Status of the IRE LEU conversion program

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R&D Manager
IRE, a world leader

- Major producer of fission $^{131}\text{I}$
- Major producer of $^{99}\text{Mo}$
  - 3 productions/week; 365 days/year
  - 50% of European needs,
  - 350 000 procedures/month
- Exportation
  - Europe
  - USA
  - Asia
  - Middle east
- Other Isotopes: Y-90, Re-188, ...
Target irradiation

- HFR (Petten)
- BR2 (Mol)
- Osiris (Saclay)
- JHR (Cadarache)
- MARIA (Swierk-Warsaw)
- LWR-15 (Rez-Praha)
- FRM-II (Munich)
LEU conversion commitment

- Currently running with HEU
- Fully committed to LEU conversion
- Security of supply

- Project fully staffed since 2011
- > 25 IRE persons involved
- > 15 M€ total budget
IRE specific LEU challenges

• Increase overall process safety

• Reduction of gaseous releases

• Production capacity : 3500Ci/week – 6D calibration

• No interruption of HEU process

• Stress test results compliance

First commercial LEU production
Feb 2016
IRE specific LEU challenges

- High impact on the purification process while minimizing the changes and the losses
  - Innovative way to trap iodine
  - Xenon trapping and decay

- Hot cell refurbishment and modifications
  - According to stress tests
  - Management of both HEU and LEU batches

- High impact on the Safety Analysis Report
Target specifications

- Maintain the U-235 content
- Increase the uranium loading
- Al alloy cladding

Fits all reactors

Reliable supply of $^{99}$Mo

Innovative target

1 Target design

Manufacturing validation

Full qualification in 5 European reactors
Target irradiation

- In BR2 reactor first
  - Highest neutron flux

- Several irradiation cycles

- Boundary conditions have been explored
  - Long irradiation time
  - High power

 ✓ Nothing unusual was noted during visual inspections
 ✓ No blistering
 ✓ No particular color
Target qualification

- On going non destructive tests
  - Visual inspection
  - Swelling measurements
  - Oxide layer thickness
  - Gamma spectroscopy

Safe use of targets

Courtesy SCK-CEN
Transport container

- Modifications of inner parts to fit plates
- Design validated for remote operations
- Simulation of dry and underwater target loading
- Applying for a new transport license
Target processing

LEU ➝ Target dissolution ➝ \(^{133}\text{Xe} \text{ cryogenic trapping}

HEU ➝ Target dissolution ➝ \(^{133}\text{Xe} \text{ trapping in decay tanks}

Filtration ➝ Acidification ➝ \(^{131}\text{I} \text{ trap}

Ion exchange column ➝ \(^{99}\text{Mo} \text{ purification}

\(^{131}\text{I} \text{ solution} ➝ \text{Target dissolution} ➝ \text{Filtration} ➝ \text{Acidification} ➝ \text{\(^{131}\text{I} \text{ trap}}

\(^{133}\text{Xe} \text{ trapping in decay tanks} ➝ \text{Target dissolution} ➝ \text{Filtration} ➝ \text{Acidification} ➝ \text{\(^{131}\text{I} \text{ trap}}
Chemical process modifications

- A unique solution
- An additional barrier in the defense-in-depth system will be provided
- On going
  - High activity test on iodine process
  - Tests on depleted uranium targets
- Processing time could be impacted
Waste management

- Uranium waste
  - A capacity problem due to new filtration conditions
  - Long term management issue

- Liquid waste
  - New waste composition
  - Increased volume of waste
  - Existing waste management facility
  - A licensing and efficiency issue
XeMo1 refurbishment

- Experience feed back of the XeMo2 renovation
- Decontamination finished in July 2013
- End of renovation of hot cells: Q3 2014
XeMo1 refurbishment

- Dedicated Hot cell for the process upstream
  - Dissolution
  - $^{99}$Mo-$^{131}$I separation step

- Common hot cells for API purifications

- Guaranty of the security supply
Risk Analysis

✓ Target qualification failure
✓ Chemical process and filtration
✓ Availability of appropriate production conditions
✓ Xe storage facility
✓ Reactor availability
✓ Regulatory approval
  ✓ Nuclear safety
  ✓ Pharmaceutical inspection
Next steps

- Target qualification: destructive tests
  - Radiochemical measurement of burnup
  - Electronic microscopy

- Cold and hot commissioning

- Process validation

- Ensuring a reliable, long term $^{99}$Mo supply
  - Target qualification in LVR15, HFR and FRM2 reactors
Conclusions

• Significant steps have been already achieved

• Significant investment have been made in LEU production environment

• Tight schedule with multiple important tasks on the critical pathway
  • High impact on IRE organization
Conclusions

• Possible conflicts with HEU productions during hot commissioning

• Higher Mo cost expected due to lower efficiency

But no compromise on the security of supply
LEU conversion project. IRE Belgium

Quarterly report n°6

Under the BOA 188839 contract
Thank you for your attention

5 key values

- Innovation
- Competence
- Team spirit
- Partnership
- Responsibility