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Continuous Improvement and the Safety Case for the Waste Isolation Pilot Plant Geologic Repository – 13467

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ABSTRACT

The Waste Isolation Pilot Plant (WIPP) is a geologic repository 2150 feet (650 m) below the surface of the Chihuahuan desert near Carlsbad, New Mexico. WIPP permanently disposes of transuranic waste from national defense programs. Every five years, the U.S. Department of Energy (DOE) submits an application to the U.S. Environmental Protection Agency (EPA) to request regulatory-compliance recertification of the facility for another five years. Every ten years, DOE submits an application to the New Mexico Environment Department (NMED) for the renewal of its hazardous waste disposal permit. The content of the applications made by DOE to the EPA for recertification, and to the NMED for permit-renewal, reflect any optimization changes made to the facility, with regulatory concurrence if warranted by the nature of the change. DOE points to such changes as evidence for its having taken seriously its "continuous improvement" operations and management philosophy. Another opportunity for continuous improvement is to look at any delta that may exist between the re-certification and re-permitting cases for system safety and the consensus advice on the nature and content of a safety case as being developed and published by the Nuclear Energy Agency's Integration Group for the Safety Case (IGSC) expert group. DOE at WIPP, with the aid of its Science Advisor and teammate, Sandia National Laboratories, is in the process of discerning what can be done, in a reasonably paced and cost-conscious manner, to continually improve the case for repository safety that is being made to the two primary regulators on a recurring basis. This paper will discuss some aspects of that delta and potential paths forward to addressing them.

INTRODUCTION

Defense-related transuranic (TRU) and TRU-mixed waste is permanently isolated from the environment at the Waste Isolation Pilot Plant (WIPP), a geologic repository 2150 feet (650 m) below the surface of the Chihuahuan desert near Carlsbad, New Mexico. Every five years, the U.S. Department of Energy (DOE) submits an application to the U.S Environmental Protection Agency (EPA) to request regulatory-compliance recertification of the facility for another five years. Every ten years, DOE submits an application to the New Mexico Environment Department (NMED) for the renewal of its hazardous waste disposal permit.

The seventh DOE Management Principle published in 2010 says that "We will succeed only through teamwork and continuous improvement." Continuous improvement in the context of a working facility suggests that opportunities are to be continually sought to optimize functions to

enhance safety and efficiency. Continuous improvement can also be applied to the case that is made for system safety to the facility's two primary regulators, the EPA and the NMED.

Internationally, guidance has been produced over the last decade on how a comprehensive case for nuclear facility safety ought to be made. The safety-case idea was suggested to the world through the advisory standard for the world's deep geological disposal facilities that was issued jointly by the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development. [1,2] The NEA created an expert working group named the Integration Group for the Safety Case (IGSC) that published a description of what a safety case ought to contain. [3] DOE has contributed to this group's leadership since its inception. Fourteen countries and three international organizations (NEA, IAEA and the European Commission's Research Directorate) participate in this group's efforts to provide consensus international guidance on how to construct a credible case for deep geological repository safety, including both the operational and post-closure phases of such a system.

The content of the applications made by DOE to the EPA for recertification, and to the NMED for permit-renewal, reflect any optimization changes made to the facility since the last recertification or permit renewal. If proposed changes cross certain predefined thresholds, regulatory concurrence is sought before the change is implemented. DOE points to such changes as evidence for its having taken seriously the "continuous improvement" portion of its operational and management philosophy.

Another opportunity for continuous improvement is to look at any delta that may exist between the re-certification and re-permitting cases for system safety and the consensus advice on the nature and content of a safety case as published [3] and still being refined by the NEA's IGSC expert group.

DOE at WIPP, with the aid of its Science Advisor and teammate, Sandia National Laboratories, is in the process of discerning what can be done, in a reasonably paced and cost-conscious manner, to continually improve the case for repository safety that is being made to the two primary regulators on a recurring basis, and that is being discussed piecemeal at various times and places in a plethora of forums involving other stakeholders.

This paper will discuss some potential paths forward to addressing continuous improvement in the WIPP case for repository system safety.

DESIRABILITY OF CONTINUOUS IMPROVEMENT IN THE SAFETY CASE

Given that the WIPP repository has been operating safely about 14 years, has received two regulatory compliance re-certifications, and has received its second permit for hazardous material disposal, there is no crisis in terms of making the regulatory case for system safety. That case has been made and accepted by the federal and state regulators.

