

*See Rpt.*

**CIMARRON CORPORATION**

P.O. BOX 25861 • OKLAHOMA CITY, OKLAHOMA 73125

S. JESS LARSEN  
VICE PRESIDENT

December 5, 1997

Mr. Kenneth L. Kalman, Project Manager  
Low-Level Waste and Decommissioning Projects Branch  
Division of Waste Management  
Office of Nuclear Material Safety and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

**Re: Docket No. 70-925; License No. SNM-928  
Cimarron Corporation  
Response to Comments on Phase III Final Status Survey Plan**

Dear Mr. Kalman:

Please find enclosed Cimarron Corporation's response to your October 3, 1997, letter transmitting NRC staff's comments on the "Final Status Survey Plan for Phase III Areas for Cimarron Corporation's Former Nuclear Fuel Facility at Crescent, Oklahoma," dated June 1997.

We trust that these responses will resolve the questions raised by the NRC staff on this Phase III FSSP. Upon your advice that these responses and the proposed alterations to specific sections of the FSSP are acceptable to NRC, we will submit the amended pages and maps for placement in the FSSP.

Please contact me if we can clarify anything for you, or in any way help expedite the approval by NRC.

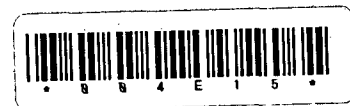
Sincerely,

*Jess Larsen*

Jess Larsen  
Vice President  
Enclosure

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A SUBSIDIARY OF KERR-MCGEE CORPORATION

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# CIMARRON CORPORATION LETTER OF TRANSMITTAL

DATE: 12/08/97

TO: M r. Ken Kalman, Project Manager  
Low Level Waste & Decommissioning Project Branch  
Division of Waste Management  
Office of Nuclear Material Safety and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001  
MAIL DROP T2F27

FROM: Mickey Hodo, Quality Assurance Manager  
Cimarron Corporation  
P.O. Box 315  
Crescent, OK 73028

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| <input type="checkbox"/> Overnight--Fed Ex  | <input type="checkbox"/> UniShippers                            | <input type="checkbox"/> Second Day Air--UPS |
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COPY NO.	DATE	DESCRIPTION
2	12/05/97	Docket no. 70-925; License No. SNM-928 Response to Comments on Phase III Final Status Survey Plan

These are transmitted as checked below:

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| <input type="checkbox"/> For Approval | <input type="checkbox"/> Approved as submitted    | <input checked="" type="checkbox"/> For your use      |
| <input type="checkbox"/> As requested | <input type="checkbox"/> Returned for corrections | <input type="checkbox"/> Return ____ corrected prints |
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REMARKS The above items are for your use. Please sign and return transmittal letter to me.

NOTE:

SIGNATURE

*Mickey Hodo*

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I HAVE RECEIVED THE DOCUMENTS IDENTIFIED ABOVE AND THE PRIOR REVISIONS OF THESE HAVE BEEN  
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PRINTED NAME OF RECIPIENT:

*Ken Kalman*

SIGNATURE OF RECIPIENT:

*Ken Kalman*

DATE RECEIVED:

*12/15/97*

If enclosures are not noted, kindly notify Cimarron Corporation

**RESPONSE TO NRC'S COMMENTS ON THE  
FINAL STATUS SURVEY PLAN FOR PHASE III AREAS  
AT CIMARRON CORPORATION FACILITY  
December 3, 1997**

**General Comment**

**1. NRC Comment:**

Based on its review of Sections 6.0, 6.4, 8.4, and 8.7, NRC staff is concerned that Cimarron may not have followed the procedures for fixed measurements of exposure rates as described in Section 5.3 in NUREG/CR-5849. The proposed Final Status Survey Plan (FSSP) does not describe how the sodium iodide survey meters proposed for the exposure rate surveys will be cross-calibrated against a pressurized ion chamber (PIC) or calibrated for the low energy emissions expected from enriched uranium in soils. Also, as noted in Section 4 of NRC Inspection Report 70-925/97-02, dated July 31, 1997, Cimarron committed to use a PIC to support future exposure rate measurements. However, the FSSP does not appear to uphold that commitment. Please explain how your meters will be calibrated.

**Cimarron Response:**

As indicated in the NRC's comment, Cimarron committed to using a pressurized ion chamber to support its exposure rate measurements. Cross checks between the Micro-R and a Reuter-Stokes Pressurized Ion Chamber (PIC) are being performed as outlined in the recently submitted "Final Status Survey Report, Phase II, Subarea J". Also, as stated in the Phase III FSSP, instrumentation calibration is performed using the applicable guidance contained in ANSI N323-1978, "Radiation Protection Instrumentation Test and Calibration." The Micro-R meter used for exposure measurements are calibrated in accordance with written and approved procedures utilizing a traceable Cs-137 source.

To confirm that such calibration procedures produce accurate field results, Cimarron personnel performed exposure rate measurements at background

locations on the site boundary in 1995 using a Micro-R meter calibrated as noted. Confirmatory measurements also were obtained later at the same locations in 1997 using a Reuter-Stokes PIC. These two data sets are tabulated below in Table 1.0. The average background as measured using the Micro-R meter was 7.6  $\mu\text{R/h}$ , and is about 15 percent less than the average for the PIC measurements of 9.0  $\mu\text{R/h}$  indicating good agreement between the two measurement methods.

TABLE 1.0			
Sample ID No.	Grid Location	Micro-R Reading ( $\mu\text{R/h}$ )	PIC Reading ( $\mu\text{R/h}$ )
UAF-BKG-1	819W-81N	9	9.8
UAF-BKG-7	1600E-120N	7	7.6
UAF-BKG-11	840W-700S	8	9.5
UAF-BKG-13	840W-288S	9	9.8
UAF-BKG-16	808W-282S	8	9.7
UAF-BKG-19	640W-700S	9	10.5
UAF-BKG-23	1610E-300S	5	7.8
UAF-BKG-25	1610E-69N	6	7.6
UAF-BKG-27	1610E-469N	7	7.8
UAF-BKG-28	1610E-634N	8	9.6
	<b>AVERAGE</b>	<b>7.6 <math>\pm</math> 2.7 (2<math>\sigma</math>)</b>	<b>9.0 <math>\pm</math> 2.3 (2<math>\sigma</math>)</b>

In addition, quarterly comparisons and/or confirmatory measurements for the Micro-R meter are obtained routinely to provide information concerning any significant measurement bias. These comparisons or confirmatory measurements are made using a PIC. As an example of these confirmatory measurements, Subarea J survey data is shown below. The quarterly confirmatory measurements included in Table 1.1 indicate good agreement between the Micro-R meter measurements and the PIC measurements. These quarterly comparisons will be continued during the gathering of the remaining decommissioning and final status survey data.

