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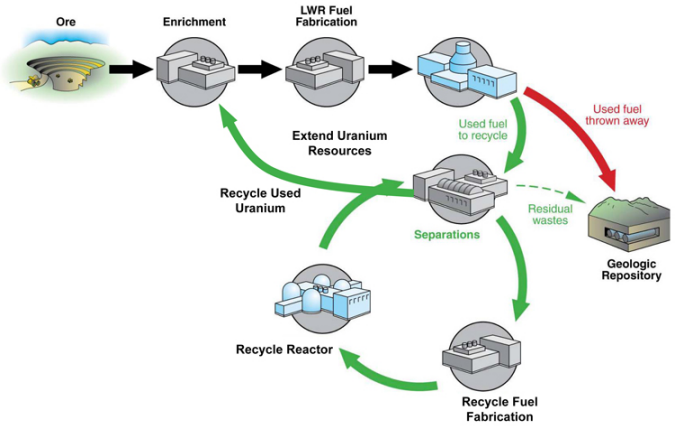
TOPICAL SESSION: NUCLEAR FUEL CYCLE SCENARIO STUDIES - INTRODUCTION



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Argonne National Laboratory (USA)

Monday, June 28, 2021
Virtual Meeting via Zoom

SESSION OVERVIEW

3:00 pm: Introduction

3:15 pm: Presentation of the fuel cycle related activities in the new European project PUMMA *Francisco ALVAREZ VELARDE (CIEMAT, Spain)*

3:45 pm: Pu multi-recycling scenarios towards a PWR fleet for a stabilization of spent fuels inventories in France – *Camille LAGUERRE (CEA, France)*

4:15 pm: Break

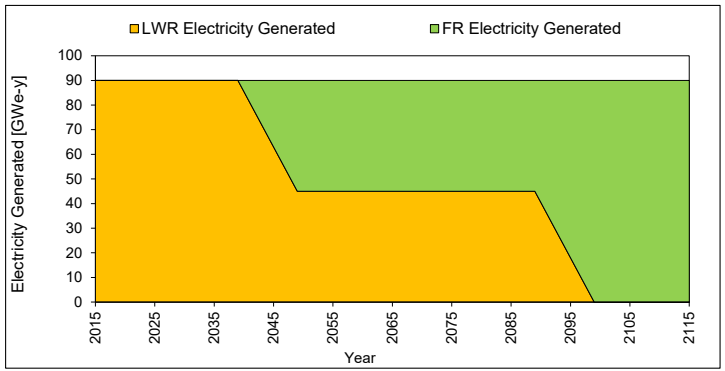
4:30 pm: Modeling Material Requirements of the Transition to HALEU Fueled Reactors - *Amanda BACHMANN (University of Illinois, USA)*

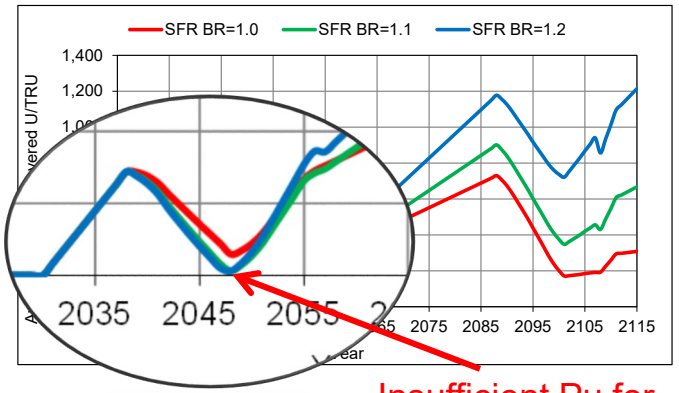
5:00pm – 5:30pm: Discussion

All times are France (host) local time (GMT +2 / CEST)

WHAT ARE SCENARIO STUDIES?

