International Standard

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Nuclear energy — Nuclear fuel technology — Determination of neptunium in nitric acid solutions by spectrophotometry

Énergie nucléaire — Technologie du combustible nucléaire — Détermination du neptunium dans les solutions d'acide nitrique par spectrophotométrie

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection,* Subcommittee SC 5, *Nuclear installations, processes and technologies*.

This third edition cancels and replaces the second edition (ISO 13465:2009), which has been technically revised.

The main changes are as follows:

— Clause 3 and 5.3 added;

— 9.2 and 9.3 updated.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document presents an analytical method for determining the neptunium concentration in nitric acid solutions after the dissolution of nuclear reactor irradiated fuels. The method is devoted to process controls at the different steps of the process in a nuclear fuel reprocessing plant.

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Nuclear energy — Nuclear fuel technology — Determination of neptunium in nitric acid solutions by spectrophotometry

1 Scope

This document specifies an analytical method for determining the neptunium concentration by spectrophotometry, with spectrophotometer implemented in hot cell or glove box allowing the analysis of high activity solutions, with a standard uncertainty, with coverage factor k = 1 of about 5 %, in nitric acid solutions after the dissolution of nuclear reactor irradiated fuels, at different steps of the process in a nuclear fuel reprocessing plant or in other nuclear facilities. The method is applicable to sample from the process containing a concentration of neptunium between 10 $mg \cdot l^{-1}$ and 400 $mg \cdot l^{-1}$ and uranium concentrations of up to 300 $g \cdot l^{-1}$.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1042, *Laboratory glassware — One-mark volumetric flasks*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Principle

As neptunium(V) is naturally the most stable of the oxidation states of neptunium and because of the high molar extinction coefficient, for this valency, neptunium is quantitatively transformed to Np(V) using a vanadium(V)/vanadium(IV) redox buffer. The neptunium content is determined by spectrophotometry by measuring the height of the absorbance peak at a wavelength of 981 nm. The result is obtained by comparison to a calibration performed under similar conditions (with the same nitrate or uranium content).

5 Interferences

5.1 Uranium (VI)

Uramium(VI) forms an intercationic complex with neptunium(V). The complex has a maximum absorption at 992 nm. The presence of uranium(VI), therefore, reduces the selectivity of the determination.

However, the formation constant of this complex is low, and up to 1,5 g of uranium can be present in the aliquot, provided that the calibration be carried out with the same quantities of uranium(VI) or that the technique of standard addition be used.

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