TABLE 1.1			
Sample ID No.	Grid Location	Micro-R Reading ( $\mu\text{R/h}$ )	PIC Reading ( $\mu\text{R/h}$ )
Phase II Affected Area J	150W-55N	8	8.9
Phase II Affected Area J	200W-80N	9	9.4
Phase II Affected Area J	140W-20S	9	9.8
Phase II Affected Area J	240W-30N	8	9.9
Phase II Affected Area J	370W-200S	8	8.9
Phase II Affected Area J	370W-30N	10	10.0
	<b>AVERAGE</b>	<b>8.7<math>\pm</math>1.6 (2<math>\sigma</math>)</b>	<b>9.5 <math>\pm</math> 1.0(2<math>\sigma</math>)</b>

Site background exposure rates of approximately 7  $\mu\text{R/h}$  have been recorded in background areas by Cimarron personnel utilizing a Ludlum Micro-R survey meter, and have been used in past reports and Plans submitted to the NRC. For example, the approved Phase II, FSSP<sup>1</sup> specified that 7  $\mu\text{R/h}$  would be used for average background. Site background exposure rates of approximately 7  $\mu\text{R/h}$  have also been determined by ORISE personnel utilizing similar instrumentation<sup>2</sup>. In addition, site background exposure rates were measured by ORAU (now ORISE) personnel in 1988 utilizing a PIC, and were determined to be 9 to 10  $\mu\text{R/h}$ <sup>3</sup>. These values are similar to the values determined by Cimarron. Cimarron's background exposure rate measurements compare favorably to those determined by a third party utilizing both a Micro-R Survey Meter and the PIC.

In summary, NUREG/CR-5849, Section 5.3, "Instrumentation Selection and Use" states that for surveys, "The instrument must be able to detect the type of radiation of interest, and must, in relation to the survey or analytical techniques be capable of measuring levels which are less than the guideline values."

<sup>1</sup> US Nuclear Regulatory Commission Letter from Mr. Ken Kalman, Project Manager, Low-Level Waste and Decommissioning Branch to Mr. Jess Larsen, Vice President, Cimarron Corporation, dated March 14, 1997.

<sup>2</sup> ORISE, "Confirmatory Survey for the South Uranium Yard Remediation, Kerr-McGee Corporation, Cimarron Facility, Crescent, Oklahoma," November 1995.

<sup>3</sup> ORAU Background Survey, "Confirmatory Survey of Portion of Sequoyah Fuels Corporation Cimarron Plant," Completed in 1988.

Cimarron meets this requirement with fixed measurements for exposure rates in accordance with NUREG/CR-5849. Cimarron, also believes that the recent comparison surveys between the Micro-R and PIC indicates good agreement and verifies previous survey data by both the company and independent organizations.

Section 8.7.3 of the FSSP will be modified by adding the following paragraph:

“Quarterly cross checks between the Micro-R meter and PIC will be performed during the gathering of all remaining final status survey data.”

**2. NRC Comment:**

The FSSP should discuss what sources will be used for calibrating the instrumentation to be used.

**Cimarron Response:**

As stated in the Phase III FSSP, instrument calibration is performed using the applicable guidance contained in ANSI N323-1978, “Radiation Protection Instrumentation Test and Calibration.” Specific requirements for instrumentation include traceability of calibrations to NIST standards, field checks for operability, background radioactivity checks, operation of instruments within established environmental bounds (i.e., temperature and pressure), training of individuals, scheduled performance checks, calibration with isotopes of energies similar to those to be measured, quality assurance tests, data review, and recordkeeping. These requirements were incorporated into the written site calibration procedures and have been audited. The audits<sup>4,5</sup> found no discrepancies.

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<sup>4</sup> NRC Inspection Report 70-925/95-01, performed January 1 and February 28, 1995.

<sup>5</sup> NRC Inspection Report 70-925/94-01, performed November 17-18, 1994.

Calibration sources used are, to the extent practical, similar in energy and geometry to those which are to be measured in the field. Calibration of the onsite soil counter is performed using uranium and thorium standards in a soil matrix similar to those collected during field sampling. Micro-R meters are calibrated using Cs-137 and readings are compared to a PIC to ensure that any bias is identified. (See previous response comment #1.) Alpha/beta survey instruments are calibrated using alpha sources (Pu-239) or beta sources (Tc-99) in a dish geometry as appropriate for the instruments. The efficiency in regions of each probe are compared to ensure that the detection efficiency is reasonably consistent. In summary, these calibration procedures are written, followed, documented, and audited.

The above paragraph will be added to Section 8.7 of the FSSP, page 31, between the first and second paragraph.

**3. NRC. Comment:**

The FSSP should discuss how previous data are of the same quality as data to be collected under this project.

**Cimarron Response:**

Cimarron has been decommissioning the site, including the gathering of a great amount of data for over 20 years. A substantial amount of the data gathered was presented in the October 1994 Site Characterization Report. Additionally, numerous other survey reports have been submitted to the NRC for review and approval; which have resulted in areas being released by the NRC for backfilling or for soil placement into the on-site disposal cell. Typical of these reports are: "Final Status Survey Report, Phase I Areas", "Report on the South Uranium Yard Remediation" "Report on the Radiological Survey Results of Option #2 Stockpile No. 3", "Final Status Survey Report, Phase III-Subarea L (Subsurface)", and the "Sample Data for On-Site Disposal Cell, Pit No. 3, Lift No. 1". The survey data

included in the numerous reports submitted to the NRC and as noted above in responses #1 and #2 were generated in accordance with written calibration and quality assurance procedures. These procedures have been revised during the ensuing years as NRC guidances have changed (i.e., NUREG 2082 to NUREG/CR-5849) to assure accuracy and application of the latest guidance.

