SEQUOYAH FUELS
A GENERAL ATOMICS COMPANY

RE: 0521-N

March 30, 2005

Fed Ex Tracking # 7904 7271 7333

U.S. Nuclear Regulatory Commission
ATTN: Mr. Myron Fliegel, Senior Project Manager
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Subject: Sequoyah Fuels Corporation, Docket – 40-8027
Response to Request For Additional Information – Reclamation Plan – Radiation Protection and Erosion Protection (TAC L52528)

Dear Mike,

Your letter dated 12/22/04 requested additional information on the Reclamation Plan with respect to radiation protection and erosion protection. A partial response was submitted in January with a commitment to provide the balance of the responses in March and April. Please find enclosed a response to the items RP2A and E, and RP3A, D, and E which were scheduled for submittal in March, 2005.

If you have any questions, don't hesitate to call me at (918) 489-5511, ext. 13.

Sincerely,

John H. Ellis

John H. Ellis
President

Enclosure

XC: Elaine Brummett, NRC
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Enclosure

Sequoyah Fuels Corporation
Reclamation Plan Review
Request for Additional Information

Radiation Protection (RP)

RP2 Benchmark Dose Modeling and Cleanup Levels

The NRC staff reviewed the Reclamation Plan, revision 2 (February 2004), Section 3 "Facility Decommissioning and Surface Reclamation," and portions of Appendix D "Site Characterization Plan," and Appendix G, "Radium Benchmark Dose Calculations." SFC used a resident farmer scenario to model (calculate) the radium benchmark dose as the first step to derive cleanup limits for uranium (U-nat) and thorium (Th-230), according to Criterion 6(6) of Appendix A to Part 40.

A REQUEST: SFC should justify the use of the resident farmer scenario for the site (are there farmers growing vegetables, fruit, grain as well as livestock in the general area), and the existence of edible fish in site surface waters. Also, indicate how likely it is that a farmer in the area produces 50 percent of the food and milk that their family consumes on 65 acres, irrigates all crops with pond water, and produces 50 percent of the family's aquatic food in that same pond.

BASIS: Section 3.2.2 indicates that the scenario chosen for the radium benchmark dose modeling is based on prudently conservative assumptions that tend to overestimate potential doses. The NRC guidance in NUREG-1620, Appendix H, indicates that a realistic dose estimate is to be provided. Conservative input parameters (assumptions) for the model could result in a high benchmark dose that is not protective, so realistic (not conservative) model parameter values should be used. Also, assuming a resident farmer lives in the process area (Figure G-1) does not appear to be realistic. The potential exposure to 5 pCi/g Ra-226 is for an undefined area with characteristics typical of the licensed site. In addition, the guidance (page H-7) states that for sites with more than 100 acres of contamination, one could assume 25 percent of the diet is from that area. SFC stated that the contaminated area is 65 acres and assumed 50 percent of the diet was from this area.

Response:

The resident farmer was identified as a likely scenario for the SFC site for the Decommissioning Plan (DP) submitted in 1998. The Environmental Impact Statement (EIS) evaluated the dose modeling done by SFC and accepted the resident farmer scenario as the likely critical group. In developing the Reclamation Plan (RP) under Appendix A, submitted in 2003, SFC updated and revised the DP to accommodate public input and extensive review already done by the NRC and its contractors. The dose modeling done for the DP was reviewed against NRC guidance on Benchmark Dose determinations to identify any necessary changes. SECY-98-084 evaluated two possible scenarios for use in calculating the Benchmark Dose for mill sites. One of the two scenarios was the resident farmer living on a Nebraska site which is conceptually similar to

the SFC site. As such, SFC did not see the need to change the scenario used to determine the Benchmark Dose.

Land use in this area of Oklahoma includes resident farmers as evidenced by the 2002 Census of Agriculture. The profile for Sequoyah County, Oklahoma reports:

- Number of farms is 1259
- 679 include farming as the primary occupation of the principal operator
- Average size of farm is 177 acres
- Land in farms by type of land
- 46% cropland
- 35% pastureland
- 15% woodland
- 4% other uses

Tabulations of Selected Items for the Zip Code of SFC in the same census reveals the following:

- 101 family operated farms
- 87 include the principal operator living on the farm (51 include farming as the primary occupation of the principal operator)
- 75 include beef cow inventory
- None include milk cow inventory
- 69 are of size between 50 and 1000 acres (26 are less than 50 acres)

The RAI questions the likelihood of several food sources and irrigation on a hypothetical farm placed at the site. Edible fish do exist in the adjacent surface water and is readily confirmed by observation or interview of local residents. SFC stocked the onsite pond with game fish which are routinely caught by local anglers. The river system is frequently used by anglers and contains the native fishes for the area. The fraction of fish produced from the adjacent surface waters cannot be objectively defended.

