Peer Review Lessons Learned – DOE and Regulator Perspectives-17140

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ABSTRACT

The DOE NNSA Nevada Field Office (NFO) Underground Test Area (UGTA) Activity requires an external peer review to complete an extensive stage of site characterization and groundwater flow and contaminant transport model(s) development. The external peer review evaluates whether assumptions, methods, and conclusions derived from model(s) outputs are based on sound scientific principles and examines the scientific appropriateness of the model(s) outputs for informing the regulatory decision. The regulatory decision which is made by the Nevada Division of Environmental Protection (NDEP) is whether the model is acceptable to advance to the next UGTA strategy stage. Depending on the specific corrective action unit, the next stage is a Corrective Action Decision Document/Corrective Action Plan or Closure Stage.

Three external peer reviews have taken place to date for the UGTA Activity. The first one resulted in a second phase of characterization and model development. The second external peer review resulted in advancement to the next UGTA strategy stage. While advancement to the next strategy stage was recommended by the third external peer review, a series of supplemental data collection and analyses and model simulation activities to address external peer review comments, including drilling three new wells and sampling multiple wells, occurred before moving into the next UGTA strategy stage.

Twelve participants representing different aspects of the peer reviews (NDEP, NNSA/NFO, science advisors, presenters, and external peer reviewers) were interviewed to generate a combined lessons learned. Questions were asked regarding their experience with the process including panel selection, focused questions, presentations, interactions between UGTA Activity participants and reviewers, and results. The interview results were combined with the outcome of a published lessons learned report developed following the first external peer review.

In general, those interviewed believed that all three external peer reviews were satisfactory and met the goals of the FFACO process. The following seven lessons

learned were identified: (1) *Ensure the panel is not biased and has a balance of technical and regulatory background*; (2) *Clearly state the review objective(s) at the start of the review*; (3) *Ask focused questions that support the peer review objective(s) but that do not ask the specific regulatory question*; (4) *Establish a peer review panel earlier in the strategy process*; (5) *Establish one point of contact for the entire review and conduct* periodic meetings with the peer review *panel to ensure focus remains on the review objective(s) and to ensure that pertinent information is provided*; (6) *Ensure that presentations are well coordinated, anomalous data or analysis results are addressed, and are focused on supporting the peer review objective(s)*; and (7) *Carefully consider the panel's recommendations prior to embarking on a particular path forward.*

INTRODUCTION

In 1996, the State of Nevada, acting by and through the Department of Conservation and Natural Resources, Division of Environmental Protection (NDEP), DOE, and DOD entered into the Federal Facility Agreement and Consent Order (FFACO) in order to, in part, identify sites of potential historic contamination and implement corrective actions based on public health and environmental considerations. The FFACO describes the strategy employed to plan, implement, and complete environmental corrective action activities at facilities where nuclear-related operations were conducted in Nevada.

The corrective action strategy, as outlined in the FFACO, identifies corrective action sites (CASs) that are grouped into corrective action units (CAUs). The CASs associated with underground nuclear tests at NNSS that have or might eventually impact groundwater resources are grouped into five CAUs (Fig. 1). These CAUs are the responsibility of the NNSA/NFO UGTA Activity.

With the possible exception of one CAU, the corrective action strategy for UGTA is executed through four stages: Corrective Action Investigation Plan (CAIP) stage, Corrective Action Investigation (CAI) stage, Corrective Action Decision Document/Corrective Action Plan (CADD/CAP) stage, and Closure Report (CR) stage. A revised strategy may be followed for one CAU that is implemented through three stages (CAIP, CAI, and CR). For this CAU, monitoring and institutional controls rather than modeling are emphasized.

