July 26, 1996

Mr. Ronald A. Milner, Director
for Program Management and Integration
Office of Civilian Radioactive Waste Management
U.S. Department of Energy, RW 30
1000 Independence Avenue, S.W.
Washington, D.C. 20585

SUBJECT: KEY TECHNICAL ISSUE RESOLUTION PLANS - RATIONALE AND INTERACTIONS

Dear Mr. Milner:

In accordance with our commitment from the May 8, 1996, U.S. Nuclear Regulatory Commission/U.S. Department of Energy (DOE) management meeting, I am transmitting the Rationale Sections (Enclosure 1) and a summary of proposed interactions (Enclosure 2) from the Key Technical Issues Implementation Plans. The interactions summary provides a listing of both scheduled interactions (those denoted by a specific date) and proposed interactions for future discussion with DOE (those listing the approximate month). We fully understand that the proposed interactions listed in Enclosure 2 are dependent on both resource limitations and the physical progress of the DOE program. It is not our desire to drive the DOE program by demanding an interaction at an inappropriate time.

If you have any questions regarding this letter, please contact Sandra L. Wastler of my staff. Ms. Wastler can be reached at (301) 415-6724.

Sincerely,

(Original signed by:)

John H. Austin, Chief
Performance Assessment and HLW
Integration Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

cc: See attached list

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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R. Arnold, Pahrump, NV
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KEY TECHNICAL ISSUE IMPLEMENTATION PLAN RATIONALE SECTIONS

SUPPORT REVISION OF THE EPA STANDARD AND NRC RULE

1.0 Rationale

Recent recommendations of the National Academy of Sciences (NAS) as well as current legislative proposals (H.R. 1020 and S.1271/S.1936) have distinct and significant implications for the regulation of high-level waste (HLW) disposal at a proposed repository at Yucca Mountain, Nevada (YM). Important differences exist between the standards recommended both by the NAS, or the Congress, and existing NRC regulations. Changes to NRC's regulations at 10 CFR 60 will be necessary under either of these new approaches and will pose significant implementation challenges and/or redirection of current NRC staff activities.

1.1 Key Technical Issue (KTI)

Appropriate and defendable implementation of the NAS recommendations or legislative proposals will require technical analyses to assist revision of the U.S. Environmental Protectional Agency (EPA) Standard and NRC rule especially in areas not addressed in previous rules (e.g., reference biosphere).

Key areas of the implementation are: compliance period and associated approach used for the compliance calculation (e.g., mean or median risk; differing levels of rigor in the analyses for time periods up to 10,000 years versus after 10,000 years); specification of the exposure scenarios (reference biospheres and critical groups); treatment of disruptive events; and treatment of human intrusion.

1.2 Significance to Repository Performance

The technical support for the standard and implementing regulation will be directed towards the identification and specification, to the extent practical, those aspects of the regulations that are necessary for proper implementation.

THERMAL EFFECTS ON FLOW

1.0 Rationale

The thermal load of the repository, of the order proposed in the Department of Energy (DOE) Site Characterization Plan (SCP), or a potentially higher thermal load, has the potential to significantly redistribute moisture within YM. Redistribution of moisture due to heat may result in extended periods of dryness in the repository during either the period of high heat or during cooling. Also, redistribution of moisture due to heat could result in channeling moisture toward waste packages. Thus, it is necessary to understand the spatial and temporal effects of the thermal load on temperature as well as liquid- and gas-phase flux in the vicinity of the repository to have confidence in predictions of containment and long-term waste isolation.

1.1 Key Technical Issue (KTI)

Predicting the thermally driven redistribution of moisture through partially-saturated, fractured porous media caused by the emplacement of heat-generating high-level radioactive waste.

1.2 Significance to Repository Performance

Specific reasons that thermal effects on flow is a key technical issue with respect to repository performance include:

- DOE's Waste Isolation Strategy in part relies on long containment times of radionuclides as a basis for waste containment and isolation.

- The near-field distribution of temperature, liquid saturation and humidity within the repository will influence corrosion of metals, mineral alteration, and near-field geochemistry. These are important factors in predicting containment time within the waste package and transport times through the engineered barrier system.

- The far-field distribution of temperature, liquid saturation, liquid- and gas-phase flux are important factors in predicting the performance of the natural barrier, in the vicinity of the repository, in terms of radionuclide releases to the accessible environment.

DOE recently developed a draft report defining the modeling and testing efforts of thermohydrologic processes for the YM site (Simmons et al., 1995). DOE recognizes many of the same issues, outlined above, concerning thermally driven moisture redistribution through partially saturated, fractured porous media. DOE also recognizes the difficulties in identifying the correct conceptual and mathematical models, boundary conditions and appropriate property values for the coupled processes involved in the movement of moisture through YM. DOE is presently conducting laboratory-scale experiments, planning field-scale experiments and advancing their capabilities in numerical modeling of the heat and mass transfer mechanisms thought to be instrumental in the redistribution of moisture. Ongoing site characterization activities will reduce uncertainty in the values of properties assigned to the geologic subsurface of YM. Included in this effort is the identification of the boundary conditions assigned to the ground surface and the conditions assumed to exist at the water table or any other surface selected as the base of the conceptual and mathematical models. Studies by DOE contractors (Buscheck and Nitao, 1994) and others (Green et al., 1995) have recognized that uncertainties associated with conceptual and mathematical models, boundary conditions and media characterization, in particular bulk permeability or matrix/fracture interactions, will remain unacceptably high in the absence of field-scale experiments conducted over sufficiently large scales of time and distance to be meaningful.

It may be concluded that NRC and DOE both consider the effects of heat on hydrologic processes to be a key component of repository performance, although there are many inherent difficulties associated with characterizing the post-closure characteristics of the hydrologic regime. Therefore, NRC has elected to conduct a detailed review of a vertical slice of the overall DOE program in the area of thermohydrology.

UNSATURATED AND SATURATED FLOW UNDER ISOTHERMAL CONDITIONS

1.0 Rationale

YM was selected as a potential HLW repository site in part due to the favorable conditions provided by an unsaturated zone up to 700 m in thickness. Low moisture fluxes and water contents in the unsaturated tuff units reduce the likelihood that water will contact the waste packages, which consequently reduces the potential for corrosion, waste form dissolution, and transport of dissolved radionuclides. Also, low moisture fluxes in the unsaturated zone, typically orders of magnitude less than flux rates in saturated units, would yield long transport times from the proposed repository to the accessible environment for radionuclides. Thus, mechanisms affecting moisture fluxes and water contents in the unsaturated zone, and mechanisms that determine the length of unsaturated-zone pathways, such as fluctuations in the elevation of the water table, will also control the release and transport of radionuclides to the accessible environment. In addition, the NAS' recommendation that standards for YM be risk-based rather than release-based, indicates that mechanisms that affect saturated zone transport and mixing must also be considered.

