RFI Plan—General Document*, K/HS-132.[4] This comparison is a screening tool used to identify those chemicals of immediate concern.

2. DATA EVALUATION

Sampling data are obtained to characterize the nature and extent of contamination present in the various media at a site. These data may be used in a quantitative risk assessment to determine the threat posed by the site to human health and the environment. In turn, the selection of the appropriate remedial alternative is partially based on the conclusions of the risk assessment. Although data from an EPA-certified Contract Laboratory Program (CLP) undergo a specified amount of data validation before being received by the user (e.g., the risk assessor), risk assessment personnel must scrutinize the data before using them in the preparation of a risk assessment. All laboratory data may not be appropriate for use in a quantitative manner. Instead, based on an evaluation of the validity of the data, some of the data may be incorporated into a qualitative assessment or eliminated from the assessment process altogether. Validation of data for use in ORGDP risk assessments will be conducted in accordance with the procedures outlined in the *Superfund Public Health Evaluation Manual*, EPA/540/1-86/060,[5] the *Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual*, EPA/540/1-89/002,[6] and the *Remedial Facility Investigation Guidance*, Vol. I, EPA 530/SW-89-031.[7]

Data evaluation is an iterative process that involves not only following set procedures but also making decisions and assumptions concerning the data based on historical information, disposal records, and "best professional judgment." Data, compiled from all possible sources (e.g., previous site investigations) will be sorted by environmental media (i.e., soil, groundwater, surface water, etc). The data may be condensed or kept separate depending on differences or similarities in collection time periods, analytical methods, or quality assurance/quality control (QA/QC) procedures. Data for all site investigations at ORGDP are compiled by the data base manager in accordance with the specifications

outlined in the *ORGDP Remedial Actions Program Data Management Plan*, K/HS-232, Rev. 1.[8] The following sections discuss each of the primary steps in the data evaluation process and some of the checks used to ensure the appropriateness and validity of the data for use in a quantitative risk assessment.

2.1 EVALUATION OF ANALYTICAL METHODS

As outlined on the flow chart in Fig. 1, evaluation of the analytical methods is the first step in the data evaluation process. Specificity, sensitivity, accuracy, and precision of the instruments and methods used for sample analysis are factors in determining the appropriateness and validity of the laboratory data. The EPA requires members of the CLP to use equipment capable of achieving specified detection limits. QA/QC procedures, such as matrix spikes, calibration curves, and surrogates, are utilized to measure the precision of laboratory procedures and instruments. The purpose of this evaluation is to generate a valid set of site-specific data based on an assortment of sensitive, chemical-specific methods with QA/QC procedures that are well documented and traceable.

2.2 SAMPLE QUANTITATION LIMITS

Sample quantitation limits (SQL) are evaluated for all the chemicals assessed at the site. As a result of this evaluation, some samples may be reanalyzed, "proxy" concentrations may be used, or chemicals may be eliminated from use in the quantitative risk assessment.

Chemicals reported as "not detected," which have only a few positively detected values in the data set, or chemicals for which the SQLs are not available will not be eliminated from the risk assessment until the following questions have been answered:

- Is the SQL of the chemical greater than corresponding standards, criteria, or concentrations derived from health-based reference values?