The technical basis for achieving the UGTA strategy is through an evaluation of each CAU using a combination of approaches, which include the following:

1. Collecting data including drilling exploration, hydrologic testing, and field and laboratory studies designed to characterize the hydrogeological setting
2. Modeling the hydrogeological setting, radiological source term, and groundwater flow and contaminant transport to forecast areas of current and future contamination
3. Iteratively evaluating models and monitoring groundwater downgradient of past underground testing
4. Identifying and documenting land-use policies (institutional controls) designed to restrict future public access to contaminated groundwater

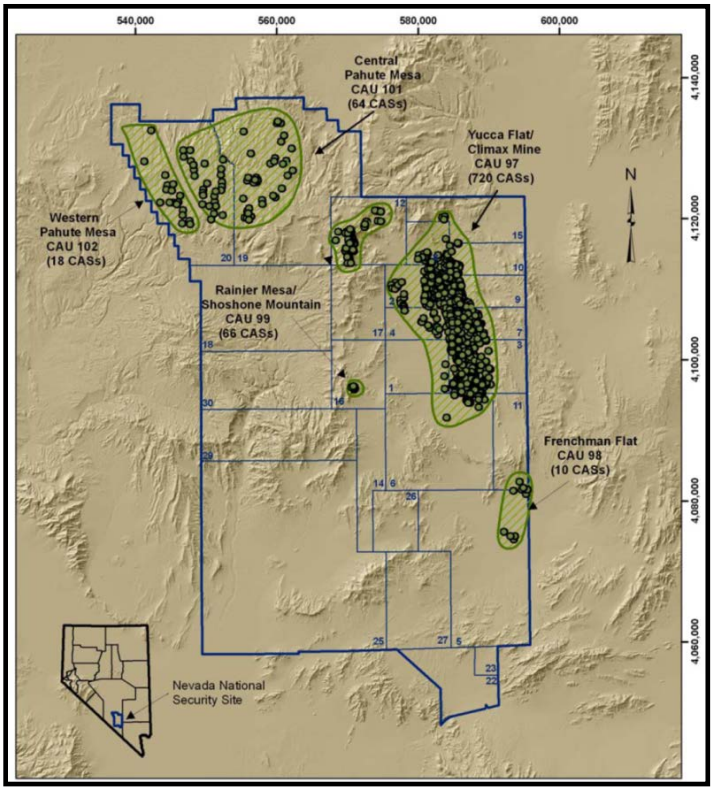

Fig 1. NNSS Map with CAS Locations

The goal of the four combined approaches is to provide the data, model forecasts, and confidence in the model results to facilitate informed regulatory decisions by NDEP and NNSA/NFO. Confidence in model results is developed through model evaluation and monitoring and the uncertainty in model forecasts is managed through institutional control of areas of potential groundwater contamination. The goal of regulatory decisions is to protect the public and environment from the risk of radiologically contaminated groundwater.

UGTA External Peer Reviews

For each UGTA CAU, an external peer review is performed at the end of the CAI stage to evaluate whether an understanding of the flow system has been demonstrated and documented; whether appropriate physical and chemical processes have been included in the model; and whether major uncertainties have been investigated. The peer review panel consists of nationally recognized subject matter experts in geology, hydrology, groundwater modeling, geochemistry, and other related fields. The peer review must be completed before the CAU can advance to the next strategy stage. Depending on the CAU, the next stage is the CADD/CAP (i.e., model evaluation focus) or closure (i.e., monitoring focus) stage (Fig. 2).

