How Long is Too Long? - 14644

David W. Esh, Christepher A. McKenney, Christopher J. Grossman
U.S. Nuclear Regulatory Commission, MS T8F5, Washington, DC; david.esh@nrc.gov

ABSTRACT

The approach to analyses timeframes is an important element to performance-based technical analyses for the disposal of radioactive wastes. There are a variety of competing influences and most stakeholders have strong and divergent views on the subject. At the fundamental level, hazard decreases with time for most waste. However, estimated risk generally increases with time due to degradation of engineered waste forms and disposal systems and delay during transport through the natural environmental to potential receptors. On the other hand, the value of information from the technical analyses is perceived to decrease due to increasing uncertainties. This leads to the fundamental question: How long is too long?

The approach selected has to provide protection of public health and safety without introducing unnecessary regulatory burden. In proposing revision to the regulatory requirements for the near-surface disposal of low-level waste, the NRC performed an extensive evaluation of the domestic and international experience on analyses timeframes, including but not limited to the technical factors (e.g. characteristics of the source term), socioeconomic considerations, and uncertainties. NRC's efforts to develop an approach to analysis timeframes for the near-surface disposal of radioactive waste are summarized.

INTRODUCTION

The regulations for the near surface disposal of low-level radioactive waste (LLW) in the United States (10 CFR Part 61 – "Part 61") were developed in the early 1980's because early disposal sites had numerous widely publicized performance issues, and Congress was concerned about the costs of future remediation. Many of the early performance issues were due to instability as a result of inadequate site characterization or inappropriate disposal practices. The regulatory approach adopted by the U.S. Nuclear Regulatory Commission (NRC or Commission) was a combination of performance-based objectives that are demonstrated through various technical analyses and more prescriptive technical requirements.

The primary component of the regulations is the set of performance objectives. In essence, the performance objectives represent principles for near surface waste disposal and include protection of the public from releases of radioactivity (10 CFR 61.41), protection of individuals who may unknowingly be exposed to radioactivity from the waste while on the disposal site following closure (10 CFR 61.42), protection of individuals during operations (10 CFR 61.43), and site stability (10 CFR 61.44). Part 61 requires these performance objectives be demonstrated with corresponding analyses that are specified in 10 CFR 61.13. The analyses vary from site-specific, performance-based analyses such as are used to demonstrate protection of the public from releases of radioactivity to analyses that rely upon compliance with more prescriptive technical requirements such as are used to demonstrate protection of inadvertent intruders.

The more prescriptive technical requirements of Part 61 include siting requirements, a waste classification system, intruder barrier requirements, and waste characteristic limitations, among other requirements. These requirements were developed through extensive interaction with stakeholders supplemented with regulatory analysis using tools that were available at the time (early 1980's). The regulatory analysis relied upon certain assumptions. Those assumptions included what materials were likely to be disposed of as LLW (i.e. volume, radiological characteristics) and the common disposal practices at the time. Therefore, some of the requirements in Part 61 are "hard wired" to the assumptions built into the regulation.

The waste classification system was developed to provide protection to individuals who may unknowingly be exposed to radioactivity from the waste while on a disposal site in the future after the site has closed. The waste classification system is used instead of long-term institutional controls because it was believed that active controls of a site could not be assured indefinitely and that even if they could they would be expensive to maintain. The waste classification system resulted in four classes of waste (A, B, C, and Greater than Class C). Unlike some international systems that have since been developed, the US system does not make different classes based on half-lives. Instead, both long- and short-lived radionuclides can be present in any of the classes with concentrations being the primary determinant of the proper waste class.

Recently, two issues came to the attention of the Commission: disposal of large quantities of long-lived waste as LLW (i.e., depleted uranium) and blending of different waste classes. Each of these issues challenge the "hard-wired" assumptions built into the prescriptive regulatory requirements. One of those assumptions was that future waste streams would not be significantly different from a radiological or risk perspective from what was initially considered in the 1982 regulation. This assumption resulted in 61.55(a)(6): That isotopes found in LLW that aren't listed in the waste classification tables in the regulation (Table 1 and Table 2) are by default Class A waste. This assumption is only valid if new waste streams are radiologically similar to the originally considered waste streams.