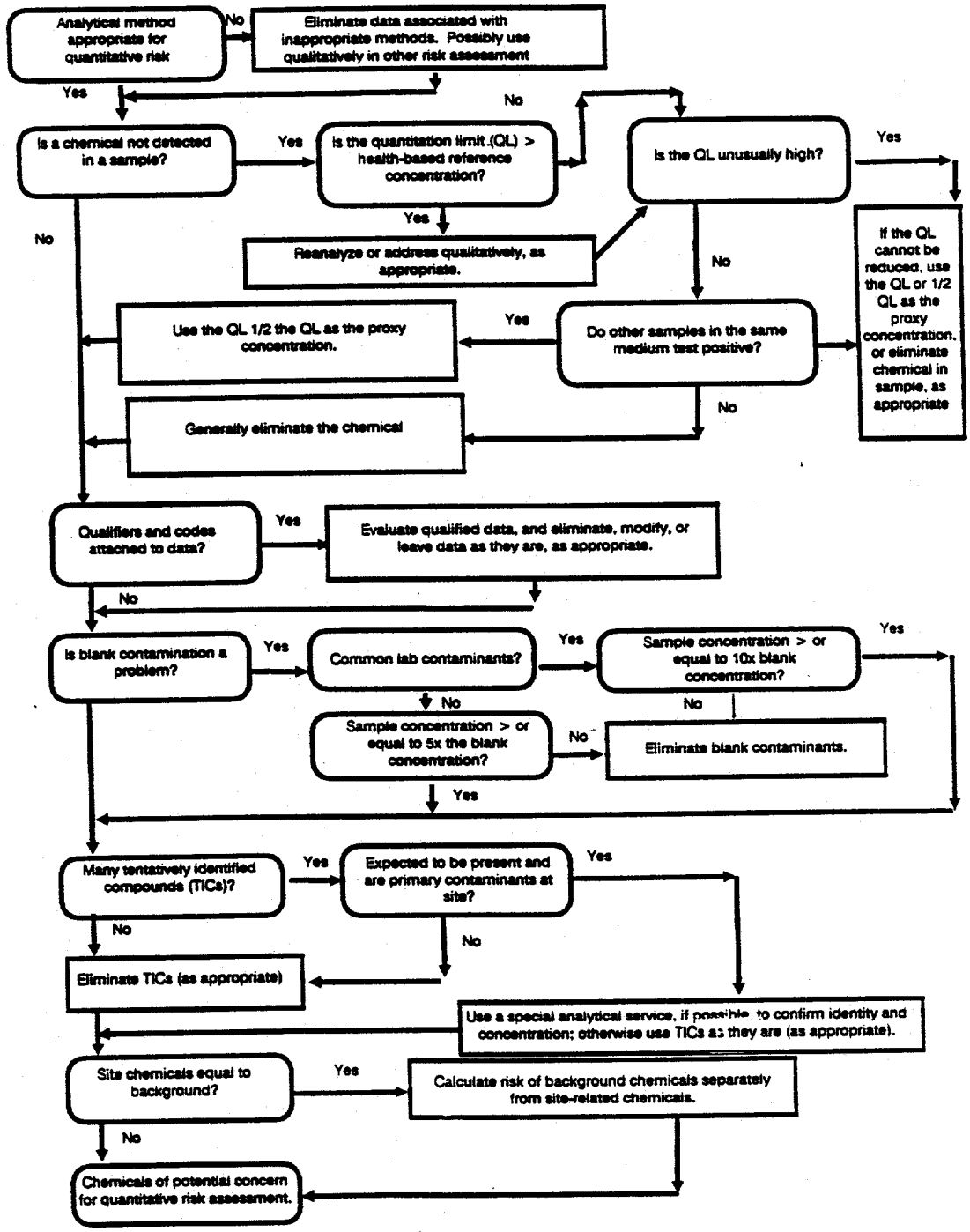

Fig. 1. Flow chart of the data evaluation process. Source: *Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual*, ref. 6.

- Is a particular SQL significantly higher than the positively detected values in other samples in the data set?
- Do only some of the samples for a given medium test positive for a particular chemical?
- Are SQLs unavailable for the chemicals?

2.2.1 SQLs Greater Than Reference Concentrations

Ideally, for those nondetected chemicals whose SQLs are greater than reference concentrations, the samples should be reanalyzed using Special Analytical Services (SAS) capable of achieving a lower SQL. If this option is not feasible, the chemical should be addressed qualitatively.

2.2.2 High Detection Limits

SQLs of organic analyses commonly vary and in many cases exceed levels practical for use in a quantitative risk assessment. The variance in SQLs can be attributed to either interference from high concentrations of other compounds within the sample or, in the case of soil samples, an insufficient amount of soil available for analysis.

Samples with high detection limits should either be reanalyzed, if possible, or eliminated from the quantitative risk assessment if their inclusion causes the arithmetic mean of the data to be greater than the maximum detected concentration. These samples should be addressed in the qualitative assessment, and the reasons for the high detection limits should be discussed.

