

Westinghouse Non-Proprietary Class 3



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LTR-NRC-22-48

December 12, 2022

Subject: Transmittal of Presentation Slides to Support Westinghouse-NRC Technical Exchange Meeting on the Updates to the Cobalt-60 Production Program (Proprietary/Non-Proprietary)

Enclosed are proprietary and non-proprietary versions of slides to support a technical-exchange meeting with the NRC on December 14, 2022, to discuss design and programmatic updates pertaining to the Westinghouse Cobalt-60 production program.

This submittal contains proprietary information of Westinghouse Electric Company LLC ("Westinghouse"). In conformance with the requirements of 10 CFR Section 2.390, as amended, of the Nuclear Regulatory Commission's ("Commission's") regulations, we have enclosed with this submittal an Affidavit. The Affidavit sets forth the basis on which the information identified as proprietary may be withheld from public disclosure by the Commission.

Correspondence with respect to the proprietary aspects of this submittal or the Westinghouse Affidavit should reference AW-22-052 and should be addressed to Camille T. Zozula, Interim Director, Management Systems and Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 1, Cranberry Township, PA 16066.

A handwritten signature in black ink, appearing to read "Zachary S. Harper".

Zachary S. Harper, Manager
Licensing Engineering

cc: Ekaterina Lenning
Richard Chang

Enclosures:

- (1) Affidavit, AW-22-052
- (2) Slides to Support Westinghouse-NRC Technical Exchange Meeting on the Updates to the Cobalt-60 Production Program (Proprietary)
- (3) Slides to Support Westinghouse-NRC Technical Exchange Meeting on the Updates to the Cobalt-60 Production Program (Non-Proprietary)

Commonwealth of Pennsylvania:

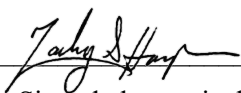
County of Butler:

- (1) I, Zachary Harper, Senior Manager, Licensing Engineering, have been specifically delegated and authorized to apply for withholding and execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse).
- (2) I am requesting the proprietary portions of LTR-NRC-22-48, Enclosure 2, be withheld from public disclosure under 10 CFR 2.390.
- (3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged, or as confidential commercial or financial information.
- (4) Pursuant to 10 CFR 2.390, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.
 - (i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse and is not customarily disclosed to the public.
 - (ii) The information sought to be withheld is being transmitted to the Commission in confidence and, to Westinghouse's knowledge, is not available in public sources.
 - (iii) Westinghouse notes that a showing of substantial harm is no longer an applicable criterion for analyzing whether a document should be withheld from public disclosure. Nevertheless, public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

- (5) Westinghouse has policies in place to identify proprietary information. Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:
- (a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.
 - (b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage (e.g., by optimization or improved marketability).
 - (c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.
 - (d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.
 - (e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.
 - (f) It contains patentable ideas, for which patent protection may be desirable.
- (6) The attached documents are bracketed and marked to indicate the bases for withholding. The justification for withholding is indicated in both versions by means of lower-case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower-case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (5)(a) through (f) of this Affidavit.

I declare that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief. I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 12/12/2022


Signed electronically by
Zachary Harper

Enclosure 3

**Slides to Support Westinghouse-NRC Technical Exchange Meeting on the
Updates to the Cobalt-60 Production Program**

(Non-Proprietary)

December 2022

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Cranberry Township, PA 16066**

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Update for the Westinghouse Cobalt-60 Program

NRC Meeting

December 14, 2022

Agenda

- Purpose
- Cobalt-60 Applications and Supply Challenges
- Background of Westinghouse Cobalt-60 Program
- Assembly Design and Qualification
- Spent Fuel Pool Criticality Approach
- License Amendment Request Content and Structure
- LAR Review Schedule
- Summary

Purpose

- Provide an update on the Cobalt-60 program and solicit NRC feedback
- Review previous communications
 - Key regulatory aspects of the application
- Address specific topics
 - []^{a,c}
 - Spent fuel pool criticality
- Submittal timeline and structure

