ACCIDENT SEQUENCE PRECURSOR PROGRAM

Comments by Tom Murley

ASP continues to be an excellent program for analyzing U.S. nuclear plant operating events. Furthermore, the analysis tools and methods are at a high level of sophistication and they continue to improve.

The robustness of the ASP results rests on the assumption that all, or nearly all, of the significant operating events and conditions in the U.S. are reported and analyzed. I believe that is the case. Therefore, I believe the ASP data are robust for analyzing the risk to U.S. nuclear plants posed by operating events that are internal to the plants.

The ASP analysis obviously does not account for potential core damage accident sequences caused by rare external events that have not occurred at U.S. plants, such as massive beyond design basis earthquakes and tsunamis, record hurricanes and flooding, comet strikes or any number of other imaginable Black Swan events. The risks posed by these rare events are not able to be reliably quantified, but they must be added to the inferred risks from ASP results for internal plant events, in order to have a more complete picture of nuclear risks.

What is missing from the ASP report are some high level conclusions on what the data all mean for the safety level of U.S. nuclear plants. For example, the ASP results showing no statistically significant trend in all precursors over the past ten years suggest that the safety level of U.S. reactors (considering only internal plant events) has reached a plateau. The results further suggest that the fleet average CDF (internal events) for all U.S. plants is about 10E-5 per reactor-year or less. This result is consistent with industry PRA analyses and SPAR analyses.

Assuming these industry and NRC CDF estimates are robust, they show <u>with high confidence</u> that the mean CDF for internal events for all U.S. plants is 10E-4 per reactor-year or less. This, in turn, would mean that for a fleet of 100 nuclear plants the mean time interval between core damage accidents in the U.S. from internal plant events is 100 years or longer. I believe this conclusion gives a reasonable level of assurance of adequate protection of U.S. public health and safety against internal nuclear plant events.

This conclusion is obviously incomplete because it does not consider the risks from rare external events. That does not mean that U.S. nuclear plants are not protected from rare external events. On the contrary, NRC has always required protection against external events, and the added protection required as a result of the N. Anna earthquake and the Fukushima earthquake and tsunami are examples of the continuing protection against external events required by NRC.

In summary, I believe the ASP results for internal nuclear plant events and the qualitative assurance of NRC requirements for protection against external events offer reasonable assurance of adequate protection of U.S. public health and safety.

Comments on ASP SECY Papers

1. From 2009, ". . . 31 per cent of the identified precursors involved event initiators or failure modes that were not explicitly modeled in the PRA or IPE for the specific plant where the precursor occurred."

   This only confirms what we already know – namely, that PRA is not a complete picture of safety risk for a plant.

2. From 2014, "Using ASP results to estimate CDF is challenging . . . . "

   We should probably give up trying to estimate CDF from ASP data and instead consider the ASP Index as a Safety Indicator in its own right. It is a far better direct indicator of safety than other secondary indicators, such as Unplanned Scrams, Safety System Failures, Integrated Personnel Dose, etc. that are routinely published by industry and repeated by NRC

3. From 2014, "The integrated ASP index . . . cannot be used for direct trending purposes because the discovery of precursors involving longer-term degraded conditions in futures years may change the cumulative risk from previous years."

   While this is true in a strict mathematical sense it should not be used as an excuse for not drawing useful inferences for the ASP Index trends. After all, this paper confidently states a statistically significant trend in 10E-4 precursors, but those data for 10E-4 precursors may also be changed because of discoveries in future years. There is no fundamental difference between the ASP Index and the group of 10E-4 precursors that would allow trending of one index and not the other.

I repeat my suggestion that NRC publish the "ASP Index Safety Indicator" as the best direct indicator of internal plant safety performance for the fleet of U.S. plants. There need be no apologies for publishing trends in the "ASP Index Safety Indicator" and drawing inferences from those trends. (This is done routinely for the Unplanned Scrams performance indicator, which is at best a second order safety indicator.) There is no need to try to tie the ASP Index to CDF estimates because the "ASP Index Safety Indicator" could stand by itself.