2.2.3 Only Some Samples Tested Positive

Chemicals not detected in some samples will be evaluated along with those samples that test positive. Nondetected values will not be omitted from the risk characterization; instead, the SQL or ½ SQL will be used in calculating a representative exposure

concentration. If there is reason to believe that the chemical is present at or near the SQL (e.g., the maximum detected result is just below or greater than the SQL), then the SQL will be used to calculate the exposure concentration. Otherwise, the ½ SQL will be used. If the use of the SQL or ½ SQL causes the arithmetic mean of the data to be greater than the maximum detected concentration, these chemicals will be removed from the quantitative assessment but included in the qualitative. Nondetected values will not be converted to zero unless site-specific information indicates that a chemical is not likely to be present and the analytical method and SQL were appropriate.

2.2.4 Chemicals for Which SQLs Are Not Available

Data received from the laboratory may contain contract required quantitation limits (CRQL), method detection limits (MDLs), or instrument detection limits (IDLs) instead of the SQL. Every effort will be made to obtain the SQLs; however, if SQLs are not available, the CRQL will be used to calculate exposure concentrations.

2.3 QUALIFIERS AND CODES

For CLP analytical results, qualifiers and codes may be attached to data by either laboratory or data validation personnel. These codes may be related to QA/QC controls or may question the reported chemical identities and concentrations. All qualifiers and codes will be addressed before a chemical is included in the risk assessment. A data validation qualifier always overrides a laboratory qualifier. Tables 1 and 2 are a list of codes and qualifiers generally used by contract laboratory programs and data validation personnel.

Table 1. CLP laboratory data qualifiers

Qualifier	Definition	Uncertain identity?	Uncertain concentration?	Include data in quantitative risk assessment?
	Inorganic chemical data			
B	Reported value is <RL but >IDL	No	No	Yes
U	Compound was analyzed for, but not detected	Yes	Yes	?
E	Value is estimated due to matrix interferences	No	Yes	Yes
M	Duplicate injection precision criteria not met	No	Yes	Yes
N	Spiked sample recovery not within control limits	No	Yes	Yes
S	Reported value was determined by the method of standard additions	No	No	Yes
W	Postdigestion spike for furnace AA analysis is out of control limits, while sample absorbance is <50% of spike absorbance	No	Yes	Yes
*	Duplicate analysis was not within control limits	No	Yes	Yes
+	Correlation coefficient for MSA was <0.995	No	Yes	Yes
	Organic chemical data			
U	Compound was analyzed for but not detected	Yes	Yes	?
J	Value is estimated, either for a tentatively identified compound (TIC) or when a compound is present (spectral identification criteria are met, but the value is <RL	*a*	Yes	?
C	Pesticide results were confirmed by GC/MS	No	No	Yes
B	Analyte found in associated blank as well as in sample	No	Yes	Yes
E	Concentration exceeds calibration range of GC/MS instrument	No	Yes	Yes
D	Compound identified in an analysis at a secondary dilution factor	No	No	Yes
A	The TIC is a suspected aldol-condensation product	Yes	Yes	No
X	Additional flags defined separately.			

[a]No for TCL chemicals; yes for TICs.

Source: Adapted from *Risk Assessment Guidance for Superfund*, Interim Final Report, Environmental Protection Agency, 1989.

Table 2. Data validation qualifiers

Qualifier	Definition	Uncertain identity?	Uncertain concentration?	Include data in quantitative risk assessment?
	Inorganic and organic chemical data			
U	The material was analyzed for but not detected; the associated numerical value is the SQL	Yes	Yes	?
J	The associated numerical value is an estimated quantity	No	Yes	Yes
R	Quality control indicates that the data are unusable (compound may or may not be present); resampling and/or reanalysis is necessary for verification	Yes	Yes	No
Z	No analytical result (inorganic data only)			
Q	No analytical result (organic data only)			
N	Presumptive evidence of presence of material material (tentative identification)	Yes	Yes	?

Source: Adapted from *Risk Assessment Guidance for Superfund*, Interim Final Report, Environmental Protection Agency, 1989.

2.4 BLANKS

To ensure that field samples have not been contaminated in the acquisition and analysis processes, the data generated from the samples are compared with data generated from "blanks." Blanks of an appropriate matrix are submitted along with actual samples and treated in exactly the same manner to ensure that (1) non-site-related contamination has not been introduced to the samples and (2) the instruments are functioning properly and the calibrations remain constant.