The Commission recognized these issues, and directed the staff to evaluate them and see if changes to Part 61 were necessary. The staff determined that changes were necessary, and considered a variety of options. These options included adding new isotopes to the waste classification tables or relying or site-specific technical analyses. The staff preferred the site-specific technical analyses because the analyses could represent the actual site conditions, waste characteristics, and other features and therefore be more representative of expected risks. In a 2009 staff requirements memorandum (SRM), SECY-08-0147, "Response to Commission Order CLI-05-20 Regarding Depleted Uranium," the Commission directed the staff to perform a limited revision to 10 CFR Part 61 to specify an explicit requirement for a site-specific analysis or performance assessment for the disposal of depleted uranium and other long-lived isotopes in a near-surface disposal facility [2]. The SRM also provided that the staff develop the technical requirements for such an analysis. The fundamental questions the staff considered which led to the consideration of analyses timeframes were:

1) Should the requirements apply only to depleted uranium?
2) What other specifications would be needed for the analyses?

Depleted uranium is somewhat unique in that it becomes more hazardous with time. In production of the depleted uranium most of the daughter products of the uranium series decay chains are removed, leaving a relatively pure uranium waste stream. Over time, the daughter products (e.g. Rn-222, Pb-210, Ra-226, Th-230) are produced by radioactive decay until equilibrium is once again reached after one million years. Depleted uranium became an issue for LLW disposal and the Part 61 regulations because this new waste stream was not anticipated when the original regulations were developed. Making a change to the regulations for depleted uranium would solve the depleted uranium problem, but would not solve the more general issue of what should be done for new waste streams. Therefore the answer to the first question was the requirements should not be limited to depleted uranium but should be more generic if possible. Rulemaking can be expensive and time-consuming, therefore an attempt was made to develop requirements that would apply to any new waste stream and obviate the need for future changes to the regulation.

While the increase in hazard of the source term for depleted uranium is somewhat unique, the long-lived characteristic of depleted uranium is not unique. All commercial LLW can contain long-lived isotopes. The current regulation does not require a timeframe for the site-specific, performance-based technical analysis. The four commercial LLW disposal facilities operating in the US are all located in Agreement States. The Agreement States all interpreted the analysis requirement differently resulting in timeframes analyzed that range from 500 years to 50,000 years for use in licensing analysis.

A timeframe is not specified in the current regulation because the general view at the time the regulation was developed was that low-level waste would be dominated by short-lived activity and that protection would be afforded for as long as the waste presented a hazard. In developing the regulation, the staff performed analyses out to 10,000 years to inform the specification of regulatory requirements including limits on long-lived isotopes [3]. If the long-lived activity is appropriately limited, a long-term site-specific analysis is not necessary because the peak radiological impact will have been captured.

Because of the ambiguity and potential for disposal of long-lived waste that exceeds what was considered during the development of Part 61, the staff sought feedback on analysis timeframes from many stakeholders over the past five years. Those stakeholders were in agreement that the analyses timeframes should be specified in future regulations because of the ambiguity of the current regulatory requirements and the potential for disposal of waste that was not analyzed during the development of the current regulation. Therefore, in addition to other less controversial changes the staff proposed to define the analyses timeframes in the regulation.

DISCUSSION

Is LLW inherently safe over the long-term (e.g. thousands of years in the future)? Yes and no. It *can* be but it doesn't *have* to be. Most of the radioactivity in low-level waste is dominated by short-lived activity. However, all of the currently operating LLW disposal facilities contain long-lived waste in sufficient quantities to potentially challenge compliance with the performance objectives. The intruder protection performance objective (10 CFR 61.42) and the associated waste classification system were developed to manage the short-lived risk to an individual who is on the disposal site following closure. However, most of the radiological doses estimated to a member of the public from releases of radioactivity from the disposal facility result from the remaining long-lived isotopes after the short-lived activity has decayed either prior to reaching the facility boundary or within the environment during transport beyond the facility boundary. Many stakeholders misinterpret the reduction of the short-lived hazard through radiological decay as indicative of the reduction of overall risk. Because of protection afforded by robust engineered and natural barriers, the waste disposal system properly isolates the vast majority of the radioactivity and any potential radiological releases are delayed for hundreds or thousands of years or longer.

Figure 1 provides the amount of reduction required by the engineered and natural systems to result in a 0.25 mSv/yr (25 mrem/yr) radiological dose to a member of the public for four commercial low-level waste disposal facilities (three operating and one closed). This type of comparison removes the time component. It also eliminates the incomplete look at narrow waste stream types over short durations. Figure 1 illustrates that the disposed waste is not inherently safe. In some cases large reductions by the various systems are needed in order to provide protection of public health and safety. For long-lived isotopes, especially those in large quantities and concentrations, the engineered barriers may not be effective in providing the reductions or the necessary barriers may be prohibitively expensive to implement.