To assure data quality, the Cimarron Corporation Quality Assurance Plan and Procedures, which are an integral part of the Cimarron Radiation Protection Program, were upgraded in 1994. A principal component of this Program is the affirmation of the quality of project work performed during decommissioning by assuring that all tasks are performed in a quality manner by qualified personnel using properly calibrated instruments. The Program ensures that all characterization and final status survey samples are collected, controlled, and analyzed in accordance with applicable quality assurance requirements such that the resulting data accuracy and validity are verifiable. Such quality controls allow independent, third-party review of analytical results.

Historically, Cimarron's instrumentation, including both portable hand held field type equipment and the onsite soil counters have been calibrated against traceable standards and/or comparable cross checks. Portable survey instruments are calibrated at least semi-annually. All instrumentation is calibrated with NIST traceable standards. This program has been in place throughout the decommissioning phase, verifying that data collected during previous characterization and final status surveys will be of the same quality as that data collected during the Phase III Final Status Survey.

Similarly, the onsite soil counting system has in the past and is today calibrated to traceable NIST standards through contractor laboratory evaluations of the on-site standards. Recently, Counter #2 was installed to replace Counter #1, which is used as a back-up system. As referenced below, independent laboratory



analysis of split soil samples by both the NRC and ORISE and other Cimarron subcontract laboratories continue to verify that soil analytical data generated from Cimarron's counting systems are acceptably accurate and reproducible. Numerous quality assurance controls and cross-checks are further discussed in the Phase III Plan, Section 8.7.4.

Throughout the decommissioning period, NRC has performed numerous inspections and ORISE has performed extensive confirmatory analyses. These inspections and confirmatory surveys have consistently affirmed the quality of the work being performed by Cimarron. Several of these audits and confirmatory surveys are discussed below.

ORISE has been employed by the NRC for verification of a majority of the decommissioning work completed to date at the Cimarron site. ORISE has conducted an evaluation of the Cimarron Soil Counting system's ability to measure accurately total uranium concentrations in soil samples. This was done by comparing ORISE sample analysis results obtained by alpha pulse height analysis and gamma spectroscopy with the results obtained from the use of the Cimarron Soil Counter. ORISE and Cimarron analysis results compared favorably at levels above background as demonstrated by the most recent confirmatory analysis performed for the On-Site Disposal Cell, Pit #3 (NRC cover letter dated July 31, 1997)<sup>6</sup>. NRC Inspection Report #70-925/97-02, which accompanied this letter, states that "no significant bias or statistical error between the licensee's soil results and the NRC's results were identified." Additionally, the confirmatory analysis performed on select soil samples collected during ORISE's site visit to investigate the South U-Yard<sup>7</sup>, and DAP-3 stockpile<sup>8</sup>

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<sup>6</sup> USNRC letter from Mr. Ross A Scarano, Director, Division of Nuclear Materials Safety to Mr. S. Jess Larsen, Vice President, Cimarron Corporation, dated July 31, 1997.

<sup>7</sup> E. W. Abelquist, "Confirmatory Survey for the South Uranium Yard Remediation, Kerr-McGee Corporation, Cimarron Facility, Crescent, Oklahoma," Oak Ridge Institute for Science and Education, November 1995.

<sup>8</sup> USNRC Letter from Mr. Michael F. Weber, Chief, Low-Level Waste and Decommissioning Project Branch, Division of Waste Management to Mr. Jess Larsen, Vice President, Kerr- McGee Corporation, dated May 31, 1995.

verified previously that Cimarron's onsite counter results are substantially identical to ORISE's results.

Throughout all phases of the Final Status Survey, Cimarron has operated in accordance with the facility's QA/QC program and has followed the methodology prescribed in NUREG/CR-5849. The Final Status Survey Reports for those areas which have been released have included the necessary data to support the survey and an evaluation of the data presented. Cimarron has committed to continue following this program.

Cimarron has reviewed its text related to this comment and feels no additions to the FSSP are considered necessary in response to this NRC comment.

**4. NRC Comment:**

The FSSP should discuss how additional samples will be taken at points having high scan levels.

**Cimarron Response:**

Cimarron believes the presence of elevated surface scan readings and the task to be undertaken subsequent to these measurements is discussed in the FSSP. Section 8.4, Surveys (Open Land Areas), second paragraph, states: "In the event that any of these survey readings exceed the limits described in Section 6.4.3., their location will be flagged for additional surveys and/or soil sampling." (We do note, however, the reference to Section 6.4.3 should be to Section 6.4.5.) Section 6.4.5 states that the guideline for scan surveys, using shielded or unshielded NaI detectors, is "twice background". For clarity, Section 8.4 of the FSSP will be modified to note this. The following sentence will be added to the second paragraph before the last sentence in this paragraph. "A reading greater than twice background requires an additional follow-up investigation. The additional investigation includes taking direct measurements to define the extent

and activity for locations exceeding twice background during the scanning survey. Also, a soil sample is collected to identify the radionuclide causing the elevated activity. Remediation would follow, if required, prior to beginning the systematic surveying."

A similar procedure is followed for buildings. Section 8.6 (Building/Surface Surveys) states, "Areas of elevated activity noted during the scan will be identified and direct measurements taken" to define the extent and activity for those locations exceeding the guideline values. Remediation would follow, if required, prior to beginning the systematic surveying. Building surface scans, "hot spot averaging" and systematic surveys are further discussed in the response to the next NRC comment and to NRC Specific Comment #12. Recommended changes to the FSSP are discussed in these responses.

**5. NRC Comment:**

The FSSP should discuss how building surface hot spots will be evaluated. NUREG/CR-5849, Section 8.5 needs to be referenced in this discussion.

**Cimarron Response:**

Section 8.6 of the Phase III FSSP discusses the procedure to be followed for surveying building surfaces and sets out the surface guideline values for buildings. This section emphasizes that surface surveys will consist of a combination of surface scans, direct measurements, and measurements of removable activity. As discussed in Section 8.6, areas of elevated activity noted during the scan will be identified and direct measurements taken.

To clarify how building surface hot spots have and will be evaluated, the second paragraph on Page 30, Section 8.6 will be modified by adding the following language prior to the last sentence in the paragraph.

"To evaluate whether this average condition is satisfied, additional measurements will be performed, and the activity level and areal extent of the elevated area will be determined. The average (weighted average) in the 1 m<sup>2</sup> area will be calculated, taking into consideration the relative fraction of the 1 m<sup>2</sup> occupied by the elevated area(s), using the relationship presented in Section 8.5.2 of NUREG/CR-5849."

