



Nuclear data for chloride fast reactors

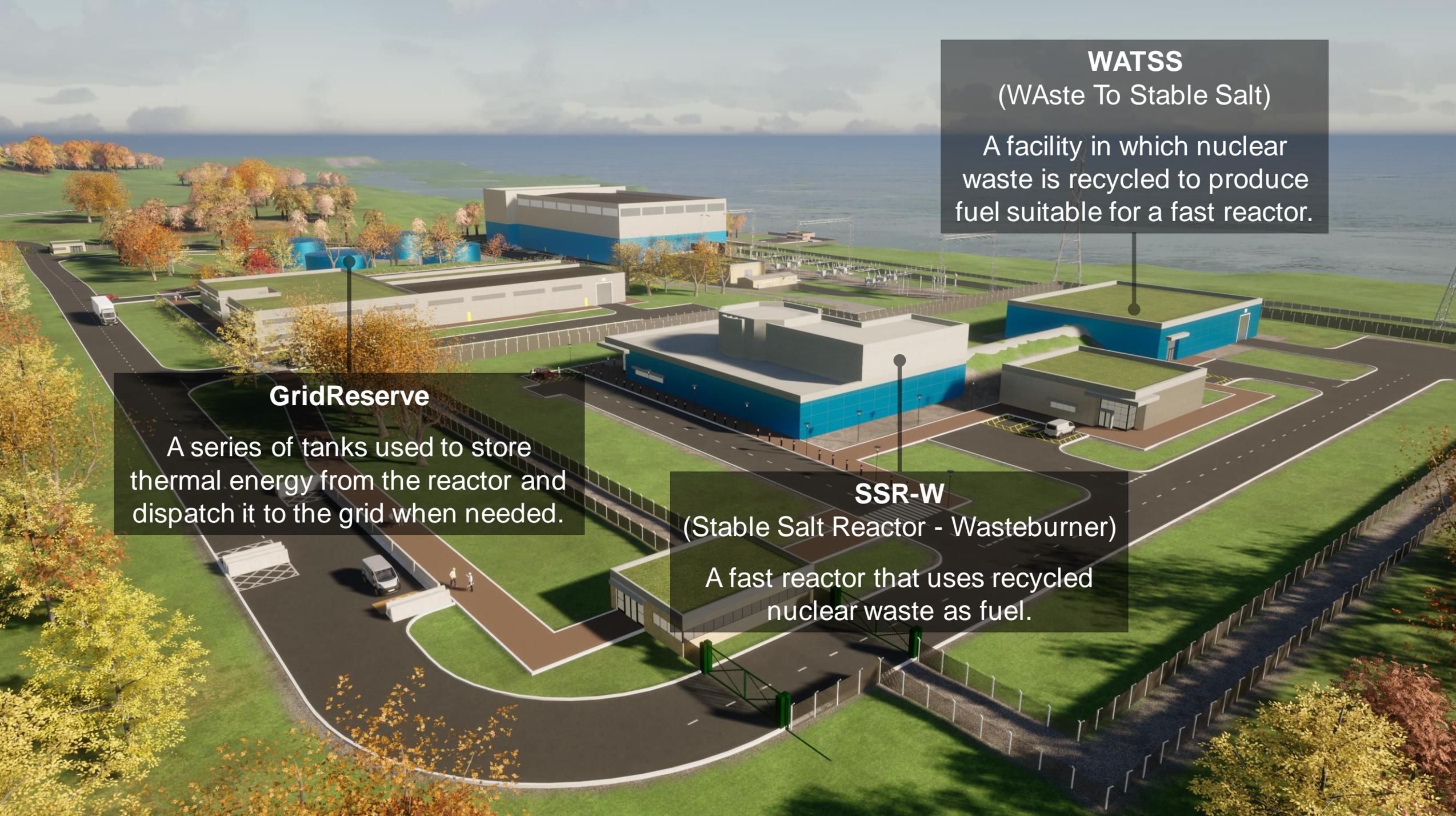
Benchmarking feedback and needs

JEFF Technical Sessions, Nuclear Data Week, 24th November 2021

Dr Tom Taylor

Introduction

- Moltex Energy is pioneering a fast spectrum “Wasteburner” reactor (SSR-W) with NB Power as its first customer
- CNSC Vendor Design Review Phase 1 completed and \$50m of federal government funds allotted



WATSS

(Waste To Stable Salt)

A facility in which nuclear waste is recycled to produce fuel suitable for a fast reactor.