1.1 Key Technical Issue (KTI)

Characterization of unsaturated and saturated flow (liquid and vapor phase) at YM under ambient thermal conditions.

1.2 Significance to Repository Performance

Specific reasons that unsaturated and saturated flow under ambient thermal conditions is a key technical issue with respect to repository performance include:

- DOE's Waste Isolation Strategy in part relies on low seepage of groundwater, long transport times and large dilution in the natural barrier as a basis for waste containment and isolation.

- The potential for the transport time of radionuclides to the accessible environment to decrease is impacted by:

  - Increased infiltration rates through the unsaturated zone
  - A rise in the water table, either through increased regional recharge or disruption of the poorly defined structural or stratigraphic features controlling the steep hydraulic gradient at the north end of the repository, thereby increasing the high-flux saturated portion of release pathways at the expense of the low-flux unsaturated portion

- Corrosion of waste packages and subsequent release rates depend on the moisture at the repository and the moisture fluxes through the repository. In turn, the distributions of moisture and moisture flux at the repository are strongly affected by:

    - Infiltration rates, possibly focused due to topographic and other surficial variability
    - Hydraulic parameter heterogeneity
    - Preferential pathways caused by fault zones and fractures
    - Formation of perched zones above or below the repository horizon
    - A rise in the water table into or near to the repository horizon

- Dilution of radionuclides in the saturated zone is affected by:

    - The degree of vertical mixing of water within the tuffaceous aquifer and between the tuffaceous aquifer and the underlying Paleozoic carbonate aquifer
    - The presence of high conductivity fault or fracture zones that may act as flow channels

NRC and DOE both consider the effects of hydrologic processes to be a key component of repository performance, although there are inherent difficulties associated with characterizing the liquid and vapor fluxes under ambient conditions. Indeed, performance assessments performed by both DOE (Sandia National Laboratories, 1992; 1994) and NRC (NRC, 1992; 1994) have consistently identified moisture fluxes, characterized by infiltration, as having the most critical impact on overall repository performance. Therefore, NRC has elected to conduct a detailed review of a vertical slice of DOE program to examine unsaturated and saturated flow under ambient conditions.

TOTAL SYSTEM PERFORMANCE ASSESSMENT AND TECHNICAL INTEGRATION

1.0 Rationale

The developing HLW standard will require that the repository system meet minimum performance standards during a prescribed performance assessment period. The analyses required to demonstrate compliance with such a standard must be capable of incorporating and propagating the complexities and uncertainties inherent in modeling natural processes (such as unsaturated flow and transport) and repository processes (such as waste package corrosion) over long periods of time (many thousands of years) for the whole repository system. Such an analyses is referred to as a Total System Performance Assessment (TSPA).

1.1 Key Technical Issue (KTI)

TSPA incorporates the relevant features, processes, uncertainties in parameters, selection of conceptual models, and potential future events into an analysis capable of estimating risk to an individual. Integration assures that the key technical issues develop technical support for their resolution and that the transfer of information among program areas will result in assessments of compliance that are transparent, adequately supported, and complete.

1.2 Significance of Issue

A long performance assessment period (presently 10,000 years) may require that the performance assessment consider combinations of disruptive events, coupling of processes, and possible changes to the flow and transport system. To ensure that the repository does not pose an unacceptable risk to public health and safety, such complex issues cannot be considered only within the subsystem process models; but must be reflected in the modeling from an overall system perspective. Examples of such complex issues include the distribution of water over packages in the repository and how this distribution can change with time and thermal effects; quantification of thermal, hydrologic, and chemical processes in the near-field of the waste package and the determination of how these processes may interact with each other; and to what degree radionuclides will mix and be transported in the aquifer system including how they interact with the biosphere to produce a dose to humans. Each of the above mentioned issues requires knowledge from more than one technical discipline and modeling which in turn requires interfacing of two or more subsystems. The development of an acceptable system modeling approach for these and other equally complex issues requires field testing, detailed process modeling, and finally abstraction. Such tasks would be performed by different groups requiring a strong integration effort to ensure successful completion.

IGNEOUS ACTIVITY

1.0 Rationale

1.1 Key Technical Issue

Predicting the consequence and probability of igneous activity affecting the repository in relationship to the overall system performance objective.

1.2 Significance to Repository Performance

Igneous activity has been occurring in the vicinity of the YM site since the Miocene period. The initial phase of igneous activity resulted in the development of the large caldera complexes of the Southwestern Nevada Volcanic Field with the associated deposition of voluminous silicic tuffs. Approximately 10 million years ago, the style of igneous activity started to change. By approximately 8 million years ago, the igneous material in the YM Region had become basaltic in composition, and the primary eruptive style was the formation of basaltic cones. This style of activity continues to the present; over the last approximately 1 million years at least 5 basaltic cones have formed within 20 kilometers of the proposed repository site. Although these volcanoes are small in comparison to other basaltic cones, the surface volume is generally of order 10^7 to 10^8 cubic meters of material. The nature and volume of subsurface material emplaced during this period of igneous activity is generally unknown. Assumptions of feeder dike dimensions suggest that at a minimum, each cone has on the order of 10^8 cubic meters or greater of material in the feeder system. In addition, studies of other areas with basaltic activity indicate that the ratio of subsurface material to surface material is on the order of 3-10 to 1. The distribution and characteristics of subsurface material is a key factor in determining the risk igneous activity may pose to a repository.

The basaltic eruptions near YM reveal an apparent increase in eruption energy through the last several million years. Earlier centers such as Thirsty Mountain had fluid eruptions with low explosiveness, while younger centers such as Lathrop Wells had higher energy eruptions capable of dispersing scoria and ash greater distances from the vent. Waste which may be incorporated in eruption products from an eruption of character similar to Lathrop Wells could be widely dispersed. If, as expected, the repository performance standard becomes dose-based, then such a dispersal pattern of waste may have important ramifications for performance calculations.

