Department of Energy
Washington, DC 20585

June 12, 2017

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Deputy Director
Mail Stop T8-F5
Washington, DC 20555-0001

WM-00073

Subject: U.S. Department of Energy Office of Legacy Management Response to U.S. Nuclear Regulatory Commission (NRC) Letter Dated February 22, 2017, "U.S. Nuclear Regulatory Commission Staff Review of 2017 *Draft Final Interim Treatment System Evaluation Plan for the Tuba City, Arizona, Disposal Site"* Dated January 2017 (Docket Number WM-00073)

To Whom It May Concern:

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) has received the U.S. Nuclear Regulatory Commission's (NRC) comments on DOE's *Draft Final Interim Treatment System Evaluation Plan* (LMS/TUB/S14717). The full text of each comment is provided below, followed with a summary response. The summary response to Comment 1 is supplemented with a table showing the NRC's specific requests found within the comment along with DOE's specific responses.

NRC Comment 1

The report discusses the potential for contamination of supplier's equipment due to the introduction of contaminated groundwater for the Solar Thermal System, Vertical Circulation in Pond and Wind-Aided Intensified Evaporation (WAIV) techniques. In addition, it appears that the DOE will rely on the equipment supplier's personnel to install some of the equipment for the trials of these techniques. The plan also states that DOE will perform Hazard and Operability (HAZOP) reviews of the techniques prior to their implementation. The DOE should ensure that all contractor/supplier personnel are provided with appropriate radiation safety training prior to beginning work at the site and that this training is fully documented. In addition, any equipment that is contaminated during the trials should be decontaminated to the appropriate release criteria and the final radiological condition of the equipment should also be fully documented. Training and equipment decontamination information and the HAZOP reviews should be maintained by the DOE for review by the NRC. The schedule indicates that equipment installation for field trials may be performed in August 2017. It may be useful for the NRC to observe the installation and/or demobilization of the equipment, and, as such, please ensure that the NRC is informed of the dates when these activities will occur at least 30 days in advance. Finally, by letter dated January 13, 2015, the NRC staff provided comments related to the potential installation of the WAIV system (ADAMS Accession Number ML14353A082) that you may want to consider in evaluating the WAIV system. Please note that, to date, the DOE has not responded to the NRC's January 13, 2015 letter.

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DOE Response

The Interim Treatment System Evaluation (ITSE) Plan allows for desktop study, including literature review, vendor contacts, internet search, and calculations, prior to implementation of field trials. Desktop study results are used to inform the decisions as to whether field trials will yield significant results. At this time, the only enhanced evaporation methods likely to proceed to field implementation are the solar thermal trial (using the existing solar thermal equipment to preheat water before it reaches the evaporation pond) and dye addition. Neither of these techniques will require use of an outside supplier's equipment or subcontracted personnel.

Field trials for WAIV and for vertical circulation are currently not planned. As the ITSE proceeds, the desktop studies of these techniques will be documented. The need for field trials may also be reevaluated during ITSE progression. The rationale for eliminating these techniques from field trials at this time is described in the following paragraphs.

WAIV. A field trial for WAIV technology is not currently considered essential to ITSE. The supplier of WAIV enhanced evaporation recently installed a system in Chandler, Arizona, as part of an industrial wastewater treatment system. DOE visited the installation and met with the supplier and the local operations and maintenance (O&M) contractor. The supplier and contractor have agreed to provide operational data to DOE. It is expected that the data provided (weather conditions, influent flow rate, water quality, evaporation efficiency) can be used to predict the efficiency of a similar system installed at the Tuba City, Arizona, disposal site.

Vertical Circulation. Based on discussion with the suppliers of vertical circulation pumping equipment a field trial is not currently planned. The supplier stated that the primary driving force for increased evaporation efficiency is a vertical concentration gradient of total dissolved solids (TDS) with higher concentrations near the bottom of the pond. The high TDS concentration layer also exhibits higher density and heat capacity, and, thus, can be warmer than the water at the pond's surface. Moving the warmer water from pond bottom to top allows for heat transfer and an increase in evaporation rate. Movement of water across the pond surface, driven by the circulation pumps, also contributes to an increase in evaporation efficiency.