GridReserve

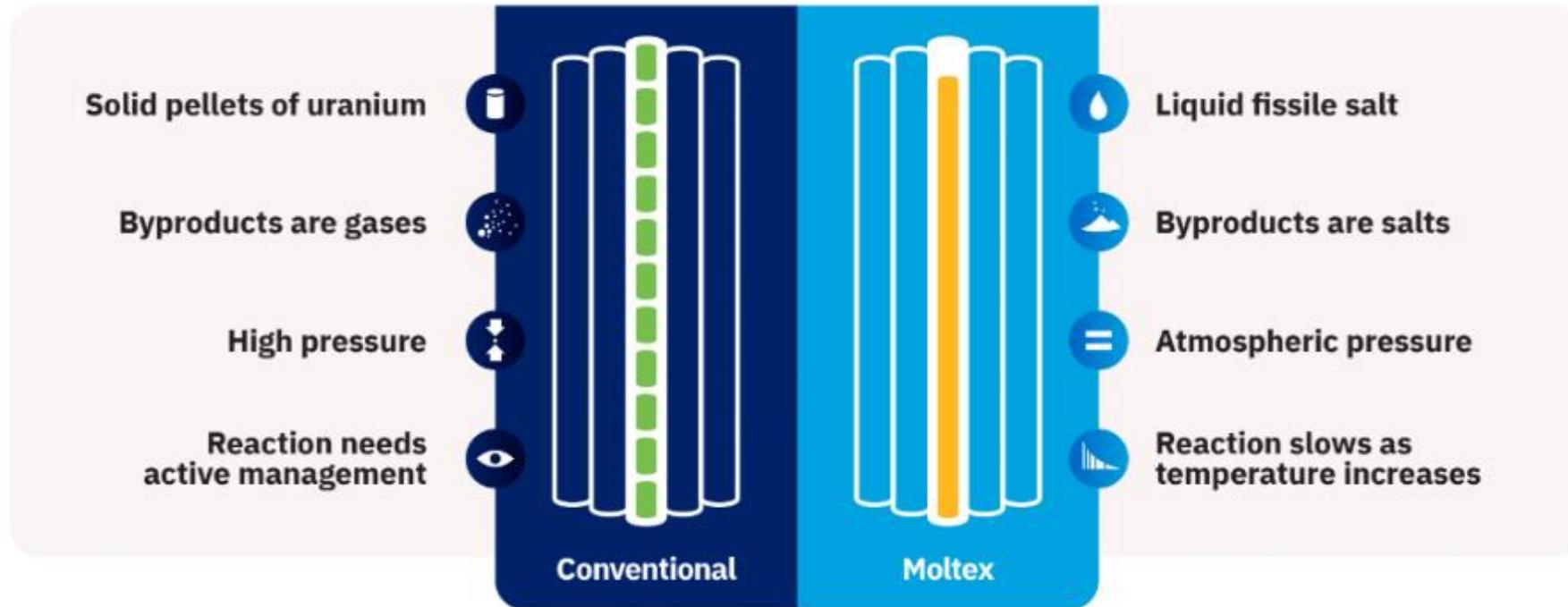
A series of tanks used to store thermal energy from the reactor and dispatch it to the grid when needed.

