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REVISED PRELICENSING PROGRAM STRATEGY FOR THE
U.S NUCLEAR REGULATORY COMMISSION HIGH-LEVEL WASTE REPOSITORY PROGRAM
("VERTICAL SLICE APPROACH")

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Division of Waste Management
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REVISED PRELICENSING PROGRAM STRATEGY FOR THE
U.S. NUCLEAR REGULATORY COMMISSION HIGH-LEVEL WASTE REPOSITORY PROGRAM

I. INTRODUCTION

In the spring of 1994, the U.S. Department of Energy (DOE) initiated its new program approach for streamlining its process for site characterization, site suitability determination, and licensing. Congressional actions in 1995 will likely lead to further changes and budget reductions to both the DOE and U.S. Nuclear Regulatory Commission (NRC) programs in future years. Therefore, the purpose of this paper is to describe how the NRC staff has streamlined its prelicensing High-Level Waste (HLW) Repository Program in response to declining budgets and changes to the U.S. Department of Energy's (DOE's) program. Specifically, this paper discusses: 1) aspects of DOE's program approach and other changes that have been important in causing changes to NRC's program; 2) revisions to the staff's program strategy, referred to as the "vertical slice approach"; and 3) how this approach is being implemented. In brief, the staff's approach focuses on resolving key technical issues with DOE, prioritizing staff activities based on issue resolution, improving the integration of all these activities, and simplifying and orienting both NRC and DOE products toward licensing. The overall objective of this prelicensing work is to help ensure that DOE prepares an acceptable license application and that the staff has the necessary review capability developed to facilitate the staff's license application reviews and the Commission's construction authorization decision.

II. DOE'S PROGRAM APPROACH AND OTHER CHANGES

The staff has reviewed the information available to date on DOE's new program approach and has presented its concerns to DOE and the Commission. The staff also identified several aspects of the program approach that led to the need for revising the staff's program. First, although it has been over one year since DOE has announced its new program approach, there has been little specific information released about its program, other than the general overall approach, the site suitability process, and isolation demonstration strategy. It is still not clear what DOE will do about topics important to licensing such as thermal strategy and repository design, use of bounding assumptions, and delayed testing until performance confirmation. Even though work is proceeding, this more specific technical information might not be available until the FY 96 Site Characterization Plan (SCP) progress report and license application annotated outline (LAAO). Moreover, refocusing the program has resulted in a sequence of reports for making high-level findings (HLFs) related to site suitability. The staff considers that more timely access to specific DOE plans is desirable to better understand the new program approach in order to give DOE feedback on whether implementation of its

program is effective for licensing. This timely guidance is needed so that crucial data will not be missed, costs to collect this data are optimized, and to help ensure that DOE prepares an acceptable license application.

Second, DOE has emphasized developing a process for making HLFs to support a technical site suitability determination in 1998. DOE's site suitability process and schedule include National Academy of Sciences (NAS) peer review of the technical basis reports for the HLFs. This process also includes opportunity for public comment. It will be important for NRC to give its views, from a licensing perspective, on important technical issues, so the NAS and DOE will be aware of potential licensing concerns before important decisions are made about suitability.

Third, it is not yet apparent that DOE has given the same emphasis to revising its licensing process that it has given to site suitability. As a result there has been limited focus on licensing needs and clearly proposing what information will be collected for the license application and what will be deferred until performance confirmation, after submittal of the license application. Although the NRC staff is encouraged by the isolation and containment demonstration strategy including key uncertainties and associated testing informally presented by DOE, a comprehensive set of licensing strategies that address all 10 CFR Part 60 requirements relevant to licensing is needed.

Finally, the recent NAS report on the Yucca Mountain standard and proposed legislation add significant uncertainty to any plans for DOE's repository program. Furthermore, potential budget reductions will likely reduce staffing and will require further streamlining of NRC's program.

In summary, the lack of specific information about how DOE will implement its new program approach, together with uncertainties about future funding and standards, makes it difficult for the staff to keep pace with changes to the program, determine their significance to licensing, and give timely feedback so as to avoid unnecessarily impacting DOE's program. This situation has caused the staff to make the changes to its program described in this paper.