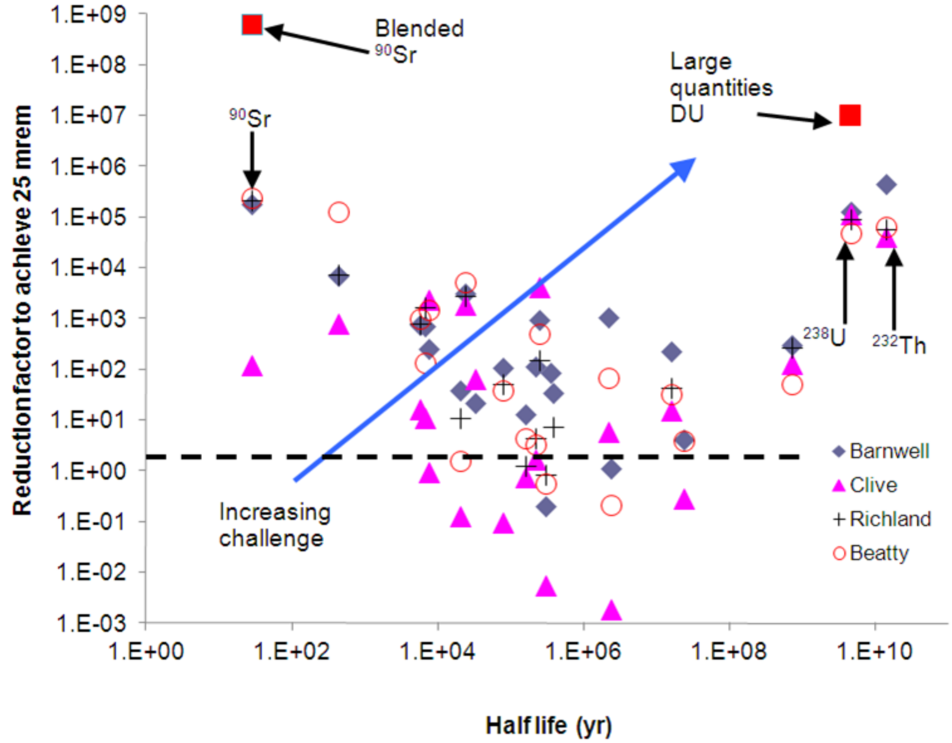
So how is protection afforded? In the radioactive waste field, a parsimonious approach to providing protection is to increase the distance between the waste and the members of the public. An isolated site in a sparsely-populated area is a great start. However, the interaction of humans with their environment is very dynamic over long timescales. Because an area is sparsely populated today does not guarantee it will remain sparsely populated in the distant future. Therefore, waste management and isolation (distance) are provided by increasing depth for long-lived waste. Figure 2 is a conceptual figure from IAEA showing the relationship between different waste classes and disposal concepts [4]. As the material becomes more difficult to manage, increasing depth of disposal is used to decrease the uncertainties and mitigate the risk. In the US, the waste classification system is not as refined as that shown here from the IAEA presenting a challenge for the management of radioactive waste. “LLW” in the US can be radiologically similar to all of these different classifications developed by the IAEA, depending on the source of the waste.

How is the necessary depth of disposal determined? Depth of disposal is determined considering technical, socioeconomic, and policy factors. International experience and advice from various technical agencies provides a diverse set of information to consider. The determination of disposal depth is set by policy then technical analysis is applied. The majority of these programs and organizations place some type of limit on the disposal of long-lived waste in the near surface irrespective of technical analyses, and many of these programs and organizations apply multiple limits (i.e., defense-in-depth). In other words, safety decisions are informed by, but not solely determined by, technical analyses. The most common types of limits are concentration and quantity limits specified before performing site-specific analyses, and limits by a combination of either disposal concept (e.g., near-surface disposal is prohibited) or requiring “long”[1] analyses.

Some programs and organizations (e.g. Switzerland, Germany) prohibit near-surface disposal of radioactive waste [5],[6]. These programs and organizations are mitigating the uncertainties of the near surface by prohibiting disposal. In their view, the increased cost of other methods of disposal compared to near-surface disposal is warranted. This approach avoids the problem of uncertainty associated with the long-term analysis of the near surface environment. Many countries develop concentration limits for long-lived waste or long-lived alpha-emitting waste that are used to determine when LLW may be considered for disposal in the near surface or when intermediate depth or deep-geologic disposal is required. The concentration limits for long-lived alpha range from around $1x10^7$ Becquerel (Bq)/kilogram (kg) to orders of magnitude lower, with higher concentrations having additional restrictions on disposal. Many are on the order of $1x10^6$ Bq/kg. Concentrated depleted uranium at disposal has a specific activity of approximately $1x10^7$ Bq/kg. With higher activity of U-234, the concentrations could be approximately $1x10^8$ Bq/kg. After in-growth of daughters, the concentrations are approximately

[1] In this context, “long” is defined as 10,000 years or longer.