The Census citation above indicates that milk is probably not produced on the average farm in this area. No information was found describing the fraction of other foods produced and consumed on the farm.

The likelihood of irrigation from the adjacent pond versus the adjacent river is not known. However, for a family garden, irrigation from the pond would be substantially easier and less costly than from the river due primarily to proximity and elevation difference.

SFC modified the benchmark dose model presented in the RP by changing input parameters to evaluate the concern for conservatism expressed in the basis for this RAI. The inputs were changed to reflect the evaluation provided in SECY-98-084 (Attachment 4, Section 4 and Table 2) for the Nebraska site as a family farm. These changes are consistent with the U.S. Census data described above, and knowledge of local habit. Specifically,

- The aquatic foods pathway was turned off,
- The milk ingestion pathway was turned off, and

- The contaminated fractions of plant food and meat were reduced from 50% to 20%.

As a result of these changes to the model, the benchmark dose was reduced to 34 mrem per year. The corresponding benchmark concentrations in soil for Th-230 and total uranium become 140 and 460 pCi/g, respectively. However, the cleanup levels for Th-230, and total uranium proposed for reclamation of the site (14 and 100 pCi/g, respectively) are significantly less than the derived values. Thus, any conservatism or liberalism applied in modeling the scenario are overwhelmed by the conservatism applied in selection of the cleanup levels.

E REQUEST: Provide the site data for site-specific values used in the dose modeling and indicate why the resulting average is representative.

BASIS: Several parameters (e.g., density of contaminated and saturated zones) are stated to be site-specific values but no data is provided to support these values.

Response:

Several site-specific values were used for hydrogeological parameters in the dose modeling prior to publishing the final Hydrogeological and Chemical Site Characterization Report (HGSCR). The final results for each parameter is presented in the HGSCR (Reclamation Plan, Appendix B) as follows:

- Transport Distribution Coefficient, *Uranium*
  - Unconsolidated soil – Table 5.5, and
  - Shale – Table 5.2.

  The final uranium distribution coefficient (k_d value) in the HGSCR vary slightly from values used as they were not final at the time of the Benchmark calculations were made. While the values are not exactly the same, they are in general agreement.

- Density of (soil zone) – Page 94.
- Contaminated (or uncontaminated) zone total porosity – Unconsolidated soil: 0.3; calculated at 0.33 using dry bulk density of 1.76 g/cm^3 and standard specific gravity value of 2.65 g/cm^3.
- (soil zone) effective porosity – Page 95.
- (soil zone) hydraulic conductivity
  - Unconsolidated soil – Table 4.9 and page 90, and
  - Shale – Table 4.9

  Horizontal hydraulic conductivity values used in the benchmark dose calculations were determined before the HGSCR was finalized. The horizontal conductivity values used are within the range measured but not the exact average. The vertical hydraulic conductivity value was assumed to be 10 percent of the horizontal values as discussed on page 90 of the HGSCR.

- (soil zone) hydraulic gradient – Shale – Page 79.

  The hydraulic gradient used in the benchmark dose calculation is approximately 2 to 3 times larger than observed in the shale layers and reported on page 79 of the HGSCR. This difference is not significant given the observed 2 or 3 order of magnitude variability in hydraulic conductivity across the site. Flow is directly related to both hydraulic conductivity and gradient (q=kia).

RP3 Final Status Survey Plan

The NRC staff primarily reviewed the Reclamation Plan, revision 2 (February 2004), Attachment B "Final Status Survey" and Attachment C "Quality Assurance Program." Site decommissioning and the final status survey plan should follow the guidance in NUREG-1620, Section 5 and relevant portions of NUREG-1575 (MARRSIM). Also, in finalizing the plan, the licensee should consider that items will be inspected during decommissioning as described in Inspection Procedure 45678.

A REQUEST: Revise page 3 to indicate that Class 1 and 2 areas (known and suspected uranium contamination) will be assessed by 100 m^2 units.

