1. CANADIAN TRANSITION TO FAST NEUTRON REACTORS

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2. CANADA'S ENERGY PROBLEM

- National Average Thermal Power ~ 400 GWt
- Fossil Fuel = 85% of Average Thermal Power
- No solar power for 6 months / year
- Wind generation intermittent
- 6 provinces and 3 territories must go nuclear to reduce fossil fuel consumption
- Fossil fuel displacement requires ~ 300 GWt of nuclear power

3. CANDU REACTORS

- Heavy water moderated
- Pressure tube design
- Natural uranium fuel
- Provide Canada fuel independence
- Unsuitable for urban siting
- Use only 1% of potential energy in fuel
- Discard used fuel containing Pu and other long lived high atomic weight radio isotopes

4. FAST NEUTRON REACTORS

- Low pressure liquid metal coolant pool allows urban FNR siting
- Liquid metal coolant allows higher operating temperature enabling simultaneous heat and electricity generation by FNRs
- Allow increasing fuel usage efficiency 100X
- Allow reducing long lived waste 1000X
- Potentially allow use of waste disposal trust funds for CANDU and FNR fuel recycling

5. CANDU FUEL CONCENTRATION

- Used CANDU fuel = 98.88% U + 0.38% Pu + + 0.74 % fission products, all as oxides
- On CANDU reactor sites use a recrystalization cascade to selectively extract U3O8 to reduce its gamma emission / kg sufficient for unshielded transport
- Transport remaining highly radio active fuel concentrates (< 10%) in lead containers to Chalk River for reprocessing

6. ELECTRO-REFINE CANDU FUEL

At Chalk River:

- Reduce fuel oxides to metals
- Selectively extract fission products and send them to 300 year storage
- Adjust fuel alloy component ratios
- Fabricate fuel rods and fuel bundles
- Ship fuel bundles in lead containers to FNR sites

7. ELECTRO-REFINE FNR FUEL

After 30 years of FNR operation:

- Receive used fuel bundles from FNR sites
- Reprocess blanket fuel rods to replace fissile Pu with fertile depleted U
- Reprocess core fuel rods to extract fission products and replace them with new Pu
- Make new FNR fuel rods and fuel bundles
- Ship FNR fuel bundles to FNR sites
- Send fission products to 300 year storage

8. PROCESS CHALLENGE

- In order to access the trust funds we must demonstrate that we can reliably extract all the actinide atoms from the KCl-LiCl salt
- In 1996 Laidler et al claimed >99.9% actinide element recovery via electro-refining indicating that less than 0.1% of actinide elements remained in the KCl-LiCl salt
- We need to identify all necessary to meet this objective and the related process throughput

9. CONCLUSION

- In Canada climate change is happening 2X to 3X faster than in the USA
- Mankind's energy future lies in converting U-238 into fissionable Pu and then using surplus Pu to initiate conversion of Th-232 into U-233
- Can we collaborate?
- Thank you for your attention
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