environmental
properties management, LLC

July 14, 2017

Mr. Ken Kalman
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Mr. Paul Davis
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, OK 73101

Mr. Robert Evans
U.S. Nuclear Regulatory Commission
1600 East Lamar Blvd; Suite 400
Arlington, TX 76011-4511

Re: Docket No. 70-925; License No. SNM-928
Attachments to May 25, 2017 Response to RAIs

Dear Mr. Kalman:

Environmental Properties Management LLC (EPM) submitted a response to requests for additional information (RAIs) to the Nuclear Regulatory Commission (NRC) and the Oklahoma Department of Environmental Quality (DEQ) on May 25, 2017.

The response to RAI SER-14 stated, *"The attached summary provides additional information regarding the analysis conducted. SER-14 Attachment 1: Criticality and Uranium Loading Calculations describes the basis for these input values, presents the calculations performs, and explains why the maximum allowable safe fissile concentration cannot be attained."*

The response to RAI SER-15 stated, *"SER-15 Attachment 1: Waste Criticality Evaluation provides the analysis used to demonstrate that a critical condition related to the transportation or disposal of the spent resin mixture is not credible."*

Both attachments will be attached to *Facility Decommissioning Plan – Rev 1* as appendices. During a recent review of the responses to the RAIs, it was noted that the submittal did not contain those attachments. Both attachments are provided in this submittal. These attachments are submitted to NRC and DEQ with the following qualifications:

1. The responses to RAIs included the appendix "number" (e.g., Appendix F) that was intended to be assigned to the appendix. The response to the RAIs included the projected appendix "number". As the decommissioning plan is being revised, the inclusion of other appendices such as permits will result in the re-numbering of appendices. For instance, the response to RAI SER-14 stated that the attachment would be included in the revised decommissioning

plan as Appendix M. The attachment provided in this submittal identifies it as Appendix P. As additional information is attached to the decommissioning plan, it is possible that this designation will change again.

2. The formatting of these attachments may change to coincide with the other appendices to maintain consistent formatting.
3. Editorial changes or clarifications based on internal review or agency comments or requests for clarification may be made.
4. Calculations will be revised based on updated influent concentration, enrichment values, and uranium absorption estimates, based on data obtained through the second quarter of 2017. Influent concentrations may also be revised to a lesser degree based on information obtained from the 2017 pilot tests.

We are confident that these changes will not alter the conclusions reached, particularly the calculations related to criticality. Updating the dataset based on data obtained in 2017 is expected to improve the conservatism (i.e., reduce the risk) associated with these calculations, rather than change the results significantly.

Should NRC or DEQ personnel have questions regarding the attachments, or the changes that may be made to the attachments in preparing *Facility Decommissioning Plan – Rev 1,* please contact me at jlux@envpm.com, or call me at 405-642-5152,

Sincerely,

Jeff Lux

Jeff Lux, P.E.
Project Manager

Attachments

cc: NRC Document Control Desk (electronic copy only)

SER-14 ATTACHMENT 1
CRITICALITY AND URANIUM LOADING CALCULATIONS

Criticality and Uranium Loading Calculations

Groundwater contaminated above release criteria will be extracted from subsurface aquifers, piped to treatment facilities, and treated to remove the contaminants by ion-exchange and/or bio-remediation processes as needed. Effluent water from treatment processes will be either reinjected into the ground or discharged to surface water in accordance with an OPDES permit. Resulting contaminated waste (spent resin) will be processed, packaged and disposed in accordance with applicable requirements. The resin matrix will consist of a hydrocarbon based resin (DOWEX 1); it becomes loaded with low-enriched uranium during the groundwater treatment process. Prior to packaging the resin matrix, non-resin material will be mixed with the resin as needed to absorb free liquid to satisfy transportation and waste disposal requirements. Since the waste will contain enriched uranium, consideration has been given to the design and conduct of the processing operations to ensure that an inadvertent nuclear criticality incident is not credible.

