American Nuclear Society

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(Errata – Replacement Tables Version)

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American National Standard Radioactive Source Term for Normal Operation of Light Water Reactors

Secretariat
American Nuclear Society

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American National Standard

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Foreword

(This Foreword is not a part of American National Standard Radioactive Source Term for Normal Operation of Light Water Reactors, ANSI/ANS-18.1-1999.)

The purpose of this standard is to provide a set of typical radionuclide concentrations for estimating the radioactivity in the principal fluid streams of a light water reactor. Some systems will have different concentrations than those indicated in this standard. The values in this report were those judged to be representative concentrations in a light water reactor over its lifetime based upon the data currently available. It is not intended that these data be used as the sole basis for design, but be used in environmental reports and elsewhere where expected operating conditions over the life of the plant would be appropriate. The data and methodology provided by previous versions of this standard have been incorporated in the GALE computer codes (see Bibliography) used for the calculation of gaseous and liquid effluents from light water reactors. The changes included in this standard should be considered in future updates of these codes.

This standard is Revision 2 of American National Standard for Source Term Specification, N237-1976 (ANS-18.1), and updates the default activity concentrations and adjustment factors associated with Revision 1 (ANSI/ANS-18.1-1984), based on the latest review of data from operating domestic nuclear power plants. The values given in this standard will be revised periodically as additional plant operating data become available.

At the time of approval, members of Working Group ANS-18.1 who developed this standard were:

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The American Nuclear Society's Nuclear Facilities Standards Committee (NFSC) had the following membership at the time of its approval of the standard:

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Radioactive Source Term for Normal Operation of Light Water Reactors

1. Scope

This standard establishes typical long-term concentrations of principal radionuclides in fluid streams of light-water-cooled nuclear power plants for use in estimating the expected release of radioactivity from various effluent streams. These fluid streams are: the coolant of a boiling water reactor (BWR), the coolant of a pressurized water reactor (PWR), and PWR steam generator fluids. The concentrations in fluid streams of BWRs and PWRs are treated in a similar manner, but have different numerical values because of the differences in design.

The numerical values given in this standard are based on available data from operating plants which use zirconium-clad uranium dioxide fuel. The values are given for a set of reference conditions, and criteria are provided for adjusting to other conditions.

2. Purpose

The purpose of this standard is to provide a uniform approach, applicable to light-water-cooled nuclear power plants, for the determination of expected concentrations in fluid streams. Through application of this standard, a common basis for the determination of radioactive source terms for normal operating conditions is established, with the goal of providing a consistent approach for those involved in the design of these facilities. Utilization of this standard is expected to aid the licensing process and the public's understanding of the impact of nuclear power relative to radionuclide concentrations and possible releases to the environment.

3. Specifications

Parameters that characterize the three types of Nuclear Steam Supply Systems (NSSS) are given in Table 1 (BWR), Table 2 (PWR with U-tube steam generators), and Table 3 (PWR with once-through steam generators). The reference plant values are based on typical systems which are sufficiently general to be applicable to most light-water reactors. The choice of these parameters is not meant to imply a recommendation of their use in selecting a plant design. Figures 1, 2, and 3 present block diagrams of the reference reactor systems and provide the bases for the removal rate equations and adjustment factors. The various radioactive elements that might be present in fluid streams have been divided into six classes, as shown in Table 4. This division was made to facilitate the adjustment procedure. Except for Class 6, these classes are based on the grouping of elements with reasonably similar chemical and physical properties, or similar behavior during normal operation. Class 6 includes all other elements that could not be classified readily in any of the other classes. The following sections describe how this standard is applied to plants that have the parametric values given in Tables 1, 2, and 3, and how to determine radionuclide concentrations if one or more parameters differ from the reference values.

3.1 Specification of Radionuclide Concentrations for Reference Plants. If the parameters of a plant are the same as those given in Tables 1, 2, or 3, the recommended radionuclide concentrations are given in Tables 5, 6, and 7. Table 5 gives the radionuclide concentrations for reactor coolant for the reference BWR. Table 6 gives the radionuclide concentrations for reactor coolant and steam generator fluid for the reference PWR with U-tube steam generators. Table 7 gives the radionuclide concentrations for reactor coolant and secondary steam for the reference PWR with once-through steam generators. These radionuclide concentrations are based on data obtained from operating nuclear plants.

3.2 Adjustment of the Reference Plant Radionuclide Concentrations to a Specific Plant. If any parameter, such as power level, flow rate, or fluid quantity, differs from the values given in Tables 1, 2, or 3 (as appropriate), the procedures described in the following paragraphs shall be used to determine the adjustment factors needed to modify the radionuclide concentrations in Tables 5, 6, and 7. Recalculated fluid stream concentrations shall be based on the numerical values provided in Tables 5, 6, and 7, which are given to only one or two significant figures. It is inappropriate to assign a greater accuracy to any fluid stream concentration calculated through