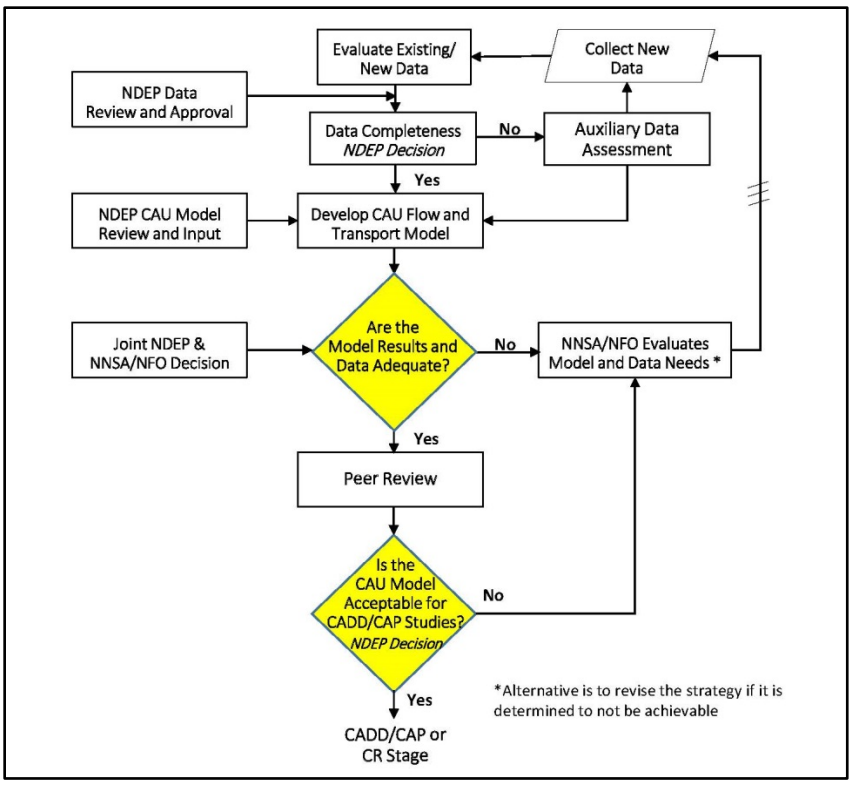

Fig. 2 Corrective Action Investigation Stage of the FFACO Process

To date, three external peer reviews for two separate UGTA CAUs have been completed to support the FFACO process. The first two reviewed models and data for the Frenchman Flat CAU. The Frenchman Flat CAU, located in the southeastern portion of the NNSS, was the location of ten underground nuclear tests (10 CASs) (Fig. 1). The third review was for the Yucca Flat/Climax Mine CAU where a total of 659 underground nuclear tests (720 CASs) took place (Fig. 1). The major aspects of the peer reviews are summarized in Table 1. As shown in Table 1, each peer review followed a somewhat different process.

During the first Frenchman Flat external peer review, the panel members identified issues relating to data insufficiency and modeling process inadequacy. They did not recommend advancing to the next strategy stage [1]. An additional characterization stage for the Frenchman Flat CAU followed this review. The second external peer review of the Frenchman Flat CAU, which took place over ten years later, supported advancement to the CADD/CAP stage [2].

Although the third external peer review panel recommended advancement of the Yucca Flat/Climax Mine CAU to the CADD/CAP stage, they made over 50 recommendations to address perceived uncertainties in the models and supporting data [3]. NDEP required that NNSA/NFO address all uncertainties identified by the panel before transitioning to the CADD/CAP stage. Supplemental data collection, including drilling three new wells and sampling multiple wells, data analyses, and

model simulations were performed. Responses to the panel's recommendations were published in a document approximately two years later [4].

DESCRIPTION

To develop a combined lessons learned, twelve participants representing different aspects of each of the three external peer reviews (NDEP, NNSA/NFO, science advisors, presenters, and external peer reviewers) were interviewed. Questions were asked regarding their experience with the process including panel selection, focused questions, presentations, interactions between UGTA Activity participants and reviewers, and results. The results of the interviews were summarized and common themes that may be beneficial as lessons learned were identified. This information is combined with the outcome of a published lessons learned report developed following the first Frenchman Flat external peer review [5].

DISCUSSION

In general, those interviewed believed that all three external peer reviews were satisfactory and met the goals of the FFACO process. The peer reviews were said to be beneficial to receive outside technical opinion on whether work is up to standard and whether the FFACO goals are met. Without the peer reviews, no real progress through the UGTA strategy may be made. Seven lessons learned from the UGTA peer reviews include the following:

Lesson 1: Ensure panel is not biased and has a balance of technical and regulatory background.

Decide whether a personal nomination or request-for-proposals process will be used for panel selection. It was stated during the interviews that using suggestions from the UGTA Activity participants for panel members could be viewed as selecting a panel that is not completely independent and that using the request for proposals process could yield a more independent and diverse group.

