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# NEXTEP Environmental

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## TECHNICAL MEMORANDUM 05-16

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Subject: *Source Term Determination for the Kerr-McGee Cushing Site*

Revision: 0

ENDORSEMENT: This document contains the results of research and technical analysis which have been reviewed and approved for publication by the Technical Director, NEXTEP Environmental, Inc.



Harry J. Newman, CHP, Technical Director

10-13-2005

Date

### 1 INTRODUCTION

- 1.1 As a part of the license termination process for the former SDMP<sup>1</sup> sites, the Nuclear Regulatory Commission (NRC) Staff is required to perform dose modeling to ensure that the facility meets the requirements of 10 CFR 20.1402. While the modeling is not the responsibility of the licensee, the licensee may elect to submit a model of their own for NRC concurrence for the purpose of expediting the license termination process. Kerr-McGee (KM) has elected to perform and submit a dose model for the Cushing site.
- 1.2 The first step in the modeling process is to determine the source term to be used in the model. This Technical Memorandum (TM) documents the soil source term data selection criteria and the data to be used as the source term input for each Sector/Area of the site.
- 1.3 Prior to the approval of the Site Decommissioning Plan (SDP) the Final Status Survey Report (FSSR) for the Unaffected Areas (UA) of the site was submitted. The FSSR was approved and the UA released from the licensed site at around the same time as the approval of the SDP. The UA Sediment Pond was released in a separate licensing action after the approval of the SDP and prior to characterization and decommissioning of the remainder of the licensed site. The UA and the Sediment Pond are treated as individual areas for the purposes of establishing the source term.

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<sup>1</sup> Site Decommissioning Management Plan (SDMP) Action Plan (57 FR 13389), April 1993.

- 1.4 Two Other Industrial Waste (OIW) disposal cells were constructed in the released area to receive non-radioactive, hydrocarbon-impacted waste. Since these cells received material from the licensed site, they are treated as a separate area for the purposes of establishing the source term.
- 1.5 Prior to full characterization and decommissioning the licensed portion of the site was further broken down into twelve (12) Sectors for Final Status Survey (FSS) purposes. The average residual activity for the twelve (12) Sectors, the UA, the UA Sediment Pond, and the OIW Cells is established herein as the basis for dose assessment purposes.
- 1.6 This TM also serves to document the Sectors in which groundwater and building surfaces have an impact on the dose model and the input data from these sources.

## 2 DATA SOURCE

- 2.1 The soil data used in the preparation of this TM was taken from the Cushing Soil Database. The data for the Unaffected Areas and the Sector 6 (Haul Road Corridor) surfaces was extracted from the Final Status Survey Reports and added to the database.
- 2.2 The data for the building surfaces was taken from the original HP surveys contained in the KM archive files. The data for the groundwater activity was taken from the *Radiological Groundwater Assessment Report*<sup>2</sup>, (RGAR).
- 2.3 The data for the OIW disposal cells is taken from the release data for the material from Acid Sludge Pit 4 and Refinery Waste Pits 30 and 39 that was disposed of as OIW.

## 3 SORTING AND ANALYSIS PROTOCOL

### 3.1 SURFACE DATA VS DEPTH DATA

- 3.1.1 For purposes of establishing the source term to be used for dose modeling, those soil sample data records with a depth value equal to or less than 1.0 meter are considered to be surface data. Those soil sample data records with a depth value greater than 1.0 meter are considered as depth data.
- 3.1.2 For those sectors/areas in which a statistically significant quantity of depth data exists, averages will be presented in one meter increments (0.0 to 1.0, 1.0 to 2.0, etc) to 3 meters. Since very little data exists below 3 meters and preliminary modeling demonstrated that the data below 3 meters have little impact on the potential dose<sup>3</sup>, no additional depths are included.

### 3.2 DATA SORT

- 3.2.1 For each Sector the average residual activity by isotope of interest will be provided for the surface. The average residual activity by isotope will be provided as a function of depth for those locations where depth data is available.

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<sup>2</sup> *Radiological Groundwater Assessment Report*, ENERCON Services, Inc., March 2003.

<sup>3</sup> The dose contribution for soils excludes the groundwater pathway since groundwater is considered separately.

