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TITLE

TENTATIVE U-233 AND THORIUM NITRATE SPECIFICATIONS

AUTHOR

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December 18, 1964

U. S. Atomic Energy Commission
Richland Operations Office
Richland, Washington

Attention: Mr. J. T. Christy, Chief
Chemical Operations Branch
Production Division

Gentlemen:

TENTATIVE U-233 AND THORIUM NITRATE SPECIFICATIONS

Reference: Letter, J. T. Christy to R. E. Tomlinson, "U-233 and Thorium Nitrate Specifications", dated November 16, 1964.

In response to your request we have reviewed the proposed thorium nitrate specifications, prepared tentative product specifications for Purex U-233 and thorium nitrates, and estimated the feasibility, cost and product composition for providing U-233 oxide at Hanford. The tentative specifications proposed for U-233 and thorium product for the Purex Plant are presented in the attached tables. The values chosen represent our understanding of feed material and reactor processing needs and our current estimate of Purex Plant capabilities. Some adjustments have been made in the thorium limits proposed in Reference 1 to reflect reactor control needs for rare earth materials.

The practicality of achieving the various impurity concentration limits in Purex will be explored as part of the planned thorium process test. We have therefore chosen to label the attached specifications as tentative until further review can be made following an analysis of the process test data. We plan to forward to you proposed specifications as soon as the data are available in early 1965. In the meanwhile, we would appreciate your comments on the attached limits.

In the event that it would be desirable to ship the U-233 as the oxide, we would propose to store the U-233 solution that is produced during the relatively short production campaigns at Purex, and to process the U-233 through the oxide facility at Z-Plant over a period of 12 months. In this manner, the capital cost of the oxide facility is minimized and design would be based on a rate of 10 kgs of U-233 per month. The capital cost of this facility is conceptually estimated at $250,000 for Z-Plant and $125,000 for lag storage (including PR cans, assuming storage at some existing location such as Gable Mountain, T-Plant, or U-Plant). The product would be $U_3O_8$ (calcined uranyl peroxide or ammonium diuranate) with a purity essentially the same as that specified for the nitrate product. The

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U-233 would be decontaminated from the radioactive daughters of U-232 immediately prior to conversion to the oxide.

It is estimated that the operating cost for converting 100 kgs of U-233 from the nitrate to the oxide would be approximately $65,000 per year, including Departmental and general overheads, but exclusive of depreciation on the above mentioned capital cost.

The above data are based on existing General Electric organization and no provision or consideration has been given to transfer operations which will take place within this period of time. Similar data prepared by other contractors may vary widely based on assumptions used.

Very truly yours,

R. E. Tomlinson

Manager
Research and Engineering

RE Tomlinson:BFJ:lmj

# TENTATIVE PRODUCT SPECIFICATIONS
## PUREX URANIUM-233 NITRATE

| Material Composition (2) | Limits | Analytical Method (1) |
|---|---|---|
| Uranium (as nitrate solution) | 50 to 350 g/l | Potential Coulometry |
| Nitric Acid | 0.5 to 1.5 lbs/gal | Hydrogen Ion |
| **Radiochemical Impurities (2)** | | |
| Uranium-232 | < 6 ppm of U-233 | Mass Spectrography |
| Uranium Isotopes | < 0.05 grams/gram of U-233 | Mass Spectrography |
| Plutonium | < 0.001 grams/gram of U-233 | TTA Extraction |
| Thorium | < 0.005 grams/gram of U-233 | Spectrophotometer |
| ZrNb-95 | < 4 uc/gram of U-233 | Multichannel Analysis |
| Ru-103, RuRh-106 | < 2 uc/gram of U-233 | Multichannel Analysis |
| Pa-233 | < 1 uc/gram of U-233 | Multichannel Analysis |
| **Chemical Impurities (3)** | | |
| Iron | < 1000 ppm of U-233 | Emission Spectrography |
| Sodium | < 500 ppm of U-233 | Emission Spectrography |
| Cadmium | < 1 ppm of U-233 | Emission Spectrography |
| Boron | < 1 ppm of U-233 | Emission Spectrography |
| Silicon | < 100 ppm of U-233 | Emission Spectrography |
| Phosphorus | < 100 ppm of U-233 | Emission Spectrography |
| Molybdeneum | < 10 ppm of U-233 | Emission Spectrography |
| Rare Earths | < 10 ppm of U-233 | Emission Spectrography |
| Ce | < 1 ppm of U-233 | Emission Spectrography |
| Sm | < 0.1 ppm of U-233 | Emission Spectrography |
| Eu | < 0.1 ppm of U-233 | Emission Spectrography |
| Gd | < 0.1 ppm of U-233 | Emission Spectrography |
| Dy | < 0.1 ppm of U-233 | Emission Spectrography |
| Other Metallic Impurities (4) | < 1000 ppm of U-233 | Emission Spectrography |
| Chloride | < 20 ppm of U-233 | Spectrophotometry |
| Sulfate | < 200 ppm of U-233 | Spectrophotometry |