The credibility of the technical review was established by having nationally recognized, highly qualified subject matter experts in geology, hydrology, groundwater modeling, and geochemistry on each review panel. However, it was stated during the interviews that one review had no weapons testing containment or radiochemistry expertise. As a result, there was no fundamental understanding of the actual risk posed by the contamination (with the kind of quantities reported) which limited that panel's perspective regarding the overall risk to the public.

NDEP stated that while the peer reviewers were highly qualified in their respective field, they were not all a perfect fit given the constraints of the FFACO process and the goals of the UGTA process (modeling, monitoring, and institutional controls). As such, all panel members should be instructed on the applicable regulatory framework.

Lesson 2: Clearly state the review objective(s) at the start of the review.

The perceived purpose of the peer review varied somewhat by those interviewed. In general, the peer review was said to be performed to show the regulator and the public that appropriate amounts of work had been done to move forward into model evaluation studies in the CADD/CAP stage. NDEP staff stated that the peer review

recommendations are used as a piece of information to determine whether the CAU is ready to advance to the next stage of the strategy.

For those conducting the peer reviews, setting the objective(s) for the review was said to be challenging as the goal is not to build a perfect model because that is not possible. Rather, the UGTA Activity participants need to know that the work passes a quality test at the conclusion of the CAI stage given that new information is gained and considered throughout the entire strategy process. Peer review recommendations often overstated issues because they did not recognize that the FFACO process also includes further model evaluation, monitoring, and institutional controls to address model uncertainties.

Lesson 3: Ask focused questions that support the peer review objective(s) but that do not ask the specific regulatory question.

Interviewees stated that the scope of the external peer review should be better defined and limited to technical issues. Interviewees thought that the choice of questions should be re-evaluated and they must be designed to meet the specific review objective(s). Questions to be answered by the external peer review panel should not be guiding nor ask for regulatory decisions to be made. However, decision criteria to determine model acceptability were needed.

One interviewee stated that the questions were designed to get answers the UGTA Activity participants desired (i.e., tried to get the panel to agree with the UGTA Activity participants) but instead only confused the reviewers because they lacked understanding of the FFACO process. The particular questions assumed the review panel would follow the UGTA Activity participant's logic which proved to be an invalid assumption.

One interviewee thought the questions should be made simpler and that a question should not be asked if the UGTA Activity participants were not willing to accept the answer because it was not the one for which they hoped. The panel should not be asked to tell the UGTA Activity participants what is wrong.

The questions should not include the specific regulatory decision that needs to be made (i.e., advancement to next strategy stage) as this decision is to be made by the regulator and not the panel members. However, the questions do need to be designed to focus attention on the FFACO process.

Lesson 4: Establish an External Peer Review Panel earlier in the Strategy Process.

Several interviewees thought that the peer review panel should be exposed to the UGTA Activity participants much earlier to better educate them on the UGTA Activity and allow them to guide important interim decisions during the technical analyses and evaluations. If an advisory panel was selected from the start of the project, that panel could follow the project as it matures, rather than having to complete a one-time review at the end of the CAI stage resulting in a final decision.

Periodic evaluations and updates from the panel were thought to make for a better, more timely, and potentially less costly product.

A similar recommendation from the lessons learned by the first Frenchman Flat external peer review was made [5]. It was recommended that the number and scope of peer reviews be increased. As a result, periodic internal pre-emptive reviews were implemented to review interim work products prior to any external peer review. The internal pre-emptive reviews are performed by a committee that consists of UGTA Activity participants independent of the work being reviewed [6]. NDEP serves as an ex-officio member on the pre-emptive review committees. While the objectives of the external and preemptive reviews are similar, preemptive reviews are performed on interim work products throughout the CAI stage. Participation of NDEP on these committees ensures transparency and dialogue on all UGTA products throughout the entire FFACO process.

Lesson 5: Establish one point of contact for the entire review and conduct* periodic meetings with the peer review *panel to ensure focus remains on the review objective(s) and to ensure that pertinent information is provided.

A single point of contact between DOE and the peer reviewers was found to be beneficial to keep the focus on the review objective(s). Periodic meetings should be held to provide timely answers to panel member's questions and provide additional information. Periodic meetings were found to help keep the peer reviewers focused on the modeling work with respect to the FFACO process and not as a science project or a path for career advancement.

