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THE ADVANCED NEUTRON SOURCE FACILITY: SAFETY PHILOSOPHY AND STUDIES*

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The Advanced Neutron Source (ANS) is currently the only new civilian nuclear reactor facility proposed for construction in the United Sta Even though the thermal power of this research-oriented reactor is a relatively low 300 MW, the design will undoubtedly receive intense scrutiny before construction is allowed to proceed. Safety studies already under way to ensure that the maximum degree of safety is inc porated into the design and that the design is acceptable to the Dep ment of Energy (DOE) and can meet the Nuclear Regulatory Commission regulations.

The safety policy of the ANS project is to safeguard the public and meet or exceed NRC regulations and policy statements. An extensive process of analysis and documentation will be followed to prove the safety of the proposed facility. The safety analysis report, require both DOE and NRC regulations, is a complete description of the propos facility with safety analyses of all relevant aspects of the plant. Early analysis efforts have been performed in certain critical areas, the main safety analysis effort will begin when the project enters th Conceptual Design phase late in fiscal year 1989 or early fiscal year 1990.

of dependencies among systems at the facility and a quantitative assessment of the frequency of system malfunctions. Both the NRC safety goals policy and the recently proposed DOE safety objectives policy are couched in probabilistic terms, so PRA must be viewed as an essential safety analysis tool for the ANS facility. For the current generation of nuclear power plants that have recently undergone the licensing review process, PRA has been used as an analysis tool <u>after</u> completion of the plant designs. For the ANS project, the PRA effort has already begun, <u>before</u> the completion of facility design. This allows safety insights from the PRA to be incorporated into the evolving plant design. The early PRA effort has already had an impact on the pre-conceptual design in the area of loss of coolant accident (LOCA) resistance.

The safety analysis of the ANS reactor must be tailored to fit the unique design and operational features of a high flux research reactor. For example, the bulk coolant temperature at the core outlet is, by design, limited to less than 100 °C. Therefore, even a large break LOCA would not involve any flashing to steam of the primary coolant, and there would be no accompanying pressure and temperature loading on containment. This removes the need to perform containment analysis for LOCAs but does not, of course, decrease the need to perform thermal-hydraulic analysis of verify adequate heat removal within the core during the depressurization that would be initiated by a line break accident.

Severe accident phenomena of concern for a high flux research reactor hypothetical severe accidents. The mass of a research reactor core is about three orders of magnitude smaller, so the potential generation of hydrogen due to chemical reaction between cladding and coolant relatively small, as is the potential energy release of hypothetical steam explosion events. The decay heat of the ANS core after shut down is about one order of magnitude lower than that of a typical power reactor, so the dissipation of this heat within containment must be considered. The ANS project has placed a high priority of passive means of decay heat dissipation. A severe accident parameter that is of greater concern for the ANS reactor than for a large power reactor is the multiplication factor of the core debris that might result from a hypothetical severe accident. A large quantity of low enriched power reactor fuel must be held in a configuration of near-optimum moderation to achieve criticality whereas a much smaller amount of moderately or highly enriched research reactor fuel could become critical under a wider range of conditions. Scoping calculations are being performed to determine the likelihood of fuel debris re-criticality and the need for devices to prevent criticality of the severe accident debris.

Preliminary accident analyses have shown that, even for the extremely unlikely hypothetical severe accidents, the off-site consequences would be low, primarily because the ANS reactor has a rather small fission product inventory and is to be housed in a low-leakage containment building. The expected low off-site consequences from severe accidents also results from the location of the reactor fuel and a large portion of the coolant system under a deep pool of water and from the limited