Waste processing operations and storage of packaged waste were evaluated in three separate areas, operating on two different criticality safety limits. There are two treatment systems and a separate packaged waste storage area. The two processing locations, although separated by over ½ mile, will be treated as a combined safe mass unit with a limit of 1,200 grams U-235 and a maximum enrichment of 5% U-235. The packaged waste storage area will be operated on a "safe concentration limit" basis, in which the packaged waste stored in this location (awaiting shipment for disposal) will not exceed the fissile exempt concentration limit of 1 gram of U-235 per 2,000 grams of non-fissile material.

A series of calculations were performed based on the assumption that the administrative controls to maintain the safe mass limit for the processing operations and the concentration limit for packaged waste are not effective. The calculations, assuming a uranium enrichment of 7.33% and utilizing an Upper Safety Limit of [k_{eff} plus 3 sigma] <0.9, demonstrate that the maximum allowable safe fissile concentration is 8 g U-235/kg Resin. This Appendix describes the basis for these input values, presents the calculations performed, and explains why the maximum allowable safe fissile concentration cannot be attained.

This evaluation concludes that it not conceivable that any combinations of upset conditions could occur that would result in a [k_{eff} plus 3 sigma] exceeding 0.9. Therefore, an inadvertent criticality incident is not credible.

Criticality Calculation Overview

The criticality calculations prepared for the study incorporate the following conservative assumptions:

1) All fissile material on the site is located in one contiguous area even though there are three physically separate locations planned.
2) The enrichment of the uranium is assumed to be 7.33% U-235, even though on average the enrichment is at a maximum of approximately 4.5% U-235 in two areas of the site and about 1.5% in another area.

3) The criticality model is based on an infinite slab model with a thickness of 7 feet.
4) The composition of the fissile material mixture is low-enriched uranium (maximum of 7.33% U-235) adsorbed on a hydrocarbon resin material.
5) No credit is taken for the administrative controls that will be implemented to maintain the safe mass limit and concentration limits specified in the license.

The analysis is based on a highly conservative value of 7.33% enriched uranium and a conservative Upper Safety Limit (USL) of k_{eff} + 3 sigma > 0.9. The analysis establishes an allowable safe fissile concentration of 8 g U-235/kg Resin.

Groundwater Processing Overview

Concentration of fissile material will occur on the ion-exchange resin as the groundwater is treated to remove the uranium. The relationship between the groundwater concentration of uranium and the uranium concentration on the resin is based on tests that were conducted using the selected resin material and using actual groundwater samples from the site.
The maximum enrichment value of 7.33% U-235 was also conservatively established. It was based on the maximum enrichment measured plus 2 sigma (95% UCL) for the highest single historic measurement of any well that will feed the three treatment trains. Samples where the uranium concentration was less than 30 pCi/L were not included because the uncertainty associated with laboratory analysis of isotope measurement value significantly increases and is not reliable.

During operations, the groundwater feed to each treatment train will consist of a blend of groundwater from a many different extraction wells. An evaluation was made of the historic values of calculated enrichment values for the wells that are located within each of the three areas that will feed the treatment trains. Table 1 presents the results for the average and maximum enrichment at the 95% upper confidence level (UCL) anticipated in each of the three treatment trains.

Table 1

	Concentration (pCi/L)	Average Enrichment	Average Propagated Uncertainty	Maximum Enrichment at 95% UCL
Train 1	≥30	3.48%	0.71%	4.19%
Train 2	≥30	2.69%	1.14%	3.82%
Train 3	≥30	1.51%	0.37%	1.88%

These maximum enrichments are less than the enrichment assumed for the criticality calculations.

Criticality Calculation Methodology and Results

Criticality calculations were performed for the following 3 cases:

- Infinite 7-foot Slab of Homogenous Resin-UO_2 Mixture
  - Enrichment of 7.33 wt% U-235
  - Fissile Concentrations ranging from 1 to 10 g U-235/kg resin

- Infinite 7-foot Slab of Homogenous Resin-UO_2 Mixture for the conditions shown in Table 2.