For the first peer review, no interaction took place after the presentations and the UGTA Activity participants were quite surprised and disappointed by the peer reviewer's responses. Interviewees thought that some review comments could have been avoided if DOE had the opportunity to defend their work before the report was completed. During the second peer review, there was a single point of contact and weekly meetings were held to answer questions and provide additional information. For the third review, the point of contact was also involved in the work and discussions were limited to information requests by the peer reviewer's. While minimizing contact with the peer review panel can be viewed as reducing potential for biasing the review process, it was considered less desirable because peer reviewers were less informed regarding the FFACO process in this case. They also risked spending unnecessary time evaluating issues that had already been considered and resolved by DOE but the results may not have been as readily available to the reviewers.

Lesson 6: Ensure that presentations are well coordinated, anomalous data or analysis results are addressed, and are focused on supporting the peer review objective(s).

Dry runs, presented to ad hoc internal peer review panels, were found to be highly beneficial in that they forced all the presenters from multiple agencies and

organizations to focus their work, completed over a number of years, even decades, into telling one story. The dry runs forced everyone to practice talks and identify needed adjustments. For the second and third reviews, each agency or organization was assigned briefings for their portion of the work. It was the first time all the work was assembled to tell a coherent story because multiple agencies and organizations worked on specific facets. For this reason, it was the only time all results were clearly woven together.

Following the dry runs, needed adjustments and data gaps could be addressed before presentation to the external peer review panel. However, it was stated that the dry runs should take place well enough in advance of the external peer review to allow changes to the final presentations. There may not have been enough time between the dry run and the external review to address all recommendations. The short time frame between preparation of material, presentation to internal peer review and then presentation to the external peer review did not allow for much flexibility to make changes to the work and/or presentation material.

Presentations to the external peer review panel must be designed to meet the specific review objective(s). The presentations covered a large amount of material in a short period of time. A presentation of the overall UGTA Activity with the end result focused on the specific CAU was said to be interesting but not all the details were needed. Therefore, higher level presentations framing the big picture that point to documents for the details were recommended so that reviewers are not overwhelmed from the beginning of the review. A facilitator for the presentations would be beneficial to focus the discussions on the FFACO process.

Since the project spans multiple years (even decades), earlier documents didn't necessarily agree with later documents due to additional data/learning. All presented results, including anomalous results and inconsistencies, must be explained. Dealing with classified data also presented a challenge as external peer review panel members requested reviews of classified data, which could not be honored.

More time was thought to be needed to consider all the technical information, especially for the Yucca Flat review. Several documents were provided to the reviewers at least a month in advance, but these totaled several thousand pages of highly technical information. Meticulously planned day-long field trips to the respective CAUs on the NNSS were found to be very beneficial and highly informative.

Lesson 7: Carefully consider the panel's recommendations prior to embarking on a particular path forward

It is important that the recommendations of the external peer review panel be thoughtfully considered and any resulting data collection efforts be carefully determined. UGTA Activity participants should not overreact to the peer review recommendations. Instead, DOE and NDEP should work together to ensure unnecessary work is not performed. In some cases, responses to the peer review recommendations may have been more extensive than necessary. For instance,

several wells were drilled and significant data were collected following the first Frenchman Flat peer review and some UGTA Activity participants believed that much of the work was not necessary because of the small number of tests in the CAU, site hydrogeologic conditions, and the large amount of modeling performed to that point showed nearly zero risk to receptors.

CONCLUSIONS

In conclusion, those interviewed believed that all three external peer reviews were satisfactory and met the goals of the FFACO process. The peer reviews were said to be beneficial in that they provided outside technical opinion on whether the work was up to standard and whether the FFACO goals were met. Seven lessons learned were identified after conducting three external peer reviews for the NNSA/NFO UGTA Activity. These lessons learned encompassed all aspects of the peer review process including: selecting the panel, identifying review objective(s), developing focused questions, the appropriate time to establish the peer review panel, establishing one point of contact, preparing and executing the presentations and responding to the panel's recommendations.