III. NRC'S REVISED PROGRAM STRATEGY

A. NRC's Overall Review Strategy for the Prelicensing Program

In 1994 the staff prepared the Overall Review Strategy (ORS), NUREG-1495, to provide the principal policy guidance to the staff for conducting its prelicensing program and license application review. This general guidance will continue to serve as a foundation for the staff's program, but its implementation will be modified using the vertical slice approach described below.

ORS provides guidance for the staff to conduct a program of prelicensing reviews and interactions with DOE and others for early identification and resolution of potential licensing issues at the staff level to help ensure that DOE will submit an acceptable license application. Additional guidance is given for developing the staff's technical basis for both prelicensing and

license application reviews, which will consist of the License Application Review Plan (LARP), independent technical assessment methods (i.e., models and codes), and results of applied technical investigations. ORS also describes how preclicensing reviews and technical basis preparation are integrated with how the staff will eventually review the license application.

Simply stated, this guidance establishes a graded approach for conducting reviews and preparing the technical basis for reviews. There would be more detailed reviews, using independent assessment methods and results of applied technical investigations for those technical areas most important to compliance with the performance objectives of 10 CFR Part 60 (i.e., key technical uncertainties). Therefore, these key technical uncertainties help focus and link together the staff's work, in all parts of the program, on what is most important to licensing. It also establishes how preclicensing reviews would be used to identify issues early and give guidance to DOE on the information needed for its license application.

B. Vertical Slice Approach for Implementing the ORS During Preclicensing

Generally, this approach builds on the strategies in ORS for conducting preclicensing reviews and for developing review capability, on an audit basis, that are focused on, and limited to, key technical issues most important to licensing. However, the changes made are intended to sharpen the focus on resolving key technical issues with DOE, focus staff activities on those issues, improve the integration of all these activities, and simplify and focus both NRC and DOE products on licensing.

This approach is often simply referred to as the "vertical slice" approach, because each technical issue is addressed with one or more sharp cuts encompassing an appropriate range of review and capability development activities. For these areas sampled, the staff builds its review capability and applies it by reviewing DOE's program in selected areas and giving guidance during the preclicensing period. This integrated audit approach is intended to be more efficient in times of reduced budgets, yet effective because of its emphasis on resolution of key technical issues important to repository performance.

This focused approach also helps the staff prioritize its work. First, priorities are established based on importance to repository performance, as the staff identifies key technical issues and uncertainties, together with related technical needs. The staff's work to address these technical needs is further prioritized by establishing work schedules based on providing DOE feedback consistent with the schedules of DOE's major milestones (including technical basis reports for DOE's HLFs for site suitability).

Specifically this approach consists of:

- 1) Focusing staff work on what is needed for resolving the key technical issues judged by the staff as most important to licensing.

Ten key technical issues were identified by a combination of the following:

1) consolidating the key technical uncertainties previously identified by the staff through a systematic analysis of the regulations in 10 CFR Part 60 and documented in the draft LARP; 2) considering the results of staff iterative performance assessments; and 3) including major technical concerns with DOE's program identified in staff reviews (e.g., Exploratory Studies Facility (ESF) design control process). Each of the 10 key issues is made up of a collection of the more detailed key technical uncertainties from the draft LARP. The resulting hierarchy of issues and uncertainties enhances integration of the various elements making up each broad issue, while preserving a more specific breakdown within each issue. Technical needs (work activities) will be identified for each key technical issue, to provide another breakdown more closely linked with the staff work. This breakdown sharpens the definition of the program and helps the staff and the Center for Nuclear Waste Regulatory Analyses (CNWRA) manage its specific work. Therefore, the resulting hierarchy of issues, uncertainties, and needs gives a structure with different levels of detail satisfying various purposes. Table 1 lists the 10 key technical issues. Related key technical uncertainties and technical needs for this new structure are under development and will further focus staff activities.

The objective of all staff work should be to resolve, at the staff level, as many of the key technical issues as permitted by budget constraints and available staff expertise. Based on this work, the staff will comment on the sufficiency of DOE's site characterization program and evaluate the effectiveness of DOE's overall program for preparing an acceptable license application. It is DOE's responsibility, through various activities in its program, to address these issues as part of its overall program that must also address many other areas for a complete license application. In contrast, the NRC staff's role in issue resolution is to review and provide guidance on the acceptability of how DOE addresses these issues. To do this the staff must also prepare its licensing review capability by developing, for these issues, portions of the draft LARP and supporting technical assessment work such as model and code development and applied technical investigations. Therefore, the staff will use its draft LARP for its prelicensing reviews. Consistent with NRC and DOE meeting agreements, issue resolution is achieved during prelicensing when NRC has no further questions and therefore agrees with DOE, at the staff level, on the acceptability and sufficiency of the information and methods presented in the LAAO.