Table 2

	Enrichment %	Fissile Concentration g U-235/kg
Train 1	4.19	2.3
Train 2	3.82	1.5
Train 3	1.88	4.2

- Transportation Model from NUREG/CR-4382 (for response to RAI-15)
  - Enrichment of 7.33 wt.% U-235
  - Fissile Concentration of 0.5 g U-235/kg matrix material
  - Matrix Material is modeled as both resin and SiO_2

For the first set of cases, the infinite slab is modeled in MCNP by filling a 7-foot tall rectangular prism with the homogenized resin-UO_2 mixture. The x and y dimensions are 100 cm in width and have reflecting boundary conditions to simulate an infinite slab. There is a 1-foot water reflector modeled in the z dimension. The results for this calculation are provided below.

The following additional modeling assumptions are made for the infinite 7-foot slab calculations:

1. The resin is assumed to be composed of carbon and hydrogen with an atomic ratio of 1.
2. The resin is assumed to have a theoretical density of 1.1 g/cm^3 with a 70% packing fraction.
3. The resin is assumed to be dry and there is no additional groundwater present. Previous calculations have shown that the resin-UO_2 mixture is over-moderated and additional groundwater reduces the reactivity.

For the second set of cases, the k_{eff} value was calculated for each of the three treatment trains using the maximum expected enrichment (95% UCL) and the maximum expected uranium concentration (95% UCL) on the resin. These calculated values are provided in Tables 3 and 4 and are shown in Figure 1. At the Upper Safe Limit (USL) of k_{eff} plus 3 sigma of 0.9, the interpolated value for the fissile concentration on the resin is 7.978 g U-235/ kg resin. This value has been rounded to 8 g U-235/ kg resin.

As shown in Table 2, the maximum expected U-235 loading on a resin bed is 4.2 g U-235 per kg of resin. This fissile uranium concentrations on the resin is approximately half of the maximum fissile concentration of 8 g U-235 per kg of resin.

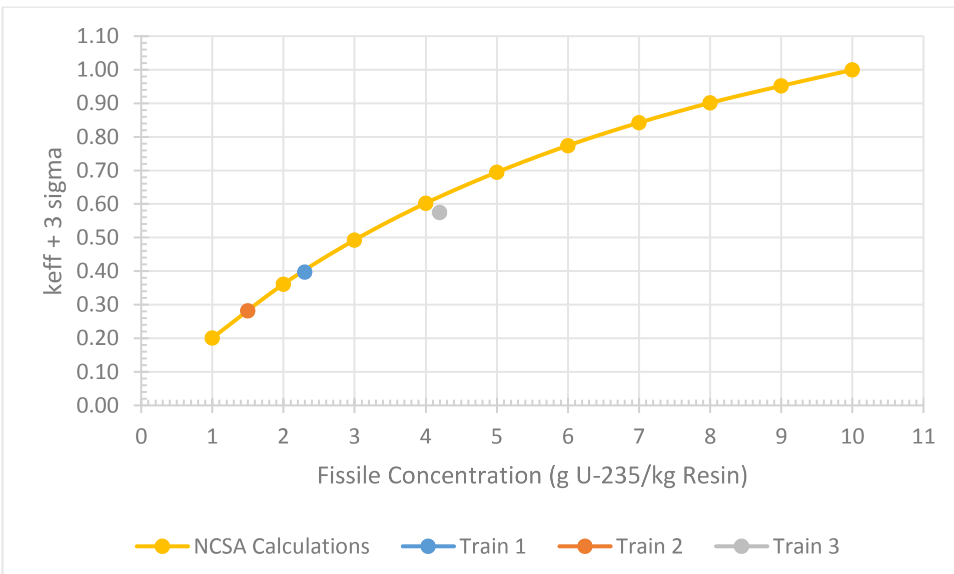
Table 3. k_{eff} Results for an Infinite 7-foot thick Slab of Resin and UO_2 at 7.33 wt% U-235

g U-235/kg Resin	**g U/kg Resin**	**k_{eff}**	**σ**	**k_{eff} + 3σ**
1	13.6	0.20069	0.00009	0.20096
2	27.3	0.36111	0.00013	0.36150
3	40.9	0.49222	0.00018	0.49276
4	54.6	0.60176	0.00021	0.60239
5	68.2	0.69380	0.00024	0.69452
6	81.9	0.77332	0.00026	0.77410
7	95.5	0.84140	0.00029	0.84227
8	109.1	0.90034	0.00031	0.90127
9	122.8	0.95089	0.00031	0.95182
10	136.4	0.99842	0.00035	0.99947