SSR-W

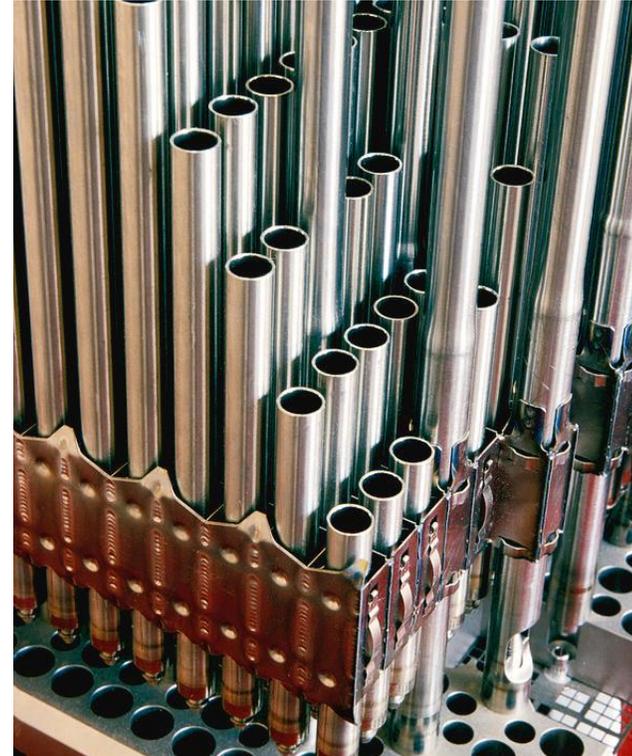
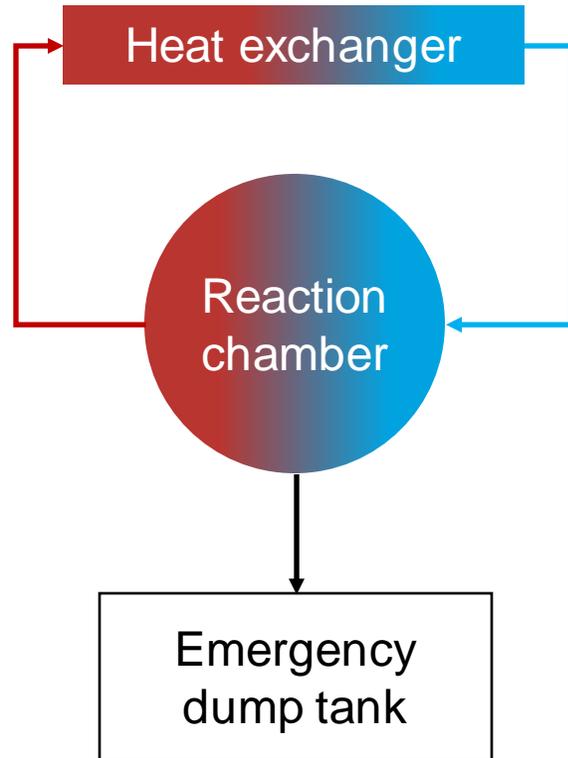
(Stable Salt Reactor - Wasteburner)

A fast reactor that uses recycled nuclear waste as fuel.