In their 2012 final report, the Blue Ribbon Commission on America's Nuclear Future (BRC), [4] recommended that the WIPP facility's success be seen as a model for siting future radioactive waste management facilities:

> . . . the approach we recommend is explicitly adaptive, staged, and consent-based. Based on a review of successful siting processes in the United States and abroad—including most notably the siting of a disposal facility for transuranic radioactive waste, the Waste Isolation Pilot Plant (WIPP) in New Mexico, and recent positive outcomes in Finland, France, Spain and Sweden—we believe this type of approach can provide the flexibility and sustain the public trust and confidence needed to see controversial facilities through to completion.

So, there is also no apparent need to convince non-regulator stakeholders, especially those living nearby or in the region, of the safety of the repository system. So why change anything that is working well? "Continuous improvement?" Yes.

There is practical reason for working at a moderate pace to modernize the case for WIPP repository safety. The following generic timeline for a geologic repository suggests that there may be a long time period, multiple working generations, in fact, from the time a repository begins to operate to its post-operational long term life as a passive underground facility assuring continued safety. Every 5 years there is a need to re-demonstrate compliance with federal standards, and every 10 years compliance with state requirements also needs to be re-demonstrated.

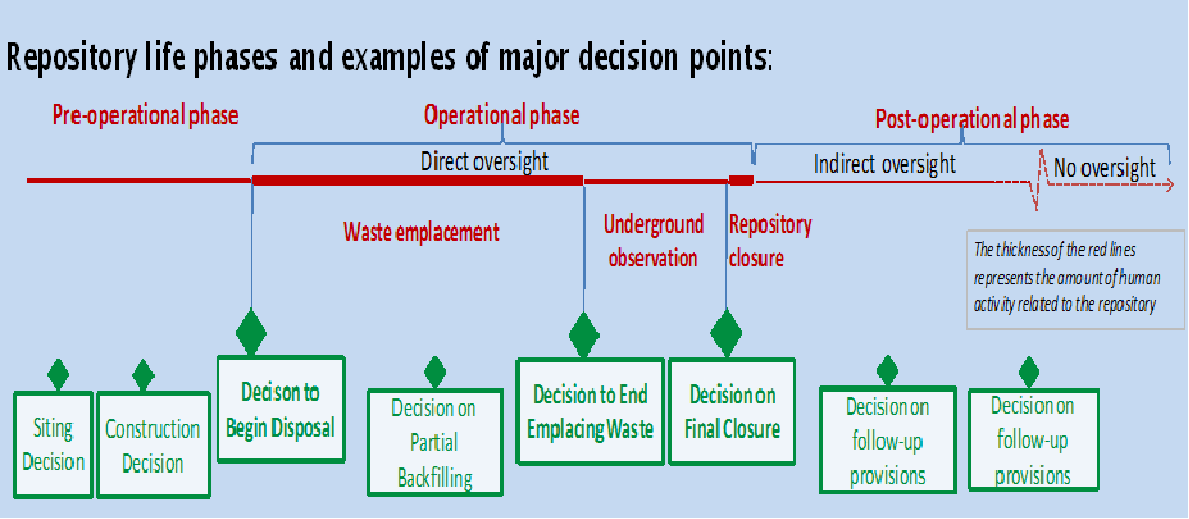

Fig. 1: Generic illustration of repository life phases and associated decisions [from 5]

What can happen in the US over that multi-generational time period? One thing that may happen is the carrying out of the first recommendation of the BRC [4]:

> First, the Environmental Protection Agency and the Nuclear Regulatory Commission should develop a generic disposal standard and supporting regulatory requirements early in the siting process. Generally applicable regulations are more likely to earn public confidence than site-specific standards. . . .

No doubt, legally the WIPP facility will be 'grandfathered' under its existing set of regulations for compliance-demonstration purposes, but there is also no doubt that the question will be asked

by various stakeholders: does the WIPP facility appear to be able to meet this new standard? It is possible that the new generic US repository standard will have elements of the more recent standard promulgated by EPA for Yucca Mountain, 40 CFR Part 197. It may also have elements of the afore-cited IAEA advisory standard [2] including its safety-case specifications. The specified regulatory period of compliance may not be 10,000 years in the new US standard, as is the case for the standard that WIPP needs to comply with, 40 CFR Part 191.