2) Developing the staff's review capability for these reviews by focusing development of LARP and independent technical assessment methods as well as conducting selected applied technical investigations.

a) LARP. Only those review plans or portions of review plans for the key technical issues will be developed and prioritized based on a schedule that would prepare the staff to conduct its vertical slice reviews of DOE's HLF technical basis reports or other major DOE milestones. Those remaining review plans not associated with the key technical issues and the HLFs will be completed after 1998 depending on budget constraints. The vertical slice approach has basically reprioritized and rescheduled review plan development, consistent with DOE's accelerated schedules for the HLFs and ESF construction. Acceptance criteria and procedures will be needed to review DOE's use of bounding assumptions and alternative interpretations, an important feature of

bounding assumptions and alternative interpretations, an important feature of DOE's new program approach.

b) **Technical Assessment Methods and Applied Technical Investigations.** Technical assessment methods consist of model and code work for the staff's independent assessment of the overall system (iterative performance assessment, (IPA)), subsystems, and selected repository processes. Methods are independently developed by the staff or available methods modified for staff use, as appropriate. Under the vertical slice approach development of assessment methods, analyses, and applied technical investigations would be limited to what is needed to achieve the following objectives.

First, appropriate assessment methods will be developed that are needed to support reviews of how DOE has analyzed each key technical issue. Assessment method development and applied technical investigations for each key technical issue will be derived from and limited to the technical needs identified for each issue and key technical uncertainty.

Second, an integrated overall system assessment approach will be taken. Developing a capability will help the staff independently understand the integrated assessments of repository systems and processes. Furthermore, sensitivity analyses can be conducted, to confirm importance to performance of the key technical issues and key technical uncertainties, as well as to identify new issues. Therefore, the overall system assessment complements the focus on selected key technical issues by keeping an overall integrated system perspective.

The above mentioned methods and the staff experience gained in conducting these assessments will provide an independent capability that will be the technical basis for developing the acceptance criteria and procedures in the LARP for these assessments. These review plans will then be used to review DOE's assessments in the LAO and supporting references such as Total System Performance Assessments (TSPAs). Staff assessments will give first-hand experience necessary for reviewing individual assessments and the integration of assessments and will help the staff evaluate conservatism of bounding assumptions, adequacy of alternative conceptual models, appropriateness of parameter distributions, and integration of information, to reflect coupled processes. Such evaluations will be critical to support the staff's review, in the near-term, of DOE's site suitability determination and supporting technical basis reports, as well as eventually reviewing site characterization sufficiency required by the NHPA and the acceptance review for docketing of the license application. For staff reviews to be responsive to DOE's HLF schedules, overall system assessments under the vertical slice approach need to be capable of rapid analysis of NRC key technical issues, key technical uncertainties, and various bounding assumptions and alternatives proposed by DOE.

3) **Conducting "vertical slice" reviews and interactions for each key technical issue.**

a) **Reviews and Interactions.** Reviews and interactions could address all levels of DOE's program that are relevant to the particular issue. These

reviews could range from DOE's preliminary conclusions about compliance in the LAAO, to the technical basis reports for HLFs, to analyses and interpretations of data, to test plans and procedures, to testing and quality assurance activities, and finally to the basic data. Appropriate draft LARP review plans will be used for these reviews. This approach also enables the staff to evaluate the effectiveness of DOE's integration of diverse activities within its program.

Recent agreements with DOE have resulted in reducing the types of DOE reports and emphasizing products that show tangible progress toward licensing. Therefore, the LAAO and SCP progress reports are the primary DOE documents for staff review and comment, although a few topical reports also have been agreed to. These reviews, however, will be focused on those sections that address the key technical issues. Reviews of all study plans previously conducted in response to agreements with DOE will no longer be conducted. However, study plans and technical reports containing data, analysis results and interpretations related to key technical issues can be reviewed either as references to the LAAO, the SCP progress reports, or in conjunction with various interactions with DOE such as site visits, quality assurance audits, or in-field verifications. Only a limited number of in-field verifications will be conducted as necessary to evaluate how DOE is addressing specific NRC significant concerns (e.g., ESF design control process).