- Fuel Cycle Scenario Simulations
  - Time-dependent simulations of evolving nuclear fleets and fuel cycle systems using fuel cycle systems codes
  - Outputs include infrastructure and mass flow requirements, time-dependent benefit and challenge metrics, costs/economics, bottlenecks, *etc.*
  - Informs on large-scale (national and multinational-level) impacts of technologies, policies, timing of decisions, R&D investment, *etc.*





Insufficient Pu for new fuel

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IMPORTANCE OF SCENARIO STUDIES

Select Applications in the United States

- MIT Update of the Future of Nuclear Power (2009)
  - CAFCA
- MIT Future of the Nuclear Fuel Cycle (2011)
  - CAFCA
- DOE-NE studies supporting spent fuel management (2012)
  - DANESS, DYMOND
- DOE-NE transition analysis (2014-present)
  - DYMOND, ORION, VISION
- DOE-NE HALEU studies for Advanced Reactor Demos (2021-present)
  - Cyclus, DYMOND
- Many International/Multinational studies as well: NEA AFCS, PUMMA, etc.

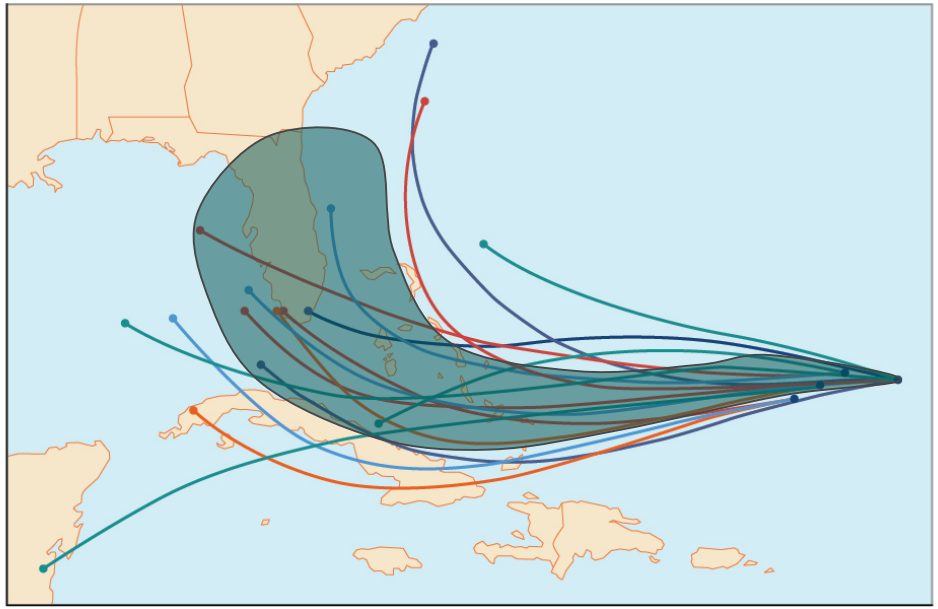
EVOLUTION OF OUR FIELD

- Traditional analysis involves changing parameters one at a time (OAT)
  - Most basic parametric calculation; assumed that all other parameters/assumptions are fixed or taken as fact (*e.g.*, commercial reprocessing of UNF begins in 2045).
  - Example Finding: “If all of these assumptions were true, then increasing the breeding ratio from 1.0 to 1.2 for all FRs will result in an initial fuel shortage.”

- Uncertainty Quantification and Sensitivity Analysis (UQSA)
  - Factoring in parametric uncertainties can yield more informative results from scenario simulations.
  - Example Finding: “Based on thousands of simulated scenarios and given the parametric uncertainties for ____, a breeding ratio of 1.1 +/- 0.05 for all FRs will minimize the fuel shortages and Pu storage requirements.”

ANALOGY: HURRICANE TRACKER

- Many individual simulations with different assumptions/models are required to generate “cone of uncertainty” (2/3 probability of path)



COMMUNICATION OF RESULTS

- Like meteorologists, we predict future scenarios (weather) for decision makers and stakeholders but also need to communicate it effectively (e.g., TV watchers don't know what barometers and low-pressure systems mean, they want to know if they need to carry an umbrella or not)
- Weather apps have evolved now to show % chance of precipitation by the hour, we should keep this example in mind when communicating results to decision makers and general audiences
- But this is a conference for meteorologists, so please don't hold back ☺