- 3.2.2 From a historical perspective, the minimal residual surface activity remaining in Building A-9 is estimated to result from a 50 – 50 mix of uranium and thorium. Building A-9 was not involved in the nuclear processing activities during operations. During characterization and decommissioning activities Building A-9 was used for administrative activities. The only source of actual contamination would have been from tracking.
- 3.2.3 The minimal residual surface activity remaining in Building 32 is estimated to result from a 75 – 25 mix of uranium and thorium. During operations Building 32 was used as a pump repair facility for the refinery. It was also used to repair pumps from the uranium processing activities.
- 3.2.4 The RGAR demonstrated that there is no impact to groundwater from thorium, consequently only the uranium data will be considered for dose modeling.

#### **4 SOIL RESULTS**

- 4.1 The average residual activity for the site surface is presented in Table 1. A line entry is presented for each of the Site Sectors, the Unaffected Areas, the UA Sediment Pond, and the OIW Disposal Cells.
- 4.2 Tables 2 and 3 contain the data for the depth slices (below 1 meter) for those Sectors/Areas where depth samples were obtained.

#### **5 BUILDING SURFACE RESULTS**

- 5.1 Table 4 lists the average direct (fixed) surface contamination values for the buildings of interest (Building A-9 and Building 32). These are the only structures that were in place during the nuclear operations at the Cushing Site that will remain after license termination. The data indicate that the average residual contamination within the buildings is insignificant; therefore, dose modeling would not indicate additional dose to building occupants. As a result, the dose contribution from on-site structures will be essentially zero.

#### **6 GROUNDWATER RESULTS**

- 6.1 As defined in the SDP and the RGAR, Sectors 1, 4, and 10 are the areas of interest for groundwater impact. The definition of the plume down gradient of RMA-11, in Sector 1, provided additional data for the groundwater associated with Sectors 2 and 6. Table 5 provides the groundwater source term inputs for Sectors 1, 2, 4, 6, and 10. The groundwater source term from licensed materials is considered to be non-existent for all other Sectors/Areas based on soil activity in the range of background below the surficial soil impact, but above the elevation of the underlying groundwater<sup>4</sup>.

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<sup>4</sup> RGAR Section 9, Ibid.

## TABLES

**Table 1**  
**Surface Soil (0 to 1 meter) Residual Activity  $\pm 1$  Sigma (pCi/g)**

Sector / Area	Residual Activity			
	U-235	U-238	U-234	Th-232
Site Average	0.03 $\pm$ 0.03	-0.02 $\pm$ 0.60	-0.37 $\pm$ 0.36	0.14 $\pm$ 0.21
1	0.07 $\pm$ 0.02	-0.31 $\pm$ 0.06	-0.43 $\pm$ 0.15	0.08 $\pm$ 0.22
2	0.04 $\pm$ 0.02	-0.18 $\pm$ 0.07	-0.37 $\pm$ 0.08	0.29 $\pm$ 0.14
3	0.04 $\pm$ 0.02	-0.15 $\pm$ 0.21	-0.35 $\pm$ 0.22	0.29 $\pm$ 0.11
4	0.05 $\pm$ 0.01	-0.06 $\pm$ 0.13	-0.24 $\pm$ 0.15	0.40 $\pm$ 0.19
5	0.02 $\pm$ 0.01	0.12 $\pm$ 0.18	-0.08 $\pm$ 0.18	0.12 $\pm$ 0.20
6	0.05 $\pm$ 0.02	-0.23 $\pm$ 0.17	-0.43 $\pm$ 0.17	0.19 $\pm$ 0.23
7	0.03 $\pm$ 0.01	0.05 $\pm$ 0.12	-0.14 $\pm$ 0.12	0.48 $\pm$ 0.12
8	0.04 $\pm$ 0.01	-0.22 $\pm$ 0.11	-0.42 $\pm$ 0.11	0.17 $\pm$ 0.17
9	0.02 $\pm$ 0.02	-0.21 $\pm$ 0.11	-0.41 $\pm$ 0.12	0.08 $\pm$ 0.07
10	0.05 $\pm$ 0.03	-0.27 $\pm$ 0.22	-0.46 $\pm$ 0.22	0.13 $\pm$ 0.15
11	0.03 $\pm$ 0.02	-0.33 $\pm$ 0.11	-0.53 $\pm$ 0.11	0.11 $\pm$ 0.19
12	0.02 $\pm$ 0.02	-0.49 $\pm$ 0.14	-0.69 $\pm$ 0.14	-0.07 $\pm$ 0.05
UA	-0.02 $\pm$ 0.04	-0.17 $\pm$ 0.50	-0.69 $\pm$ 0.59	0.22 $\pm$ 0.31
Sed Pond	0.07 $\pm$ 0.06	2.05 $\pm$ 1.04	0.64 $\pm$ 0.58	-0.07 $\pm$ 0.16
OIW Cells	-0.02 $\pm$ 0.10	-2.12 $\pm$ 0.88	-1.03 $\pm$ 0.60	-0.45 $\pm$ 0.26