Previous Communications

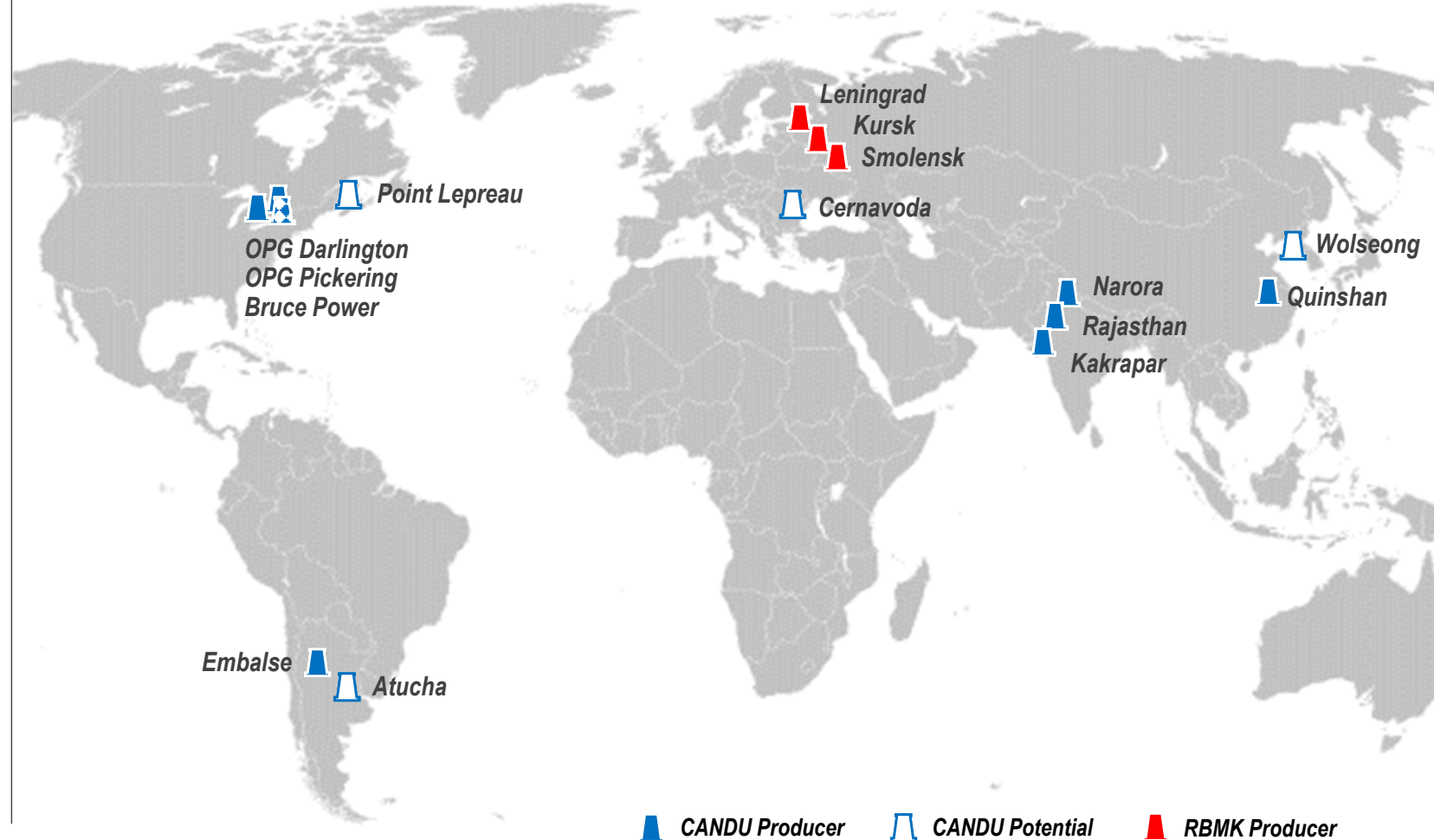
- July 2020 – Program overview
 - Component design, production process, safety analyses, licensing
- May 2021 – Classification of Cobalt-60 byproduct material
 - Capsule marking and NRC reporting
- January 2022 – Present revised capsule marking and 10CFR20 reporting approach
 - Following feedback from NRC, our approach was adjusted to comply with the requirements of 10CFR20 and the National Source Tracking System
- September 2022 – COBA Design and Program updates, as part of the Fuel Performance Update Meeting

