Team 1 Supply Chain in Nuclear Fuels Executive Summary

The nuclear industry in Canada continues to play an important role in the Canadian Energy Sector by providing 16% of Canada's total electricity requirement in nuclear power plants. As a Tier 1 country in the nuclear industry with over 70 years of experience, Canada has a strong reputation of delivering quality in its products, service and knowledge. However, over the past several decades lack of government, and of a national long-term nuclear strategy has led to a stagnating industry. After analyzing the supply chain of the nuclear fuel cycle in Canada, from mining to disposal and reprocessing, any vulnerabilities and opportunities have been identified with recommended actions or points for further investigation.

At the start of the supply chain, uranium ore is extracted from the Earth using a variety of methods depending on site geology. The ore is then converted to yellowcake, an intermediate material in the overall processing to usable fuel, and stored awaiting transport. A European Union study found that the lack of harmonization and overregulation in transporting nuclear material such as yellowcake is a key barrier in the supply chain not just for Canada, but worldwide. As an experienced tier 1 nation in the nuclear sector, Canada should take the lead in harmonization efforts. Secondly, rail should be explored to potentially shorten transit times and increase safety. Furthermore, mining and fabrication companies within Canada should work to use domestic uranium for CANDU, rather than exporting and re-importing yellowcake.

After the uranium ore is mined and converted to yellowcake, the next step in the fuel cycle is fuel enrichment and fabrication. Through the CANDU design, Canada does not require an enrichment stage, saving up to 50% of costs associated. The CANDU design also leads to much lighter and smaller fuel bundles which are easier to fabricate, transport and handle. Canada has also placed its fabrication facilities close to its reactors, which is advantageous in reducing overall cost associated with transporting the fuel bundles. Canada should promote these advantages associated with the CANDU design on the global stage.

After the fuel is fabricated, it is transported to nuclear plants and stored in areas close to the reactor. Once the fuel is spent in the reactors, it is first kept in water-cooled pools to allow for the radioactivity and heat associated to die down, and then it is kept in longer-term dry storage awaiting final disposal and/or reprocessing. As the Canadian fleet of nuclear reactors age there are two key problems that may arise that have been observed in American operations. First, proper waste inventory planning must be put into place if the lifetime of the plant is extended. Second, proper training for all employees when moving and storing spent fuel should be implemented to maximize cooling.

Nuclear Waste Management, is the final stage of the fuel cycle, is one of the hardest operations management challenges in the world. With strict oversight from the IAEA, short term high level waste management techniques have been standardized worldwide. For long term management, France, Finland, and the UK's positive social and cultural responses to novel waste management technologies promoted Deep Geological Repositories and Nuclear Reprocessing Facilities. Increased social awareness programs and financial incentives are recommended to be promoted. There is also potential for starting a reprocessing plant on the Bruce Power site, with the capacity of serving Canadian as well as American sites, with close access to the railway lines.