Table 4. k_{eff} Results for Resin in Three Trains

Train	Enrichment (wt. % U-235)	Fissile Concentration (g U-235/kg Resin)	k_{eff}	σ	$k_{eff} + 3\sigma$
1	4.19	2.3	0.39689	0.00016	0.39737
2	3.82	1.5	0.28120	0.00012	0.28156
3	1.88	4.2	0.57345	0.00025	0.57420

Figure 1. k_{eff} Results for an Infinite 7’ Slab of Resin and UO_2 at 7.33 wt% U-235



Possible Upset Conditions for Groundwater Extraction and Process Operations

The following process upset condition could potentially occur, either individually or in conjunction:

1. Major resin spill
2. Major groundwater spill
3. Equipment rearranged to consolidate all within one building including waste containers from storage location
4. External event such as earthquake or high winds disrupts building integrity and process equipment integrity and location

5. Operational errors during the operation of the process equipment such as misaligned valves

The geometric model for the criticality calculations assumes that the configuration of the fissile unit is a 7-foot thick infinite slab at the maximum concentration allowable on the resin matrix. None of the above events would result in a configuration of fissile material outside the model used in the evaluation.

Possible Upset Conditions for Resin Loading

The normal operational condition is that the groundwater feeds to each treatment train as a combined flow from a number of extraction wells such that the uranium mass concentration and the U-235 enrichment is a composite average of many extraction wells.

To address an upset condition in which all of the groundwater comes from a single well location at the highest uranium mass concentration, the well sample data was reviewed and the highest mass concentration sample was identified. The value is further increased by the 2 sigma uncertainty to obtain the maximum groundwater concentration at the 95% confidence level. The concentration of the uranium on the resin is then calculated using the Upper Bound equation for the loading of the resin. This Upper Bound value is then further increased by adding the 2 sigma value to obtain the maximum uranium concentration on the resin at the 95% confidence level. The U-235 enrichment for this groundwater stream is taken as the maximum enrichment at the 95% confidence level for the particular well. These calculation results are presented in Table 5 for each of the three areas that feed the three Trains.

Table 5

Treatment Area and Well	Maximum Influent Uranium Concentration	Maximum Influent Uranium Concentration at 95% UCL (μg/l)	Maximum Uranium Loading on Resin 95% UCL (g/kg)	95% UCL Uranium Enrichment (% U-235)	Maximum U-235 Loading on resin at 95% UCL (g/kg)
Train 1 Well MWWA-03	562	593	55	5.50%	3.0
Train 2 Well T-63	127	139	39	3.40%	1.3
Train 3 Well TMW-13	4,560	4,841	221	1.55%	3.4

This approach is conservative because it adds the 2 sigma uncertainty to each measured and calculated parameter. These U-235 loadings are bounded by the assumption in the criticality calculations in that the U-235 enrichment is 7.33% and the safe resin concentration is 8 g U-235/kg resin.

The results show that for all three treatment trains both the maximum fissile uranium concentration on the resin and the maximum U-235 enrichment are well within the conservative assumptions utilized in the criticality calculations. The postulated upset condition has an extremely low probability of occurring and the extended time frame over which it would have to continue without detection, but regardless the upset condition would not exceed the bounding assumptions utilize in the criticality calculations. Based on this information, it is concluded that no process operations equipment or management measures are required to be identified as items relied on for safety (IROFS).

Conclusions:

The criticality calculations described here demonstrate that the process will remain subcritical for loadings of up to 8 grams U-235 per kg of resin. A review of potential upset conditions indicates that it not considered credible that a combination of upset conditions could occur that would exceed both the U-235 enrichment and the uranium mass loading utilized in the calculations. Therefore, the probability of an inadvertent criticality incident is not credible. The following list summarizes the primary reasons that support the conclusion stated.