As mentioned earlier, a major emphasis of DOE's program approach is the focusing of site characterization testing and analyses, to support the accelerated schedule of HLFs leading up to DOE's site suitability determination in 1998. Although these findings and determinations are DOE's responsibility, as directed by Nuclear Waste Policy Act of 1982 (NWPA) and the DOE Siting Guidelines in 10 CFR Part 960, much of the information is relevant to licensing. For this reason the staff will conduct its prelicensing reviews of those activities which are related to the key technical issues and give DOE timely guidance on the adequacy of its site characterization program for the preparation of an acceptable license application. Therefore, these reviews will allow the staff to evaluate how effective DOE's program approach is for the ultimate purpose of licensing.

The types of open and documented interactions with DOE, including participation by other parties, will not change under the vertical slice approach. Therefore, the interaction strategy in ORS and the procedures used for many years consistent with NRC and DOE procedural agreements will continue. What has changed is that future interactions will be more focused on progressing toward resolution of the key technical issues for an acceptable license application. Interactions and associated reviews will facilitate early awareness of and feedback to DOE on revised DOE plans, available data and analysis results, and other activities (e.g., the ongoing elicitation concerning volcanic probabilities). This new, more proactive, approach is particularly important during a time period when DOE's program has changed, but the details of these changes are not yet documented for external use.

For some interactions, like site visits or in-field verifications, the staff might be reviewing data, analyses methods and results, together with how DOE implements its procedures. These types of interactions would be carefully

scheduled with DOE, to ensure that DOE has adequate time for formulation and review of its activities, as well as to avoid unnecessarily disrupting plans or schedules when activities are underway. To support this goal of minimal impact on DOE, the staff will be taking a more integrated view in planning needed interactions. The objective is to have a more effective and efficient set of interactions, for each technical issue, that coordinates various interactions such as site visits, observation of quality assurance audits, Appendix 7 visits, technical exchanges, in-field verifications, and technical meetings. This approach will also coordinate interactions with DOE's revised schedules. Finally, under the vertical slice approach, the recent practice of having bimonthly management meetings will continue. These meetings have been effective for openly identifying and resolving concerns that need management attention to make progress.

Interactions on selected issues will continue with other parties such as the Nuclear Waste Technical Review Board and the peer review panels of the NAS. Such interactions would be primarily related to the staff's work on the key technical issues for licensing.

b) Documenting Reviews and Interactions

Under the vertical slice approach, the staff is using only three types of reports: letter reports, Prelicensing Evaluation Report, and Issue Resolution Progress Reports. Letter reports simply refer to a variety of reports that the staff has been using routinely. Examples include letter reports to document technical exchanges, site visits, or meetings. Observation of quality assurance audits result in an observation audit report. The staff review of DOE SCP progress reports would continue to be transmitted to DOE in a letter report. Therefore, the staff's ongoing practice will continue to provide early staff feedback on concerns about the acceptability of how DOE is addressing the issues. All staff concerns will continue to be documented as open items, which will be tracked by the Open Item Tracking System (OITS) as described in ORS.

The Prelicensing Evaluation Report will document the staff's review of how DOE has addressed the key technical issues in its preliminary compliance demonstrations in the LAAO and its references. Numerous sections of the LAAO may be needed to address different aspects of a key technical issue. Therefore, it is not expected that the LAAO will completely address an issue in a single section. The staff will need to review whatever sections are appropriate. Specifically, the staff will indicate the areas where it is reasonably satisfied with the DOE approach, and the areas where the staff can identify concerns (open items) about the DOE program, that must be resolved by DOE before it can submit the license application. These open items will also be tracked by the staff using OITS. There will be rationales for areas acceptable and for areas of concerns. This approach not only keeps the reviews within the licensing context, but also preserves an institutional memory for future licensing. As with DOE's LAAO concept, the staff will be iteratively preparing an evaluation that will evolve eventually into the Safety Evaluation Report after the staff reviews the license application. Sections of the Prelicensing Evaluation Report can be prepared and released to DOE any time during the year, to provide timely feedback. If budget

constraints allow, however, one consolidated Prelicensing Evaluation Report will be prepared each year. In this way DOE and NRC will have a tangible product, showing both progress toward licensing, and the remaining areas of concern.