The evaluation of the probability of igneous activity affecting a repository, and the resultant consequences, has no known precedent. There have been some studies evaluating the probability of volcanic activity in the vicinity of active cones. However, these probabilities are for surface eruptions only and do not consider subsurface events. Perhaps more importantly, these probabilities are based on the study of single vents with repeated activity, such as strato volcanos and calderas, not the probability of an eruption at a specific site where there is a spatial uncertainty as well as temporal. Although similar attempts to estimate the probability of seismic events have been performed, the data base supporting probabilistic seismic hazard analyses is much greater, and the resulting uncertainties are significantly less than for volcanic hazard assessment. Furthermore, there is general agreement on the data needs and analysis techniques to be used in probabilistic seismic hazard assessment, whereas in assessing igneous activity hazards there is still significant disagreement over which effects must be estimated, and how they should be measured.

The most severe consequence of igneous activity would most likely be disruption of the repository by a volcanic feeder dike leading to direct release of radioactive material at the surface. However, a more likely scenario is an igneous event occurring in the repository vicinity without direct intersection. Such an event could release corrosive gases and produce a thermal anomaly which might degrade the engineered barriers and have a deleterious effect on ground water flow patterns.

DOE has recently released a report documenting the results of a Probabilistic Volcanic Hazard Assessment (PVHA) using expert elicitation, and a synthesis report discussing volcanic hazards is scheduled for submission to NRC late in the 1996 fiscal year. Review of these reports, and subsequent interactions with DOE are expected to require significant staff effort over the next year. Staff reviews of the 1995 Volcanism Status Report and the 1995 report on structural controls and eruptive effects by Golder Associates reveal significant differences between DOE and NRC positions on igneous activity probability and consequences. There are only minor differences between NRC and DOE on favored disruption probability values based on regional recurrence rates. NRC and DOE seem to agree that the value most likely lies between 10^{-8} and 10^{-7} per year. However, DOE appears to effectively reduce the probability through the use of igneous activity source zones. NRC does not oppose the use of such source zones, but the geometry of several zone models is highly suspect. Some zones supposedly based on underlying geologic structures are drawn to include the Crater Flat volcanoes but exclude the repository, effectively reducing the repository disruption probability. Abundant evidence suggests that the repository lies in the same structural domain as the Crater Flat cones, so the site should be included within volcanic source zones which honor structural features and regional tectonic models. On the topic of igneous activity consequences, NRC disagrees with DOE's consequence analyses of TSPA-95, which refer to analyses from TSPA-91 and TSPA-93. In particular, the eruption volumes and the values used for rate of wall rock incorporation are not conservative. To date, no estimate has been made for potential doses from waste scattered by a volcanic event.

Resolution of these issues will first require NRC and the Center for Nuclear Waste Regulatory Analysis (CNWRA) to thoroughly document the technical bases for the disagreements. Along with working toward issue resolution, the igneous activity staff will continue to probe the vulnerabilities in DOE's waste containment and isolation strategy as they relate to volcanic hazards. Toward these ends, major activities during fiscal year 1997 and the remainder of 1996 include: providing geologic bases for NRC's preferred probability values; studying eruption characteristic of Lathrop Wells and analog volcanoes to better understand the transport of xenolithic material to the surface; and completing sensitivity and bounding analyses for the amount and character of waste which could be carried to the surface, along with dispersal patterns.

STRUCTURAL DEFORMATION AND SEISMICITY ISSUES

1.0 Rationale

DOE has identified seismically active faults in and around both the YM candidate repository block and in Jackass Flat. DOE has recorded a moderate earthquake within 15 km of both sites and continues to measure vertical displacement at YM. These observations have led DOE to stipulate that both fault displacements and earthquakes are likely to affect YM and vicinity in the next 10,000 years and it will consider these geologic hazards in repository design, operation and post-closure performance assessments. The discovery of elevated concentrations of Cl-36 in the ESF indicates the potential importance that structural controls may have on hydrologic flow and, consequently, the performance of a repository at YM. Flow through fast pathways may be effected by future fault slip and earthquakes. The potential for disrupting groundwater flow, waste packages, engineered barriers, stability of underground and surface facilities pose risks of non-compliance with radiological safety and environmental protection standards from continuing tectonic activity (fault slip and seismicity) at YM. Therefore, structural deformation and seismicity may need to be considered in the evaluation of long term performance of the repository.

1.1 Key Technical Issue (KTI)

What reasonable and prudent tectonic and fracture-network models of YM should be considered in assessments of repository design, waste isolation and performance?

DOE's development and use of tectonic and fracture-network models to assess future structural deformation and seismicity magnitudes and rates of changes in the geologic setting should be supported by corroborative methods of field investigations, in situ measurements, natural analog studies, lab tests and computer simulations. The models should comport with evidence of paleotectonic activity and be traceable to baseline conditions. DOE's overall performance assessment should include those important aspects of structural deformation and seismicity that could substantially influence long-term behavior of the repository. The performance assessment model(s) should be consistent with the relevant seismotectonic and structural data and the more detailed 'process models.'

1.2 Significance to Repository Performance

Fault slip, earthquakes and accompanying perturbation of pre-existing fractures or propagation of new fractures can disrupt fractured flow paths thereby changing the groundwater flow system, radiogenic heat flow and refluxation systems, hydrothermal and igneous systems, and can deform or mechanically breach waste packages. Also, structural deformation and seismicity may degrade the performance of some engineered and natural barriers (e.g., underground drifts and alcoves, capillary barriers, Calico Hills non-welded rocks). Such degradation could lead to poorer overall repository performance than if the barriers remain fully effective.

Structural discontinuities, faults and fractures, can provide the beneficial effect of rapid drainage through or around an underground repository, but can also be fast pathways or barriers to water or heat flow. Vibratory ground motion, especially when repeated during periods when canisters are particularly fragile, can disrupt waste packages causing premature releases. Fault slip and ground motion through underground and surface facilities during the operational phase can cause loss of function of systems, structures and components, personal injury and premature release of radionuclides. Furthermore, the presence of structural discontinuities and other rockmass heterogeneities may become heat pipes or reflux pathways during the thermal loading and cooling phases of repository performance. Thus, structural deformation and seismicity can affect radionuclide source term, flow pathways and ability to model repository behavior, thereby tending to contribute uncertainties to pre-closure and long-term performance assessments.