1. The enrichment in the groundwater would have to exceed 7.33% U-235 which is significantly higher than that measured on the site.
2. The uranium fissile concentration in the resin would have to exceed the limits calculated. Historical data of uranium concentration from groundwater sampling data and the tests conducted on the resin materials provides the information to show this is not feasible.
3. The infinite slab geometry of the model bounds any possible configuration of SNM on the site.
4. The resins provide a limiting concentration of fissile buildup dependent on the concentration of uranium in the groundwater.
5. The higher enrichment in the groundwater is limited to a different and physically separate area from that where the higher groundwater concentrations of uranium are present. It is not physically possible to introduce these two separate groundwater sources into one treatment system.
6. No specific operations systems or management measures are IROFS.

SER-15 ATTACHMENT 1
WASTE CRITICALITY EVALUATION

WASTE CRITICALITY EVALUATION

Introduction

This document provides justification for NRC approval of a revised license possession limit for License Number SNM-928 to facilitate timely and cost-effective decommissioning operations. The proposed limit includes specific conditions for the possession and storage of materials that meet the requirements for exemption from classification as fissile material as per 10 CFR 71.15. This change is focused on safety and control of materials containing low concentration of special nuclear material generated during decommissioning operations involving treatment of groundwater. This change will allow an acceptable means to store packaged "fissile exempt" materials prior to transport to an off-site facility for disposal. This change is necessary to facilitate efficient and timely decommissioning operations by allowing greater flexibility for removal of low concentration special nuclear material (SNM) and more efficient transportation.

The proposed license amendment is compatible with NRC's goals for the decommissioning program. As stated in the NRC's *Program Evaluation of Changes to the Decommissioning Program* (September 2003), "Because of the persistent challenges facing the Decommissioning Program as well as the high cost to licensees for decommissioning, the staff believes that its near-term goal should be to continue improving the efficiency and timeliness of decommissioning activities at all decommissioning sites without impacting safety or public confidence." The proposed change will allow the licensee to perform decommissioning more efficiently. In addition, this approach reduces unnecessary regulatory burden associated with decommissioning at the Cimarron Site and has no adverse impact on public safety.

The primary basis for the requested changes is to facilitate handling, transportation and disposal of large volumes of materials containing low concentrations of SNM. NRC regulations pertaining to SNM, particularly 10 CFR Part 70 and 73, were established primarily for the safe handling and control of various quantities of stock material for the fuel cycle. Low concentration residues being stored prior to transportation and disposal as waste do not pose the same hazards and concerns as stock material and therefore should not require the same level of regulatory control to maintain comparable safety. The NRC has previously approved similar activities as discussed in this Appendix.

Due to the limited number of active SNM-licensed sites undergoing decommissioning, the NRC has deferred changes in the regulations and the current practice is to address decommissioning regulatory issues through the amendment and exemption process.

Authorization for Possession and Specific Conditions of Use of Fissile Exempt Materials

The efficient and effective decommissioning of the Cimarron Site will require the treatment of groundwater. The treatment process generates ion-exchange resins and biomass containing low concentrations of uranium. The current license contains mass possession limits for enriched uranium. Although appropriate for higher concentration SNM, these limits place significant constraints on the decommissioning process when material contains low concentrations of low enriched uranium.

The proposed license amendment requested in this application incorporates a new possession limits based on the limitations of "fissile exempt" material. NRC and Department of Transportation (DOT) regulations for the transportation of radioactive material provide for the safety of packaged materials that are stored on site pending transport for either recycling or disposal. 10 CFR 71.15 exempts from classification as fissile material any material which meets a specified ratio of fissile to nonfissile material mass.

Section 6.2 of the December 2015 Decommissioning Plan proposes the addition of Item D to the possession limit table. Item D would enable the licensee to accumulate and store containers of waste meeting the transportation requirements for fissile exempt materials, independent of the U-235 mass possession limit. This would enable the licensee to store containers of low level radioactive waste until a full load is accumulated for transportation to an off-site disposal facility.

