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design bases for facilities for LMFBR spent fuel storage in liquid metal outside the primary coolant boundary

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Foreword

(This Foreword is not a part of American National Standard Design Bases for Facilities for LMFBR Spent Fuel Storage in Liquid Metal Outside the Primary Coolant Boundary, ANSI/ANS-54.2-1985.)

This standard provides minimum design requirements for the design of Liquid Metal Fast Breeder Reactor (LMFBR) Spent Fuel Storage Facilities, outside the primary coolant boundary, using liquid metal for decay heat transfer. It sets forth general guidelines and specific design parameters which, if used, could assist in design efforts. It does not, however, relieve the designer of the responsibility for compliance with specific construction codes referenced herein.

The guidance available for establishing radionuclide source terms from stored spent LMFBR fuel was limited at the time this standard was written. It is expected that as the industry matures information will become available which will enable more complete guidance to be provided. In the absence of such guidance the designer should use prudent engineering judgment. The designer is also reminded that U.S. Nuclear Regulatory Commission (NRC) regulatory guides exist which contain information that should be referred to in designing systems and components.

The standard was developed under sponsorship of the American Nuclear Society (ANS). This standard was developed by Working Group ANS-54.2 of the American Nuclear Society which had the participation of the following members during the period it prepared and approved the standard.

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Design Bases for Facilities for LMFBR Spent Fuel Storage in Liquid Metal Outside the Primary Coolant Boundary

1. Introduction and Scope

1.1 Purpose. Protection of the general public and operating personnel is of primary importance in design and construction of the LMFBR spent fuel handling and storage facilities. This document provides safety criteria for these facilities through establishing minimum safety-related design requirements.

It must be recognized that the facilities described in this standard are actually links in the chain of several interrelated facilities and functions; they therefore depend on and interface with other facilities and functions outside the scope of this standard. The designer is directed to take note of the several interfacing systems for the facilities described herein to assure that the conditions imposed can indeed be met by the facility being designed.

This standard is based on systems engineering criteria developed for existing liquid metal cooled reactors (both domestic and foreign), the Fast Flux Test Facility, Clinch River Breeder Reactor Plant and the Large LMFBR Conceptual Design Study sponsored by the U.S. Department of Energy.

1.2 Scope. This standard presents minimum design requirements for facilities used in storage and preparation for shipment of spent fuel (including blanket material) at LMFBR power stations. The standard contains requirements for the design of the ex-vessel storage tank (EVST), systems for decay heat transfer by liquid metal,[1] spent fuel storage racks, liquid metal make-up, instrumentation and cleanup systems, EVST structure and integrity, radiation shielding, ventilation, and filtration and radiation monitoring systems. The standard also specifies shipping cask interface requirements, including illumination, radiation monitoring, and requirements for handling and decontamination of the shipping casks. Design requirements for building structure and integrity, including requirements for ventilation, containment, and communications are also included.

[1]Sodium or NaK (a mixture of sodium and potassium).

1.3 Limits of Application. Satisfactory fuel storage facilities utilizing other cooling methods (e.g., water or gas cooling) may be designed; however, this standard does not apply to, nor does it preclude, such designs. Examination or pre-storage requirements of new fuel is beyond the scope of the standard. Criteria presented herein are not intended to preclude design improvements; it is, however, expected that departures from these criteria to accommodate new or unusual applications will be clearly identified and justified.

This standard defines the functions of LMFBR spent fuel facilities located external to the primary coolant boundary including both equipment and systems. This standard includes basic requirements and system criteria for consideration in design, construction, fabrication, surveillance, maintenance, and operation.

2. Definitions

backup system. A system of equivalent functional capability to the system it backs up which need not be the same seismic category and safety class as the system it backs up.

redundant systems. Separate systems of equivalent functional capability, with either identical or diverse operating principle, with the same seismic category and safety class.

relocatable components. A generic term meant to include items within the reactor vessel, excluding the vessel internals, which must be handled or shifted in position during, preparing for or recovering from fuel loading or refueling. Some examples are: control rods, flow limiting orifices, and shields.

Safe Shutdown Earthquake (SSE). The Safe Shutdown Earthquake (SSE) is that earthquake which is based upon an evaluation of the maximum