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Integrated Data Base for 1993: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics

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electrical growth projection (and associated discharged spent-fuel schedule) used throughout this report is the 1993 DOE/EIA No New Orders Case.[11] In addition, this document also includes a set of nuclear capacity and spent-fuel projections associated with the 1993 DOE/EIA Lower Reference Case to illustrate, for planning purposes, a conservative upper bound of commercial nuclear power growth.[11] The No New Orders and Lower Reference spent-fuel and power-capacity projection cases are each based on a unique set of assumptions involving nuclear electricity generation growth, reactor fuel burnup levels, reactor construction schedules, and reactor operating lifetimes and capacity factors. These assumptions are documented by DOE/EIA in ref. 11. In particular, the No New Orders Case assumes that all reactors will be retired upon the expiration date of their respective operating licenses. By contrast, the 1993 Lower Reference Case assumes that 50% of the reactors will have their respective operating licenses renewed for 20 years past the 40-year period for nominal operation.

Detailed information about reactors already built, being built, or planned in the United States for domestic use or export as of December 31, 1992, is provided in report DOE/OSTI-8200-R56 (ref. 12). That document contains a comprehensive listing of all domestic reactors categorized by primary function or purpose: viz., civilian, production, military, export, and critical assembly.

The data for total waste inventories (which comprise historical data) are obviously less accurate than the values recorded for recent waste additions. The number of digits used in reporting these values is generally greater than justified in terms of numerical significance, but this proves useful and necessary for bookkeeping purposes. In some cases, the values cited are significantly different from those previously reported. This is generally a result of improved estimates, new measurements, or redefinition of terms. Explanations are given in such cases. Many of the comments received during the final review stage of this report deal with changes that have occurred after December 31, 1992—some as recently as February 1994. These changes are generally cited in footnotes.

For the sake of brevity, many of the figures and tables of this report use the exponential (E) notation. As examples of this notation, the constant 1.234E+2 means 1.234×10^2, or 123.4; and 1.234E−4 means 1.234×10^{-4}, which is 0.0001234.

0.4 WASTE CHARACTERISTICS AND UNITS REPORTED

Principal characteristics reported for most radioactive wastes discussed in this report include volume, radioactivity, and thermal power. All characteristics are reported in metric units and, depending on the waste form, can be significant considerations in meeting the requirements for waste treatment, storage, and disposal. Waste volume is reported in cubic meters (m^3) and generally reflects the amount of space occupied by the waste and its container. Radioactivity represents the rate of spontaneous disintegration of the radionuclides comprising the waste. In this report, radioactivity is measured by a unit called a curie (Ci), which is 3.7×10^{10} nuclear disintegrations per second. Over time, radionuclides decay to nonradioactive, stable isotopes. As an example, the short-lived radionuclides found in spent nuclear fuel rapidly decay during the first few years after the fuel is removed from a reactor.

It should be noted that while waste volumes accumulate with time by conventional addition, total radioactivity does not. Because of radioactive decay, cumulative activity cannot be based on reported annual additions; rather it must be estimated from knowledge of the waste composition, which includes the radionuclides comprising the waste, their concentrations, and decay attributes (e.g., half-lives and decay schemes). In this report, decayed radioactivity is generally estimated for various wastes by an abridged version of the ORIGEN2 code (ref. 13).

Thermal power is a measure of the rate of heat-energy emission resulting from the decay of radionuclides in a waste. Like radioactivity, thermal power is not cumulative by conventional addition because of radioactive decay. Information on thermal power is needed in the design of shipping casks, storage facilities, and repositories where temperature rise, especially with regard to spent fuel and HLW, is an important concern. Thermal energy generation rates are highest for spent fuel, HLW, and remote-handled TRU waste. They may also be important for certain types of LLW. The unit of thermal power used in this report is the watt (W), which represents 1 joule of thermal energy emitted per second. Estimates of thermal power are based on radionuclide composition as well as total activity. While levels of thermal power may not be significant for certain waste forms (particularly some types of LLW), they are nevertheless reported for the major radioactive waste categories referenced in this report to provide a standard for comparison.

For spent fuel and TRU waste, mass is reported to provide better assurances of accountability. Spent fuel is reported in units of metric tons of *initial* heavy metal (MTIHM) to avoid difficulties and confusion arising from the need to estimate ranges of varied heavy-metal content (MTHM) that result from different levels of enrichment and reactor fuel burnup. Mass is reported in kilograms (kg) for the TRU radionuclides comprising TRU wastes.

In this report, quantities of generated wastes are expressed in terms of either the amount of mass (kg) or volume (m^3) produced in a given calendar year. Thus, generation rates for wastes are expressed in either kilograms per year (kg/year) or cubic meters per year (m^3/year), depending on the availability of site information. Annual generation rates are reported in this document for spent fuel, TRU waste, LLW, and mixed LLW. Annual