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American National Standard
Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)

Secretariat
American Nuclear Society

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Reporter R. Davis

1.4 Overall Design Considerations

(a) Short-lived high specific activity radionuclides, particularly those of Iodine 131 and Xenon 133 are no longer present in significant quantities in spent fuel that has aged for more than one year since discharge from the reactor core.

(b) Decay heat generation is significantly reduced in one year old spent fuel, notwithstanding this reduction in heat generation, the maximum temperature of the fuel during handling and in-storage must be limited to prevent deleterious metallurgical and chemical reactions

(c) The as-received mechanical integrity of the fuel cladding must be maintained during handling and storage

2. Definitions

The terminology defined herein will be referred to throughout the standard and use of capital letters will signify a defined term (e.g., Design Events)

canning. The placing of spent fuel in a container for purposes of confinement.

confinement. The structure, systems, or components provided for the purpose of preventing the release of radioactive particulate matter to the environs above the radiological protection limits, it may be either a physical barrier or high efficiency filtration

damaged fuel. Spent Fuel Assemblies which exhibit visible evidence of structural damage to the Fuel Rod cladding

Design Events. Design Events are occurrences which need to be considered in system and installation design They can be classified according to their expected frequency of occurrence, and when so classified, used in conjunction with objectives associated with maintenance of system capability to provide a logical and systematic approach to protection by design This standard employs four Design Event catagories which are referenced to specify system performance requirements in Section 5, ISFSI Performance Requirements.

The set of Design Events for a particular ISFSI, and the classification of each event of that set according to frequency of occurence, can be determined only upon consideration of the functional design and external envir nment unique to that ISFSI For each of the following Design Event categories, however, certain events, expected to be appropriate for a typical ISFSI, are provided as guidance for developing a site specific set of events

(1) **Design Event I.** Design Event I consists of that set of events that are expected to occur regularly or frequently in the course of normal operation of the ISFSI Examples are.

(a) Transportation Package receipt, inspection, unloading, maintenance, and loading

(b) Spent Fuel Assembly transfer from Transportation Package to Storage Area.

(c) Handling of radioactive waste generated during ISFSI operation

(d) Fuel Unit preparation

(e) Insertion of Fuel Units into or retrieval from storage structure.

(2) **Design Event II.** Design Event II consists of that set of events that, although not occurring regularly, can be expected to occur with moderate frequency or on the order of once during a calendar year of ISFSI operation. Examples are:

(a) A loss of external power supply for a limited duration

(b) A single operator error followed by proper corrective action

(c) Minor mechanical failure of spent fuel Transfer Machine during operation

(d) Failure of any single active component to perform its intended function upon demand

(e) Spurious operation of certain active components.

(f) Minor leakage from flanged piping or component connections of radioactive liquid waste handling system.

(3) **Design Event III.** Design Event III consists of that set of infrequent events that could reasonably be expected to occur during the lifetime of the ISFSI. Examples are:

(a) A loss of external power supply for an extended interval.

(b) Major mechanical malfunction involving the spent fuel Transfer Machine during operation (no loss of shielding but retrieval of fuel required)

(c) Dropping a Fuel Unit in a hot cell area

(d) Passive failure of radioactive liquid waste retaining boundary.

(e) Loss of shielding optical oils in a hot cell viewing window.

(4) **Design Event IV.** Design Event IV consists of the events that are postulated because their consequences may result in the maximum potential impact on the immediate environs Their consideration establishes a conservative design basis for certain systems with Important Confinement Features Typically this set of events will consist of plant specific design events as defined in design phenomena. Examples are.

(a) Natural phenomena

(b) Man-induced low probability

design phenomena. Those natural phenomena and man-induced low probability events for which an ISFSI is designed Subpart E of Title 10, Code of Federal Regulations, Part 72, "Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (ISFSI)" [5] or ANSI ANS 2 19 1981 [4] provide the requirement for indentification and evaluation of design basis external natural or man-induced events Subpart F of 10 CFR 72 [5] provides the general design criteria for structures, systems, and components that are Important Confinement Features

fuel rod. That portion of the Spent Fuel Assembly that contains the recoverable uranium, plutonium, and fission products These items are long, slender, cylindrical, sealed metallic tubes termed cladding, containing sintered pellets of fuel material.

fuel unit. The fundamental item to be stored in the ISFSI It can be a Spent Fuel Assembly, canned spent fuel, or consolidated fuel rods

important confinement features. Those features of the ISFSI whose function is·

(a) to maintain the conditions required to store spent fuel safely (e.g , heat removal system if provided), or

(b) to prevent damage to the spent fuel during handling and storage (e g., transportation package unloading equipment), or

(c) to provide reasonable assurance that spent fuel can be received, handled, stored, and retrieved without undue risk to the health and safety of the public Dose commitment criteria provided in American National Standard Guidance for Defining Safety-Related Features of Nuclear Fuel Cycle Facilities, ANSI N46.1-1980 [6] are available for use in determining systems, structures, and components that have Important Confinement Features with respect to public health and safety

independent spent fuel storage installation (ISFSI). A complex designed and constructed for the storage of spent fuel and other radioactive materials associated with spent fuel storage An ISFSI which is located on the site of another facility may share common utilities and services with such a facility and be physically connected with such other facility and still be considered to be independent, provided that such sharing of utilities and services or physical connections does not

(a) increase the probability or consequences of an accident or malfunction involving components, structures, or systems that are Important Confinement Features, or

(b) reduce the margin of safety as defined in the bases for any technical specifications of either facility.

lag storage. In-process surge storage of Fuel Units

limited air. The storage atmosphere which limits the inventory of oxygen such that if all the oxygen is assumed to react chemically with the fuel pellets, the Fuel Rod cladding would not be damaged

nuclear facility. Structures, buildings, and systems provided to utilize or process fissionable material: i e , nuclear power plant or reprocessing plant

shall, should, and may. "Shall" denotes a requirement "Should" denotes a recommendation "May" denotes permission, neither a requirement nor a recommendation

spent fuel assembly. A single fabricated unit of Fuel Rods (with support structures) discharged from a light water power reactor, still in the same mechanical configuration in which it was irradiated, and which meets the criteria for post-irradiation decay of this standard It contains recoverable uranium, plutonium, and fission products

storage concepts. The following definitions are based on the major characteristics of each concept, namely the predominant heat transfer path, shielding, portability, location with respect to grade, degree of independence of individual storage cells, and the storage structure.