



# Industrialization of LEU Mo-99 target production

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# 1. Introduction

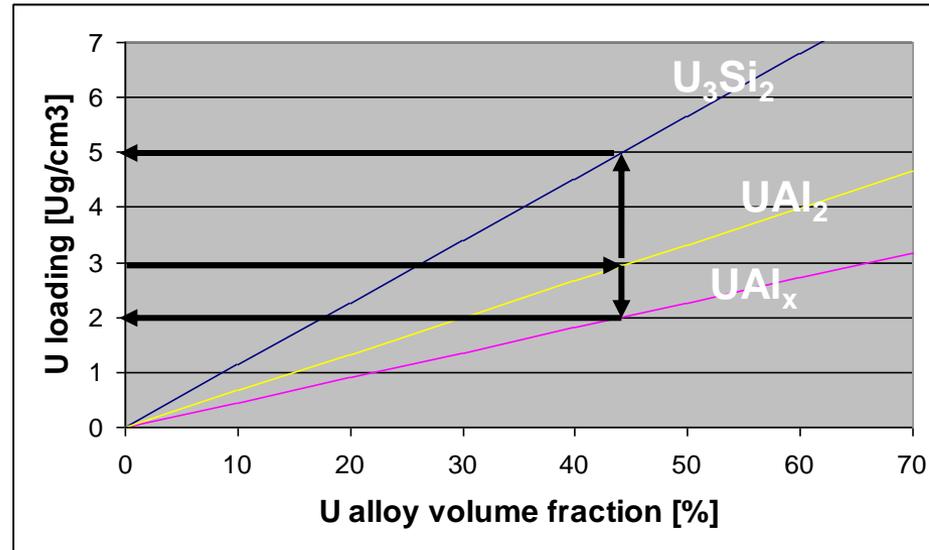
## ► Historic:

- ◆ 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

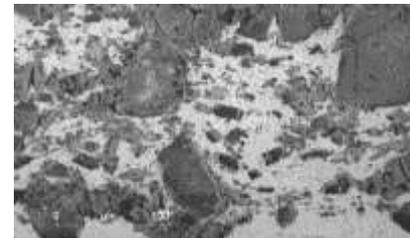
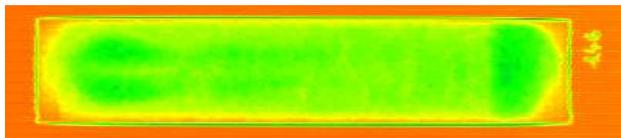
# 1. Introduction

## ▶ $UAl_2$ LEU target manufacturing challenges:

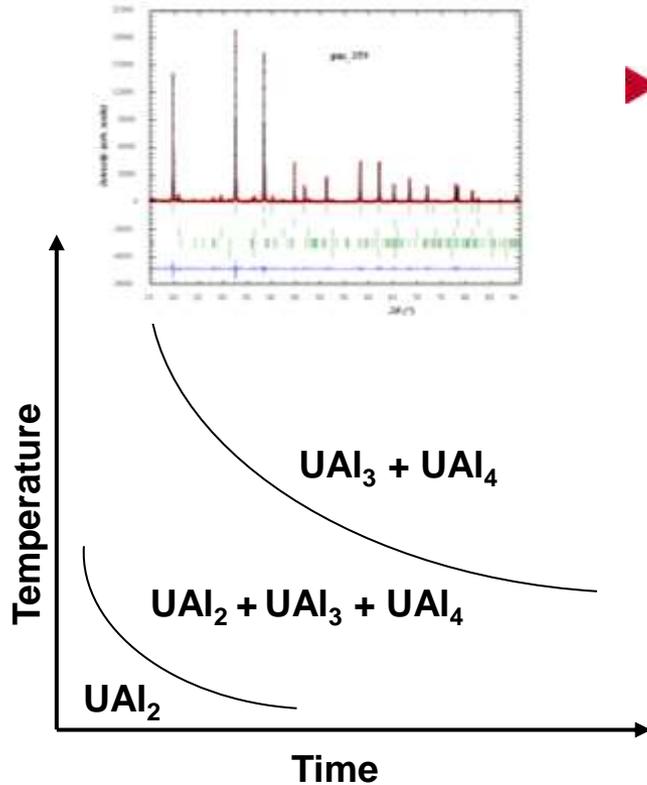
- ◆ 3 gU/cm<sup>3</sup>  $UAl_2$  target seen as VHD fuel equivalent to a load of 5 gU/cm<sup>3</sup> using  $U_3Si_2$  fuel and 2 gU/cm<sup>3</sup> using  $UAl_x$  fuel