In addition to evaluations related to criticality safety to transportation, similar studies have been performed for disposal of similar materials. In November 1994 NRC issued NUREG/CR-6284, *Criticality Safety Criteria for License Review of Low-Level Waste Facilities.* This study provided nuclear criticality safety levels for disposal of materials in terms of areal density (grams per square foot). Later the NRC issued NUREG/CR-6505, *The Potential for Criticality Following Disposal of Uranium at Low-Level Waste Facilities* in June 1997. This study provided nuclear criticality safety levels for disposal of materials in terms of concentration limits. NUREG/CR-6505 is the technical basis for the current waste acceptance criteria (WAC) for disposal of SNM. WAC for enriched uranium (comparable to transportation requirements) include a limit of 1,900 pCi/g U-235 for enrichments less than 10% or a limit of 1,190 pCi/g U-235 for enrichments of 10% or greater.

Given that there are different criteria for transportation (mass ratio) and disposal of low concentration enriched uranium (radionuclide concentration), a comparison will be useful. Conversion of the of transportation requirements from mass ratio (2,000 grams nonfissile for every gram fissile) to radionuclide concentration results in 1,080 pCi/g U-235. Since this is less than the WAC for enriched uranium, the fissile exempt concentration for transportation is the most conservative and limiting value. Furthermore, materials that meet the transportation requirements for fissile exempt will also be acceptable for disposal since U-235 concentrations will be less than WAC limits.

In addition, shipments of spent resins must adhere to the definition of "Fissile Exempt". The definition of "fissile exempt" is based on the assumption that the fissile material is pure U-235 (i.e. 100% enrichment), therefore the applicable regulations for the transport of the waste from the nuclear criticality safety standpoint are conservative for any material that may be encountered during decommissioning at the Cimarron Site where the enrichment of the uranium is limited to approximately 4% U-235.

Another potential concern regarding fissile exempt materials is security. In NRC Regulatory Guide 5.59, *Standard Format and Content for a Licensee Physical Security Plan for the*

Protection of Special Nuclear Material of Moderate or Low Strategic Significance states that the quantity of concern for gross theft is estimated as 75 kg of U-235. At the fissile exempt concentration (1,080 pCi/g U-235) this converts to approximately 165 tons of waste material. Moreover, as part of the evaluation for WAC and an Order exempting the disposal facility from requirements relative to possession of SNM published in 68FR74986-74988, the NRC stated, *"Safeguarding SNM against diversion or sabotage is not considered a significant issue because of the diffuse form of the SNM in waste meeting the conditions specified."*

Since the fissile exempt criteria for transportation is less than the WAC, material meeting fissile exempt should not be considered a significant security issue, since diversion or sabotage of low concentration material is not a practical threat. Therefore, once material has been demonstrated to meet fissile exempt criteria, no additional physical protection measures under 10 CFR Part 73 for SNM should be required. This concept of a specific exemption from the regulations in 10 CFR 70 for a waste disposal site was given to both the Clive, UT and Andrews, TX disposal sites. A license provision to exempt packaged materials from the license possession limit was issued to ABB for the Windsor Site by License Amendment #66 dated October 29, 2009 (License # 060-00217-06, Docket # 030-03754).

Resin which accumulates uranium will be mixed with sufficient non-fissile material to comply with both fissile exempt criteria and disposal site WAC. The mixed LLRW will be transferred into appropriate transport containers meeting transportation requirements for fissile exempt materials. The initial demonstration that the waste material meets the transportation requirement will be based on process control measurements that conservatively determine the mass of U-235 accumulated in each batch of LLRW mixture (spent resin). This initial mass determination will be added to the site SNM inventory, but will not count against the mass possession limit for U-235. Samples of each batch of the LLRW mixture will be collected, and the concentration and mass of SNM for each container will be determined. Adjustments will be made to the site SNM inventory as necessary to reflect the revised mass concentrations determined from analytical results and the measured container weights to establish the final mass of U-235 in each container and document that the transportation regulations have been met.