BASIS: Page 3 of Attachment B indicates that only the Ra-226 and Th-230 areas will be surveyed by 100 m^2 units. The uranium is also being remediated under Part 40, Appendix A, Criterion 6(6) and should be assessed by the same unit size.

Response:

The introduction to 10 CFR40, Appendix A, states that, "Licensees or applicants may propose alternatives to the specific requirements in this appendix." SFC is proposing an alternative strategy for the verification survey post-reclamation. The final status survey plan was developed recognizing that contamination of soil may have occurred from different and independent parts of processing at SFC. In SRM-02-0095, the NRC concluded that the "activity at the front-end of the ... processing was uranium milling, and thus produced 11e.(2) byproduct material as its waste." The back-end of the operation was a uranium conversion process, and thus produced source material (non-11e.(2)) as its waste. Areas of soil contaminated by either end of the process are readily identified by knowledge-of-process and results of site characterization.

SFC is applying the requirements of 10 CFR 40, Appendix A to areas of soil contaminated by the front end of the process. Contamination of soil from the front-end of the process is characterized by the presence of Th-230 in excess of uranium. The Reclamation Plan, Attachment B, Final Status Survey, classifies these areas as "Th-Ra" areas and describes a final status survey consistent with 10 CFR 40, Appendix A, Criterion 6 (6). Particularly, the final status survey of "Th-Ra" areas will be performed on units of 100 m^2.

SFC is proposing to use a MARSSIM approach for final status survey to areas of soil contaminated by the back end of the process. NRC recognizes MARSSIM as the survey method of choice for license termination in all cases that do not include 11e.(2) by product material. Contamination of soil from the back-end of the process is characterized by the relative absence of Th-230 in the presence of uranium. The Reclamation Plan, Attachment B, *Final Status Survey*, classifies these areas as class 1, 2, or 3 areas and describes final status survey requirements consistent with MARSSIM. The final status survey of class 1, 2, or 3 areas will be completed relative the respective MARSSIM guidance for size of units

D REQUEST: Provide details on the soil cleanup verification as recommended in NUREG-1620, Section 5.2.

BASIS: Attachment B, Section 3.5, discusses Th-230 and Ra-226 cleanup verification. SFC proposes to take one sample from each unit but does not indicate the size of the sample or how it will represent the entire unit. Section 3.5.2 states that in situ measurements may be substituted for soil samples, but there is no indication of how these will be done or how comparable the results would be to soil analysis. Section 3.5.4 states that gamma measurements may be substituted for some U-nat and Ra-226. Isotope-gamma correlations were not presented to substantiate that the approach is acceptable. In particular, uranium concentrations are unlikely to be correlated with gamma levels and in situ measurements of soil alpha radiation are difficult.

Response:

This response is organized according to the following paragraphs of NUREG-1620, Section 5.2: (4) Gamma Guideline Level, (5) Instruments and Procedures, and (7) Final Status Survey.

Gamma Guideline Level

The Reclamation Plan, Attachment B, *Final Status Survey*, Section 3 mentions use of gamma measurements to support a soil sample scheme; one to support final status surveys for Class 1, 2, and 3 Areas (total uranium in soil), and one to support final status surveys for Th-Ra Areas (total uranium, Th-230, and Ra-226 in soil). The terms in *situ measurements* and *gamma measurements* are interchangeable within the Reclamation Plan, Attachment B.

For Class 1, 2, and 3 Areas, the use of gamma measurements will be to support a soil sampling scheme (see Sections 3.1 – 3.3). The intent is to provide an integrated survey strategy of gamma scanning and soil sampling to determine compliance with a cleanup level of total uranium in soil. Use of the gamma scan in these cases will not be based on a quantitative correlation but either on a detection sensitivity assumed from MARSSIM Table 6.7 or a qualitative assessment by comparison to background. The scan is intended to find areas of elevated activity not detected by soil sampling on a systematic pattern, or to provide a qualitative level of confidence that no areas of elevated activity were missed by sampling on a random pattern and no error was made in classification of the area.

