Industrialization of LEU Mo-99 target production

Bertrand STEPNIK  AREVA-CERCA

Mo-99  2013 Topical Meeting
April 1-5, 2013
Chicago, Illinois
1. Introduction
   - Historic
   - LEU UAl$_2$ target manufacturing challenges
2. LEU UAl$_2$ target industrialization
   - Long term R&D investments
   - Industrial production methods
3. AREVA-CERCA contributions to supply chain security
4. Conclusion
1. Introduction

Historic:

- In 2007, investigations on UAl$_2$ LEU targets started:
  - First manufacturing options:
    - Large AREVA-CERCA experience on HEU targets & fuel plates
    - Internal funding R&D program
  - First target batches produced and delivered in 2008
- From 2009 to 2012, industrial production:
  - High target quality obtained & Reliable delivery
  - Safe irradiation & High Mo-99 quality production
  - AREVA-CERCA produces routinely UAl$_2$ LEU Mo-99 targets
- From 2013, consolidation phase in progress to secure the production:
  - Investments to meet new nuclear safety standards and to modernize processes in order to insure long term reliable production and deliveries
  - Target processes optimize and adjust regarding specific needs
1. Introduction

» UAl₂ LEU target manufacturing challenges:

- 3 gU/cm³ UAl₂ target seen as VHD fuel equivalent to a load of 5 gU/cm³ using U₃Si₂ fuel and 2 gU/cm³ using UAlₓ fuel

- U-Al phases modified during thermal manufacturing steps
  \[(UAl₂ + Al → UAl₃ + UAl₄)\]
2. LEU UAl₂ target industrialization

Thanks to long term R&D investments:

- Close cooperation between AREVA-CERCA and its customers i.e. NTP, ANSTO, IRE and NRG/COVIDIEN
- Manufacturing processes optimized in several steps and refined continuously (quality improvement)
- Dedicated investigations are in progress to check the possibility to optimize the design
- R&D being performed to further understand basic principle and to propose new options
2. LEU UAl₂ target industrialization

- Thanks to industrial production methods:
  - Low $^{187}W$ content achievement
  - Lean 6 sigma methodology

To define W content goal
To monitor continuously the process
To implement statistical process control
To develop W measurement methodology
To identify variables with potential impacts on the process
To monitor these variables
To investigate and to establish the cause-and-effect relationships
To improve the process in several steps
To set-up a new state process
2. LEU UAI₂ targets industrialization

Benefits from industrial production methods:

- Achievement of more stringent specifications
- Industrial process improved and controlled within 1 year
- Targets delivery in due quantity and time
3. AREVA-CERCA contribution to supply chain security

- AREVA-CERCA is a stakeholder in the deployment of LEU Mo-99
- LEU targets manufactured routinely and in a reliable and industrial manner
- Thousands of LEU targets are supplied worldwide to:
  - NTP Radioisotopes (Pty) Ltd, a NECSA subsidiary
  - ANSTO Radiopharmaceuticals
- LEU qualification programs are in progress for:
  - IRE
  - NRG/COVIDIEN
3. AREVA-CERCA contribution to supply chain security

AREVA-CERCA is a key partner to secure Mo-99 supply chain:

- Production facility strictly regulated and inspected by independent safety authorities
- Significant investments on the facility to insure sustainable supply
- AREVA-CERCA is upgrading its production infrastructure and organization to meet the global demand of LEU targets

Nevertheless, some unexpected events – internal or external - may occur in the Mo-99 supply chain which may produce a risk of shortage:

- Stockpile of HEU & LEU material and targets should be maintained to insure supply in case of any unexpected events
- Strategic response should be defined by the stakeholders
4. Conclusion

- AREVA-CERCA manufactures $\text{UA}_2 \text{LEU}$ targets routinely:
  - in a safe, industrial and reliable manner,
  - with high quality standards,
  - Meeting delivery schedules

- We have leveraged benefit from our customer partnerships

- We invest to upgrade our production facility

- We are continuously improving Mo-99 LEU targets

- In order to avoid any risk of shortage, AREVA-CERCA advises to build an optimized stockpile of uranium and targets