The vertical circulation technique is more effective for relatively deep ponds with a wide range of TDS concentration and conditions that favor vertical stratification. The TDS concentration in the Tuba City pond is approximately 150,000 milligrams per liter (mg/L). It is unlikely that a significant gradient of TDS concentration exists and, therefore, it is unlikely that a significant enhancement of evaporation rate can be achieved at the Tuba City site through operation of vertical circulation pumps. Vendor case studies from other sites can be used as indicators of the maximum potential increase in evaporation efficiency.

NRC's specific requests within Comment 1 and DOE responses are provided in the following table.

NRC Request	**DOE Response**
The DOE should ensure that all contractor/supplier personnel are provided with appropriate radiation safety training prior to beginning work at the site and that this training is fully documented.	No involvement of supplier personnel is currently planned. Contractor personnel will be provided with appropriate radiation safety training in the event that the trials require additional training beyond the normal requirements of the site. Radiation safety training for onsite contractor staff covers interim treatment operations (pumping contaminated groundwater to the evaporation pond). Training records will be maintained, and may be provided to NRC upon request.
Any equipment that is contaminated during the trials should be decontaminated to the appropriate release criteria and the final radiological condition of the equipment should also be fully documented.	Use of vendor-supplied equipment is not currently planned. Existing equipment (solar thermal system) that comes in contact with contaminated groundwater will be decontaminated. An 8000-gallon containment tank has been purchased for use in the solar thermal and dye addition trials. At the conclusion of field trials the containment tank will be decontaminated and stored for future use. Documentation of decontamination methods and results will be maintained.
Training and equipment decontamination information and the HAZOP reviews should be maintained by the DOE for review by the NRC.	DOE will maintain training and equipment decontamination information, and records of HAZOP reviews. It is anticipated that onsite Contractor staff will perform the solar thermal and dye addition field trials. As their training currently covers interim operation of the groundwater treatment system, the need for additional training is not anticipated. Temporary piping and alternative duty for existing equipment will be required for the solar thermal field trial. A piping and instrumentation diagram, specific to the field trial, will be prepared and will be the basis for HAZOP. The HAZOP report will be provided to the NRC.
It may be useful for the NRC to observe the installation and/or demobilization of the equipment, and, as such, please ensure that the NRC is informed of the dates when these activities will occur at least 30 days in advance.	The NRC will be informed at least 30 days prior to installation of equipment for field trials. Notification prior to changes in flow routing and alternative duty of existing equipment for the solar thermal trial will also be provided.

NRC Request	**DOE Response**
Finally, by letter dated January 13, 2015, the NRC staff provided comments related to the potential installation of the WAIV system (ADAMS Accession Number ML14353A082) that you may want to consider in evaluating the WAIV system.	Previous input from NRC with regard to potential installation of a WAIV system will be considered. As noted above, the need for an onsite field trial of the WAIV technology has been precluded through installation of a system at an industrial facility in Chandler, Arizona. Operational data for the Chandler installation will be available to DOE.
Please note that, to date, the DOE has not responded to the NRC's January 13, 2015 letter.	Response to the NRC's January 13, 2015, letter was provided in correspondence from DOE dated May 27, 2015. A copy of the response can be provided, upon request.

NRC Comment 2

The report indicates that the DOE will install additional monitoring wells at the site to support the Geochemical Analysis and Aquifer Response to Extraction Strategies and that the wells will be installed in the December 2016 – January 2017 timeframe. Please provide the status of the installation of the wells and their proposed or actual locations. By letter dated July 28, 2016, the NRC staff provided comments related to the installation of additional ground water monitoring wells for areas deemed to be lacking in information and that might help determine if the contaminant plume has moved into the aquifer system beneath some portions of the lower terrace. (ADAMS Accession Number ML 16200A294). In addition, the Aquifer Response to Extraction Strategies may be relying on the groundwater flow model for the site to simulate the aquifer and plume response to various extraction strategies including static and dynamic pumping approaches. Finally, by letter dated March 28, 2016, the NRC staff provided comments related to the Tuba City groundwater flow model from 2015 (ADAMS Accession Number ML 16075A139) that you may want to consider as you develop the Aquifer Response to Extraction Strategies.

DOE Response

Construction of additional monitoring wells occurred in the January–May 2017 time frame. A figure showing well locations and a table listing well construction information are provided as attachments. The previous NRC staff comments (letters dated March 28, 2016, and July 28, 2016) were integral to the process of locating the new wells.