(a)



(b)

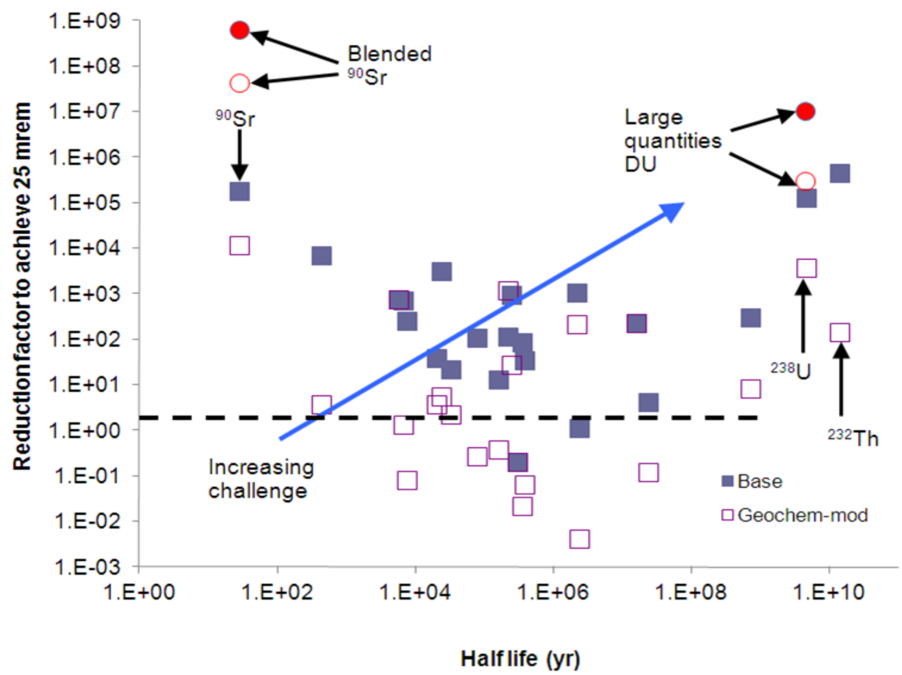
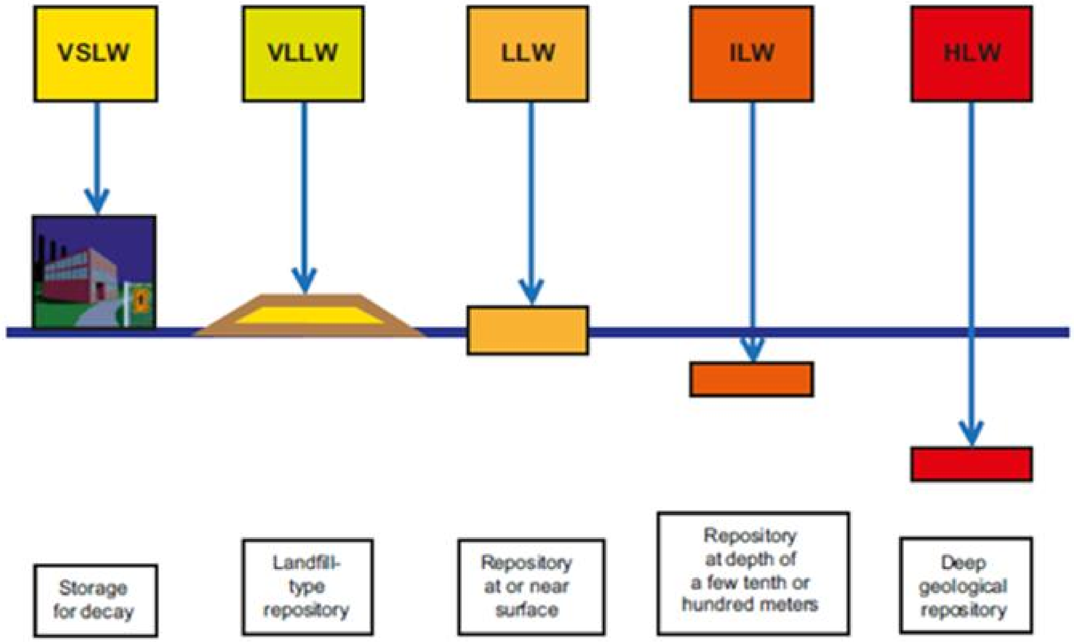


Fig. 2 (a) The Relative Performance Needed to Achieve 0.25 mSv (25 mrem) Total Effective Dose Equivalent Based on the Waste Inventory Disposed of at Four Different LLW Facilities; (b) The Relative Performance in (a) Modified by the Geochemistry (e.g., Solubilities).