(1) Sample methods and analytical procedures are summarized in HW-53368, "Analytical Technical Manual", February 1961.

(2) Samples taken of each product batch from the product sample tank in Purex for these analyses. A product batch would contain approximately six kilograms of uranium-233.

(3) Samples taken of every fifth product batch for these analyses.

(4) Al, Be, Bi, Ca, Co, Cr, Cu, K, Mg, Mn, Ni, Li, Pb, Sn, Zn

# TENTATIVE PRODUCT SPECIFICATIONS
# PUREX THORIUM NITRATE

| Material Composition (2) | Limits | Analytical Method(1) |
|---|---|---|
| Thorium (as nitrate solution) | 3 to 4 lbs/gallon | Volumetric Analysis |
| Nitric Acid | 0.3 to 1.5 lbs/gallon | Hydrogen Ion |
| **Radiochemical Impurities (2)** | | |
| Plutonium | < 10 ppb of thorium | TTA Extraction |
| Uranium (excludes U-233) | < 10 ppm of thorium | Fluorimeter |
| Uranium-233 | < 20 ppm of thorium | Mass Spectrography |
| ZrNb-95 | < 10 uc/lb of thorium | Multichannel Analysis |
| Ru-103, RuRh-106 | < 20 uc/lb of thorium | Multichannel Analysis |
| Pa-233 | < 2 uc/lb of thorium | Multichannel Analysis |
| **Chemical Impurities (3)** | | |
| Silicon | < 100 ppm of thorium | Emission Spectrography |
| Phosphorous | < 100 ppm of thorium | Emission Spectrography |
| Molybdeneum | < 10 ppm of thorium | Emission Spectrography |
| Cadmium | < 1 ppm of thorium | Emission Spectrography |
| Boron | < 1 ppm of thorium | Emission Spectrography |
| Mg + Ca + Al | < 500 ppm of thorium | Emission Spectrography |
| Fe | < 100 ppm of thorium | Emission Spectrography |
| Rare Earths | < 40 ppm of thorium | Emission Spectrography |
| Ce | < 5 ppm of thorium | Emission Spectrography |
| Sm | < 0.5 ppm of thorium | Emission Spectrography |
| Eu | < 0.5 ppm of thorium | Emission Spectrography |
| Gd | < 0.5 ppm of thorium | Emission Spectrography |
| Dy | < 0.5 ppm of thorium | Emission Spectrography |
| Other Metallic Impurities (4) | < 500 ppm of thorium | Emission Spectrography |
| Chloride | < 20 ppm of thorium | Spectrophotometry |
| Sulfate | < 200 ppm of thorium | Spectrophotometry |

(1) Sample methods and analytical procedures are summarized in HW-53363, "Analytical Technical Manual", February 1961.

(2) Samples taken of each product batch from the product sample tank for these analyses. A product batch would contain approximately six tons of thorium.

(3) Samples taken of every fifth product batch for these analyses.

(4) Be, Bi, Co, Cr, Cu, K, Mn, Na, Ni, Li, Pb, Sn, Zn

# END

DATE
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