Alberta's Nuclear Option: A Uranium–Oil Sands Joint Production

Duane Pendergast| Computare.org

Energy Bridge Magazine, Spring 2011
Updated: February 28, 2011
Chinese: 阿尔伯塔省的核能选择
(Login required, p. 31)

Canada's conventional oil and gas reserves may be in decline, but the country's huge oil sands and uranium ore resources are of "energy superpower" proportions. Interestingly, these two world-class energy resources can be developed synergistically: abundant nuclear energy can be used to help produce and extend fossil fuel resources, thus serving as a bridge to a world much less dependent of fossil fuel energy. *Energy Bridge* contributor **Duane Pendergast** examines this opportunity — and its challenges.

Double-Edged Sword of Oil Sands Extraction

Outcrops of bitumen deposits have been known to Canada's inhabitants for centuries. Although some of the deposits are easily accessible near the surface, they still must be separated from sand and modified through the addition of hydrogen or removal of carbon to produce useable crude oil similar to conventional oil resources. The additional expense incurred in the mining of oil sands long made them economically uncompetitive with conventional oil. Yet most of the oil sand deposits are too deep underground to apply surface mining methods. New methods, including steam-assisted gravity drainage

(SAGD), involve the injection of steam underground to cause the softened bitumen to flow to the surface. Unfortunately, the carbon dioxide from burning natural gas in this process contributes significantly to Canada's share of global greenhouse gases, and consumes an otherwise valuable resource.

Modes of Integrating Nuclear

Canada's nuclear industry offers a compelling solution to many oil sands extraction and upgrading challenges. Variants of Canada's CANDU reactor system have been studied extensively for this purpose over the years. A large reactor system could be configured to provide both steam and electricity — or only electricity — to oil sands projects and other consumers. A 2009 presentation from AECL, Canada's national nuclear company, indicates that a large CANDU reactor could provide steam sufficient to serve a 300,000 barrel per day SAGD extraction plant. Most SAGD facilities are currently only 30,000 to 50,000 barrels per day in size. The excess energy could be used for the sake of generating electricity which could be used, among other purposes, to produce hydrogen for the bitumen upgrading process. Another possible application is the direct electrical resistance heating of oil sands deposits, rather than steam, to facilitate extraction. In this way, the energy from large reactors, based on current commercially-proven nuclear technology, could be integrated into the overall energy economy.

Small is Beautiful

Some proponents of nuclear energy believe oil industry needs would be better served by smaller reactors dedicated to a single oil extraction project in a distributed energy production model. The international nuclear industry, keen to participate in the development of these reactors, has several such reactors in varying stages of development, but progress is slow as their design and licensing standards are not as well established than those of current large systems. Some small reactors incorporate elements of more advanced reactor types. Ultimately, nuclear technology will need to be developed to take advantage of "advanced" fuel cycles such as breeder reactors which are able to extract up to 100 times more energy from uranium than current commercial reactors.

Will Alberta Go Nuclear?

There are now no nuclear power plants in Alberta, but interest in nuclear energy has grown over the past few years with the course of the debate charted in the main by the twin concerns of climate change and nuclear energy safety. Meanwhile pragmatists are quietly engaging in actions to clear a path to the future. The Alberta government recently completed a study of nuclear energy, coupled with public consultation, which concluded with cautious endorsement in December 2009.

Then Alberta Energy Minister Mel Knight opened the path for industry to develop nuclear power in the province when he said, "Alberta will maintain its existing policy where power generation options are

proposed by the private sector in the province and considered on a case-by-case basis. We will work with the federal government regarding any nuclear power application to ensure provincial rules and environmental standards are respected."

Bruce Power, operator of the world's second biggest nuclear facility in Ontario, formed a subsidiary to investigate the market for nuclear energy in Alberta. Currently, the company is evaluating the feasibility of a nuclear power facility near Peace River.

The Petroleum Technology Alliance of Canada (PTAC) is a not-for-profit multi-stakeholder association of organizations striving to enhance the overall performance of the Canadian hydrocarbon energy industry through innovation. PTAC has begun to consider the potential benefits of nuclear energy for oil sands extraction and upgrading and has completed a preliminary review of nuclear options. It anticipates that adoption of nuclear energy will be a lengthy process that could unfold over a 15-year time horizon.

The Canadian Nuclear Safety Commission is in the process of paving the way for the licensing of alternative reactor concepts. A regulatory document titled "Design of Small Reactors" has been prepared for public consultation, establishing a set of general design requirements to be aligned with accepted international codes and standards. A small reactor is defined as a facility with a power level less than 200 megawatts thermal (MWt) used for research, isotope production, steam generation, electricity production or other applications. These standards will set the stage for the introduction of alternate nuclear technologies into the oil patch.

Bitumen-Uranium Synergy

Canada's oil sands and uranium resources can be developed synergistically, thereby firstly extending petroleum reserves and, ultimately, enabling nuclear energy's staged replacement of dwindling conventional oil and other fossil fuels. In this way the pursuit of nuclear energy effectively becomes a bridge to the future by increasing the world's supply of fossil fuel resources while enabling the development of nuclear technology with which to fully unlock the energy available from uranium resources. As fossil fuel resources are eventually depleted, nuclear energy will emerge to become a major – if not *the* major – source of the energy humanity needs to maintain a prosperous future