**This presentation intends to cover major changes
since the last update**

Cobalt-60 Supply and Demand

! DEMAND CHALLENGES

- Co-60 supply continues to grow (aging populations, advanced medicine, COVID, etc.) but **lags demand**
- Limited number of CANDU and RBMK remaining for extra Co-60 production
- Reactor refurbishments and shutdowns will strain supply chains
- U.S. consumes 50% of world's Co-60 supply but produces **NONE**
- Approximately []^{a,c} of Co-60 supply today comes from **Russia**



A New Reactor Platform for Cobalt-60 Production

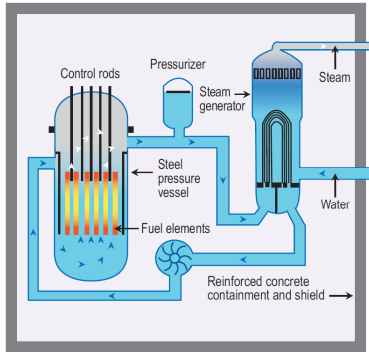
Characteristics Across Four Common Reactor Units

Characteristic	PWR	BWR	PHWR (CANDU)	LWGR (RBMK)
# Operating Units	277 (64 U.S.)	80	49	15
Fuel Type	UO ₂	UO ₂	UO ₂	UO ₂
Fuel Form	Enriched	Enriched	Natural	Enriched
Coolant	H ₂ O	H ₂ O	D ₂ O	H ₂ O
Moderator	H ₂ O	H ₂ O	D ₂ O	Graphite
Temperature	320°C	285°C	60°C*	70°C**
Pressure	15.5 MPa	7.6 MPa	Atmospheric*	6.9 Mpa**
Neutron Flux	Medium	Medium	High	Medium

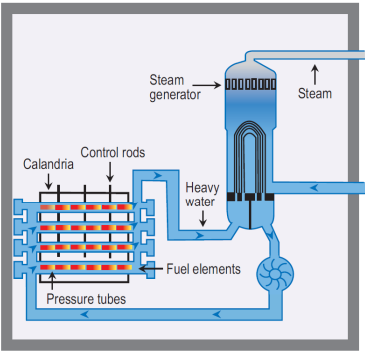
* Cobalt targets irradiated in cylindrical calandria that contains moderator at stated conditions
** Cobalt targets irradiated special channel cooling circuit (SCCC) that contains light water at stated conditions



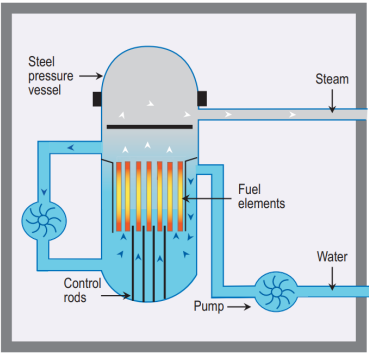
Reactor Types



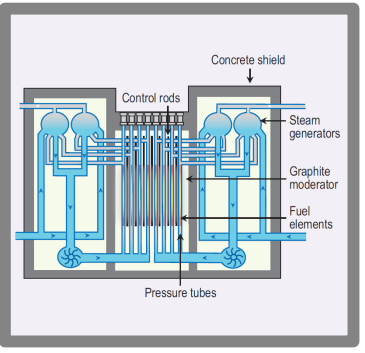
A Pressurized Water Reactor (PWR)