VSLW = very short-lived waste, VLLW = very low-level waste, LLW = low-level waste
ILW = intermediate-level waste, HLW = high-level waste.

Fig. 2 General Relationship Between Waste Classification and Disposal Concept (from IAEA).

1×10^9 Bq/kg. Currently, Part 61 places limits on the concentrations of transuranic long-lived waste that are suitable for disposal in the near-surface environment (3.7×10^6 Bq/kg). Establishing concentration limits for long-lived waste can mitigate the uncertainty associated with long-term analyses, while providing protection of public health and safety in a parsimonious approach.

Even when concentration limits are applied, technical analysis in some form is used to help inform safety decisions. A variety of programs use technical analyses to determine the suitability of material for disposal. The approaches vary considerably, but the majority require analysis consistent with the persistence of the hazard [7],[8]. Though the validity of long-term calculations is questioned in some international agency documents, most regulatory programs do not seem to follow this advice and, instead, require long-term information to inform regulatory decision-making.

If analyses are used, what should be the timeframe? The analysis timeframe is one of the important elements of the technical analyses. The analysis timeframe influences what information must be provided to demonstrate compliance with the Subpart C performance objectives in 10 CFR Part 61. In general, a longer analysis timeframe results in the consideration of more features, events, and processes. In addition, it can be more technically challenging to demonstrate compliance for a longer analysis timeframe, compared to a shorter value, if radiological risk persists well into the future. Selection of analysis timeframes for a LLW disposal facility is a contentious issue, extending back to as early as 1995. In the US, stakeholders continue to have strong opinions on the subject. When specifying an analysis timeframe for a radioactive waste disposal facility, technical factors (e.g., the characteristics and persistence of the radiological hazard attributed to the waste), socioeconomic factors (e.g., transgenerational equity), and policy factors need to be considered [9], [10]. The staff considered these factors when developing an approach for the proposed regulation.

At a high-level, policymakers are trying to balance their perceptions of the factors depicted in Figure 3 below. Uncertainty is perceived to increase with time. Uncertainty is believed to decrease with disposal depth. Facility costs are known to increase with disposal depth, at least when moving from near surface disposal to deep geologic disposal. The final component is the regulatory burden or cost associated with analysis timeframes. Costs are perceived to increase substantially with longer analyses. Sometimes perceptions and reality can differ, namely:

- It is not uncommon in long-term performance assessments to project higher uncertainty at earlier times in the calculations, which contradicts perceptions. This is because releases of small amounts of high-specific activity materials can cause large doses and those releases can be driven by variability in temporal processes (e.g. distribution coefficients, probability of early failure of engineered barriers). However, this result decreases the confidence of some stakeholders in the analysis results because it is not anticipated.
- The increases in cost of the regulatory requirement associated with the analysis timeframe can in some cases differ substantially from perception (perception shown with solid line in 3(c)). Costs should increase if 1) the problem is more complex, and 2) the risks are larger and more challenging to mitigate. But the length of the analysis timeframe by itself does not increase costs significantly. This conclusion was developed by querying practitioners who have completed both short- and long-term analyses (shown by the dashed line).

If the risk is low, the cost of the analysis should be low *regardless* of the timeframe. However, if the risk is large and the site is dynamic or has stability issues, then the costs of the analysis, review, and approval will most definitely increase. In a risk-informed framework, costs should increase if risks increase. And if risks are projected to increase, cost increases should not be limited by truncating the analyses unless justified by socioeconomic and policy factors. However, the cost of the analysis is not estimated to be significant on a relative basis when compared to even basic disposal facility post-closure maintenance costs [11].

The cost of the analysis is primarily determined by three factors: 1) risk, 2) complexity, and 3) quality. Many of the costs associated with the analyses are fixed regardless of timeframes, especially for quality. Development of a site conceptual model, characterizing the site to develop site-specific data, building a computational model to describe waste release and transport through the environment – all of these tasks are necessary regardless of the timeframe analyzed. The additional cost associated with longer timeframes comes into play when the hazard is long-lived and the site is complex or dynamic, therefore the potential for risk remains. For example, an erosion control design may be used to mitigate erosion at a waste disposal facility located in an erosive environment for hundreds to a thousand years, but the geomorphological models may not be developed enough to support the justification of performance after this timeframe. In this example, the costs associated with developing the science and engineering for extended timeframes could be significant. However, a simple and cost-effective way to manage this uncertainty could be to limit the inventory.