In 1997, the Department of Energy received the results of an international peer review it had requested of its draft long-term repository performance assessment. This reviewed assessment was to become part of its Compliance Certification Application of 1999. The NEA and the IAEA jointly performed this peer review.

Review results [6] suggested that although the experts conducting the review saw the compliance case as technically competent and sound, there was frustration on the part of reviewers concerning the transparency of the case being made for safety. It was highly technical, written for regulatory experts only, not for any other audience. There was also a complaint about how its narrow focus on compliance with the applicable US regulation, 40 CFR Part 191, which is quite different from regulations adopted in other countries, made cross-comparisons very difficult.

A new generic US repository standard, even though it would in all likelihood not legally apply to WIPP, would re-open such inter-comparison frustrations. This can be avoided by broadening and updating the approach to describing system safety so that it addresses various times of potential interest, and various performance measures. International guidance also suggests writing transparent summaries of the case being made for safety, including arguments for safety that are understandable by less-technical stakeholder audiences.

POTENTIAL TECHNICAL IMPROVEMENTS IN THE SAFETY CASE

In a recent report, Sandia National Laboratories [7] used a Figure from an older report by the National Research Council of the National Academies [8] to illustrate the opportunities for continuous improvement in the components of a safety case with time through a repository's life.

The figure, Figure 2 here [re-titled from the original] was obviously wrong in assuming that at the start of operations, the safety strategy and the repository design would stop being re-evaluated and optimized. The figure is correct, however, in asserting that "The depth and breadth of the arguments for each element of the safety case becomes more substantial during the phased development of the repository." That is another way of saying that "continuous improvement" is to be the goal of the implementer, and is a valid expectation on the part of stakeholders.