This process will maintain sufficient documentation and control of the material to ensure nuclear criticality safety during decommissioning operations, as well as accountability of the material while it remains at the Site. Reporting of SNM transactions and inventory to Nuclear Materials Management & Safeguards System (NMMSS) will be in accordance with NRC regulations.

Resin Waste Criticality Evaluation

The resin processing operation involves blending resin with non-resin material. Blending will result in uniform distribution of SNM throughout the packaged waste matrix in compliance with the transportation requirements. The blended waste will be containerized for shipment and will be certified to meet all the requirements of the Waste Acceptance Criteria (WAC) for the disposal site. The blended waste will comply with the following specific WAC requirements:

1) The SNM will be uniformly distributed throughout the matrix of the resin, a hydrocarbon material. This material is considered soil-like but is not a SiO_2 matrix.

2) The waste form will be in containers which will be disposed at the licensed disposal site in accordance with license requirements for containerized waste for the disposal site.

Discussions have been held with the proposed waste disposal site to confirm that the packaged waste does conform to the WAC. This Appendix provides the analysis used to demonstrate that a critical condition related to the transportation or disposal of the spent resin mixture is not credible.

Summary of NUREG/CR-6505 Assessment

The analysis in NUREG/CR-6505 is based on a conservative model where the SNM in the disposed waste has been mobilized and transported to a lower elevation, then concentrated on soil in an optimum geometry with an optimum water content.

The analysis performed in NUREG/CR-6505 is not based on the form of the waste at the disposal site that meets the WAC. NUREG-6505 Vol. 1 Section 10.1.3 identified the following basic assumptions that were used to model the waste disposal site for the disposal of Special Nuclear Material (SNM). Using these assumptions, the transported fissile material yielded subcritical conditions:

1) the SNM is uniformly distributed throughout the soil,
2) the soil matrix is SiO_2, and
3) the SNM-contaminated soil matrix has a spherical geometry and an optimal water content for nuclear criticality.

The analysis further stated that the probability of transporting the ^{235}U and concentrating it into a suitable geometry and density to achieve criticality is very low. Additionally, the results confirmed that SiO_2 is a conservative soil matrix for nuclear criticality evaluations. Finally, the analysis concluded that a slab configuration seemed the most likely to yield a potential for criticality.

The analysis did not model the SNM bearing waste at the point of placement in the disposal site. Instead, it modeled the mobilization of the uranium from the original waste disposal location, transport to and concentration at another location by hydrogeochemical processes into a specific geometry that was evaluated for nuclear criticality safety.

The form of the initial waste in the disposal site is not considered in this analysis. However, this analysis was used to justify the concentration limits that have been established for the waste disposal sites as issued by the NRC.

Comparison of Cimarron Waste Stream to a SiO_2 Matrix

The uranium bearing waste streams that will be generated at the Cimarron Site meet the requirements of the Waste Acceptance Criteria (WAC) for the planned disposal site. To compare the resin waste matrix with a comparable SiO_2 matrix, the model named in NUREG/CR-5342, "Assessment and Recommendations for Fissile-Material Packaging Exemptions and General Licenses Within 10 CFR Part 71" was used for comparison of the two different matrices in the transportation mode.

The transport criticality calculations from NUREG/CR-5342 model an array of 55-gallon Transport drums containing a resin or soil matrix. The drums are assumed to be 55-gallon, 20-gauge 316 stainless steel, DOT-17E drums. The array size was chosen to represent 5 transport vehicles worth of fissile material. The array size is 27 x 27 x 6, with a hexagonal pitch and surrounded by a 30.48-cm thick water reflector. A VISED plot of the MCNP geometry for this calculation is shown in Figure 1. The fissile concentration is 0.5 g ^{235}U/ kg matrix material with an enrichment of 7.33 wt. % ^{235}U. The fissile concentration is the maximum concentration permitted under the Transportation regulations.