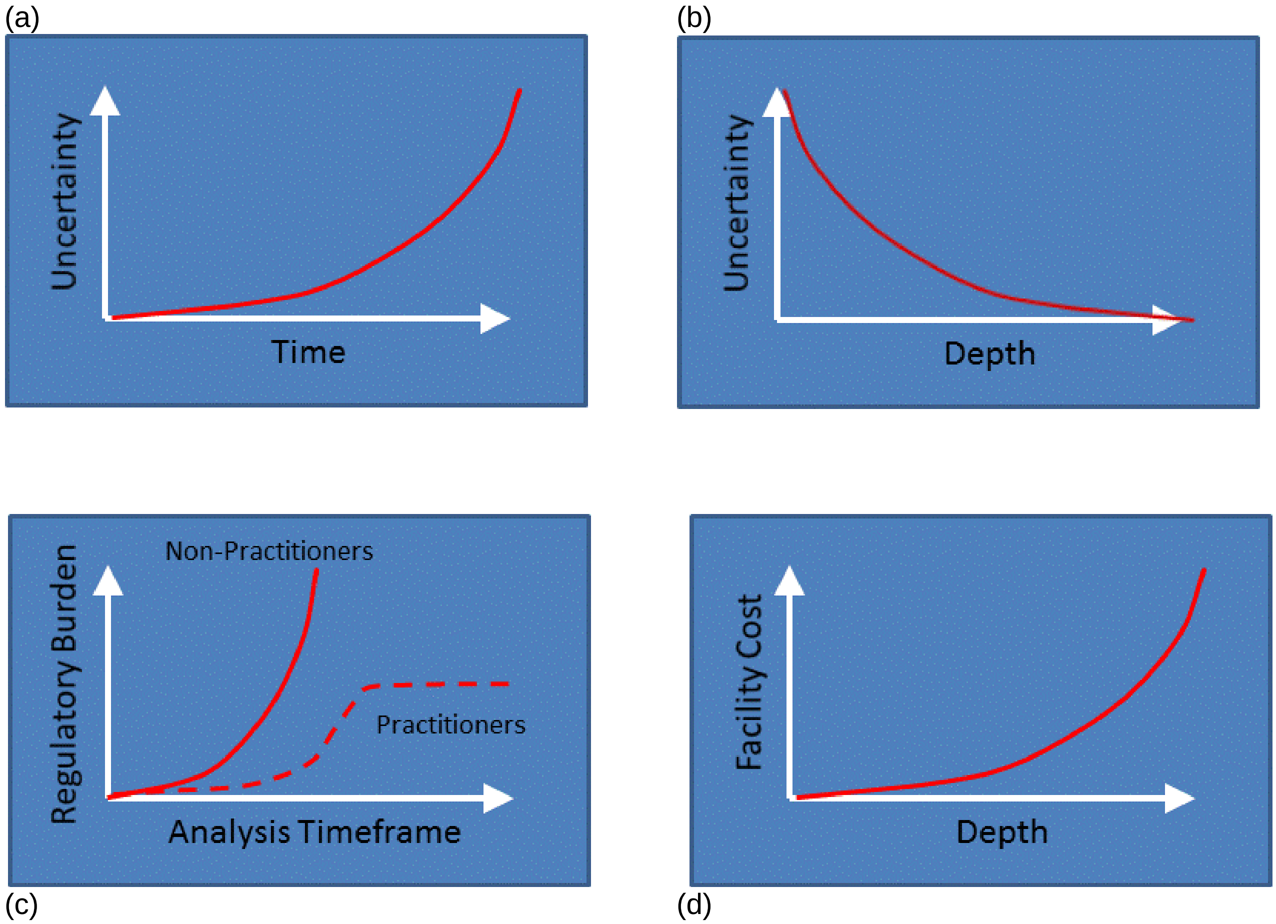


Fig. 3 Conceptual Decision Variables For Development of Analysis Timeframes.

As conceptualized in Figure 3(c), the regulatory burden associated with extended timeframes does not increase substantially until much later than perceived by many stakeholders. For a uniform level of quality and the same inventory, the burden does not increase until near-surface geomorphic processes (e.g. glaciation at a Northern site, ~ 10,000 years or longer) or longer-term geologic processes (~ 100,000 years or longer) become significant. Then at very long-times the burden plateaus because at very long-times there is very little information to justify and support simulated conditions, and it is impractical to develop the information in many cases. However, physical scientists use natural analogs in many fields and they can be used to develop valuable insights in the behavior of natural systems over very long periods of time.