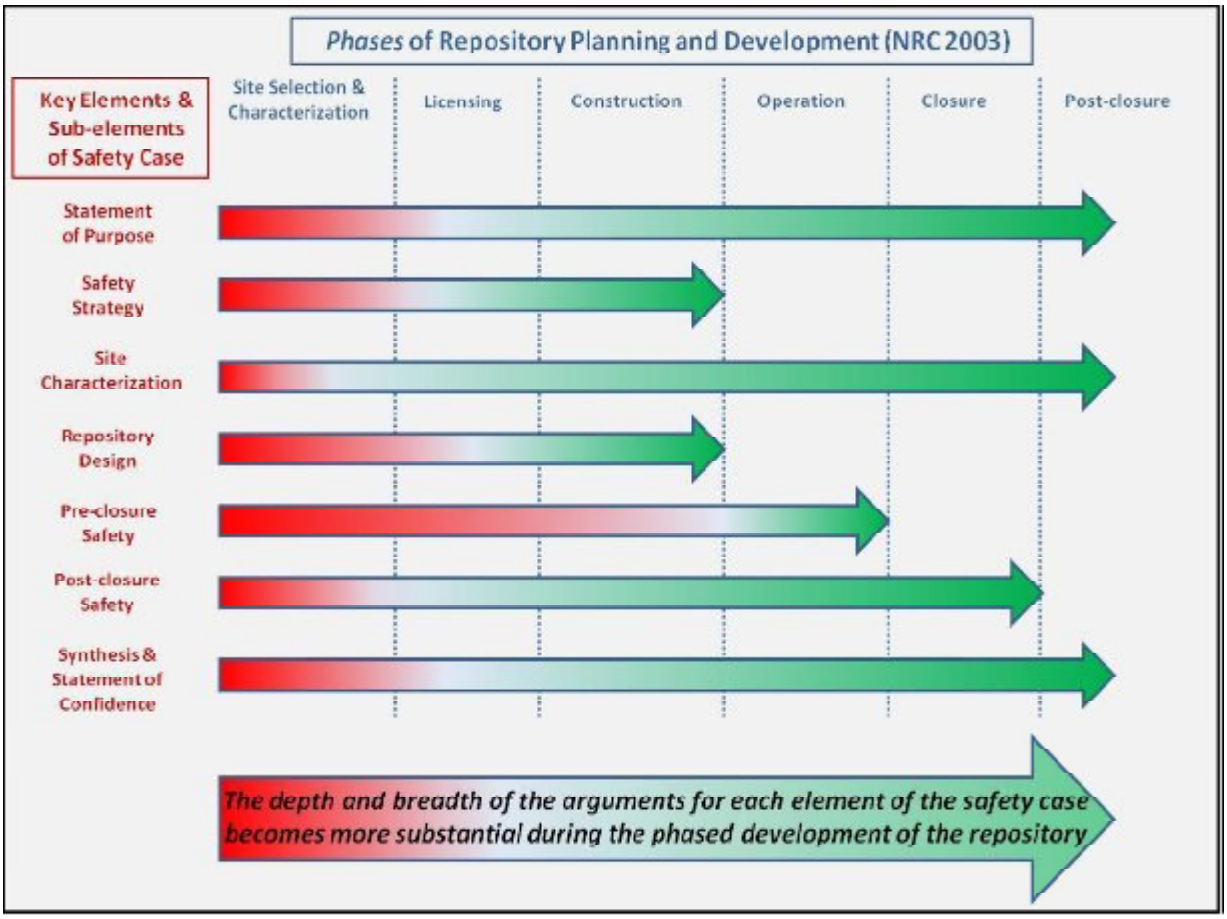

Fig. 2. Evolution of Safety Case Components as Part of Repository Development [from 7,8].

The intent of the Sandia report [7] was to suggest what needed to be done if there was a national desire for a new repository in bedded salt for waste forms not currently being disposed in WIPP. However, its principle observations about opportunities and approaches to advancing the safety case with time apply just as well to the safety case for an existing repository in bedded salt with an existing scientific information base.

The opportunity in this instance is not so much to expand the scientific basis as it is to reconfigure aspects of the safety case to be accessible to less technical stakeholder audiences, to allow more transparent comparisons with international advisory standards and other nations' cases for repository safety, and eventually to allow comparison with new US regulations (whether applicable to WIPP or not) and new proposed US repositories. Within technically reasonable limits, it allows using WIPP as the US model for what ought to be expected by a 2potential host community in terms of both operational and long-term safety from a repository.
A recent compilation of the state of the art in Methods for Safety Assessments (MeSA) was published by the Nuclear Energy Agency [9].

Of particular interest in this document were two of its figures suggesting the context needed to support a comprehensive case for system safety:

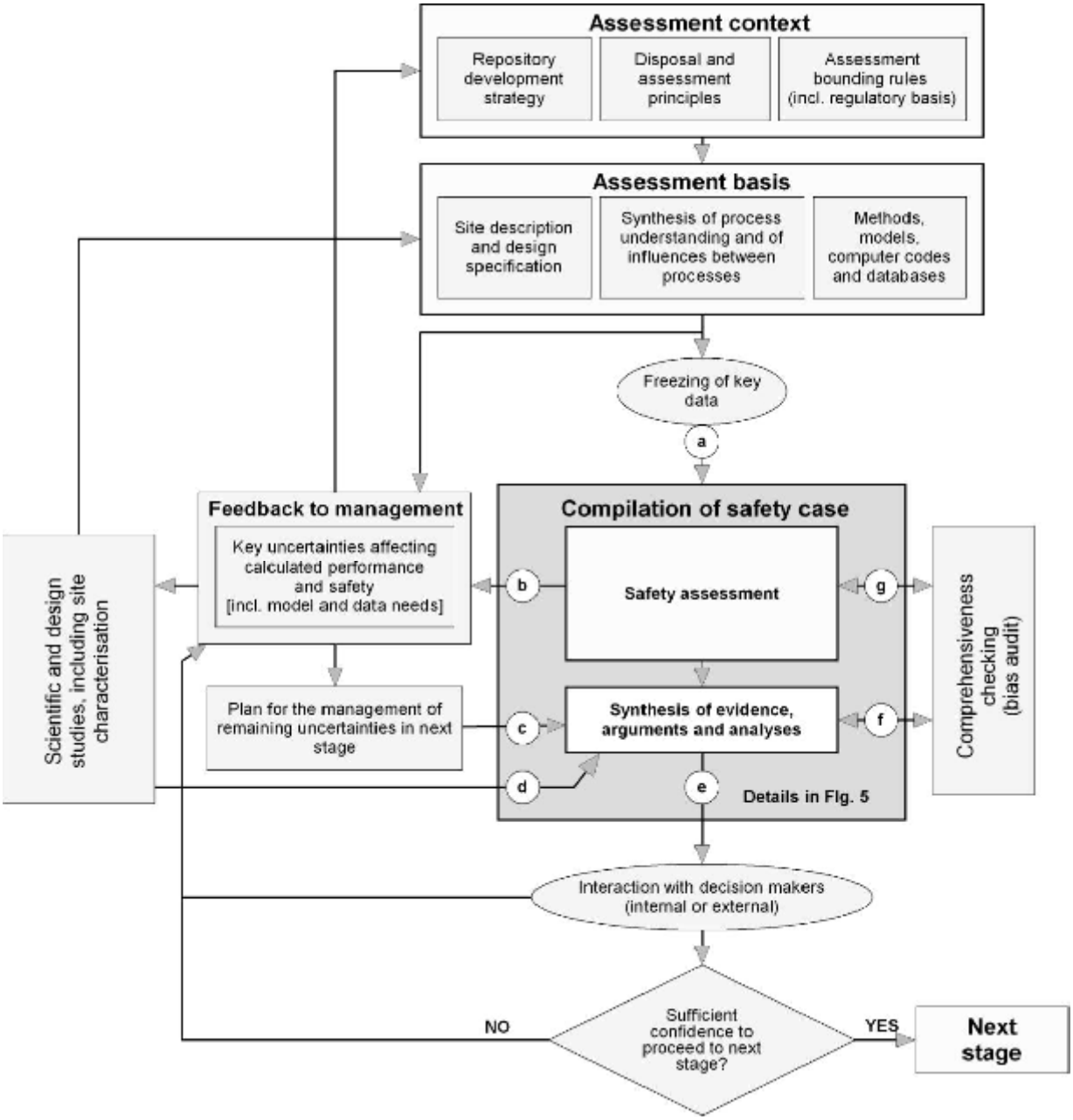

Fig. 3 High-level generic safety case flowchart with key elements and linkages. Arrows labelled with letters correspond to the same letters in Figure 4 [Figure 4.1 in ref. 9].