- ◆ U-Al phases modified during thermal manufacturing steps ( $UAl_2 + Al \rightarrow UAl_3 + UAl_4$ )

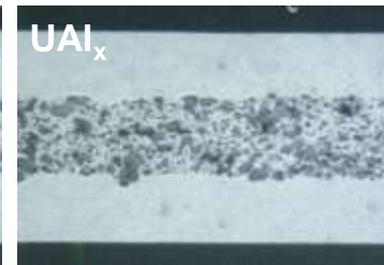
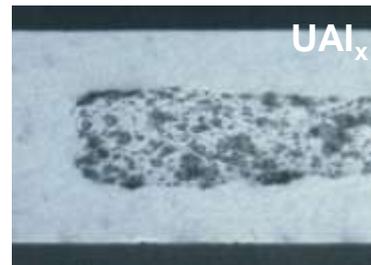
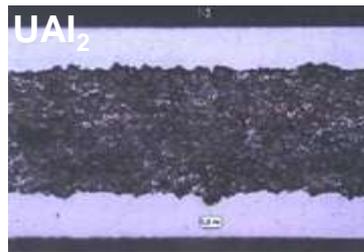
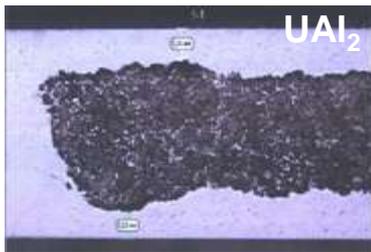


## 2. LEU $UAl_2$ target industrialization



► 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 perform to further understand basic principle and to propose new options



# 2. LEU UAI<sub>2</sub> target industrialization

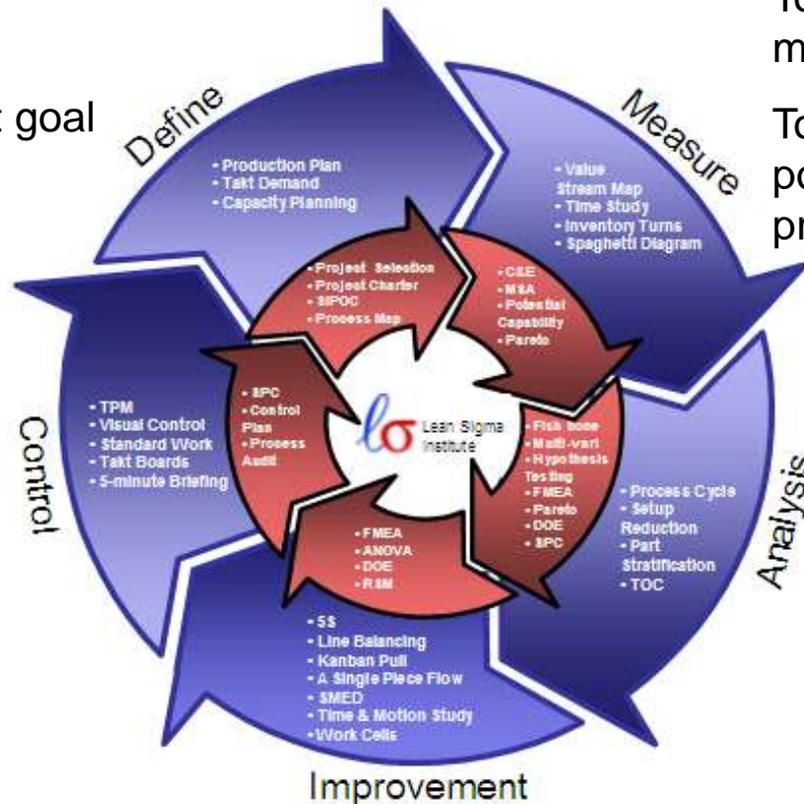
► Thanks to industrial production methods:

- ◆ Low <sup>187</sup>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

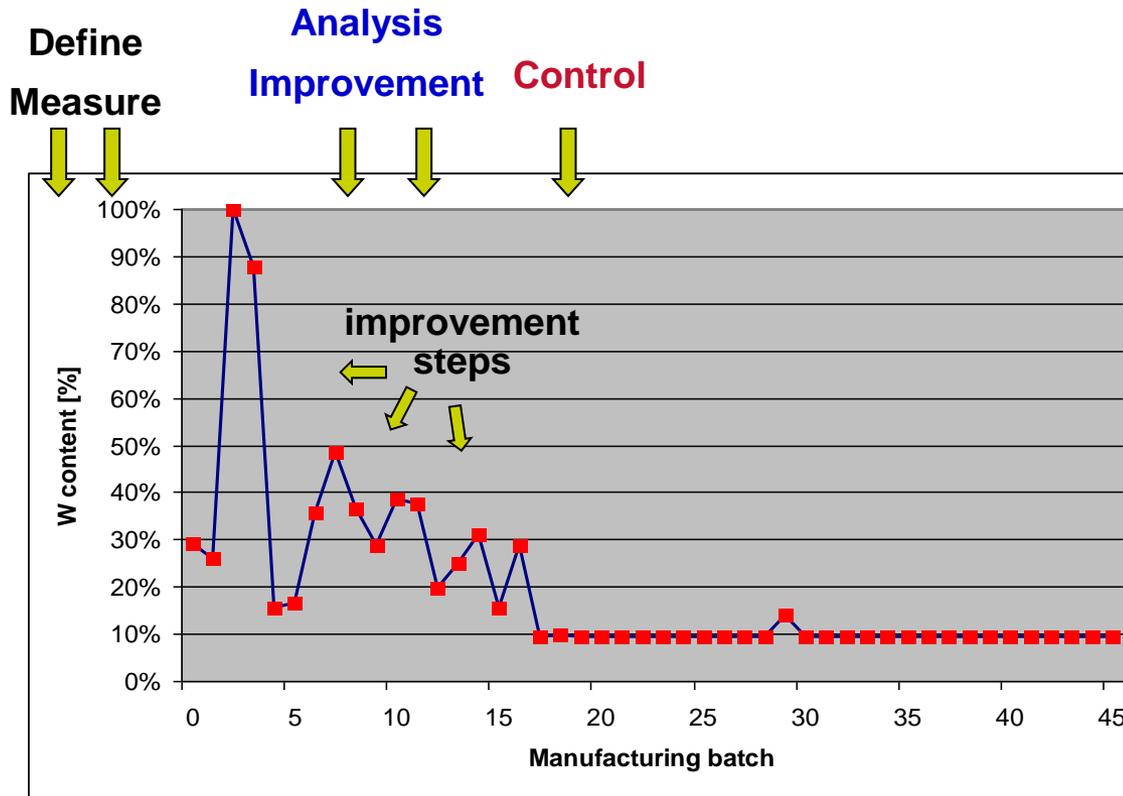
To investigate and to establish the cause-and-effect relationships

To improve the process in several steps

To set-up a new state process

## 2. LEU $UAl_2$ targets industrialization

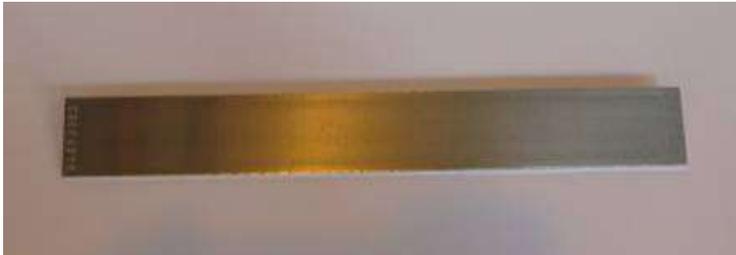
- Benefits from industrial production methods:



- ◆ 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  $UAl_2$  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