### **Specific Comments**

#### **1. NRC Comment:**

Section 6.0 notes that the radiological criteria and guideline values for Phase III will be the same as those utilized for Phases I and II. The Phase III FSSP should be revised to clearly state the criteria to be used.

### **Cimarron Response**

The reference to Phase I and Phase II in Section 6.0 in the Phase III FSSP was intended to assure the NRC that Cimarron continues to decommission and survey the site in accordance with radiological criteria previously approved by the NRC. The radiological criteria listed in both the Phase I and Phase II FSSP's are similar to those criteria stated in Section 6.4 of the Phase III FSSP. The criteria to be used for continued site decommissioning as presented in Section 6.4, is summarized below:

- Section 6.4 - "Survey Objective" - Specifies that the guidance, including data evaluation, promulgated in NUREG/CR-5849 will be utilized throughout the conduct of the Final Status Survey.
- Section 6.4.1 - "Buildings and Equipment" - Specifies that release limits are those published in Table 1 of the NRC's 1987 guidance for decommissioning of facilities and equipment prior to release for

unrestricted use. The table is reproduced in the FSSP on Page 18. The average exposure rate guideline value as measured at 1 meter from the surface for internal building surfaces is 5  $\mu$ R/h above background.

- Section 6.4.2 - "Surface Soil Activity" - The unrestricted release residual concentration of enriched uranium, which may remain in soil, is specified as BTP<sup>9</sup> Option #1 material. The BTP Option #1 guideline is up to an average of 30 pCi/g total uranium above background within a 10 m x 10 m grid. The average soil activity is to be determined from the analysis of a minimum of four locations per 100 m<sup>2</sup> area. The maximum enriched uranium soil concentrations within a 100 m<sup>2</sup> grid area may not exceed three times the Option #1 limit (i.e., 90 pCi/g total uranium). "Hot Spot: averaging is to be performed per the formula  $(100/A)^{1/2}$  times the guideline value.
- Section 6.4.3 - "Volumetric Activity for Onsite Disposal" - Specifies that soil up to the BTP Option #2 upper limit for enriched uranium may be disposed on-site in the NRC approved on-site disposal cell. The average concentration of radioactive material that may be buried under a minimum four feet of soil cover is 100 pCi/g total uranium above background (100% soluble), and up to 250 pCi/g total uranium (insoluble). To date, Cimarron has decommissioned the facility using the conservative assumption that the residual uranium in soils is soluble. The maximum total uranium soil concentration for any "hot spot" location within a 100 m<sup>2</sup> grid may not exceed three times the Option #2 limit (i.e., 300 pCi/g total uranium).

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<sup>9</sup> USNRC, "Branch Technical Position on Disposal or On-Site Storage of Residual Thorium and Uranium from Past Operations", FR. Vol. 46, No. 205, Page 52061, October 23, 1981.

- Section 6.4.4 - "Averaging Methodology for Subsurface Residual Activity" - Specifies that subsurface residual activity will meet the BTP Option #1 criteria when evaluated per the NRC guidance in "Method for Surveying and Averaging Concentrations of Thorium in Contaminated Subsurface Soil". This guidance was transmitted per NRC letter from Mr. Kenneth L. Kalman to Mr. Jess Larsen, dated February 25, 1997. In Cimarron's August 26, 1997 letter from Mr. Jess Larsen to Mr. Kenneth L. Kalman, the company committed to following this guidance. Cimarron presented its application of this guidance to the decommissioning for release of Waste Ponds #1 and #2 in a meeting with NRC staff on April 10, 1997 at NRC headquarters. At that time, NRC indicated that Cimarron appeared to have applied the guidance correctly in identifying Option #2 materials (as determined from the subsurface guidance document) to be removed and leaving behind residual Option #1 concentrations.
- Section 6.4.5 - "Gamma Surface Survey (Open Land Areas)" - This section specifies that when the NaI instrument is used for a gamma scan or systematic survey, any reading greater than twice background indicates an area requiring additional investigation.
- Section 6.4.6 - "Exposure Rate Survey (Open Land Areas)" - This section specifies that the average exposure rate, within a 100 m<sup>2</sup> area, may not exceed 10  $\mu$ R/h above background at 1 meter above the surface. The maximum exposure rate for any discrete location within the unit area may not exceed 20  $\mu$ R/h above background. Background has been established as 7  $\mu$ R/h.
- Section 6.2 - "Site Background Levels" - The background exposure rate to be used for the site is 7.0  $\mu$ R/h when surveying with a  $\mu$ R-

meter. When using the Cimarron on-site soil counter, the average background value for soils of 4.0 pCi/g total uranium is used. The derivation of this background soil value was discussed in the response to NRC Specific Comment No. 2 above.

As discussed above, the Phase III radiological criteria and guideline values summarized above (except Subsurface Residual Activity, Subsection 6.4.4) are the same as those used for all areas of Phase I and Phase II. Cimarron believes that no changes to the FSSP are required to respond to this NRC comment.

**2. NRC Comment:**

Section 6.2 (last paragraph) discusses how Cimarron established its background rates. NRC staff requests that the data points and the statistical technique that was used to determine the average background exposure-rate be referenced in the FSSP and reported in the Phase III Final Status Survey Report (FSSR). It is not clear whether the average background exposure rate was characterized according to the procedures in Section 8.6 of NUREG/CR-5849. It is also not clear if the raw background data were measured with a properly calibrated Ludlum Micro-R meter (see general comment above). Furthermore, Section 6.2 should also be revised to address the background for soils and building and equipment surfaces.

**Cimarron Response:**

Through numerous submittals and approvals, Cimarron and ORISE have established a background exposure rate of 7  $\mu$ R/h when utilizing a Ludlum Micro-R Meter and 9 - 10  $\mu$ R/h when surveying with a PIC. In response to NRC's General Comment #1 above, Cimarron presented the data and data comparisons developed by Cimarron for the Micro-R meter which has been cross checked with the PIC and discussed the fact that instrumentation is calibrated to NIST standards. The data utilized for these cross checks were

presented with that response. Additionally, the included calculation demonstrates that the ten Mirco-R survey locations were adequate for determining background exposure rates .