The Issue Resolution Progress Report is a new report that will be prepared as necessary or appropriate. The purpose of this report is to document the staff's perception, based on the results of a collection of activities, about the progress toward resolution of the key technical issues and the effectiveness of DOE's new program approach overall. Attention will be given to progress made, types of concerns and trends identified, causes for these concerns, and how effectively DOE is resolving concerns.

4) Enhancing integration of staff work by reorganizing staff teams.

In addition to emphasizing technical issue resolution for licensing, the vertical slice approach also is intended to improve integration of NRC activities. Although the staff's work on LARP and IPA has contributed to integration, and will continue to do so under the vertical slice approach, NRC and CNWRA staff team organization has been changed to enhance integration of work and the interaction of staff, from different technical disciplines, who are needed to address the key technical issues. Discussing the issues from different disciplinary viewpoints will improve communication and coordination of activities necessary for an integrated licensing product. To achieve this, a vertical slice team for each of the 10 issues has been established. The organization and responsibility of these teams are described more in section IV.B. The technical leads and project managers for each vertical slice team will meet periodically to help integrate staff activities "horizontally" across the vertical slice activities for projects such as LARP development and technical assessments. In addition, the Yucca Mountain team will continue to function as a forum for exchanging information about DOE activities and the staff technical and quality assurance reviews and interactions.

C. Strengths and Weaknesses of the Vertical Slice Approach

Numerous strengths are associated with the vertical slice approach. The focus of the program is sharpened by giving priority to those NRC staff activities related to the most important licensing issues, and what both DOE and NRC will need to address them. This will promote resolving issues at the staff level during prelicensing, thereby improving both confidence in the prelicensing process and progress in the program overall toward preparation of a license application. Integration of the NRC program is improved by coordinating the necessary activities and technical disciplines needed to prepare for and conduct reviews of each issue. This approach's auditing nature also will efficiently evaluate a wide range of DOE activities and how well they are integrated for use in licensing. These evaluations will provide the staff with real-time access to specific information about DOE's program, which will be used to determine, for each issue, how effectively DOE is implementing its new program approach for licensing. Such feedback will therefore be more timely and should minimize impacting DOE schedules and costs because of delays or repeating work. Finally, in a time of declining resources, this approach is an efficient, and yet effective, use of limited resources. The approach would remain useful regardless of the resource level because the number of

issues and level of effort for each issue can be determined by the resources available.

Although the staff prefers the vertical slice approach, its weaknesses must be acknowledged. By focusing all the staff's prelicensing reviews on only key issues, many parts of DOE's program and associated sections of the LAAO will not be reviewed by the staff before submittal of the license application itself. Therefore, the license application may be incomplete; this could result in more time being needed for the staff's acceptance review, for docketing the license application or even more time for the compliance review. The risk of this occurring can be decreased if DOE evaluates the staff's prelicensing comments for the key issues and determines if the comments are applicable to other parts of the program not reviewed by the staff; if so, DOE could make appropriate adjustments to its program.

Another weakness is that the staff's key issues may not turn out to be the most important to licensing. As a result, the staff may overlook other licensing vulnerabilities in its reviews, or scarce resources could be inadvertently expended on less important issues. This might always be a risk because of the judgments involved in selecting issues, and changes in the relative importance of issues, as more information is gained. In any event, this does not mean that important issues will go unaddressed for licensing, because the burden is on DOE to submit a license application with all the information needed for licensing. Another way that the staff expects to decrease the risk from this weakness is the continued use of performance assessment, both to confirm the importance of the key issues, as well as to identify other issues of comparable importance that the staff should address. Finally, the staff will be meeting with DOE and other parties to compare views on the most important issues regarding repository performance. Changes could be made to these issues, if warranted.

Depending on budget constraints, the staff may not be able to complete its LARP by the time of license application submittal. The staff has prioritized review plan development so that the most important review plans supporting the key issues will be completed first consistent with DOE's HLF schedule. To do this, many review plans were accelerated, and other lower priority review plans were delayed. While there is a possibility of not completing these low-priority review plans, the risk of making a safety finding is considered low because these review plans do not address key issues most important to performance.

Finally, during prelicensing, the staff will only be reviewing those sections of the LAAO containing the technical basis for the HLFs that are related to the key issues. The staff intends on providing DOE and the NAS with these comments, so that technical concerns important to licensing will be available to the NAS as it conducts its peer review. Comments will not be available, however, for those areas not reviewed, because these areas are not considered critical to licensing.

