ADDRESSING CLIMATE CHANGE CHALLENGES THROUGH NUCLEAR TECHNOLOGY

By Kevin Routledge, President of AMEC NCL

With the continued commitment of the Ontario government to eventually phase out the coal plants as part of their green energy plan, and with climate change moving to the top of the political agenda worldwide, carbon free options, including nuclear energy, will become even more important for meeting the growing energy demands of the province.

In Canada, nuclear power accounts for 15.5 per cent of the electricity mix, and provides 54 per cent of Ontario's electricity sources. However, Ontario's nuclear plants are aging, and many will be in need of refurbishment over the next decade. If these aging nuclear plants are not refurbished, Ontario will be left with only 5,900 MW of nuclear capacity by 2015 – only a small fraction of what will be needed; and with large scale options, such as gas fired plants, subject to price volatility, the fuel required for this will likely be in scarce supply.

In October 2005, Bruce Power, Ontario's second largest utility, awarded AMEC a contract to project manage the restart of two of its nuclear reactors, Units 1 and 2, at its Bruce A power station. Bruce Power, which is located on the shore of Lake Huron, is home to eight CANDU pressurized heavy water reactors. Units 1 and 2 were shutdown in the mid-1990s when the then owner Ontario Hydro decided to concentrate resources on operating its other reactors. The enormous significance of this project can be seen in the investment required to bring the Units on line again. The project is estimated to cost C$2.75 billion (US$2.43 billion), funded by the private sector, and is expected to be complete in 2009.

AMEC is providing project, contract and construction management for this highly complex project, as well as engineering acceptance, and the health, safety and environmental programs and oversight. Currently, the project has over 2,000 staff, working both on and offsite, which is near the peak of workers expected during the project.

The restart project is one of the largest and most challeng-

ing engineering projects to take place in North America. The project requires a series of refurbishments, upgrades and enhancements to the two reactors. The work includes:

The replacement of reactor's pressure tubes and calandria tubes (480 in each reactor);

Replacements of half the length of feeder pipes, which provide water to the fuel channels;

Steam generator replacements (8-110 t vessels in each unit);

Electrical systems upgrades;

Main condenser refurbishment;

Turbine refurbishment;

Feed water heater refurbishment;

Shutdown system 2 (SDS2) enhancement; and

Significant other maintenance on both nuclear and other plant equipment.

For the remainder of the plant, the opportunity is being taken to upgrade and enhance other nuclear and non-nuclear systems. For example, 30 transformers in the two units contain polychlorinated biphenyls (PCBs). These will be removed and replaced with non-PCB transformers.

After both nuclear and non-nuclear systems have been refurbished and upgraded, Bruce Power will request permission to refuel Units 1 and 2 from the Canadian Nuclear Safety Commission. During refueling, the reactor will be loaded with natural uranium fuel, except for a small number of depleted uranium fuel bundles, used to fine-tune reactivity in the fresh core, at specific locations. Each reactor will require 576 22.5 kg fuel bundles or approximately 260 t of fuel for the initial refueling.

From a physical standpoint, this project is extremely challenging, but this project is also demanding from a regulatory standpoint. Refueling will require a license amendment enabling Bruce Power to move the reactors from a safely-laid up state to a guaranteed shutdown state. Refueling and associated operations such as refilling the primary heat transport system, final system integration, and commissioning will precede synchronization to the power grid by approximately five months.

The overall aim is to improve the safety of the reactors, and to increase potential generation capacity and reliability. Completion of the project will enable each Unit to produce safe, economical power for an additional 25 years.

Since the project commenced on October 31, 2005, the project continues to schedule, and has achieved the following milestones:

The environmental assessment was approved, without any negative interventions;

An offsite training facility has been set up and operated, with, to date, over 3500 workers trained in project processes, prior to them starting work on site;

Major offices and warehousing facilities are in place;

A construction island has been created around Units 1 and 2, with separate processes and procedures from the operating units;

Both Units has been fully isolated from the other units, and decontaminated; with work at the reactor face in Unit 2 already able to be undertaken in "civvies";

Feeders in Unit 2 have been removed and progress is well in hand for removal of the fuel channels; and,

Ten of the 16 new stream generators have arrived on site and four are now installed.

Safety is of paramount importance on this project, and, to date, over 5 million hours have been worked on site without a lost time incident. In addition doses to workers are well below budgets, as is the radioactive waste being dealt with on the project. Environmental impacts from the construction work have been minimal.

In addition to AMEC, there are other well known Canadian companies involved with this project including Atomic Energy of Canada Limited (AECL) , who is replacing the fuel channels of the reactors; Babcock and Wilcox, who is supplying the steam generators and installed bulkhead plates to isolate the units; SNC Lavalin, who is removing and installing the new steam generators; Siemens Canada, who is responsible for refurbishing the turbines and the electrical systems; and Acres/Sargent Lundy, E S Fox, RCM Technologies, General Electric of Canada, and Ontario Power Generation, on the balance of the work.

Though refurbishments can be completed faster, and the costs are less than building a new nuclear power station, legacy issues and proximity to the operating Units, make it more complex. The task of removing steam generators, as well as pressure tubes, calandria tubes and feeder pipes at the same time significantly increases the challenge, particularly as a number of these evolutions are first of a kind in the industry.

The Bruce A restart is just the first stage of a much broader C$4.25 billion (US$3.76 billion) program to extend the life of the station planned by Bruce Power. With increasing demand, and aging assets, the success of the Bruce A restart is critical to securing Ontario's energy future.

With the Bruce A restart project now well advanced and on schedule, this project will ensure nuclear power continues to play a key role in a diverse energy strategy for Ontario.

Kevin Routledge is President of AMEC NCL, the nuclear division of AMEC in North America, and was until very recently the Project Director for the Bruce Restart project. For more info contact kevin.routledge@amec.com