What is done domestically? Table I summarizes the approaches to analysis timeframe used in a variety of waste disposal or remediation programs in the US. There are a variety of approaches used for analysis timeframes within the US, and even within the NRC. A number of stakeholders have the misconception that because “waste”, radioactive or not, is involved that the approaches should be identical. However, the purpose of the decision is critical. A decision regarding remediation of existing radioactivity is fundamentally different from a decision regarding the planned disposal of radioactive waste. In remediation, a past decision has already been made that cannot be reversed resulting in an impact that must be mitigated. The risk from remediation (e.g. to workers, public from transportation, public from disposal at a new site) must not exceed the risk from no-action to justify the action. For a disposal, the decision is focused on planned placements of radioactivity in the future. The goal of disposal decisions made today should, in part, be to avoid becoming a remediation decision tomorrow. Therefore the standards for remediation vs. disposal should be and commonly are different.

With respect to the near-surface disposal of large quantities of depleted uranium that initiated the NRC's Part 61 rulemaking effort, some stakeholders have argued that because NRC has a 200 year minimum (to 1,000 year goal) standard under 10 CFR Part 40 for uranium mill tailings, the NRC should adopt a similar standard for disposal. Purveyors of this inaccurate comparison rely upon the false notion that both depleted uranium and uranium mill tailings pose equivalent risk profiles because they are both waste and contain uranium. The mill tailings in the US are approximately 400-500 times less concentrated in uranium than the large quantities of depleted uranium being considered for disposal. Further uranium the mill tailings have most of the daughter products present in the waste stream at the time of disposal, whereas, depleted uranium as discussed earlier, has almost no daughter products present at the time of disposal. In addition, the 10 CFR Part 40 regulations were developed in response to large problems caused by improper management of uranium mill tailings. Even though material is disposed, the problem is most similar to a remediation problem and in no manner is the risk from the disposal of mill tailings comparable to the risk from disposal of depleted uranium. Even in Germany, where all low-level waste is to be disposed in a mined cavity, an exception was made for uranium mill tailings.

Some stakeholders have made the argument that the timeframe for analysis for LLW disposal should be the same as remediation under 10 CFR Part 20. A site decommissioned under 10 CFR Part 20 uses a 1,000-year compliance period. Unrestricted release analysis assumes the residual radioactivity following cleanup at the remediated site is potentially contacted immediately upon release of the site. Likewise, the residual radioactivity is already in the environmental media (i.e., soil, water). There are usually no engineered barriers and limited delays from the natural system in unrestricted release decommissioning analyses. In the vast majority of analyses, the peak risk for unrestricted release occurs during the 1,000-year compliance period and, in most cases, in the first year of release. Essentially, the delays that are accounted for in the LLW disposal analyses are eliminated or greatly reduced in the site decommissioning analyses.

There are four operating commercial low-level waste disposal facilities in the US. Three of the four have used (or currently are reviewing) analyses of 10,000 years or longer to demonstrate compliance with the performance objectives in 10 CFR Part 61. These analyses that have undergone review by the pertinent regulators have withstood legal challenge. Some stakeholders have stated that a 10,000 year or longer compliance period would prohibit licensing; the experience base suggests this statement is false.

In addition, in the 1990's the staff of the NRC performed a detailed analyses to look at the compliance period for LLW disposal using computer simulations at a generic waste disposal site using representative inventory data [12]. The staff concluded that a 10,000 year compliance period was necessary for traditional commercial LLW to demonstrate the performance of the site (e.g. natural features) with respect to mobile, long-lived radionuclides.

Table I. Approaches to Analysis Timeframes for Various Waste Disposal and Management Programs

MATERIAL	HAZARD	DURATION	ACTION	TIMEFRAME REQUIREMENT	BASIS[1]
EPA RCRA	Chem	∞[2]	Disposal	30+ yrs	Nontechnical
Uranium Mill Tailings	Rad	LL	Remediate	200 yrs (<1,000 yrs)	Nontechnical
Part 20 unrestricted release	Rad	SL-LL	Remediate	1,000 yrs	Technical
DOE Order 435.1	Rad	SL-LL	Disposal	1,000 yrs	Nontechnical
LLW Disposal Facility (Part 61)	Rad	SL-LL	Disposal	[10,000 yrs][3]	Technical
EPA Underground Injection	Chem	∞	Disposal	10,000 yrs	Technical
DOE WIR	Rad	SL-LL	Remediate	DOE: 1,000 yrs[4] NRC: 10,000 yrs	Technical
DOE Siting Guideline (10 CFR 960)	Rad	LL	Disposal	100,000 yrs	Technical
EPA HLW/SNF/TRU Generic Standards	Rad	LL	Disposal	10,000 yrs	Technical
EPA HLW/SNF Site-Specific Standards	Rad	LL	Disposal	10,000 yrs–15 mrem 1,000,000 yrs–100 mrem	Technical

1 Bases given a "technical" description are those derived primarily considering the characteristics of the waste and the attendant disposal concept. Those given a "nontechnical" description as based on policy or socioeconomic considerations.