The total number of background measurements needed to satisfy the guidance in NUREG/CR-5849, Section 8.6 is as follows:

$$N_B = \left[ \frac{t_{95.5} \cdot S_x}{0.2 \cdot \overline{X}_B} \right]^2$$

where

$N_B$  = number of background measurements required

$\overline{X}_B$  = mean of initial background measurements

$S_x$  = standard deviation of initial background measurements

$t_{95.5\%, \text{ diff}}$  = t statistic for 95.5% confidence at  $df=n-1$  degrees of freedom, where n is the number of initial background data points

The ten Micro-R survey readings listed in Table 1.0 were evaluated to determine if the number of background data points was acceptable.

The mean and standard deviation for this data (Table 1.0) were calculated to be 7.6  $\mu\text{R/h}$  and 1.35  $\mu\text{R/h}$ , respectively; the t statistic is 2.262 for 9 degrees of freedom. The total number of determinations required to establish an average background is:

$$N = \left[ \frac{2.262 \cdot 1.35}{0.2 \cdot 7.6} \right]^2 = 4.0$$

Since the number is less than 10, no additional surveys to establish background are required.



Additionally, Phase III FSSP, Section 6.2, Page 8, third paragraph, addresses the residual activity for background uranium in soil. A value of 4.0 pCi/g total uranium has been established for background. The derivation of this value was presented in Cimarron's letter from Mr. Jess Larsen to Mr. Michael F. Weber, Chief, Low-Level Waste and Decommissioning Project Branch, US NRC, dated June 21, 1995 in response to questions on the "South Uranium Yard". The NRC accepted the derivation of background for "enriched" uranium with their approval to backfill the South Yard by letter dated July 7, 1995.<sup>10</sup>

At the NRC's request, Cimarron further performed a "Critical Value Determination" which recognized all significant contributions to the statistical variability for soil background. The "Critical Value Determination" was submitted to the NRC by letter dated July 23, 1996 from Mr. Jess Larsen to Mr. Ken Kalman. The observed variability in background concentrations is due to both counting variability as well as from spatial variability. The critical value determination resulted in total uranium background concentrations (at both the 95% and 99% confidence level) substantially greater than the 4.0 pCi/g total uranium value currently utilized by Cimarron. The critical value provides an upper bound for the normal distribution and could be used to determine when a single sample result in an unaffected area may require additional evaluation.

Average background for buildings and equipment has not been presented, nor is Cimarron using it during decommissioning. Acceptable surface contamination levels for releases of buildings and equipment are presented by Table 6.1 on page 18 in the FSSP. These values are absolute values, recorded by properly calibrated portable survey equipment. Ambient background has not been subtracted from these values.

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<sup>10</sup> USNRC letter from Mr. Michael F., Weber, Chief, Low-Level Waste and Decommissioning Project Branch, Division of Waste Management, to Mr. Jess Larsen, Vice President, Cimarron Corporation, dated July 7, 1995.

Cimarron believes that no change to the FSSP are required to respond to this NRC comment. However, this discussion will be included and cited in the Final Status Survey Report.

**3. NRC Comment:**

Section 6.3.1 and Section 6.4.4 note that additional soil data will be gathered for Waste Ponds 1 and 2 to demonstrate that these soils meet the Branch Technical Position Option 1 criteria and can therefore be left in place. Likewise, Section 8.2 notes that final characterization data, including subsurface averaging data, will be included in a separate submittal to the NRC and only summarized in the Phase III FSSR. However, there is no specific mention of when these data will be presented. NRC staff encourages Cimarron to present these data for our review before it is incorporated into the Phase III FSSR. Failure to do so may delay our review of the Phase III FSSR.

**Cimarron Response:**

As stated in Section 6.4.4, Cimarron will apply the NRC's BTP Option #1 guidance to Uranium Waste Ponds #1 and #2 for volumetric averaging of subsurface soils containing residual contamination. During a meeting with the NRC on October 2 - 3, 1996, the NRC staff recommended that Cimarron consider applying the subsurface averaging methodology for residual activity being developed by the NRC for other licensees. The NRC guidance document that provides this method for averaging elevated areas of subsurface soil concentrations was sent to Cimarron by cover letter from Mr. Ken Kalman to Mr. Jess Larsen dated February 25, 1997. This document titled "Method for Surveying and Averaging Concentrations of Thorium in Contaminated Subsurface Soil", describes a set of decommissioning performance objectives for subsurface soils that the NRC has found acceptable at other sites. As stated in Mr. Kalman's letter, "Although the methodology was written for thorium it can be applied to uranium as well."

This NRC guidance assumes that soils containing residual contamination are excavated and brought to the surface where surface exposure pathways, and the surface averaging method apply. The surface averaging method used for excavated subsurface soils is consistent (although modified by the new guidance) with that used in NUREG/CR-5849. The acceptable concentrations (guideline values) which have been calculated by Cimarron for comparison to the final status survey data for the two Uranium Waste Ponds are a function of the excavated soil volumes. The calculated guideline values result in projected exposures similar to those representative of BTP Option #1 soils (30 pCi/g total uranium) with widespread surface contamination.

The methodology, the guidance values derived, and the preliminary data evaluation completed by Cimarron for both waste ponds were discussed with the NRC in Washington on April 10, 1997. The NRC representatives at that meeting included Mr. Dave Fauver, Mr. Ken Kalman, Mr. Tim Johnson, and Mr. John Hickey. At that meeting Cimarron discussed the preliminary soil survey data based upon one foot soil samples increments and committed to removing several soil areas within both waste ponds that exceeded the guideline values. Also, Cimarron discussed the fact that the final survey data would be evaluated and presented in one meter (i.e., 3 to 4 foot) increments per the methodology contained in the NRC's subsurface averaging guidance. NRC representatives at that meeting indicated that this method of data presentation met the guidance criteria.

In Cimarron's August 26, 1997 response to NRC's questions pertaining to the Decommissioning Plan, the company formally committed to follow the subsurface volumetric averaging guidance. The methodology's performance objectives put forth in the NRC guidance document are being followed in determining the Option #1 guideline values for subsurface soils. Presently these guidelines are being applied to the final status survey soil data for the two

Uranium Waste Ponds. Soil remediation of both waste ponds and the placement of 3 feet of clean fill (i.e., cap material) over Waste Pond #2 has been completed. The survey data compilation, data comparisons, drawings, and guideline value deviations are being assembled into the Subarea O, (i.e., Uranium Waste Ponds #1 and #2) Final Status Survey (i.e., subsurface only) Report for submittal. Cimarron anticipates submitting the "Subsurface" Subarea O FSSR by mid-January. The final status survey data for the Subarea O surface soils will be forwarded as a separate report at a later date, once all surface contouring and grading is completed and the survey data has been assembled and analyzed. Uranium Waste Ponds #1 and #2 both have been combined into Subarea O (Uranium Waste Pond #1 was moved from Subarea M to O) as noted on the revised Drawing No. 95 MOST-RF3, included with this response.