The EPA considers acetone, 2-butanone (methyl ethyl ketone), methylene chloride, toluene, and phthalate esters to be common laboratory contaminants. If a blank contains detectable levels of these, sample results should be considered positive for site-related contamination *only* if concentrations exceed ten times the maximum amount detected in any blank. If other contaminants on the Target Compound List are detected in the blanks, site samples are considered positive only if concentrations are five times the maximum amount detected in any blank. Comparing the site-related data with the control data is a vital part of the quality control and validation procedures.

2.5 TENTATIVELY IDENTIFIED COMPOUNDS

The identity and reported concentration of a tentatively identified compound (TIC) is questionable. Whether or not TICs are included in the quantitative risk assessment depends on the frequency of the TICs and site-specific historical information. If few TICs are reported, if no historical information indicates that a TIC may be present, or if the exposure concentration would be greatly exaggerated by including the TIC, then they will be eliminated from the quantitative assessment. If, however, evidence supports the presence of the TIC, SAS methods should be used to confirm the data. If impractical, the TIC will be included as a chemical of potential concern, but the uncertainties will be noted.

2.6 BACKGROUND CONCENTRATIONS

A comparison of sample concentrations with background concentrations will be conducted to identify the non-site-related chemicals that are found at or near the site. If background risk might be a concern, it will be calculated separately from site-related risk. Often, however, the comparison of samples with background is unnecessary because of the low risk usually posed by the background chemicals compared with that of site-related chemicals.

2.7 POTENTIAL CONTAMINANTS OF CONCERN

A set of chemical data and information will be compiled when the evaluation is completed. Lists of media-specific samples (to be used in exposure assessment) and of chemicals of potential concern will be needed. Included on the list of potential chemicals of concern for each media will be those chemicals which have no J-type qualifiers, have concentrations significantly above blank or background levels, are TICs but have information supporting inclusion, and are transformation products of chemicals known to be present.

The list of potential contaminants of concern will be evaluated quantitatively in the baseline risk assessment. This assessment will consist of an evaluation of the potential transport/migration pathways, exposure pathways, receptors, and health effects that might result from exposure to these chemicals.

3. PRELIMINARY SCREENING OF POTENTIAL CONTAMINANTS OF CONCERN

The list of contaminants of potential concern generated as a result of the data evaluation will be compared with existing state and federal standards and guideline values derived from health-based criteria. All guideline values used as screening tools were derived from standard intake rates (Table 3) issued by EPA. The derivations of these guideline values are described in Sects. 3.1 and 3.2. This comparison is a preliminary screening to identify chemicals of immediate concern and may not include all the contaminants evaluated in the quantitative risk assessment. Maximum contaminant levels (MCLs), which are promulgated federal regulations, will be used as the primary screening tool for all groundwater, surface water, and Extraction Procedure Toxicity (EP-Tox) leachate samples from each of the surface impoundments. Acceptable concentration values for contaminants in soil and water listed in *RCRA Facility Investigation Guidance*, Vol. I,[3] and Table 2.2 of the *RFI Plan—General Document*[4] will be used as the next screen for the analytical data. As the last screening step, radionuclide concentrations will be compared to the de minimus levels listed in Table 4 of this report.

3.1 DERIVATION OF GUIDELINE VALUES

The guideline values listed in Tables 8.6 and 8.7 of *RCRA Facility Investigation Guidance*, Vol. I,[3] and Table 2.2 of the *RFI Plan—General Document*[4] are not promulgated standards but are rather "to be considered" guidelines. These values were derived from health-based criteria such as reference doses (RfDs), carcinogen potency factors (CPFs), acceptable intake—chronic (AICs), and acceptable intake—subchronic (AISs), using the equations and the assumptions listed below.

Table 3. Assumptions used to calculate guideline values

	Exposure period (years)	Body weight (kg)	Ingestion rate (as noted)
		Surficial soils	
Adult	70	70	0.1 g/d
Child	5/70	16	0.2 g/d
		Surface and groundwater	
Adult	70	70	2.01 L/d

Table 4. De minimus levels for radionuclides

Element	Concentration (pCi/kg)
Occupational exposure[a]	
Americium-243	2.2E–02
Cesium-135	1.2E+01
Niobium-94	1.1E+01
Strontium-90	5.7E–01
Technetium-98	1.7E+01
Uranium-235	3.1E–01
Uranium-238	3.2E–01
General public exposure[b]	
Americium-243	5.1E–04
Cesium-135	2.6E–01
Niobium-94	2.6E–01
Strontium-90	1.3E–02
Technetium-98	3.8E–01
Uranium-235	7.0E–03
Uranium-238	7.3E–03

[a]Occupational exposure was calculated using an exposure duration of 8 h/d, 250 d/year, or 83.3 d/year.

