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Canadian Developments on Tritium Fuel Cycles for Fusion Energy

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Since the beginning of the nuclear era, Canada has been a leader in the area of deuterium and tritium technologies. CANDU nuclear power stations use deuterium oxide to enable a chain reaction of fission in natural uranium, thereby requiring the development of deuterium oxide production and management. Neutron capture by deuterium leads to formation of tritiated deuterium oxide in CANDU reactors. This, in turn, has driven the development of technologies and best work practices for tritium capture, extraction, and handling. The Canadian nuclear industry is extending those established tritium technologies and experience into nuclear fusion applications by working with fusion organizations to develop solutions at all technology readiness levels.

Mature technologies like tritium capture, water detritiation, tritium handling, getter beds, and tritium monitors and measurements can be used in a DT fuel cycle with no or minimal modifications. Supporting these are fully-developed process simulations, design experience, assets and operating experience that can be immediately used for D-T fuel cycle design. Currently, CNL and other Canadian firms are directly providing these technologies to national and international fusion projects or working with them on how to deploy these technologies themselves.

For areas with low technology readiness levels, Canada is leveraging its assets to help develop the new technologies required by fusion projects. For example, CNL's tritium facility is licensed to handle up to two million Curies of gaseous tritium (200 grams) and 100's of Curies/kg of aqueous tritium in the lab. This ability means that CNL's tritium facility is an excellent place to perform highly tritiated tests, such as tritium permeation through materials for fusion energy. CNL is planning molten metal test loops for tritium breeding and extraction technology tests and demonstrations, as well as developing a cost competitive and compact Thermal Cycling Adsorption Process (TCAP) unit, and a variety of installations of Combined Electrolysis and Catalytic Exchange (CECE) systems and equipment.

This presentation will detail some of the above activities in Canada.

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