Conventional vs. SSR-W fuel

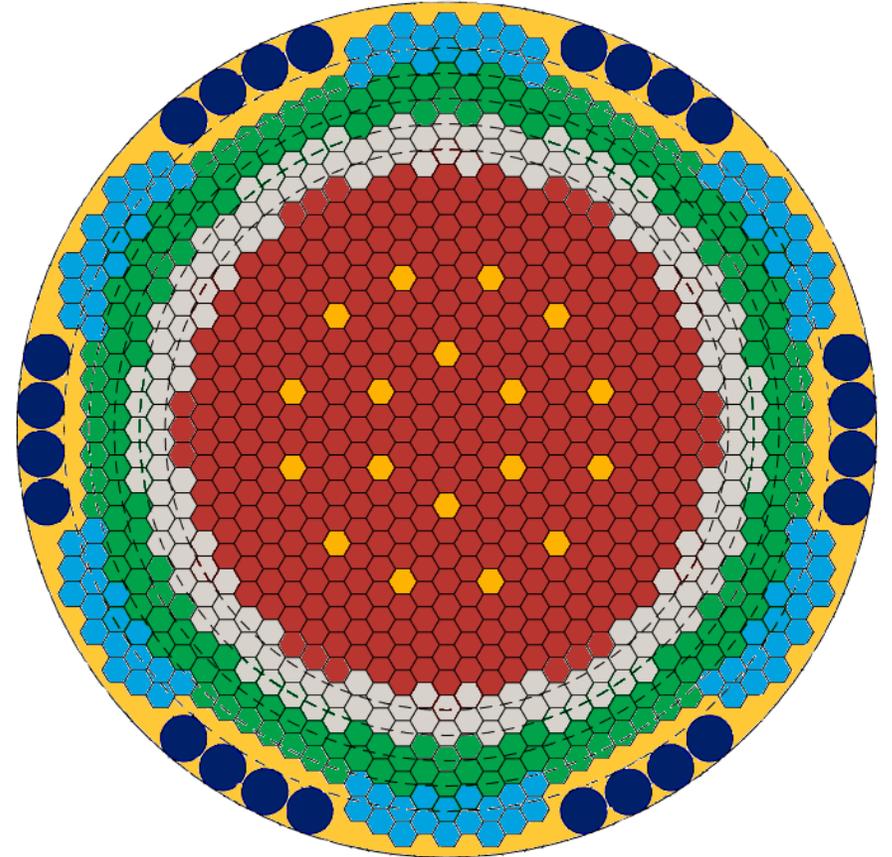


Molten salt reactors vs stable salt reactors



SSR-W reactor overview

- 300 MWe molten chloride fast reactor
- Patented WAste To Stable Salt process to extract transuranics from spent CANDU fuel and produce SSR-W fuel
- Pool-type reactor at atmospheric pressure
- Pumped flow
- Passive shutdown
- Natural convective cooling to remove decay heat