The revised Drawing 95MOST-RF3 will be included with the revision to the FSSP. Cimarron believes that no other changes to the FSSP are required to respond to this NRC comment.

**4. NRC Comment:**

Section 6.3.2 discusses remediation actions taken at the trash incinerator but does not mention whether this area will be included in the Phase III final status survey. Please specify whether it will be included in a final status survey. NRC staff suggests that Cimarron add a general direction that all Phase III areas be included in the final status survey.

**Cimarron Response:**

The trash incinerator location is included in Phase III, Subarea M. This subarea, along with all other Phase III Subareas, will be included in the Phase III Final Status Survey. The incinerator location will be included in the Final Status Survey Report for Phase III, Subarea M. The final status survey for this subarea is in progress, but has not been completed.

Section 8.0 of the FSSP will be modified by adding to the beginning of the first paragraph the following sentence:

"All Phase III Subareas will be included in the Phase III Final Status Survey."

**5. NRC Comment:**

Section 6.3.2 discusses onsite roads and the possible need for decontamination. How will these roads be surveyed? Is there any possibility that radioactive contaminants are trapped between layers of asphalt comprising these roads? How will this factor into the survey or sampling methodology? How will this road material be handled if it is above Option 1 criteria?

**Cimarron Response:**

The issue of how "paved surfaces" are to be surveyed was discussed in Cimarron's response to NRC's comments on the Phase II FSSP. That response was:

For exterior paved surfaces, the August 1987 surface contamination criteria from NRC's "Guidelines for Decontamination of Facilities and Equipment Prior to Release from Unrestricted Use" are being utilized by Cimarron Corporation. However, the activity is averaged over 100 m<sup>2</sup> as opposed to 1 m<sup>2</sup>. NUREG/CR-5849 treats paved surfaces as open land areas (See "Open Land Surveys", NUREG/CR-5849, Section 4.2.3, page 4.16). Systematic grid surveys for open land areas are performed on a 10 m x 10 m grid as noted in Figure 4-4 (page 4.17) in NUREG/CR-5849. This treatment of paved surfaces as "Grounds" is also discussed in Section 4.3.7, page C-25 of NUREG/CR-5849.

The NRC agreed with this response, and approved the Phase II FSSP by letter March 14, 1997. **However, no asphalt roads presently exist within Phase III areas.**

Phase III FSSP will be modified to better define the disposition of roads (and parking areas) presently located within the Phase III area. These roads are gravel or dirt type roads some of which previously were covered with asphalt. Roads and parking areas in close proximity to the Uranium Plant operation area were asphalt. Other roads onsite were, in general, gravel. The asphalt from Phase III area roads and parking areas were removed beginning in the late 80's and stockpiled as part of the on-going decommissioning process. The asphalt was removed to facilitate subsurface soil characterization and remediation as required. All asphalt including that which was discovered to have residual activity between the layers has been removed and stockpiled. This asphalt has subsequently been crushed and characterized. The status of this asphalt stockpile was addressed by Cimarron in its October 17, 1997 letter to the NRC from Mr. Jess Larsen to Mr. Ken Kalman. The NRC forwarded several comments to Cimarron pertaining to Cimarron's October 17 response by letter dated November 7, 1997. Cimarron will forward its responses to the NRC as soon as they are completed.

The existing gravel/dirt roads will be surveyed as open land areas receiving a 100% surface scan prior to soil sampling. As discussed in Section 8.5, page 28, roads will be sampled at 5 m intervals along the length with 1 sample location per each 100 meters in length sampled down to 4 feet or rock. This procedure for surveying gravel/dirt roads was also included in the Phase II FSSP submitted on January 28, 1997 in response to NRC questions. As discussed above, this Phase II Plan was approved by the NRC by letter dated March 14, 1997 from Mr. Kenneth L. Kalman to Mr. Jess Larsen.

Any materials found during the surveys above the Option #1 criteria, will be handled as Option #2 material or greater as appropriate. Option #2 material will be placed into the on-site disposal cell, and Option #4 material will be packaged for off-site disposal.

Section 6.3.2 of the FSSP, page 14, under "On-Site Roads" will be modified with the addition of the following paragraph as the beginning paragraph.

"No asphalt roads or parking lots exist within Phase III areas. The asphalt from area roads and parking lots were removed beginning in the late 80's and stockpiled as part of the on-going decommissioning process. The asphalt was removed to facilitate subsurface soil characterization and remediation as required. Existing gravel roads will be surveyed as open land areas per NUREG/CR-5849.

**6. NRC Comment:**

Section 6.3.3 notes Cimarron's belief that groundwater restoration is not justified. This is a matter that will not be brought to closure until after Cimarron and the Oklahoma Department of Environmental Quality have completed their risk assessment and NRC staff makes its decision. Such statements are premature and misleading, and should be qualified accordingly.

**Cimarron Response:**

Cimarron Corporation understands and agrees that the groundwater issues have not been brought to closure. The areas of groundwater impacts are associated with past disposal/operational activities and those areas have been excavated and materials removed and shipped off-site. The aquifers are "tight" and in some instances unsaturated in the impacted areas making a pump and treat system impractical. Cimarron is also working with the State of Oklahoma DEQ regarding this groundwater issue.

**7. NRC Comment:**

Section 6.4.4 should be revised to clearly state how the averaging criteria will be used for Burial Areas 1 and 2.

**Cimarron Response:**

By this comment, the NRC may be confusing Burial Areas #1 and #2 with Uranium Waste Ponds #1 and #2. Section 6.4.4 addresses the soil averaging criteria to be applied to Uranium Waste Ponds #1 and #2. This criteria was not applied to Burial Areas #1 and #2, as they were remediated and released by the NRC prior to the issuance of the new guidance as discussed in the response to NRC Specific Comment No. 3. Burial Area #1 which is located in Phase II Subarea F, was remediated, surveyed, and released per NRC License Amendment #9 issued by letter from Mr. George M. McCann, US NRC to Dr. John Stauter, dated December 29, 1992. A surface survey of this area will be included as part of the final status survey for Phase II, Subarea F.

