Site Evaluation Process – Yucca Mountain Examples
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What were the drivers behind the scope of scientific work, and the associated cost and time, required for evaluation of the WIPP and Yucca Mountain sites?

The principal factors that affected the scope of scientific investigations at Yucca Mountain over the last 20 years included both regulatory and technical aspects. Examples of regulatory factors include the regulations themselves as well as the associated quality assurance requirements. Examples of technical factors include the repository and waste package designs, new information that affected the post-closure safety basis, and technical reviews from peers, stakeholders and the regulators.

Several of the regulatory and technical factors changed during the course of the Yucca Mountain site evaluation process leading up to the site suitability determination and the license application. For example, the regulatory framework was modified twice, once to develop a risk-based standard derived from recommendations from a Congressionally-mandated National Academy of Science panel and once based on a court ruling that necessitated extending the period of performance to one million years. The quality assurance requirements, especially those related to scientific modeling, evolved several times during the period and were continually the focus of reviews that resulted in numerous corrective actions that required significant rework.

Technical factors also changed the scope of scientific work. For example, the waste package design changed significantly as the scientific information evolved and a more robust engineered barrier system was designed. In addition, as alternative thermal management design strategies were identified and adopted, additional scientific modeling and analysis were required. New information that affected the scientific investigations included changing interpretations of water flow through the unsaturated tuffs based in part on uncertain interpretations of observations of apparent bomb-pulse chlorine-36.

In addition to the changing requirements, a significant driver affecting the scientific and design activities was internal and external reviews of the ongoing scientific investigations. The internal reviews included reviews performed by scientific peers including other national laboratories, contractors and DOE technical staff. External reviews included those by the Nuclear Regulatory Commission staff (most notably the 293 key technical issues and the subsequent requests for additional information following the submittal of the license application) and the Nuclear Waste Technical Review Board.

How can a future site evaluation (not site selection) process be designed to allow the many necessary and sometime conflicting goals for site evaluation to be met in a credible way within a reasonable time and at a reasonable cost?

As noted above, one of the reasons for the evolving scope and therefore schedule and cost was the changing requirements, whether regulatory, quality assurance or technical, as well as the learning curve for the scientists in interpreting these requirements. Any potential future site evaluation would be well served to first have transparent regulatory and quality assurance requirements specified early in the process, with the responsibilities of the management and technical staff in implementing these requirements being well defined.

In addition, having a preliminary safety case based on an initial design concept and regional or analog geologic information would allow the scientific staff to focus on the most significant distinguishing characteristics affecting the performance. The preliminary safety case should include an explicit evaluation of the significance of the relevant features, events and processes in order to prioritize the scientific investigations. The safety case is expected to evolve as additional scientific and design information is developed. Once the above regulatory and technical requirements are developed and accepted; the quality, scope, schedule and cost of the scientific work should be controlled by accepted project management practices.