Example SSR-W configuration

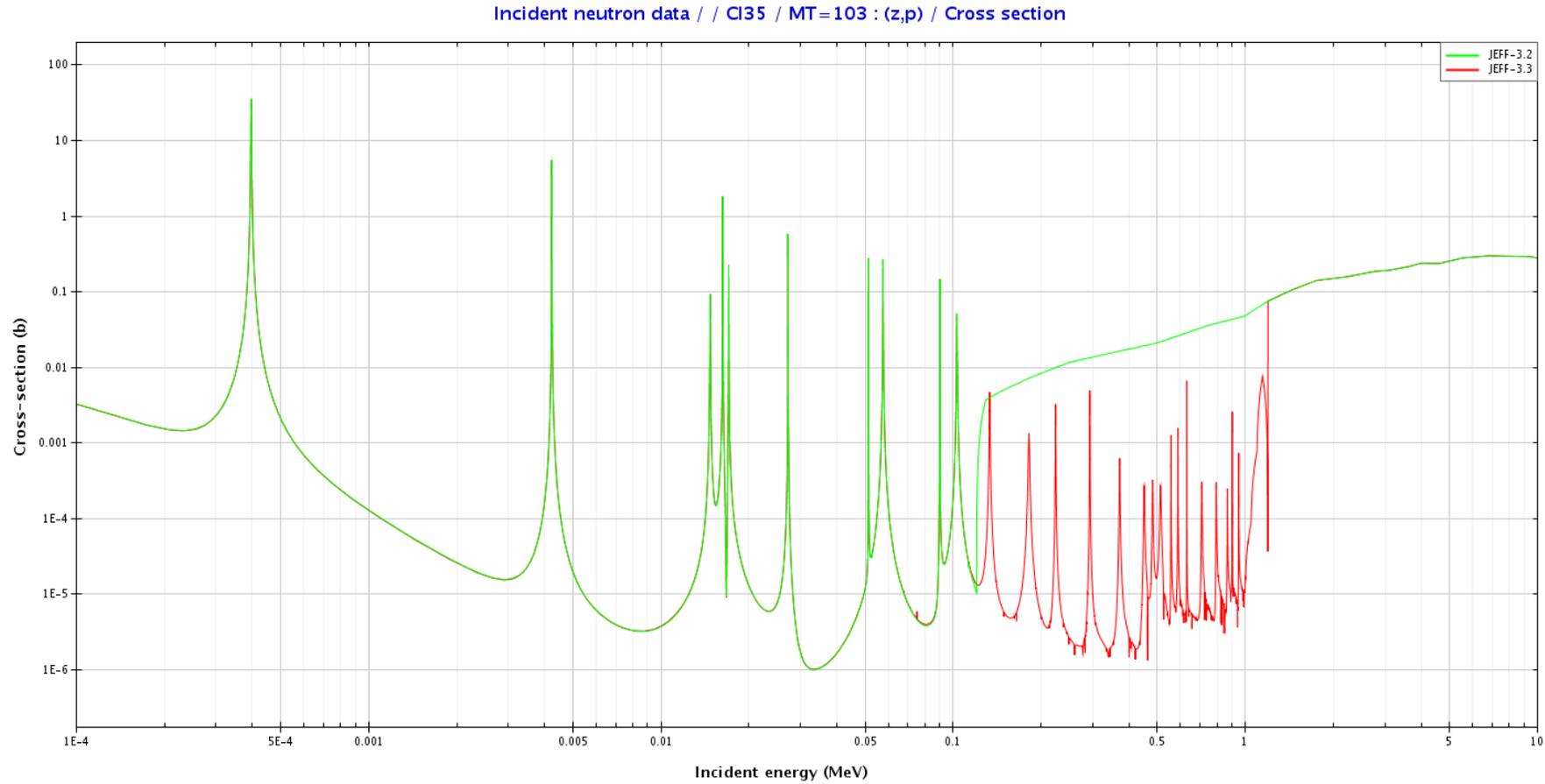
Chloride salts

- Molten salt reactors often assume fluoride salts (MSRE experience)
- Advantages for fast systems in using chlorides, due to the harder spectrum
 - Better actinide burning
 - Better U-Pu fuel cycle performance
- Other advantages and disadvantages of chlorides relative to fluorides, e.g., melting points.

Status of Cl nuclear data

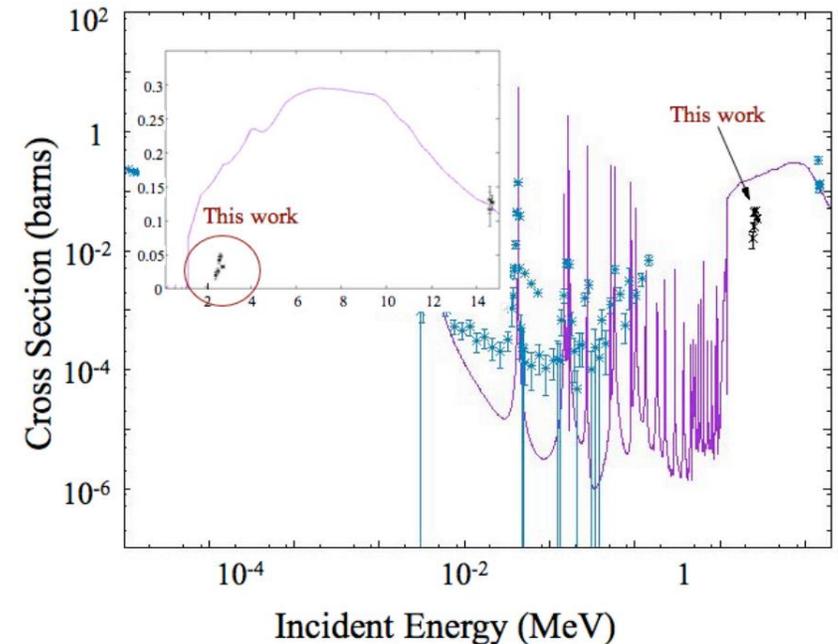
- Cl-35 cross sections for capture are significant at high energy, and there are multiple paths open
 - (n, gamma), (n, alpha), (n, p)
 - No covariance data in JEFF-3.3
- Large change in the dominant reaction (n, p) cross section in recent libraries (JEFF-3.3 contains ORNL resonance parameter update using Reich-Moore)

Status of Cl nuclear data



Sensitivity to Cl nuclear data

- Large difference in eigenvalue for the SSR-W: higher by ~4000 pcm in JEFF-3.3, and dominated by Cl-35 change
- Sensitivity also high to direct perturbation of Cl-35 (n,p) cross section in the MeV range
 - Little experimental data at high energies
 - Recent measurements (Batchelder, 2019) indicate non-statistical behaviour around 2.7 MeV, and a significantly reduced cross section compared to that in JEFF-3.3
 - Direct perturbation in this energy range gives order 1000 pcm change
- Reactivity coefficients also show reasonable sensitivity



J. C. Batchelder et al., Phys. Rev. C 99, 044612, 2019

Relevance

- Previous investigation of a fast molten chloride reactor (REBUS-3700) by EDF R&D
 - Concluded more accurate Cl data needed
- Fast molten chloride systems possibly also being investigated by the CEA
- US interest via the MCFR (Southern Company & TerraPower)
 - DoE funding allocated for new Cl-35 measurements (University of Berkley)



Thank you

tomtaylor@moltexenergy.com