REPOSITORY DESIGN AND THERMAL-MECHANICAL EFFECTS (RDTM)

1.0 Rationale

DOE is currently excavating the Exploratory Studies Facility (ESF), the site of experiments to be used in the characterization of YM as a potential site for a geologic repository for civilian-generated high-level radioactive waste. If YM is determined to be a suitable site for development of a repository, the ESF would become a part of the repository. The excavations currently under progress and the tests that will be conducted at the ESF may have long-term impacts on post-closure performance of the geologic repository. DOE's current plan is to acquire enough data to be able to perform, by the year 1998, a viability assessment for constructing a geologic repository at the YM site. The quantity of data to be used for this viability assessment will be less than that which was planned under DOE's previous approaches to characterize the site. As a preparation for the viability assessment and the possible license application, DOE will produce synthesis reports and a Project Integrated Safety Assessment (PISA) report. NRC will be reviewing these reports prior to the review of DOE's viability assessment report. NRC plans to concentrate its resources on key technical issues, that have uncertainties, which will have to be addressed by DOE in the viability assessment report and also in the license application. NRC plans to interact with and provide guidance to DOE in these areas, as necessary.

The construction of ESF and the design of GROA (reference design for viability assessment) are a major part of DOE's efforts for the viability assessment. Repository design has to address issues such as thermal impacts and retrievability during its relatively long design life. Repository emplacement drifts housing heat producing waste in a partially saturated jointed rock mass poses technical uncertainties. These uncertainties are associated with predicting the effects of thermal-mechanical-hydrological-chemical (TMHC) interactions between the host rock and the surroundings during the life of the repository. Particularly, the thermal-mechanical (TM) interactions, over the long design life, play a key role in the repository design as well as in assessing its performance. This KTI implementation plan addresses the effects of thermal-mechanical interaction related issues for both postclosure and preclosure design of repository.

1.1 Key Technical Issue (KTI)

The key technical issue is the evaluation of time-dependent thermal-mechanical coupled response of jointed rock mass. Postclosure performance assessment requires an understanding of the thermal-mechanical response of the jointed rock mass over the long-term design life (thousands of years) as it impacts near-field environment and waste package degradation, performance of seals, and flow and radionuclide transport mechanism. Designing for the preclosure or operations period (about 100 years) requires an understanding of the thermal-mechanical response of jointed rock mass as it impacts the drift stability and retrievability.

In order for NRC staff to have confidence that DOE's construction of ESF and reference design of GROA are progressing in such a way that no major potential licensing problems pertaining to this KTI will unexpectedly arise in the future, the staff needs to review DOE thermal load strategy and thermal-mechanical analysis, ESF construction and operations, GROA design; and verify other related items such as implementation of design control process, and demonstration of flowdown of regulations and document hierarchy. It should be noted that the past NRC objections to DOE's site characterization plans were mostly issues related to ESF design, construction, and the design control process and the associated quality assurance.

1.2 Significance to Repository Performance

Repository openings should be stable during the 100-year operations period. In addition, the retrievability option should be maintained until permanent closure of the repository. During the first 300 to 1000 years of the repository, the thermal-mechanical interaction in the rock mass around the drifts and the resulting changes in the near-field hydrology have an impact on the substantially complete containment requirement of the waste package. During the post-closure time (up to 10,000 plus years) the thermal-mechanical-hydrological interactions and resulting changes in the near-field hydrology have an impact on the performance of the waste package and flow and radionuclide transport processes at the repository. DOE's waste containment and isolation strategy assumes that water seeping in to the drifts and contacting with the waste packages will be small. An understanding of the thermal-mechanical interactions of the jointed rock mass and its impact on near-field hydrology is a key technical issue significant to the repository performance and needs to be addressed by NRC.

The mining industry standard practice can not be blindly applied to the repository design because of unusual design conditions such as heat, moisture, and relatively long design life. The thermal load and hence the repository thermal environment has an impact on the design. The long design life requires a consideration of uncertainties in the useful life of support systems under the repository environment, the THMC interaction impacts on the stability of drift openings, and changes in rock properties with time in the repository environment. Maintaining the retrievability option requires the drift openings to be stable until permanent closure, and the drift environment depends on whether the drifts are backfilled or not. During the containment period (up to 1000 years) for the waste packages, rock fall initiated by an unstable drift roof has an impact on the waste package performance. During the post closure period, any fracture/joints opening-up because of the TM interaction impacts on the flow and transport mechanism at the site and, hence, is significant to the performance of the repository.

NRC staff will interact with DOE and provide feedback on deficiencies in the ESF construction and GROA design control process, and will identify potential licensing issues that would be significant to the repository performance.

CONTAINER LIFE AND SOURCE TERM

1.0 Rationale

The waste package is the primary engineered barrier in the mined geologic disposal system (MGDS) planned at YM, Nevada. In the present DOE strategy for waste containment and isolation for the YM site, the performance of the waste packages for the first several thousand years after emplacement is extremely important. DOE has formulated several hypotheses, that if correct, would demonstrate that waste can be isolated at the proposed YM site for long periods of time. These hypotheses state that: (i) corrosion will be negligible for thousands of years because the heat will cause low relative humidity and thus prevent an aqueous film from forming on the container; (ii) the outer layer of the container will cathodically protect the inner layer and thus limit the corrosion rate; (iii) once waste packages are breached, the mobilization of radionuclides will be slow; and (iv) the engineered barriers will limit the migration of radionuclides into the host rock. The objectives of the container life and source term KTI implementation plan are to: (i) independently evaluate these hypotheses and perform sensitivity analyses of waste package performance; (ii) assess the adequacy of DOE's demonstration of the validity of the hypotheses; and (iii) assist in NRC evaluation of the total system performance assessment (TSPA).

DOE's waste package design effort consists of four phases; Advanced Conceptual Design (ACD), Viability Assessment Design, License Application Design, and Final Procurement and Construction Design. Three design concepts are proposed by DOE in the ACD (ref. Mined Geologic Disposal System Advanced Conceptual Design Report, March, 1996):

1. Canistered Fuel Waste Package Concept (CF WP)
2. Uncanistered Fuel Waste Package Concept (UCF WP)
3. Defense High-Level Waste Package Concept (DHLW WP).

The ACD CF disposal container conceptual designs come in two sizes, large and small; the large CF size containing either 21 PWR or 40 BWR spent nuclear fuel (SNF) assemblies; and the small CF containing either 12 PWR or 24 BWR SNF assemblies. The ACD UCF WP comes in four sizes, with the same length but different diameters to contain assemblies of 21 PWR, 44 PWR, 12 PWR and 24 BWR SNF assemblies. The DHLW WP can house four HLW glass pour canisters. Each sealed CF and UCF canister and four DHLW pour canisters will be placed into their respective disposal containers. Each container will be sealed with two closure lids which will be welded into place.