The 2015 Tuba City groundwater flow model may be used, to the extent practicable, in development of ITSE groundwater extraction strategies. Note that ITSE data collection and evaluation initiative will include efforts to evaluate aquifer response to actual versus model-predicted hydraulic stresses. These efforts also may result in an update, if required, of the groundwater flow model and should provide resolution to some of the March 28, 2016, NRC comments on the model report.

NRC Comment 3

Section 3.4.3 discusses testing the immobilization of contaminants through addition of ferric chloride. Any testing should also include the testing the effectiveness of the technique over the long-term. For example, if ferric chloride were no longer added to the system, would the contaminants remain permanently immobilized or would contaminants become mobile once again. The section also discussed the mobilization of contaminants through addition of sodium bicarbonate. It was not clear to NRC staff what objective from the Interim Treatment System Evaluation Plan this would fulfill. In addition, if a field test were to be performed, the existing system of extraction wells would need to be relied upon to capture the mobilized contaminants. This would necessitate that the conceptual model for flow and transport at the site would need to be very well understood so that additional contaminates are not inadvertently added to the system.

DOE Response

During the recently completed monitoring-well installation program, core material was collected from wells drilled in the contaminant plume and from wells that are not impacted by the plume. Bench-scale geochemical testing of contaminated and non-contaminated aquifer material is scheduled for July 2017. Test plans will be prepared in June. NRC specific comments relating to contaminant immobilization and mobilization tests as described in the ITSE Plan are presented in the following paragraphs.

Contaminant immobilization testing. The long-term effectiveness of contaminant immobilization may be simulated by addition of the immobilization chemistry in a test column and running water through the column until immobilization begins to fail, as indicated by increasing uranium concentration in column effluent. The number of test pore volumes will be recorded and will be indicative of the length of time that immobilization additives remain effective. The frequency, required volume, and concentration for re-introduction of immobilization additives can be estimated, based on bench-scale results. Full-scale feasibility would be dependent on development of a method to effectively deliver and disperse the immobilization additives.

Contaminant mobilization testing. Contaminant mobilization testing is planned in support of ITSE Objective 2, which includes "determination of solubility of contaminants in altered groundwater chemistry" and Objective 5, which includes use of "aquifer/formation geochemical analyses" as a basis for development of optimized extraction and treatment alternatives. The feasibility of uranium mobilization and capture as a conceptual groundwater remediation strategy will be evaluated.

Similar to the immobilization tests, mobilization additives would be run through the columns until the uranium concentration in the column effluent declines, indicating that virtually all of the recoverable uranium has been removed from the column sample. The volume, flow rate and concentration of mobilization additives can be estimated, based on bench-scale results.

If the results of mobilization testing show that uranium recovery is a potentially viable remediation strategy, field testing would not be performed with the existing system of extraction wells. Field testing would be preceded by evaluation of groundwater and

contaminant data and modeling to further support the viability of the concept. If a conclusion is reached that field testing is justified, the field test would involve installation of new wells for injection and extraction. The field test plot could be operated in a manner that is conventionally applied in "in situ recovery" (ISR) mining operations. In a typical ISR wellfield, four injection wells are located around a central extraction well in a five-spot pattern. Injection wells are used to introduce sodium bicarbonate into the uranium-bearing (source area) portion of the formation. The injection flow is also normally aerated to optimize uranium solubility and recovery. The extraction flow rate (from the center well in the five-spot) would be slightly higher than the combined injection flow rate to establish an effective zone of influence (capture zone) and limit the potential for migration of solubilized uranium away from the wellfield. The practicality of an ISR approach to groundwater remediation may be limited by physical constraints, as a significant portion of the plume resides underneath the disposal cell. However, an ISR wellfield configuration may be feasible as a downgradient system to control contaminant migration.

Column tests will also be performed to provide an indication of the natural attenuation capacity of the aquifer. Unimpacted groundwater collected from the site will be run through columns containing contaminated core samples to determine if sorbed or precipitated forms of uranium will migrate under natural conditions. Conversely, contaminated groundwater, collected from a well at the site, will be run through columns containing uncontaminated core samples to determine if dissolved contaminants become immobilized naturally through surface sorption or geochemical changes.

Please call me at (970) 248-6073 if you have any questions. Please address any correspondence to:

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Sincerely,

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