IV. IMPLEMENTING THE VERTICAL SLICE APPROACH

A. Management Oversight

A Management Review Board has been established to provide management oversight of the vertical slice approach. The Board's Chairman is the Deputy Director of the Division of Waste Management (DWM) and Board members include the DWM and the Office of Nuclear Regulatory Research (RES) branch chiefs involved with the HLW repository program, and the CNWRA Technical Director.

In its management oversight role, the Board will: 1) coordinate and approve new policy and changes to existing policy for the program direction; 2) approve implementation plans; 3) coordinate policy-level guidance for consistent implementation; 4) periodically review program implementation and products; 5) promptly resolve internal problems raised by Board members; and 6) promptly raise concerns to DOE requiring management attention to facilitate issue resolution.

The formation of the Board or of the new team organizations and responsibilities described below in no way diminishes the long-standing responsibility of the NRC branch chiefs and section leaders and CNWRA managers for supervising the work of their respective staff members participating on these new teams. Therefore, the branch chief and section leader for the technical team leader has the technical lead for the issue. Similarly, the projects branch chief and section leader has the lead for the project management and policy for all the teams. Day-to-day implementation problems should be resolved by appropriate line management. Board members should present, for Board resolution, those problems that are contentious, have major impact on the whole program, or affect policy.

B. Team Organization, Staffing, and Responsibilities

As described in section III.B., Vertical Slice Teams have been established for each of the ten key technical issues. Each team has a technical team leader and a project manager from the NRC staff. Additional team members are drawn from both NRC and CNWRA technical staff, as needed, to provide the technical expertise to address the full scope of a particular issue.

Each Vertical Slice Team is responsible for conducting and integrating all the work needed to address the issue, consistent with the guidance given in this paper and following detailed implementation plans described in Section IV.C. Therefore, each team member is responsible for contributing, in his/her assigned area, to an integrated team effort that aggressively pursues resolution of the issue. Problems that cannot be resolved by the team should be raised by the technical team leader to the lead section leader and branch chief for resolution, or, if necessary, by the Board.

Establishing teams with a multidisciplinary focus on key technical issues sets up a structure that promotes integration of the technical work. However, all team members and their management committing to a team work attitude is the fundamental element needed for successful integration, regardless of the organizational structure used.

As previously mentioned, the technical leads and project managers for each vertical slice team will meet periodically to help integrate staff activities "horizontally" across the vertical slice activities, for projects such as LARP development and technical assessment. For example, the LARP review plan work for each vertical slice would be coordinated and eventually incorporated into a revision to the LARP by the LARP project manager. In addition, the Yucca Mountain team will continue to function as a forum for exchanging information about DOE activities, as well as for coordinating the staff's technical and quality assurance reviews and interactions with DOE.

C. Key Technical Issue Implementation Plans and Operating Plans

The policy guidance in this paper will be implemented through the Key Technical Issue Implementation Plans, together with DWM and CNWRA Operating Plans. These plans will give the specific guidance for the staff to manage its work. For each of the 10 key technical issues, the Vertical Slice Teams will prepare a Key Issue Implementation Plan that consists of the following information: issue rationale; scope (LARP review plans, key technical uncertainties, DOE qualifying condition and HLFs), DOE interactions and staffing (scopes, schedule, discussion); and NRC internal activities (scopes, schedule, discussions). The highest priority activities should be identified so the work considered by the team to be most critical to issue resolution is clear. Also included in the discussions should be how performance assessment will support the staff's work toward issue resolution.

The activities and schedules in each of these plans are also collated into the Operating Plans for DWM and for the CNWRA, as required to manage the contract support.

V. CONCLUSIONS

1. A vertical slice approach has been developed to streamline the NRC HLW repository program, in response to declining budgets and changes to DOE's program.
2. This approach focuses on resolving key technical issues with DOE, prioritize staff activities based on issue resolution, improving the integration of all these activities, and simplifying and orienting both NRC and DOE products toward what is needed for an acceptable license application.
3. Staff prelicensing activities will focus on resolving key technical issues with DOE at the staff level. Based on this work, the staff will evaluate, during prelicensing, the overall effectiveness of DOE's program for preparation of an acceptable license application.