The following assumptions are made for the transport model (these are consistent with the parameters described in the NUREG/CR-5342):

1. The pitch between transport drums is assumed to be equal to the drum outer diameter. Increasing the pitch only increases neutron leakage and decreases reactivity.
2. The interstitial area between drums is set to a void to decrease neutron absorption between drums.
3. The resin is assumed to be composed of carbon and hydrogen with an atomic ratio of 1 with a density of 0.96 g/cm^3. (Table 3-1 of NUREG/CR-5342)
4. The soil is assumed to be SiO_2 with a density of 1.6 g/cm^3. (Table 3-1 of NUREG/CR-5342)

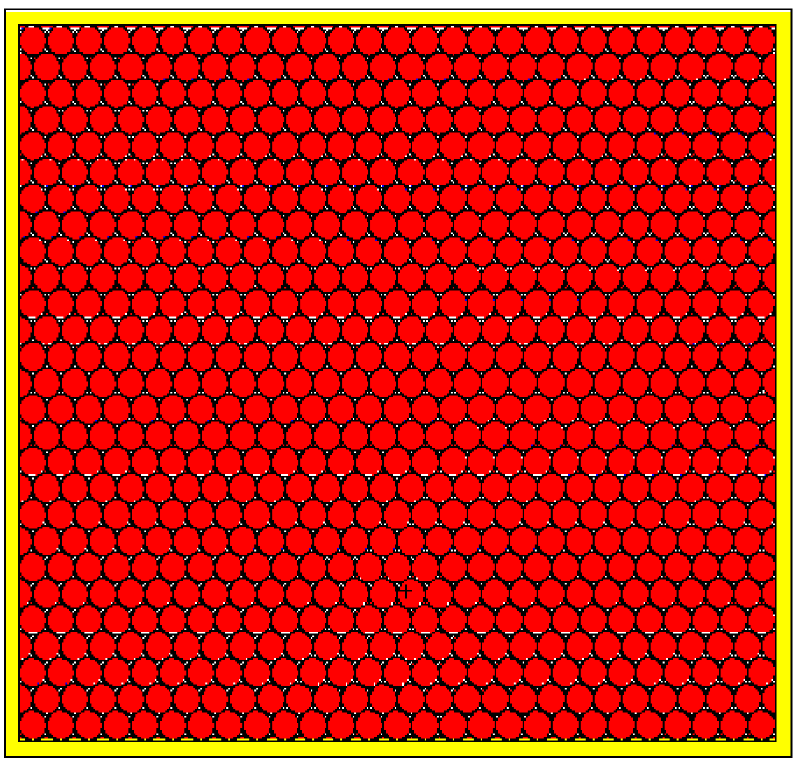


Figure 1 – X-Y Slice of MCNP Geometry for 27x27x6 Transportation Array of 110 gal. Drums

Table - k_{eff} Results for a 27x27x6 Array of 110 gal. Drums containing 0.5 g ^{235}U /kg Matrix Material

Matrix Material	**Fissile Concentration (g U^{235}/kg Matrix)**	**Enrichment (wt. % U^{235})**	**keff**	**σ**	**keff + 3σ**
Resin	0.5	7.33	0.10091	0.00005	0.10106
Soil (SiO_2)	0.5	7.33	0.28866	0.00023	0.28935

<u>Criticality Evaluation Conclusions</u>

These calculations demonstrate that the Cimarron waste stream, consisting primarily of a resin matrix, has a lower k_{eff} than the SiO_2 matrix used as the basis for establishing the limits in the transportation regulations. The assumptions used for the calculations are conservative for the waste to be transported from the Cimarron site to the waste disposal facility.

<u>Summary</u>

Fissile exempt materials have been evaluated by the NRC and shown not to pose any nuclear criticality safety or SNM physical security concerns. These changes will reduce unnecessary regulatory burden associated with decommissioning. In addition, it will allow more effective transportation of waste to the disposal site, reducing the risk of accidents. NRC has approved or allowed similar activities for such materials at other licensed facilities. This change will allow EPM to complete decommissioning in a timely and efficient manner and achieve license termination for unrestricted use, with no adverse consequences to safety.