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TABLE 1. Summary of Three Peer Review Processes

Activity	**Frenchman Flat Phase I**	**Frenchman Flat Phase II**	**Yucca Flat Phase I**
Preparation			
Panel Selection	Recruit prestigious academicians recommended by the contractor and DOE.	Sole-source subcontracts were awarded based on UGTA participant recommendations of nationally known technical experts. Focus was placed on candidates with consulting experience and oriented toward problem solving.	Competitive bid process with request for proposals and statement of work. Candidates with Nevada experience were chosen. Membership included balanced and experienced academicians and consultants.
Focused Questions	1) Are there fatal flaws? 2) Is the conceptual model correct? 3) Are the physical processes properly incorporated into the model – are the approximations acceptable? 4) Is the level of detail commensurate with the goals of the model? 5) Is the modeled uncertainty inclusive of reality with 95 percent certainty? 6) How can the model be validated and at what scales (basin scale, testing area scale, or test cavity scale) is validation feasible? 7) Is the modeling approach used for Frenchman Flat CAU transferable to the other CAUs? 8) Are there additional wells (or other data) which will be critically important in reducing the uncertainties in the Frenchman Flat model?	1) Are the modeling approaches, assumptions, and model results for the CAU consistent with the use of modeling studies as a decision tool for resolution of environmental regulatory requirements? 2) Do the modeling results adequately account for uncertainty in models of flow and transport in the hydrological setting of the CAU? 3) Are the supporting geologic, hydrologic, and geochemical data and modeling results adequate for a transition to CAU model evaluation?	1) Are the approaches, assumptions, and results consistent with the use of the models as decision tools for meeting *FFACO* regulatory requirements? a. Are the models of sufficient scale/resolution to adequately forecast contaminant transport in the CAU setting? b. Have the key processes been included in the models? c. Are the flow and transport modeling results and uncertainties technically sound and defensible? d. Are the conceptual models used in the different flow and transport models sufficiently consistent to provide representative integrated model results? 2) Are the datasets and modeling results adequate for a transition to model evaluation studies in the CADD/CAP stage?
Implementation			
Presentations	Reviewers were provided four draft technical documents (> 1,000 pages) that described the modeling activities. Briefings (2 days) made primarily by the contractor, describing all aspects of the flow and transport model. Field trip to site.	Reviewers were provided an overview document (200 pages) describing the regulatory framework, conceptual models, modeling approach, model construction, and model results. Briefings were made by all participant agencies (4 days) and focused on individual contributions and expertise. A mock peer review was performed prior to actual review. Field trip to site.	Reviewers were provided the final flow and transport document (> 1,000 pages) along with other documents that described the data, data analysis, and modeling activities. Briefings were made by all participant agencies (5 days) and focused on individual contributions and expertise. A mock peer review was performed prior to actual review. Field trip to site.

Activity	Frenchman Flat Phase I	Frenchman Flat Phase II	Yucca Flat Phase I
Interactions	Very little contact between modelers and peer reviewers following the presentations.	Scheduled weekly conference calls with Science Advisor as the point of contact. Calls allowed the focus on the issues rather than scientific details not significant to the FFACO goals.	Communication on an as-needed basis with the Technical Integration Manager as point of contact. Supplementary information was provided to the peer reviewers.
Closeout			
Report	Report was prepared by Peer Reviewers with no interaction with DOE or modelers.	Report was prepared by Peer Reviewers and accepted by DOE and modelers with little to no argument.	Draft report prompted discussions with peer reviewers to dispute some recommendations. Peer reviewers did not revise the majority of the recommendations in the final report.
Comment Response	Required phase II with new wells drilled, significant data analyses, and new models developed (11 years). New corrective action investigation plan was developed.	Responses to comments were included as an attachment to letter to NDEP requesting advancement to the CADD/CAP stage.	270 page report describing new data collection (including 3 new wells and groundwater sampling), data analysis, and model simulations to demonstrate to NDEP that the CAU model was acceptable for the CADD/CAP stage. Report was reviewed by the internal UGTA preemptive committee

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