The risk posed by potential security threats and safety issues at storage sites and during transportation is generally considered low. Whether this risk is acceptable, however, is subjective, and opinions vary widely. What benefits to consolidated storage, related transportation, or even upgrades at current sites (which could involve significant handling of fuel) would make changes to the *status quo* worthwhile?

Transportation risk analysis methodologies became somewhat formalized with the development of NUREG-0170, "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes", in December 1977. As part of this work, the transportation risk assessment code, RADTRAN, was also developed. Transportation risks in this study were estimated at the dawn of the computer age, with relatively limited accident data, crude routing models, and limited experimental data. As such, conservative assumptions needed to be made at discrete steps along the analytic path that resulted in upper-bound estimates with generally agreed large conservatisms.

Since 1977, studies have been conducted to refine the estimates in NUREG-0170 as computer capabilities have increased, Federal accident databases and routing models have become more sophisticated, and experiments have been conducted assessing package responses to severe loading environments. Two studies of note are NUREG/CR-4829 (referred to as the Modal Study, 1987) and NUREG/CR-6672 ("Re-examination of Spent Fuel Shipment Risk Assessments", 2000). Over these 23 years, transportation risk estimates for accident conditions have been reduced by orders of magnitude from the NUREG-0170 estimates. This result validates the adequacy of the regulations and provides much more realistic assessment of accident risks. As part of their continual assessment of the adequacy of the regulations, the NRC is near completion of a study that up-dates the work in NUREG/CR-6672.

One of the early formal estimates of security consequences (as opposed to safety) was published by the NRC in 1980 (referred to as the Urban Study, NUREG/CR-0743) that looked at a malevolent attack on a truck transport in a densely populated urban environment. This study built on earlier work that included large conservatisms, much like the early work estimating transportation safety risk. Because of the variability in results, the NRC and DOE have both sponsored experimental work to develop a better understanding of release mechanisms and subsequent dispersal. Following 9/11, the NRC sponsored extensive studies of different types of malevolent attacks on storage and transportation casks. These studies have been reviewed by the National Academies of Science and provided much of the technical basis for the NRC to review protection strategies. Unlike the safety risk assessments, much of the data and results from the security risk assessments are classified, which limits the ability to engage the public in discussing protective measures.

Given the improvement of analytic capabilities, growth in the experimental database, an excellent safety record in transportation operations over the last several decades, as well as the evolution in terrorist threats, several observations can be stated:

- Transportation of spent nuclear fuel is safe.
- The robust nature of spent fuel casks (storage and transport) acts to mitigate potential consequences from a terrorist attack. This is corroborated by the GAO study, "Spent Nuclear Fuel – Options Exist to Further Enhance Security", GAO-03-426, July 2003.
- Lack of openness with security assessments can inhibit public acceptance of spent fuel transport and storage.

Given this background, it is difficult to propose specific recommendations to improve security. Based on comprehensive assessments coupled with security up-grades as warranted, the NRC has a functional process to assess operational practices to be sure that the storage and transportation of used fuel is safe, secure, and compliant with the regulations. In principal, we can always

attempt to do more, but this leads to a do-loop mentality that presupposes that what is provided is never good enough. Issues associated with consolidated storage, removal of used fuel from orphaned sites, and security up-grades at existing sites are all worthy of careful consideration. However, they should be evaluated from a systems context in which a full range of risks and benefits are addressed.