INTERNATIONAL STANDARD

ISO 10645

First edition
1992-03-01

Nuclear energy — Light water reactors — Calculation of the decay heat power in nuclear fuels

Énergie nucléaire — Réacteurs à eau légère — Calcul de la puissance résiduelle des combustibles nucléaires

Reference number
ISO 10645:1992(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10645 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Sub-Committee SC 3, *Power reactor technology*.

Annex A forms an integral part of this International Standard.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

Introduction

The decay heat power of nuclear fuels is the thermal power produced by radioactive decay of fission and activation products of the nuclear fuel following the shutdown of a nuclear reactor. It is an important physical quantity for the design of systems in which the decay heat power has to be taken into consideration as a heat source.

This International Standard gives the local generation of decay heat power as a function of the thermal fuel power during operation. The spatial distribution of the energy conversion into heat, e.g. γ-radiation, is not considered. If required, evaluation of this is left to the user.

The calculation procedure used has the advantage of enabling decay heat power to be calculated with an accuracy comparable to that of summation codes but without the need for complicated calculations.

For calculating the decay heat power or its individual components, the user can employ methods and data bases of his own, provided that their validity is established. For the fission product contribution, this requires comparison with this International Standard.

The power generated by delayed neutrons and activated structural material is not considered in this International Standard.

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Nuclear energy — Light water reactors — Calculation of the decay heat power in nuclear fuels

1 Scope

This International Standard provides the basis for calculating the decay heat power of non-recycled nuclear fuel of light water reactors. For this purpose the following components are considered:

— the contribution of the fission products from nuclear fission;

— the contribution of the actinides;

— the contribution of isotopes resulting from neutron capture in fission products.

This International Standard applies to light water reactors (pressurized water and boiling water reactors) loaded with a nuclear fuel mixture consisting of ^{235}U and ^{238}U. Its application to recycled nuclear fuel is not permissible.

The calculation procedures apply to decay heat periods of 0 and 10^9 s.

2 Definitions

For the purposes of this International Standard, the following definitions apply.

2.1 decay heat power of nuclear fuels: The thermal power produced by radioactive decay of fission and activation products of the nuclear fuel, following shutdown of a nuclear fission reactor.

2.2 operating time: The entire period from the first charging of the reactor with fuel until the final shutdown considered.

2.3 decay time: The time elapsing after the operating time.

2.4 power histogram: This approximates the true variation of power with time, subdivided into intervals of constant power output and fuel composition.

3 Symbols and subscripts

3.1 Symbols

Symbol	Quantity	Unit
$A(t)$	Factor to be applied to the decay heat power of the fission products P_S for calculating the contribution P_A of the actinides (excluding ^{239}U and ^{239}Np)	—
$f_i(t)$	Decay heat power of the fission products at time t after a single nuclear fission of the fissile nuclide i	$\frac{\text{MeV/s}}{\text{by fission}}$
$\Delta f_i(t)$	Standard deviation of $f_i(t)$	$\frac{\text{MeV/s}}{\text{by fission}}$
$F_i(t_k, T_k)$	Decay heat power of the fission products of the fissile nuclide i at time t_k after the irradiation time interval T_k referred to one fission per second	$\frac{\text{MeV/s}}{\text{by fission/s}}$
$\Delta F_i(t_k, T_k)$	Standard deviation of $F_i(t_k, T_k)$	$\frac{\text{MeV/s}}{\text{by fission/s}}$
$H(t)$	Factor to be applied to the decay heat power of the fission products P_S for calculating the contribution P_E from neutron capture in fission products (excluding capture in ^{133}Cs)	—