Burial Area #2 is located in Phase III, Subarea L. This Burial Area has been remediated, final surveyed and backfilled per NRC authorization letter dated November 8, 1996 from Mr. Ken Kalman to Mr. Jess Larsen. In this letter the NRC states, "Based upon its review of these submittals and the additional subsurface sampling data, the NRC staff is satisfied that the criteria for unrestricted release have been met". Based upon this release, the area has been backfilled and graded. The surface area survey will be included in the final status survey for Subarea L.

Cimarron's response to NRC's Specific Comment #3, discusses the Option #1 subsurface averaging methodology to be applied to Uranium Waste Ponds #1 and #2 and the guideline values derived.



Cimarron believes that no changes to the FSSP are required to respond to this NRC comment.

**8. NRC Comment:**

Section 6.4.2, first paragraph, fifth sentence. The reference to NUREG/CR-5849 should be clarified by adding the following words to the end of the sentence: "Section 8.5.2. for soils."

**Cimarron Response:**

Cimarron will add to the end of the fifth sentence in Section 6.4.2 the phrase, "Section 8.5.2 for soils."

**9. NRC Comment:**

Section 7.3 references License Amendment No. 13. This should be changed to License Amendment No. 14, which, is the amendment that actually incorporates the radiation protection plan. In addition, the text should be modified to explicitly reference the radiation protection program that was approved in License Amendment 14.

**Cimarron Response:**

Section 7.3 will be modified by revising the second sentence and the first bulleted item to read as follows:

"The Cimarron Radiation Protection Program currently in place for all decommissioning activities which was recently modified and updated per SNM-928 Amendment No. 14, is administered through the use of the following documents:

- License SNM-928 Amendment #14"

**10. NRC Comment:**

Section 8.5. NRC staff believes that Cimarron's procedures for the collection of surface soil samples and conduct of exposure rate measurements in open land areas are consistent with procedures in NUREG/CR-5849. However, the following information should be included in the FSSR:

- a. For subsurface areas not previously sampled, Cimarron should present a written justification for its proposed sampling frequency of subsurface soil; one location for every twenty 5m X 5m grid areas.

**Cimarron Response:**

Cimarron was pleased to hear that the NRC staff believes that Cimarron's procedures for collection of surface soil samples and for conducting exposure rate measurements are consistent with the procedures in NUREG/CR-5849. Cimarron also believes that their procedures for subsurface sample collection are consistent with NUREG/CR-5849.

Cimarron was conservative in its designation of affected versus unaffected areas of the site. Numerous locations designated as affected areas onsite have subsurface soils that are unaffected by past site operations. It is these areas that are to be sampled per the frequency discussed in the response above. Cimarron has completed extensive subsurface sampling throughout the site as part of the overall characterization process for site decommissioning. These results are documented in numerous reports previously submitted to the NRC, including the October 1994 Characterization Report. Where it was determined by Cimarron that there was a potential for residual activity below the surface, these areas were investigated with subsurface borings, and if required those areas were remediated. The subsurface sampling data was utilized in planning the remediation. Any other affected areas onsite, not believed to contain residual below grade activity, were scheduled for subsurface sampling at the

frequency presented in Section 8.5 (i.e., one location for every twenty 5 m x 5 m grid areas). These subsurface soils can be treated as an unaffected subsurface area even though the surface is being surveyed as an affected area.

This soil sample frequency (i.e., one location for every twenty 5 m x 5 m grid areas) was agreed to per discussions with Mr. Tim Johnson, Mr. Boby Eid and Mr. Ken Kalman from the NRC, and Mr. Joe Kegin, site manager for Cimarron, in a conference call on December 12, 1996 at which the NRC's comments on the Phase II Final Status Survey Plan were being discussed. This agreed sample frequency was formalized in Cimarron's January 28, 1997 letter from Mr. Jess Larsen to Mr. Ken Kalman responding to NRC's October 31, 1996 Phase II Plan comments. Based upon this response the NRC approved the Phase II Plan by letter dated March 14, 1997. As agreed, this sample frequency only applies to affected areas that have not been previously cored to depth, and where there is little reason to believe that subsurface residual contamination is present. Unaffected areas do not require subsurface sampling. It should be clarified, Phase III contains only areas of the site designated "affected" per NUREG/CR-5849.

Cimarron believes that no changes to the FSSP are required to respond to this NRC comment.

**10.b. NRC Comment:**

NRC staff notes that the frequency and locations of subsurface soil samples, as presented in this paragraph, would be appropriate only if the subsurface soil areas were justified as unaffected areas.

**Cimarron Response:**

See Response to 10. a.

**10.c. NRC Comment:**

Section 4.2.4 of NUREG/CR-5849 indicates that "The number and locations of samples should follow the same pattern as described above in section 4.2.3 sampling depth of surface soil." For unaffected areas, this procedure requires 30 randomly-selected locations and a scan of a minimum of 10 percent of the soil to be scanned. Cimarron should also present the written procedure it will follow, if any of these subsurface samples exceed the averaging criteria for unrestricted release of areas contaminated with enriched uranium.

**Cimarron Response:**

The reference quoted from Section 4.2.4 of NUREG/CR-5849 applies to areas onsite where "there is [a] potential for residual activity below the surface layer." This position also is stated in Section 6.5.5 of NUREG/CR-5849, third paragraph, which states, "Location of known or suspected subsurface activity are sampled using the same grid block spacing and systematic pattern as used for surface areas of high contamination potential." As discussed in 10.a., Cimarron has cored those areas onsite where there was reason to believe that below grade residual activity was present. NUREG/CR-5849 does not suggest that other areas onsite, even affected areas, where there is no reason to suspect subsurface contamination, be cored during the final status survey. The sample frequency discussed in the FSSP, Section 8.5 applies to affected areas onsite that have not been previously cored and when there is no reason to believe that subsurface residual activity exists. Cimarron would also like to clarify that unaffected areas do not require subsurface sampling per the guidance in NUREG/CR5849.

Should any of the subsurface samples collected per Section 8.5 of the Phase III FSSP exceed the Option #1 guideline, then off-set samples will be collected to determine the extent of the elevated activity, and to provide additional data for performing subsurface soil averaging and/or excavation.

Cimarron believes that no changes to the FSSP are required to respond to this NRC comment.