A Pressurized Heavy Water Reactor (PHWR/Candu)



A Boiling Water Reactor (BWR)



A Light Water Graphite-moderated Reactor (LWGR/RBMK)

Background of Program

- Westinghouse and Nordion (Canada) are developing an innovative isotope production technology, and with our partner utilities, plan to produce Cobalt-60 in Pressurized Water Reactors (PWRs).
- Nickel-plated slugs of Cobalt-59 target material will be provided by Nordion to the capsule vendor (Veridiam), where the target material will be sealed in []^{a,c} capsules.
- The capsules are then loaded into cobalt burnable absorber assemblies (COBA) at the Westinghouse Columbia Fuel Fabrication Facility.
- COBAs are inserted into Westinghouse fuel assemblies, shipped to the plant site and loaded into the reactor core as fuel assembly components to be irradiated for multiple fuel cycles, producing Cobalt-60.

Background of Program (cont.)

- After removal of the assemblies from the core, the activated capsules are harvested (removed from the COBAs), loaded into a Nordion-supplied transportation cask, and transferred to Nordion's facility in Canada.
- At Nordion, the Cobalt-60 slugs are removed from the capsules and packaged as sealed sources according to activity levels appropriate for supply to Nordion's customers for use in sterilization and medical use applications.
- Similar to other fuel inserts, such as WABAs (wet annular burnable absorbers) and RCCAs (rod cluster control assemblies), empty COBAs are to be inserted in spent fuel assemblies and stored in dry-casks.

COBA Assembly Design

COBA Assembly Design (cont.)

a,c

COBA Assembly Design (cont.)

a.c



COBA Assembly Design (cont.)



COBA Capsule Design

a,c



COBA Capsule Qualification

a,c



COBA Design and Qualification – Summary

a,c

COBA Assessment of Failure Mechanisms

- Co-60 release would require a failure of capsule integrity
- Potential COBA capsule failure mechanisms considered include:

a,c

Risk Considerations

- COBAs do not pose a Public Risk
 - Insertion of COBA assemblies in the core will not cause new reactor accidents or alter the progression of already existing potential severe core damage scenarios. No change in core damage frequency or large early release probability is expected. Thus, in accordance with RG 1.174, Revision 3, COBAs should be limited to a “very small risk change” and pose a negligible impact on public risk.
 - Since cobalt is not volatile, public dose impacts following severe core damage sequences should not be significantly changed.

Spent Fuel Pool Criticality Impact

- As part of the implementation of the Cobalt-60 program, impacts to spent fuel pool storage criticality will be evaluated.
- Preliminary analysis has suggested any reactivity impact due to the program is likely due to changes in fuel management as a result of implementation and will be addressed on a plant specific basis.
- Evaluations are expected to result in the following scenarios depending on the vintage and specific analysis of record (AOR) details.
 - I. AOR is of a newer vintage and contains most or all modern expectations in terms of methodology. Here an evaluation may result in no impact or the potential for addressing the impact under either 10 CFR 50.59 or an update to the AOR to adjust storage curves.
 - II. AOR is of medium vintage and includes most/all modern methodology impacts. Some methodology may require updating. An evaluation may result in an update to the AOR to incorporate impacts to adjust storage curves up to a full re-analysis (LAR) depending on specific details of the analysis.
 - III. AOR is of older vintage and predates many modern SFP criticality analysis expectations. In this case, a full re-analysis (LAR) is likely to incorporate modern expectations.

License Amendment Request Content and Structure

- To address the requirements of 10 CFR Part 30, a license amendment will be necessary.
- LAR submittals will be prepared for multiple licensees.
- To make the review more efficient, the submittals will be structured as follows:
 - License Amendment Request – significant similarity between licensees
 - Technical Report – will provide the bulk of the technical supporting information and would be common across multiple plants
 - Plant-specific information

LAR Content and Structure (cont.)