[b]General public exposure was calculated using an exposure duration of 365 d/year.

The guideline values were derived using the RCRA RFI standard assumptions for body weight, intake rate, and exposure period from Table 3. Derivation of guidelines for carcinogenic compounds (i.e., back-calculation of an acceptable concentration from a CPF) assumes a 70-year exposure period, whereas guidelines for noncarcinogens may assume a more limited exposure period.

Guideline values calculated from RfDs and AIC/AISs were obtained using the following formula.

$$\text{Guideline} = \frac{(\text{RfD/AIS/AIC}) \times \text{body weight}}{\text{ingestion rate}} .$$

When calculating a guideline value for a carcinogen from a CPF, the risk level (which is defined as 1×10^{-6} in ref. 3) must be taken into consideration. Therefore, the above formula becomes:

$$\text{Guideline} = \frac{\text{risk level of } 1 \times 10^{-6} \times \text{body weight}}{\text{CPF} \times \text{ingestion rate}} .$$

These guideline values do not represent cleanup criteria and are to be used as a screening tool for identifying chemicals of immediate concern only.

3.2 DE MINIMUS LEVELS FOR RADIONUCLIDES

The de minimus levels included in Table 4 of this report were calculated using the following equation:

$$DE = C \times IR \times EF \times HE \times CF$$

or

$$C = DE/(IR \times EF \times HE \times CF) ,$$

where

DE = committed dose equivalent (occupational = 5000 mrem/year, general public = 500 mrem/year),
C = concentration (unknown),
IR = ingestion rate (0.0002 kg/d),
EF = exposure duration (d/year),
HE = committed dose equivalent conversion factor (Sv/Bq) for body organ/tissue or whole body (effective),
CF = unit conversion factor (3.7×10^9).

As a result of substituting actual values for the variables in the above equation and solving for the concentration, the units are (mrem × Bq)/(kg × Sv). So that these units could be converted to pCi/kg, the following dimensional conversion was employed to obtain a conversion factor:

$$\frac{\text{mrem} \times \text{Bq} \times 0.01\ \text{Sv} \times 1\ \text{rem} \times 2.7\text{E}{-11}\ \text{Ci} \times 1\ \text{pCi}}{\text{kg} \times \text{Sv} \times 1\ \text{rem} \times 1000\ \text{mrem} \times 1\ \text{Bq} \times 1.0\text{E}{-12}\ \text{Ci}} = 2.7\text{E}{-04}\ \text{pCi/kg}\ .$$

4. SUMMARY

Analytical data from the sampling activities at the K-1407-B Holding Pond and the K-1407-C Retention Basin will be evaluated according to the procedures outlined in this report. In addition, a preliminary screening of the data will be conducted to identify those chemicals that are of immediate concern for each of the impoundments. Subsequent to these evaluations, a baseline risk assessment will be conducted to determine the threat (if any) to human health and the environment for each of the areas.

REFERENCES

1. *Closure Plan for the K-1407-B Holding Pond*, K/HS-216, Martin Marietta Energy Systems, Inc., Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, April 1988.

2. *Closure Plan for the K-1407-C Holding Pond*, K/HS-221, Martin Marietta Energy Systems, Inc., Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, May 1988.

3. *RCRA Facility Investigation Guidance*, Vol. I, OSWER Directive 9502.00-6C, U.S. Environmental Protection Agency, December 1987.

4. *RFI Plan—General Document, Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee*, K/HS-132, Martin Marietta Energy Systems, Inc., Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, March 1987.

5. *Superfund Public Health Evaluation Manual*, EPA/540/1-86/060, Environmental Protection Agency, October 1986.

6. *Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual*, EPA/540/1-89/002, Environmental Protection Agency, December 1989.

7. *Remedial Facility Investigation Guidance*, Vol. 1, EPA 530/SW-89-031, Environmental Protection Agency, May 1989.

8. *ORGDP Remedial Actions Program Data Management Plan*, K/HS-232, Rev. 1, Martin Marietta Energy Systems, Inc., Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, December 1988.

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