For Th-Ra Areas (Section 3.5), gamma measurements will be used in lieu of soil sample results if a quantitative relationship can be established between instrument response and soil activity. Such a relation cannot be established at this time because a soil sampling/gamma measurement data set has not been developed in accordance with the guidance in NUREG 1620. The primary areas from which the data would be gathered are currently inaccessible: the footprints of Pond 1 Spoils Pile, Clarifier A Basin, and Pond 2. Noting that Th-230 is the primary contaminant within the scope of Section 3.5, SFC does not expect to be able to rely on gamma measurements in place of soil samples.

Instruments and Procedures

The instruments and procedures used to determine soil background radioactivity and the gamma scanning baseline are the same as those proposed for the final status survey. Survey instruments and sensitivity are described in the Reclamation Plan, Attachment B *Final Status Survey*, Table 2-3. Instrument calibration is addressed in Reclamation Plan, Attachment D, *Radiation Protection Program*, Section 2.7. A description of the survey techniques proposed in the Reclamation Plan is as follows:

Scanning Surveys Of Land Areas

Gross gamma measurements of land areas will made with a NaI(Tl) radiation detector coupled to a handheld scaler/ratemeter. Measurements will be collected by keeping the detector within two feet above ground surface while walking or driving over the area at a rate comparable to a casual walk. In open areas, the measurements will be made along a straight path between opposite borders of the area being surveyed and the distance between paths will be approximately five feet. In wooded areas, the measurements will be made along paths allowed by brush and trees.

The scaler/ratemeter, along with global positioning system (GPS) equipment, will be coupled to a data logger. A gamma measurement taken from the ratemeter and a location reading from the GPS unit will be recorded approximately every two seconds by the data logger. Each measurement will be recorded as gross counts per minute. The location will be recorded with respect to the reference coordinate system described in the Reclamation Plan, Attachment B. The expected density of measurements for an area is 60 to 80 measurements per 100 square meters.

Soil Sampling

Soil sampling of land areas will be performed in a known and consistent fashion according to written operating procedures. The location will be recorded with respect to the reference coordinate system described in Reclamation Plan, Attachment B. The soil sample will be collected from the top six inches of soil.

Soil plugs will be collected from five evenly spaced locations across a 100m2 grid for Th-Ra areas described in Reclamation Plan, Attachment B, Section 2.3. The five plugs from a six inch layer will be combined to create one composite soil sample.

Sample collection activities will include documentation on a field log, decontamination of equipment between sample locations, and collection of replicate samples at a rate of one per 10. Sample collection will also include creation of duplicate samples at a rate of one per 10. Chain-of-custody procedures will be applied beginning at the time of sample collection.

Soil samples will be shipped to an offsite laboratory for preparation and analysis. The preparation will include removing rocks and vegetation, drying, grinding, mixing/blending, and then acid leaching an aliquot of the prepared soil. These preparation techniques will be carried out in accordance with laboratory-specific procedures.

Upon termination of reclamation activities, stored samples and sample remains will be disposed.

Final Status Survey

As stated earlier, SFC does not expect to be able to rely on gamma measurements in place of soil samples. If a gamma measurement technique cannot be developed to substitute for a soil sample, then Section 3.5.2 specifies that a soil sample will be collected from every unit (100 m^2) of a respective Th-Ra area. This strategy was predicated on the knowledge that the Th-Ra Areas are relatively small and that such a sampling protocol would be affordable.

The instruments and procedures used to determine soil background radioactivity and the gamma scanning baseline are the same as those proposed for the final status survey.

E REQUEST: Provide the quality assurance procedure for the final status survey.

BASIS: Attachment B, Section 4.2 (page 13) states that a quality assurance procedure will be developed for the final status survey effort. That procedure should be provided as part of the final status survey plan, so that staff can determine that the survey will be conducted in an acceptable manner.

Response:

The quality assurance procedure specified in section 4.2 has not been written. The procedure was envisioned as an operating procedure written to the approved survey plan. The survey plan contains significant boundaries or conditions that must be known in order to develop this procedure. Two such conditions are the basic survey approach and the cleanup levels.

SFC has proposed a survey approach for the site which incorporates guidance from MARSSIM for portions of the site, and follows 10 CFR 40, Appendix A, Criterion 6 for portions of the site. The two survey methods differ substantially with respect to requirements for sample strategy. The cleanup levels also have considerable impact on decisions regarding planning, design, and implementation of the final status survey, and therefore associated QA/QC activities. It is premature to develop a description of QA/QC activities for planning, design, and implementation of the final status survey until the final survey plan is approved.