**Table 2**  
**Depth Soil (1 to 2 meters) Residual Activity  $\pm 1$  Sigma (pCi/g)**

Sector / Area	Residual Activity			
	U-235	U-238	U-234	Th-232
Site Average	0.04 $\pm$ 0.02	-0.19 $\pm$ 0.47	-0.56 $\pm$ 0.28	0.21 $\pm$ 0.26
1	0.04 $\pm$ 0.01	-0.63 $\pm$ 0.20	-0.83 $\pm$ 0.20	-0.03 $\pm$ 0.16
2	0.06 $\pm$ 0.10	-0.46 $\pm$ 0.74	-0.66 $\pm$ 0.74	0.42 $\pm$ 0.28
3	0.04 $\pm$ 0.02	0.23 $\pm$ 0.63	0.03 $\pm$ 0.63	0.38 $\pm$ 0.13
4	0.08 $\pm$ 0.02	-0.15 $\pm$ 0.33	-0.33 $\pm$ 0.34	0.60 $\pm$ 0.66
8	0.04 $\pm$ 0.01	-0.49 $\pm$ 0.26	-0.69 $\pm$ 0.26	-0.01 $\pm$ 0.18
10	0.03 $\pm$ 0.02	-0.47 $\pm$ 0.17	-0.67 $\pm$ 0.16	-0.03 $\pm$ 0.10
11	0.06 $\pm$ 0.03	-0.35 $\pm$ 0.13	-0.55 $\pm$ 0.13	0.32 $\pm$ 0.41
Sed Pond	0.00 $\pm$ 0.06	0.77 $\pm$ 0.67	-0.74 $\pm$ 0.83	-0.15 $\pm$ 0.12

**Table 3**  
***Depth Soil (2 to 3 meters) Residual Activity  $\pm 1$  Sigma (pCi/g)***

Sector / Area	Residual Activity			
	U-235	U-238	U-234	Th-232
Site Average	0.04 $\pm$ 0.01	-0.30 $\pm$ 0.49	-0.57 $\pm$ 0.33	-0.09 $\pm$ 0.29
1	0.03 $\pm$ 0.02	-0.73 $\pm$ 0.20	-0.92 $\pm$ 0.21	0.10 $\pm$ 0.24
4	0.06 $\pm$ 0.03	-0.31 $\pm$ 0.35	-0.51 $\pm$ 0.36	0.56 $\pm$ 0.62
8	0.03 $\pm$ 0.01	-0.64 $\pm$ 0.06	-0.84 $\pm$ 0.06	-0.20 $\pm$ 0.01
10	0.03 $\pm$ 0.01	-0.53 $\pm$ 0.13	-0.73 $\pm$ 0.13	-0.06 $\pm$ 0.12
11	0.05 $\pm$ 0.01	-0.22 $\pm$ 0.07	-0.40 $\pm$ 0.10	0.28 $\pm$ 0.09
Sed Pond	0.05 $\pm$ 0.05	0.61 $\pm$ 0.65	-0.02 $\pm$ 0.22	-0.12 $\pm$ 0.15

**Table 4**  
***Building Surface Residual Direct Activity***

Sector	Building	Average Net Activity	
		$\alpha$ (dpm/100cm <sup>2</sup> )	$\beta$ - $\gamma$ (dpm/100cm <sup>2</sup> )
Site Average	Remaining Structures	8	162
9	Building A-9	10	103
10	Building 32	6	168

**Table 5**  
***Residual Groundwater Activity (Total Uranium)***

Sector	Average Gross Activity (pCi/liter)	Average Net Activity (pCi/liter)
Site Average	14.88	12.42
1	42.73	40.27
2	16.79	14.33
4	2.81	0.35
6	3.70	1.24
10	0.25	-2.21