2 Some chemical waste, and even some metals, will degrade in the environment.

3 This is the value recommended in NUREG-1573 by the Performance Assessment Working Group.

4 DOE has evaluated 10,000 years, and in some cases longer, in waste determinations completed since 2005.

What is the Right Amount of Time? If an approach informed by site-specific technical analysis is used to manage the risks from the near-surface disposal of LLW, what should be the duration of the analysis? As discussed previously, the overwhelming majority of international programs either require a long-term analyses or place restrictions or prohibitions on the disposal of long-lived radioactive waste in the near-surface environment. If a material is not suitable for disposal as low-level waste it can be disposed of in other waste management systems. The uncertainties associated with the long-term, near-surface environment are appropriately managed with this approach.

The regulatory agency must make a safety decision. As with any decision, uncertainty can impact a safety decision. Some stakeholders view the uncertainty associated with long timeframes as special or different, but it is fundamentally no different than the epistemic and aleatory uncertainty associated with estimating the failure of an active engineered system for a reactor. The safety decisions may be different but the uncertainty is not. A safety decision on short-term risk is likely to have active mitigation possible to reduce the consequences or decrease the probability. In addition, research may be completed that can validate a model used for a short-term engineered system, whereas long-term performance assessments cannot be validated in the traditional sense. However they must be supported with multiple lines of evidence such that a qualified individual could conclude that the analysis represents a reasonable estimate of the system performance.

The purpose of completing a performance assessment of an LLW facility is to ensure that public health and safety is protected to prescribed limits with an acceptable degree of confidence. In the NRC's terminology, that degree of confidence is described as reasonable assurance. The results of compliance analysis are not to be interpreted as unequivocal numerical proof of the expected behavior of a waste disposal facility because of the uncertainties associated with the time periods involved. However, that information has been and can continue to be used for regulatory safety decisions. The primary issue becomes a value of information issue. Uncertainty must be considered in a decision, but it should not be used as the basis for a safety decision. Uncertainty can prevent someone from making a safety decision but the presence of excess uncertainty does not ensure safety, it only clouds the ability to determine safety. The decision regarding analysis timeframes then becomes a technically-informed, socioeconomic policy decision.

Many programs have a policy position that future generations should be afforded the same level of protection as afforded the present generation. A few programs (e.g., IAEA), also go on to state that for extended timeframes the value of information may become meaningless. These same programs state that public health and safety must be protected for as long as the material remains hazardous. It may appear contradictory to require technical analyses of long-term protection, but then also consider that information meaningless. The missing link between the two previous statements is the use of a waste classification system or inventory limits. In order to be protective, the waste classification system or inventory limits cannot be limited to analyses using a truncated analyses timeframe; the analyses must be based on peak hazard or risk from all relevant release processes and pathways.

The authors do not believe the information expressed in the results of long-term performance assessments is meaningless or of little value. The results should be from high-quality analyses with adequate model support. But the information has value in understanding:

- If the waste is low risk, moderate risk, or high risk,
- How the system will perform given the state of current knowledge,

- The relative performance of engineered and natural barriers,
- The relative impacts of different design changes, and
- If inventory limits may be necessary to mitigate long-term risks and associated uncertainties.

In addition, the staff does not believe that excess uncertainty is a sufficient justification to be more permissive in terms of permitting risks to public health and safety. The current generation has the obligation to manage its waste since it derives the benefit from producing those wastes. For these reasons, the staff proposed two- and three-tier analysis timeframe systems that don't truncate information, but attempt to scale the regulatory limits with the change in the value of information caused by the changes in uncertainty [7],[8].

NRC Policy: This section to be completed or removed pending the Commission's development of the Staff Requirements Memorandum on the proposed Part 61 rulemaking package.

CONCLUSIONS

Development of an approach to analyses timeframes for the near-surface disposal of LLW is a complex issue with many variables. Diverse and strong opinions among stakeholders are the norm, not the exception. The staff performed extensive analysis to develop an approach to recommend to the Commission. The analysis considered technical factors (e.g. source term and hazard, radionuclide transport), domestic and international experience, socioeconomic factors, and uncertainty. The staff proposed two- and three-tier analysis timeframe systems that don't truncate information, but attempt to scale the regulatory limits with the change in the value of information caused by the changes in uncertainty. The staff considered the results of long-term performance assessments useful in the regulatory decision making process.

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