It is well known that spent fuel will dominate the radionuclide inventory (about 97 percent of the total) in the repository and provide the greatest potential for "source term" mobilization from the waste packages relative to vitrified HLW. As spent fuel poses the greater risk to repository licensing, this plan will focus on activities related to spent fuel waste package degradation issues. The CF-based design may be utilized at most (88) of the commercial nuclear power reactor facilities. The UCF-based design may be utilized at the remaining (19) reactor facilities.

The outer wall of the overpack will be a thick corrosion-allowance steel such as A516 Grade 55 (a wrought C-Mn steel) or A387 Grade 22 (2.25 Cr - 1 Mo) and the inner wall of the overpack will be a corrosion-resistant Ni-base alloy, alloy 825. The container life KTI will focus on evaluating the long-term performance of the ACD overpacks.

Staff evaluations of subsystem and overall system performance will be supported by the Engineered Barrier System Performance Assessment Code (EBSPAC) which is currently under joint development by CNWRA and NRC staff. EBSPAC will be developed in stages and will consider the following main topics: materials stability, near-field environment, general corrosion/oxidation, localized corrosion, stress corrosion cracking, corrosion potential and galvanic effects, release from spent fuel, release from glass, colloid formation and transport, cladding performance, and release from partially failed waste packages. An EBSPAC User's Manual will be developed in FY96 and near-term EBSPAC development in this plan will focus on those technical areas that can support the staff's review of the TSPA-95 results.

The current long-term planning basis for EBSPAC development is to have a code available to "exercise" for waste package evaluation by the end of FY96. EBSPAC will eventually be incorporated into the NRC total system performance assessment code (TPA). Continued development of review procedures and acceptance criteria for waste package and other engineered barriers will also be an important part of this plan. These procedures and acceptance criteria will eventually be incorporated into the staff license application review plan (LARP).

1.1 Key Technical Issue (KTI)

Predicting container life and radionuclide source term over long periods of time in deep geologic repository environment.

1.2 Significance to Repository Performance

The waste package is the source of radionuclide release from the repository. A major factor in the evaluation of release rates from the repository is the prediction of waste package degradation under relevant repository environments. This KTI addresses two of the five performance-based attributes planned for by DOE in its Viability Assessment: waste package life (containment) and, rate of release of radionuclides from breached waste packages (Draft, "Highlights of the U.S. DOE Updated Waste Containment and Isolation Strategy for the Yucca Mountain Site", July 1996, p.5).

EVOLUTION OF THE NEAR-FIELD ENVIRONMENT

1.0 Rationale

The Siting Criteria for disposal of High-Level Nuclear Waste, as delineated by NRC in 10 CFR 60.122 include a variety of favorable and potentially adverse geochemical conditions that will affect the overall performance of the repository. Specifically, 10 CFR 60.122 describes favorable conditions that, together with the engineered barrier system will provide reasonable assurance that the performance objectives related to waste isolation will be met. 10 CFR 60.122 also describes geochemical conditions that could adversely affect the integrity of the engineered Barrier System (EBS), the release of radionuclides, and the alteration of the host rock. An integral aspect of the geochemical conditions associated with the geologic repository is the composition of the groundwater. The chemical composition of groundwater in the repository is expected to alter with heating of the host rock and emplacement of a variety of materials in the repository. Heating of the host rock due to waste emplacement in the repository will also result in heating of the groundwater. In the absence of desiccation, the effect will be acceleration of host rock-water and EBS-water interactions that would otherwise take place over very long time periods. Increased temperatures will also affect the thermodynamic properties and stability fields for materials. The chemistry of groundwater can have a significant effect on the integrity of waste package materials, the processes of waste form alteration, and subsequent radionuclide transport. Man-made or natural materials introduced during construction of the repository, such as concrete and microorganisms, can also have an impact on the composition of waters that come in contact with the EBS. The two primary concerns related to the chemistry of the groundwater are:

- Groundwater chemistry in the near field can impact waste package corrosion and waste form alteration, radioelement speciation and solubility, distribution of radioelements among solid (including colloids), liquid, and gas phases, dissolution/precipitation and sorption/desorption reactions.

- Characterization of the evolution of near-field groundwater chemistry is a challenging problem because of difficulties in sampling and analyzing water in unsaturated media, the transient thermal regime of the near field, uncertainty in fluid fluxes, uncertain thermodynamic and kinetic properties of geologic and engineered materials, interactions among natural and engineered system components, and coupling of processes.

These concerns are difficult to resolve at the present time for the following reasons:

- There are difficulties associated with adequately modelling coupled flow-transport-chemistry systems.

- The man-made and barrier materials of the EBS are not yet well-defined.

- The designs of the waste packages and disposal locations in the repository are not well-defined.

- *The thermal-hydrologic regime of the repository has not been established.*

DOE recently developed a "White Paper" describing the role of geochemical studies in the Program Approach to License Application development (Simmons et al., 1995). DOE recognizes many of the same issues that are outlined above concerning the effect of near-field waters on the integrity of the waste packages and the degradation of the waste form. DOE also recognizes the need for and the difficulties associated with developing coupled-geochemical-hydrologic models.

DOE Waste Isolation Strategy (DOE, 1995) outlines five hypotheses that will serve as the basis for demonstration of compliance:

1. Seepage rates into the repository emplacement drifts are low

2. Complete containment of waste can be maintained by waste packages under repository conditions for thousands of years.

3. Mobilization rates of waste in breached waste packages are low.

4. Engineered barriers limit transport of radionuclides to the host rock.

5. Concentrations of radionuclides are strongly diluted during transport and mixing in the natural barriers.

The chemistry of groundwater in the host rock and seeping into the repository will have a direct impact on the containment, mobilization, and effectiveness of the engineered barriers. Therefore, it is essential to establish the effect of near-field geochemistry on the processes and materials in the near-field, and the subsequent effect on overall performance.

It may be concluded that NRC and DOE both consider the chemistry of groundwater in the near field to be a key component of repository performance, although there are many inherent difficulties associated with characterizing the post-closure characteristics of the groundwater. Therefore, NRC has elected to conduct activities that will help to define the essential elements for defining the chemistry of the near-field, establishing the sensitivity of performance to the near-field environment, providing feedback and guidance to DOE concerning its work on the near-field and to develop acceptance criteria for evaluating the proposed YM site.