Applicable Regulations

- 10 CFR Part 50 Appendix A, General Design Criteria
 - GDC 10, "Reactor design"
 - GDC 11, "Reactor inherent protection"
 - GDC 60, "Control of releases of radioactive materials to the environment"
- 10 CFR Part 30, "Rules of General Applicability To Domestic Licensing of Byproduct Material"
- 10 CFR Part 20, "Standards For Protection Against Radiation"
- Regulatory Guide 1.174, Revision 3, "An Approach For Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis"
- Regulatory Guide 1.240, "Fresh and Spent Fuel Pool Criticality Analysis"

Technical Report – Table of Contents

1

Purpose and Summary

2

Description of the Cobalt-60 Production Process

3

Cobalt Burnable Absorber (COBA) Assembly Design

3.1

Design considerations

3.2

Description of design

3.3

COBA Fabrication Process

4

Mechanical Design Evaluation

5

Thermal and Hydraulic Evaluation

5.1

Core Bypass Flow and Control Rod Function

5.2

COBA Rodlet Design Thermal-Hydraulic Analysis

a,c

Technical Report – Table of Contents (cont.)

6 Materials

7 Nuclear Design

- 7.1 Methodology
- 7.2 Benchmarking of Nuclear Methods
- 7.3 Reactor Core Design Approach
- 7.4 Implications on Reload Safety Evaluation

8 Safety Analyses

- 8.1 PCWG Design Parameters and Best Estimate Flows
- 8.2 Non-LOCA Transients
- 8.3 LOCA
- 8.4 SFP Building Doses
- 8.5 Steam Generator Tube Rupture and Dose Analysis
- 8.6 Fuel Handling Accident

a,c

Technical Report – Table of Contents (cont.)

9 Effects on Spent Fuel Pool

- 9.1 SFP Criticality
- 9.2 Time to Boil
- 9.3 Gamma Heating

10 Harvesting

- 10.1 Harvesting Process Overview
- 10.2 Harvesting Workstation Tooling
- 10.3 Electrical and Software
- 10.4 Foreign Material Control
- 10.5 COBA Waste Disposal
- 10.6 Effects Within Spent Fuel Pool
- 10.7 Exposure to Personnel

11 Measurement of Cobalt-60 Activity

- 11.1 Hardware
- 11.2 Process Activities
- 11.3 Software and Data Capture

12 Capsule Tracking and Reporting

Technical Report – Table of Contents (cont.)

13 Transport Package and Transportation

- 13.1 Applicable Standards and Regulations
- 13.2 Transport Package and Source Design
- 13.3 Shipment Of Empty Transport Packages
- 13.4 Loading and Preparation For Radioactive Shipment
- 13.5 Pre-Shipment Testing
- 13.6 Transportation From Reactor Site To Nordion
- 13.7 Receipt Of Transport Package At Nordion

14 Plant Specific Changes

- 14.1 Impact on Current Licensing Basis (AOR, UFSAR, TS, LAR for 10CFR30)
- 14.2 Physical plant changes in order to insert/harvest the Cobalt Assemblies
- 14.3 Plant procedural changes
- 14.4 Impact on reactor operations
- 14.5 Co-60 harvesting procedure

LAR Review Schedule

Proposed LAR review schedule for lead plant

- Pre-submittal Meeting 2-3 months prior to LAR submittal
- LAR/TR Submittal Licensee dependent
- License Amendment Issuance 12 months after LAR submittal

Summary and Conclusions

- Provide an update to the Westinghouse Cobalt-60 program.
- Explained in more detail the COBA assembly and capsule design and qualification, and our plan for addressing postulated failure mechanisms.
 - Presents a reasonable basis for the []^{a,c} design approach
 - Demonstrates sufficient protection against release of Cobalt-60
- Presents proposed approach for the spent fuel pool criticality analysis.
- Provides LAR/technical report content and structure that will provide sufficient technical information and promote an efficient review.
- Offers a reasonable LAR submittal and review schedule.