**11. NRC Comment:**

Section 8.5 discusses composites of samples taken at depth. Does this mean that one sample was analyzed to represent a 4 ft depth? This is unacceptable unless the acceptance criteria was modified. Separate samples should be taken and analyzed to represent each depth level. Also, Cimarron should describe how it will determine when it has gone to an acceptable depth. Normally, NRC staff will accept data that shows the licensee is at background levels and that there is a consistent trend downward to background levels.

**Cimarron Response:**

Section 8.5, page 28, first complete paragraph states, "Cimarron has collected and composited these subsurface samples, at one foot intervals, down to a maximum depth of 4 feet." For clarity, the following sentence will be added after this sentence: "What this means is that Cimarron collects individual soil samples at depth from 0-1', 1'-2', 2'-3' and 3'-4'; thus four samples per location." This sampling frequency is very conservative in that NUREG/CR-5849 recommends samples be collected at 1 m intervals. It should be noted that a portion of the final status survey data for Uranium Waste Pond #1 was collected on a 3 foot interval for comparison to the subsurface guideline values.

To clarify how Cimarron determine that it has sampled to an acceptable depth, the following paragraph will be added prior to the first complete paragraph on Page 29. "In general, once the soil data has been recorded, it is reviewed by the Project Manager and RSO (or RSO designee) to determine if further characterization or remediation is required or if the data is acceptable. The data review process is to verify that approved QA/QC procedures have been followed,

the Option #1 guideline values have been met, and that no further characterization, remediation or sampling is required."

**12. NRC Comment:**

Section 8.6 should be revised to clearly specify what the measurement frequency will be for upper walls, ceilings, and overhead structures. Note that no specific information is provided. The frequencies should be consistent with NUREG/CR-5849, Section 4.2.3.

**Cimarron Response:**

As discussed in Section 8.6, the survey frequency for upper walls, ceilings and overhead structures is to be performed per the guidance in NUREG/CR-5849. NUREG/CR-5849 specifies that survey coverage of these areas is dependent upon the contamination potential of the surfaces. Section 8.6 of the FSSP states that, upper walls, ceilings and overhead structures will be surveyed at a frequency similar to floors and lower walls if operating history and the initial scans indicate the presence of residual activity. In general, based upon the initial characterization surveys, flat surfaces of the upper walls and roof and exterior surfaces were found to contain residual activity at levels below 25% of the guideline value. For this reason, upper walls, ceilings and exterior surfaces for the buildings within Phase III areas may be surveyed at a frequency different from the lower walls and floors. Structural members, including those with horizontal surfaces will be surveyed at a frequency similar to lower walls and floors. Locations of areas of elevated activity which are identified during the scan or survey will then be further surveyed with direct measurements to define the extent and activity levels. Remediation will be performed as necessary.

For clarity, the recommended survey frequency for all surfaces associated with buildings within the Phase III area is being presented herein and will be added to

the FSSP, Section 8.6. The proposed survey methodology for Phase III building surfaces is presented below with the addition of new Section 8.6.1:

#### "8.6.1 Survey Methodology

The specific procedures to be followed in scanning and surveying the buildings and structures within Phase III areas are as follows:

a) Interior Floors:

The surfaces will be 100% scanned for alpha and beta/gamma. Areas of elevated activity which are identified during the scan will then be further surveyed with direct measurements to define the extent and activity levels. Remediation will be performed if guidelines values (Table 1 of NRC's 1987 guidance) are exceeded; areas will be resurveyed as necessary.

Systematic surveys (fixed surveys and smear surveys) for alpha and beta/gamma will be performed at a spacing equivalent to a 1 m x 1 m grid on the floors. Systematic Micro-R measurements will be taken at one meter from the floor at a frequency equivalent to one measurement per every 4 m<sup>2</sup> (i.e., 2 m x 2 m grid) of surface area.

b) Interior Walls:

Characterization surveys have shown that upper interior flat surfaces are not expected to contain residual activity that exceeds 25% of the guideline value. However, Cimarron has elected to survey all of these surfaces similar to a lower wall survey. The surface will be 100% scanned for alpha and beta/gamma. Areas of elevated activity which are identified during the scan will be addressed as discussed in a) above. Cimarron will perform systematic surveys for alpha and beta/gamma, including direct and

removable activity surveys, at 1 m x 1 m grid spacing. Exposure rate measurements will be taken with a Micro-R meter at 1 m from the surface at a frequency of one measurement per every 4 m<sup>2</sup> of surface area along the lower walls (i.e., 2 m in height).

c) Roof Support Beams:

Support beams and, in general, horizontal surfaces will be 100% scanned for alpha and beta/gamma. Areas of elevated activity will be addressed as discussed in a) above. Systematic measurements for alpha and beta/gamma will be taken at one meter intervals on all accessible sides along beams and supports.

d) Interior Ceiling:

The surfaces will be 100% scanned for alpha and beta/gamma. Areas of elevated activity will be addressed as discussed in a) above. Systematic survey measurements for alpha and beta/gamma will be taken at a frequency equivalent to a 1 m x 1 m grid or less.

e) Exterior Side Walls:

Surfaces will be 100% scanned for alpha and beta/gamma. Areas of elevated activity will be addressed as discussed in a) above. Systematic measurements will be taken on all walls at a frequency of one location per every 2 m x 2 m grid intersect. Surveys will be taken for both alpha and beta/gamma. Exposure rate measurements will be taken with a Micro-R meter at 1 meter from the wall surface at a frequency equivalent to one measurement per every 4 m<sup>2</sup> of surface area along the lower wall (i.e., 2 m in height).



f) Roof Exterior:

All surfaces will be 100% scanned for alpha and beta/gamma. Areas of elevated activity will be addressed as discussed in a) above. Systematic surveys for alpha and beta/gamma will be taken at locations equivalent to a 1 m x 1 m grid.

g) Hot Spot Averaging

Residual activity exceeding 15,000 dpm/100 cm<sup>2</sup> shall be remediated and follow-up surveys performed. Areas of elevated activity between 5,000 and 15,000 dpm/100 cm<sup>2</sup> will be tested in accordance with NUREG-5849, Section 8.5.2, to assure that the average surface activity level within a contiguous 1 m<sup>2</sup> area containing the elevated area is less than 5,000 dpm/100 cm<sup>2</sup>."

As noted, this language which includes the survey frequency will be added to Section 8.6 of the FSSP.