1.1 Key Technical Issue (KTI)

- Characterization of the evolution of near-field environment is a challenging problem because of difficulties in sampling and analyzing water in unsaturated media, the transient thermal regime of the near field, uncertainty in fluid fluxes, uncertain thermodynamic and kinetic properties of geologic and engineered materials, and coupling of processes.

1.2 Significance to Performance

• Groundwater chemistry in the near field is one of a number of conditions which can affect waste package and waste form alteration, radioelement speciation and solubility, distribution of radioelements among solid (including colloids), liquid, and gas phases, dissolution/precipitation and sorption/desorption reactions. Thus, near-field groundwater chemistry can affect containment, release, and transport of radionuclides.

RADIONUCLIDE TRANSPORT

1.0 Rationale

A fundamental concern in evaluating the suitability of YM as a potential repository for high-level radioactive waste is the possibility of radionuclide transport through the subsurface from the repository to the accessible environment. In the DOE Waste Isolation Strategy (DOE, 1995), radionuclide transport is mentioned in two of the five key hypotheses that need to be tested in any suitability demonstration for a proposed repository at YM. These include limited radionuclide migration through the EBS into the host rock, and dilution by dispersion and mixing. A number of processes, such as sorption, matrix diffusion, dispersion, mineral precipitation, radioactive decay, and dilution may serve to retard radionuclide transport, ultimately leading to a reduction in potential dose to human. This is especially true for the longer time periods recommended by the NAS (NAS, 1995). The work under this KTI is intended to lead to resolution of the issue through the use of quantitative models describing transport in repository performance under geochemical and hydrologic conditions specific to YM.

1.1 Key Technical Issue (KTI)

This KTI is concerned with the processes which may affect radionuclide transport from the repository to the accessible environment.

1.2 Significance to Repository Performance

Radionuclide transport is a key technical issue with regard to repository performance for several broad reasons:

- Dose-calculations of the type recommended by the NAS ultimately require an estimate of concentrations of different radionuclides in aqueous, gas, and/or solid phases that may come in contact with the biosphere at or near the site. These concentrations will vary as a function of space and time, depending on the processes that control the rate of radionuclide transport through the subsurface and the effects of changes in system chemistry and hydrology. Therefore, processes that control the reduction (or increase) of radionuclide concentration in the groundwater need to be studied in any evaluation of repository performance.

- In DOE Waste Isolation Demonstration Strategy, waste mobilization and radionuclide transport are discussed as key mechanisms in determining the dose-rate curve (DOE, 1995). Transport through the EBS and transport and dilution in the far-field are specifically mentioned as hypothesis that need to be tested.

- DOE TSPA activities (TSPA-93 - Wilson et al., 1994; TSPA-95 - DOE, 1995) include retardation as part of the transport calculations. Probability distributions are assumed for K_d values for different radioelements and different hydrogeologic units in both the unsaturated and saturated zones.

The assigned distributions are based largely on informal expert elicitation, and the justification for the selected distributions is not well documented within TSPA.

- DOE has funded research at Sandia National Laboratories investigating hydrogeochemical transport (Yeh et al., 1995a,b). These models include a wide variety of processes such as sorption, dispersion, and precipitation/dissolution that may contribute to radionuclide retardation.

- Understanding of geochemical processes that influence radionuclide transport may be used to offset uncertainties in hydrologic models of the YM system (Simmons et al., 1995). Not understanding the degree to which these processes are affected by changes in system chemistry/hydrclogy makes it difficult to reasonably bound radionuclide transport.

This key technical issue is difficult to resolve at the present time for the following reasons:

- A number of different physical and geochemical processes may influence radionuclide migration through the subsurface at YM.

- Processes affecting radionuclide retardation are strongly influenced in turn by system chemistry and hydrology.

- Likely flow paths and their mineralogies have not been firmly established for the YM system.

- Available information to determine the degree of mixing and dilution in the saturated zone is limited.

- Geochemical processes are non-linear, and coupling geochemistry with flow models is typically computationally intensive.

- Many of the parameters that are necessary to construct predictive sorption models are either unknown, poorly characterized, or still subject to much debate. These include parameters such as thermodynamic data, effective mineral surface areas, and rate constant information.

The geochemical and hydrological systems at YM are complex and have not been determined within an agreed upon limit of uncertainty. This makes it difficult to establish reasonable boundary and initial conditions for modeling of transport processes. The system heterogeneity makes it especially difficult to determine bounding values for radionuclide transport, given the possible changes in key parameters such as pH through space and time. Sensitivity analyses can provide some insight as to which parameters have the greatest effect on repository performance, and identify those areas of the KTI for which bounding calculations can be used in performance assessment.

Both NRC and DOE have attempted to include the effects of geochemistry on radionuclide transport in their performance assessment calculations (e.g., Wilson et al., 1994; Wescott et al., 1995). However, there remains sufficient uncertainty in both the hydrological and the transport models used in these efforts that continued study of radionuclide transport is warranted. Therefore, NRC has elected to conduct a detailed review of a vertical slice of the overall DOE program in the area of radionuclide transport.

SUMMARY OF PROPOSED NRC INTERACTIONS

	TECHNICAL EXCHANGES	
Date/Location	**Topic**	**Comments**
October, 1996 [will re-evaluate need after completion of 7/24 App 7]	Near-Field Coupled Processes; Thermal Load Strategy and Thermal-Mechanical Response at Yucca Mountain; and Thermohydrologic Modeling and Testing	Discussions intended to resolve or narrow difference on issues related to noted topics
October 29, 1996*	Disposal Criticality	Provide an opportunity for NRC staff to raise questions on the Technical Report that is to serve as the basis for the DOE's 1998 Topical Report on Disposal Criticality Analysis Methodology. Identify any concerns and issues and propose resolution for such issues.
November 14, 1996*	Volcanism - PVHA, probability and consequence	Discuss DOE's PVHA process and results; NRC's analysis of volcanic hazard; NRC review of PVHA; probability and consequence of disruptive events
January - February, 1997	TSPA95	NRC staff will present results of final review.
January - March, 1997	Tectonic Models of Yucca Mountain	DOE's current range of tectonic models of Yucca Mountain and their importance to safety, design and performance.

