Pros and Cons for Each Conceptual Type of the Fuel Cycle Significance Determination Process

The NRC staff considered three conceptual types for a fuel cycle significance determination process (FCSDP): qualitative, case-by-case, and probabilistic risk assessment (PRA)-based. The FCSDP must be realistic/accurate, practicable, cost effective, and consistent. The staff evaluated the pros and cons of each FCSDP type based on these considerations. The pros and cons for each type are presented below.

Qualitative Type

This type of evaluation would be based on qualitative criteria, not actual numerical risk quantification, but with similar risk and safety significance objectives as the case-by-case and PRA-based types. This process would be based on an evaluation of the deficient condition with respect to duration, the reduced number and quality of controls, and the potential consequences. Staff envisions that a refined risk-index method as in NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," would be part of this approach along with consideration of licensees' Integrated Safety Analyses (ISAs).

Pros: Simpler and less resource intensive than the case-by-case and PRA-based types.

Recognizes the limitations on quantitative data and tools available and applicable to the fuel cycle industry.

Assignment of controls to general categories would be more objective than justifying assignment of generic failure data to plant-specific controls.

The significance evaluation would be more predictable and consistent across licensees and types of deficiencies.

Cons: This type would be the least realistic and precise of the three approaches to be considered. However, since the FCSDP consists of four levels of significance, an order-of-magnitude ranking is sufficient.

Case-By-Case Type

As described in the ISA/PRA comparison paper, this type of evaluation would be performed on a case-by-case basis and be informed by the ISA. These evaluations would be performed by the U.S. Nuclear Regulatory Commission (NRC) staff, with information from licensees, and would evaluate the safety significance of each inspection finding when it occurs. The conservatisms in the ISA results would be adjusted using standardized NRC guidance and data as needed. The staff considers that this type would be a simplified quantitative method.

Pros: The significance evaluation would not be as realistic as the PRA-based type evaluation, but would provide sufficiently realistic results (i.e., order-of-magnitude) for determining the significance of inspection findings. The validity of the evaluations would be established during testing of the method developed.

The significance evaluation would be consistent across licensees and types of deficiencies.

Less resource intensive than the PRA-based type since analysis is done on a case-by-case basis.

Generic; therefore, simpler than a plant-specific quantitative analysis as in the PRA-based type.

Cons: Quantitative risk technology for fuel cycle is not sufficiently developed to support this type.

A backup method might be required because a technical difficulty might preclude this type of evaluation being completed in a timely manner to support an ongoing oversight process.

PRA-Based Type

This type of evaluation is based on fully quantitative PRAs performed before an FCSDP process is applied. It is analogous to the significance determination process of the reactor oversight process and would require a full PRA for all processes at all facilities. This type would also require inspector notebooks, or similar guidance, for performing significance evaluations. These PRAs would have to be performed by licensees, due to the great variety of process designs and their unique and proprietary nature.

Pros: This type would be based on each licensee's PRA. Therefore, this type would be based on each licensee's best information and analysis, performed with adequate time available, and with results already available to the NRC staff when the inspection finding occurs. Thus, the significance evaluation would be based on a higher quality of risk information than the other types, and so the results should be more realistic.

Cons: Large resource expenditures for both the NRC and licensees to develop and implement because quantitative tools and data for fuel cycle PRA would have to be developed.

PRAs would not be standardized because each licensee would carry out its PRA differently. Therefore, the significance evaluations might not be consistent across licensees. NRC development of standards, tools, and data would help, but would require extensive resources and time.

Quantitative risk technology for fuel cycle is not sufficiently developed to support this type. To support this type, failure data would need development or endorsement, computer analysis capabilities for a variety of fuel cycle risk phenomena would have to be developed, and probabilistic variations in magnitudes of criticality events, chemical releases, and weather would have to be developed for fuel cycle situations.