Table 1 - List of Key Technical Issues

- 1. Igneous Activity**
- 2. Structural Deformation and Seismicity**
- 3. Hydrologic Characterization of Structural Features Which Significantly Affect Water and Vapor Movement**
- 4. Thermal Effects and Redistribution of Moisture**
- 5. Thermal-Mechanical-Hydrological-Chemical Coupled Processes**
- 6. Evolution of Groundwater in the Near-Field Environment**
- 7. Waste Package Degradation**
- 8. Geochemical Effects on Radionuclide Transport Within and Beyond the Thermally Affected Zone**
- 9. Methods of Assigning Probability to and Estimating the Consequences of Disruptive Scenarios**
- 10. Exploratory Studies Facility**

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("VERTICAL SLICE APPROACH")
HIGHLIGHTS OF INTEREST TO THE DOE

- o The vertical slice approach has been developed to streamline the NRC program in response to declining budgets and changes to DOE's program.
- o NRC vertical slice activities will focus on the resolution, at the staff level, of key technical issues significant to repository performance.
- o Using this audit approach, NRC will evaluate the overall effectiveness of DOE's program for preparing an acceptable license application and the sufficiency of site characterization.
- o The vertical slice approach will facilitate prioritizing NRC activities based on significance to repository performance, will integrate NRC activities to focus on issue resolution, and will simplify NRC and DOE products and interactions toward preparing an acceptable license application.
- o Plans for implementing the vertical slice approach for each key technical issue are under development by NRC staff. NRC urges scheduling technical exchanges to discuss the key technical issues as well as the implementation plans.
- o Specifically, the Vertical Slice Approach:
 1. Focuses the NRC program on those interactions and activities needed to resolve, at the staff level, the key technical issues judged by the staff as most important to repository performance.
 - NRC staff will focus its review and guidance on these issues.
 - Issue resolution is consistent with NRC-DOE agreements.
 - 10 key technical issues have been identified based on performance assessment and a systematic evaluation of regulatory requirements.
 - Although DOE must demonstrate compliance with all licensing requirements, this audit approach will provide insight to the effectiveness of DOE's program for the key technical issues.

2. Focuses the development of the License Application Review Plan (LARP) and independent models and codes on the key technical issues; prioritizes review plan and model development consistent with DOE's schedules for high-level findings and other important milestones.
3. Includes "vertical slice" reviews and interactions for each issue.
 - Reviews and interactions with DOE and others are specifically identified in key technical issue plans for implementing the vertical slice approach. These interactions will focus on selected DOE activities and documents relevant to an issue in a time frame compatible with DOE's activities (from the compliance conclusions in the License Application Annotated Outline to supporting models, data, and testing procedures).
 - Reviews will use the draft LARP and will focus on how DOE's program is addressing the key technical issues.
 - The results of these reviews will be used to evaluate the effectiveness of DOE's program.
 - DOE will need to determine if NRC comments are applicable to other parts of its program not reviewed and make appropriate adjustments.
 - The types of open and documented interactions with DOE, including other parties, will not change; however, interactions will be focused on progressing toward resolution of issues.
 - Emphasis will be given to early access to information and feedback to DOE.
 - Interactions will be carefully scheduled with DOE so as to avoid unnecessarily impacting DOE's program.
 - Interactions will be carefully planned and coordinated to optimize the exchange of information while simplifying formal preparation for these interactions.
 - Only a limited number of in-field verifications will be conducted as necessary to evaluate how DOE is addressing specific NRC significant concerns (e.g., ESF design control process).
 - Reviews and interactions will be documented using letter reports, Prelicensing Evaluation Reports, and Issue Resolution Progress Reports.
 - Letter reports have been used routinely to document interactions and transmit results of staff reviews.

- Prelicensing Evaluation Reports will document reviews of portions of DOE's LAAO and references related to the key technical issues; acceptable areas and concerns (open items) will be documented to show progress toward an acceptable license application.
 - Issue Resolution Progress Reports will be prepared to document the staff's perception based on the results of a collection of activities, about the progress toward resolution of the key technical issues and effectiveness of DOE's new program approach.
4. Enhances integration of staff work by reorganizing staff teams.
- Multidisciplinary teams have been established for each issue to help coordinate all activities needed to address each issue.
 - The Yucca Mountain Team will continue.
 - An NRC Management Board has been established to review the progress of the vertical slice program, and to promptly raise concerns to DOE requiring management attention to facilitate issue resolution.