* Agreed to in 7/15/96 Interactions Telcon

DETAILED DISCUSSIONS OF PROPOSED NRC TECHNICAL EXCHANGES:

October, 1996 — Technical Exchange: Coupled processes in the near-field environment

KTI Teams: Thermal Effects on Flow, Evolution of the Near-Field Environment, Radionuclide Transport, Repository Design and Thermal-Mechanical Effects, Container Life and Source Term, TSPA and Technical Integration

Applicable DOE Waste Containment and Isolation Strategy Hypothesis: Hypotheses applicable to the near-field environment are 1) low seepage of groundwater; 2) long containment times of radionuclides; 3) low mobilization of radionuclides; and 4) long transport times through the engineered barrier

Objectives: 1) Resolve Data Subissues with respect to thermal, mechanical, hydrological, and chemical study in the exploratory studies facility. 2) Resolve technical subissues on DOE consideration of coupled processes in modeling.

Scope: This technical exchange will evaluate the evolution of the near-field as affected by interrelated thermal, hydrologic, mechanical, and chemical processes. The thermal and mechanical loading associated with waste disposal will result in changes in hydraulic flow and chemistry of the groundwater, which, in turn, affect waste package degradation and the release and transport of radionuclides. Interactions of warm water and vapor with the host rock and components of the repository are also expected to affect flow paths, which will then affect radionuclide release and transport. Testing and modeling TH, TC, TM, and HC processes is integral to support overall-system performance assessments. Heater testing, coupled process modeling, supporting experimental work, and appropriate aspects of repository components and design will be discussed. Integration of abstracted coupled process models for inclusion in the TSPA model will also be discussed.

October 29, 1996 — Technical Exchange: Disposal Criticality

Objective: This Technical Exchange would be held to discuss DOE's Technical Report on disposal criticality, which will have been provided to NRC in September 1996, for NRC staff's information. The

November 14, 1996 Technical Exchange: Probabilistic Volcanic Hazard Analysis/Probability and consequence

KTI Teams: Igneous Activity

Applicable DOE Waste Containment and Isolation Strategy Hypothesis: Volcanic events within the controlled area will be rare and the consequences of volcanism will be acceptable.

Objectives: 1) Discuss DOE's PVHA process and results, providing NRC comments; 2) Discuss NRC analysis of volcanic hazard; 3) Discuss the probability and consequence of disruptive events for use in performance assessment, determining resolvable issues and defining differences.

January, 1997 Technical Exchange: Discuss staff final comment on the TSPA95

KTI Team: Igneous Activity

Applicable DOE Waste Containment and Isolation Strategy Hypothesis: None

Objective: Resolve technical subissue on volcanic hazard risk assessment

Focus: The proposed exchange would focus on the concerns related to PVHA

January - March, 1997 Technical Exchange: Discuss DOE's current range of tectonic models

KTI Team: Structural Deformation and Seismicity

Applicable DOE Waste Containment and Isolation Strategy Hypothesis: None

Objectives: 1) Resolve data subissue with respect to technical bases for tectonic models; 2) Resolve alternative conceptual models subissue; 3) Resolve model validation & verification subissue; and, 4)Resolve selected technical subissues on seismic sources, contemporary stress distribution, fault activity, displacement and seismic hazard analyses, large hydraulic gradient, fault-magma interactions

Focus: The focus of the exchange or meeting would be DOE's current range of tectonic models of Yucca Mountain and vicinity. Emphasis would be on the importance of those models to safety, design and performance.

Justification: DOE has stated its intent to evaluate tectonic models and synthesize supporting data in order to identify inconsistencies and uncertainties in its understanding of structural deformation that has occurred and might occur at and near the site. DOE has recognized

Technical Report will contain the basis for DOE's risk-based approach to disposal criticality to be used in the 1998 Disposal Criticality Analysis Methodology Topical Report. DOE will also discuss draft responses to NRC's October 1995 comments on the annotated outline for the Topical Report.

Scope: Agenda will be negotiated prior to meeting.

Location: Las Vegas, NV

November 14, 1996 Technical Exchange: Probabilistic Volcanic Hazard Analysis/Probability and consequence

KTI Teams: Igneous Activity

Applicable DOE Waste Containment and Isolation Strategy Hypothesis: Volcanic events within the controlled area will be rare and the consequences of volcanism will be acceptable.

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January - March, 1996 Technical Exchange: Discuss DOE's current range of tectonic models

KTI Team: Structural Deformation and Seismicity

Applicable DOE Waste Containment and Isolation Strategy Hypothesis: None

Objectives: 1) Resolve data subissue with respect to technical bases for tectonic models; 2) Resolve alternative conceptual models subissue; 3) Resolve model validation & verification subissue; and 4) Resolve selected technical subissues on seismic sources, contemporary stress distribution, fault activity, displacement and seismic hazard analyses, large hydraulic gradient, fault-magma interactions

Focus: The focus of the exchange or meeting would be DOE's current range of tectonic models of YM and vicinity. Emphasis would be on the importance of those models to safety, design and performance.

Justification: DOE has stated its intent to evaluate tectonic models and synthesize supporting data in order to identify inconsistencies and uncertainties in its understanding of structural deformation that has occurred and might occur at and near the site. DOE has recognized that tectonic models may constrain disruptive event scenarios. Most of DOE's work on tectonic models are preliminary reports on geophysical investigations or on tectonic models of Crater Flat and YM. A surveillance of DOE's tectonic modeling program (YMP-SR-95-010) indicated that DOE's 3-D geologic model was not fully integrated into the work of process modelers. A Technical Exchange on Tectonic Models would be the second meeting on the subject and should facilitate resolution of the numerous subissues listed above.

Some Points On the Path to Resolution:

* Range of tectonic models DOE has under consideration was considered briefly in Appendix 7 meeting May/96

* Review Seismotectonic synthesis report due to DOE August 1, 1996

* Agree on classification of faults that are Type I faults (optional - could be the subject of another interaction).