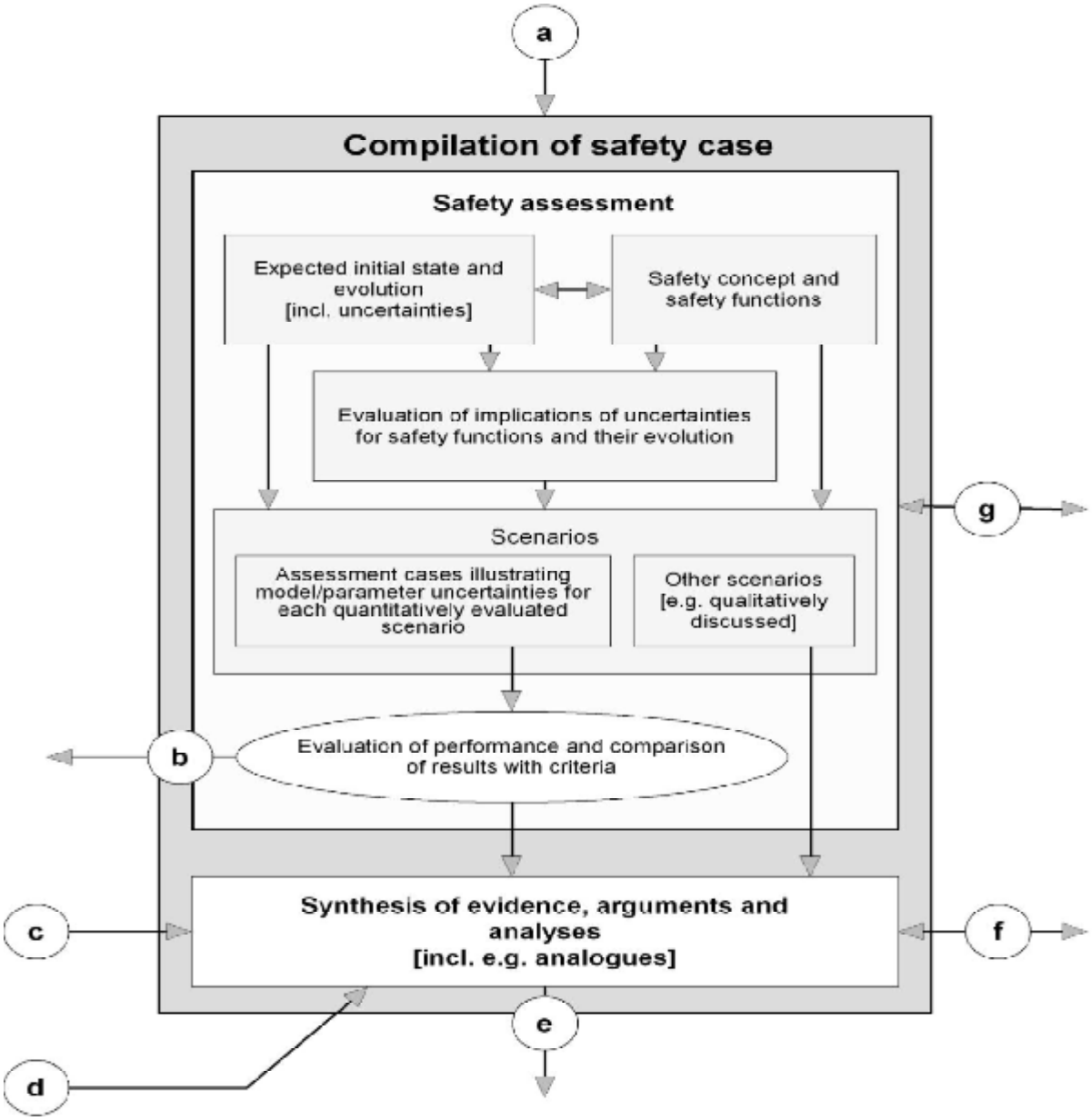

Fig. 4: Generic flowchart of the safety assessment component of the upper level generic flowchart in Figure 3. [Figure 4.2 in ref. 9].

Figures 3 and 4 suggest many things are needed to support a credible and comprehensive case for long-term safety (the focus of the MeSA Project was long-term repository safety). Each one of these listed items has its counterpart in the documentation submitted for showing that the WIPP repository continues to meet its regulatory compliance requirements.

Two areas are somewhat different in the WIPP context. First, WIPP is an operating repository, hence the idea that we are still in a step-wise progression toward operations, as suggested in these

two figures, is not applicable. The "Next stage" in Figure 3 needs to be understood, in the WIPP context, to suggest there has been no loss in confidence because of new information, or because of changes in operations or design. Therefore there remains sufficient confidence to suggest that WIPP remains in compliance with long-term radiological performance requirements for another 5 years, and 10 years for the hazardous waste permit renewal.

Second, the words "safety function" recur in Figure 4. The WIPP performance assessment is based on scenarios created though combinations of features, events and processes, or FEPs. The safety function concept is implicit in that approach. The international community is suggesting that a more broadly understandable approach is to describe a broad "safety concept" for a repository in terms of several "safety functions" that may change in relative importance over time:

> The safety concept is the understanding of why the disposal system is safe, irrespective of identified uncertainties and detrimental phenomena; i.e. why it is expected to be robust. It includes a description of the roles of the natural and engineered barriers and the safety functions that these are expected to provide in different time frames, and why the disposal system is expected to be safe. [9, p. 30]

An opportunity for improvement in terms of WIPP safety case transparency may thus be translating the current highly detailed and technical FEPs-based approach into a safety function approach. This would not be a large or difficult task, and may aid several types of stakeholders to better understand what makes this repository safe in the very long term.

DISCUSSION

Continuous improvement is more than just a lofty ideal. It is part and parcel of a nuclear safety culture. It involves always being vigilant and observant in the work place, and continually looking for ways to increase efficiency without sacrificing safety. Continuous improvement in the case being made for repository safety would broaden understanding of the basis for repository safety and thus potentially broaden support for the continued operation of the repository with the constraints of policy and law.

Continuous improvement and broadening of the WIPP safety case would also facilitate the comparison of WIPP system safety with the safety projections being made for other repositories, either domestic or international. WIPP as the first geologic repository in the US sets a national standard for safety. Perhaps siting future US repositories would be made easier in terms of public and political acceptance if it can be shown for a proposed repository that it is very likely to offer the same level of protection for its regional citizenry as is being offered by WIPP to its regional citizenry.

A first step that may be useful to several types of stakeholders is to make the case for WIPP safety more transparent through translating or mapping its FEPs approach into a safety-functions approach to explain what is important to long term safety.

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