	APPENDIX 7 VISITS	
July 24, 1996	Heater Tests	Discuss staff comments on DOE's thermal heater test design report
August 15-16, 1996	YMSCO Long Range Planning	Understand DOE's detailed program plans
August, 1996 - San Antonio, TX	Geologic 3D Model	Obtain NRC feedback on newly released 3D geologic model
September 10, 1996	PVHA - Expert Elicitation Process	Provide DOE comment on the expert elicitation process used in PVHA.
September, 1996	Seismic Design Topical Report	Discuss Staff comments on seismic design topical report and resolve design methodology issues.
September, 1996	Infiltration	Discuss DOE shallow infiltration info remains consistent with that closing the issue
September, 1996	TSPA 95	NRC/DOE comparison of TPA simulation results
September 29, 1996	PVHA/Expert Elicitation	Provide NRC feedback on expert elicitation aspects of PVHA
November, 1996	Natural Fractures at YM	Understand DOE's fracture data/model uncertainty/limitations to simulation
November, 1996	Container Materials and Assessment	Discuss long-term materials testing and assessment by DOE

DETAILED DISCUSSIONS OF PROPOSED NRC APPENDIX 7 VISITS:

July 24, 1996

Appendix 7: Heater testing

Objective: 1) Obtain clear understanding of the thermal heater test design and the intended objective of the test. 2) Provide DOE comments on the design of the thermal test design report. (Thermal Effects on Flow; Repository Design/Thermo-Mechanical Effects; Near Field Environment)

August 15-16, 1996

Appendix 7: YMSCO's Long Range Planning

Objective: To understand DOE's replanning of the site characterization program. To discuss context, goals, integration of Long Range Planning. To provide insight for NRC to ask questions about YMSCO's planning to 2002.

Location: Las Vegas, NV

August, 1996

Appendix 7: 3-D Geologic Model

Objective: Provide DOE feedback from NRC/CNWRA on DOE's newly released 3-D Geologic model. (Structural Deformation/ Seismicity, Igneous Activity)

Location: CNWRA, San Antonio, Texas

September, 1996

Appendix 7: Discuss staff comments on seismic design Topical Report and resolve design methodology issues.

KTI Team: Repository Design and Thermal-Mechanical Effects

Applicable DOE Waste Containment and Isolation Strategy Hypothesis: None

Objective: Resolve technical subissue on applicability of performance-goal based seismic design methodology for repository design.

Focus: The proposed exchange would focus on the concerns related to the review of the seismic design methodology topical report.

Justification: DOE's seismic design methodology as proposed in the topical report calls for using a performance goal-based design (PGSD) method. This PGSD method uses seismic design loads determined from a design basis event and scaled accordingly based on the relative importance of the particular systems, structures, or components. This method has also been proposed to be applicable to the design of underground openings and ground support systems. In this methodology DOE has recognized the potential effect of repetitive episodes of seismic loads to be important, in the context of seismic design of the geological repository. This potential effect will be accommodated, based on the methodology, through a program of maintenance and rehabilitation that will be a part of the detailed seismic design. Several concerns that may have implications on safety issues and repository performance have been currently identified during the review of DOE's seismic design methodology topical report. Some of the concerns may need to be resolved through a technical exchange with DOE.

September, 1996

Appendix 7: TSPA95

Objective: Meeting between DOE staff and TSPA KTI team for the purpose of providing final comments on DOE TSPA 95 and assuring DOE's clear understanding of NRC concerns. Differences in assumptions, abstractions, simulation methodology will be discussed. (TSPA/Integration KTI)

September, 1996

Appendix 7: Infiltration

Objectives: (1) to ensure that we have the most recently collected field data on shallow infiltration, (2) to ensure that NRC and CNWRA staffs are informed of the full scope of DOE's continuing work under this topic, and (3) to confirm that the views expressed by L. Flint and A. Flint in their Fall AGU abstract (titled "Lateral Diversion of Water in the Paintbrush Tuff.....") continue to be consistent with their latest field data and with the results of other DOE/USGS investigators.

September 29, 1996

Appendix 7: Discuss staff comment on the expert elicitation aspects of the PVHA report

KTI Team: Igneous Activity

Objective: Provide DOE feedback on use of expert elicitation in PVHA

November, 1996

Appendix 7: Natural Fractures at YM

Objectives: 1) Understand DOE's fracture data and model uncertainty for basecase. 2) Understand limitations of DOE's simulation of future repository fracture characteristics. (Structural Deformation/Seismicity)

Focus: Existing fracture data for spatial variation of aperture, coatings, orientation, size, interconnectivity, and cross-cutting relationships as a function of mechanical layering, proximity to major faults, and geographic position. Spatial heterogeneity and anisotropy of the fracture pattern. Consider possibility that the regional stress field controls degree of dilation of fractures as a function of their orientation. Evidence for correlating and connecting surface and subsurface fracture data from wells and ESF. Constraints for establishing a fracture population to be used in simulations of groundwater flow, tunnel stability, heat propagation and displacement on normal faults in and near the potential repository site.

Justification: Fracture flow was not considered in TSPA95. New data like recent anomalous Chlorine-36 measurements in fracture systems and unexpected intense fracturing within the repository horizon encountered by the ESF suggest potentially higher rates of infiltration and groundwater flow than previously considered. Furthermore, zones of intense fracturing encountered by the ESF increase concerns regarding repository stability. Role of fractures in groundwater flow and tunnel stability needs to be assessed in TSPA.

November, 1996

Appendix 7: Container Materials Testing and Container Life Assessment

Objective: To discuss long-term materials testing and container assessment being done by DOE and resolve differences in container performance modeling. (Container Life/Source Term)

Scope: To discuss DOE's approach and test results on dry/aqueous/drip/localized corrosion and resolve differences in modeling for these failure modes.

Location: Lawrence Livermore National Laboratories, Livermore, California.

QA MEETING:

QA AUDIT OBSERVATION: NRC is aware of that DOE has audits planned through December, 1996. NRC may participate as observers in some of these audits. However, NRC participation is dependent upon the specific focus of the audit and the decision to participate will be made once the scope and technical focus of the audit is defined.

August/ September, 1996	QA Audit: Mineralogic and Geochemical Alteration. NRC Participation in DOE observation audits. (Near Field Environment KTI)
September 16-19, 1996	QA Audit: Postclosure Tectonics - Characterization of Volcanic Features. NRC Participation in DOE observation audits. (Igneous Activity KTI)
September 23-27, 1996	QA Audit: UZ Hydrochemistry. NRC Participation in DOE observation audits. (Near Field Environment KTI)
TBD	QA Audit: NRC Participation in DOE observation audits of Lawrence Livermore National Laboratory (LLNL). (Container Life/Source Term KTI)
TBD	QA Audit: NRC Participation in DOE observation audits of Sandia National Laboratory (SNL). (Container Life/Source Term KTI).