



Leading the Next Generation Technology

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Association's Annual Seminar

The Nuclear Renaissance - Powering Up

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Please Check Against Delivery

Slide 2 - Leading the Next Generation CANDU Technology

- We had a very interesting morning and I hope you will find the afternoon equally productive. It is a daunting task to “lead world-wide” as the advertised title of this talk suggests – so I will focus much of my remarks on Canada and especially on Ontario where AECL's technology is indeed leading.
- A lot has been said in the past 2 years about the looming power crunch Ontario is facing ... as coal is phased out, old plants are retired and demand increases as population and the economy grows.
- Short-term measures underway to meet the looming capacity gap include renewables, conservation, refurbishing CANDUs, and incremental gas
- Many acknowledge that this will not be enough to assure adequate, reliable and competitive supply in Ontario, Canada's economic engine – sustained growth is at stake.
- Most agree that if we are to remove coal in Ontario we will need new baseload as older plants are phased out, and the only 2 viable options are new build nuclear and perhaps in the longer term some hydro.

➤ To retain anywhere near nuclear's current share of the energy mix we will need to refurbish and build new plants. In the U.K. this notion of replacing shutdown plants with new build is referred to as replacing nuclear with nuclear – here in Canada, we refer to it as replacing CANDU with CANDU.

➤ Pollsters tell us that the majority of people in Ontario who want clean, available reliable safe and affordable electricity see new nuclear as inevitable.

➤ If new nuclear is indeed inevitable, you have to plan for it now. Ontario has to start the approval processes now – especially the Environmental Assessment or EA for site-specific new nuclear projects – to meet the earliest in-service date of 2014.

(insert slide 3

Shows why we think new build is inevitable)

➤ What we are talking about is replacing, or adding to existing nuclear capacity with new CANDUs on existing sites in supportive communities – we are not talking about greenfield sites.

➤ We can't afford to wait, because of the perceived length of time & uncertainties of the EA process, and the potential it has to push out the date for project starts.

Slide 4 - Advanced CANDU Technology Solutions

- Well, if the message conveys a sense of urgency about the nuclear option, then it is also valid to ask the question: Are we ready to deliver?
- What I'd like to do this afternoon is briefly update you on what we at AECL are doing to be ready to continue delivering CANDU technology to Ontario and around the world.
- To elaborate I will touch on each of the topics as listed on the slide.
- But first, let me remind you that AECL has a total life cycle approach, starting with CANDU R&D at Chalk River Laboratories, through to CANDU product design and engineering, to project management and nuclear services and waste management.
- AECL's unique capability is also supported by an integrated network of strong CANDU manufacturers, suppliers and partners – without which there would be no ability to deliver the CANDU product.
- Some have questioned the level of support of the federal government for AECL. In response, I need only refer you to Minister Efford's remarks last night in which he expressed the strongest level of support for the CANDU and AECL.
- In fact rather than give my talk, I was tempted to read Minister Efford's speech over again - it is enormously gratifying to hear that the government is behind our industry – fully supports AECL and the ACR, including a commitment to more funding.

- The federal government continues to make significant investments in CANDU technology, and they are demonstrating a strategic vision in doing so.
- Obviously, at the same time, new investments will have to be made in the infrastructure to support the technology as well, and the government acknowledges this obligation.

Slide 5 - Refurbishment Technology

- Now let's turn to the first topic : refurbishment of reactors.
- CANDU reactor refurbishment is being undertaken today as an essential interim step prior to next-generation ACR technology being project ready.
- Duncan says he would build new today if we were ready, but as a practical matter, we have to begin to fill the capacity gap with refurbishments while the EA and licensing processes are completed. This takes time, and in the interim, CANDU refurbishment makes the most sense for 2 reasons:
 - It is economic and it can be done on a timely basis to ensure continued baseload supply.
 - Refurbishments basically deliver a half-price new power plant – one that will operate for another 25 or 30 years and generate another 5 billion dollars or so worth of electricity – cleanly, safely, reliably. It is a good option.
- In the immediate future, we are looking forward to an announcement of the Bruce 1 & 2 refurbs, and a positive decision on the Point Lepreau refurbishment project in New Brunswick.

- This will be followed by additional refurbishments in Ontario, in Quebec, and in Korea and Argentina, where we are currently in negotiations to start refurbishment projects there.
- We are off to a good start, thanks to three large refurbished CANDUs coming back into service recently. CANDU is once again generating half of Ontario's electricity.
- So it just makes sense to get the most value out of your existing investment in CANDU while you plan new build infrastructure for the future.

Slide 6 - CANDU Refurbishment Technology

- In case you're not aware, CANDU is the only commercial reactor specifically designed to have its reactor core structures replaced. We have been investing in this capability for some time.
- Pressure tubes and calandria or 'core' tubes can be replaced following their first 30-year life span.
- And since AECL's R&D efforts have advanced fuel channel technology over time, the new tubes are even more robust. Naturally, the ACR incorporates these advances in component and material technology.
- The following animated clip shows just a hint of the hi-tech robotics, tools and technology developed by AECL to ensure a low-cost, safe and efficient re-tubing, while minimizing waste by-products.

[ROLL CLIP slide 7]

This is a simulation of the advanced tooling we are using to remove pressure tubes from the reactor core and to reduce their volume. You can see a tube being extracted from the core, tube is removed, the machine crushes a section of the tube and then cuts the section into small pieces. The whole process takes about 13 minutes. The machine is shielded and any debris is contained so that personnel can work in the area. The machine is fully prototyped and ready to go.

- As has been said before, successful refurbishment requires significant up-front investment in project planning and project management – this is critical to a smooth, on-time and on-budget refurbishment project and avoiding problems.
- An outsourced refurb requires a strong dedicated utility - a model that is key to engaging AECL and its partners on an equitable, risk-sharing basis. Bruce Power has stepped up to fill this role.
- In terms of the Pickering 1 refurbishment project, while based on a different approach, OPG has made solid progress, and we all look forward to this reactor being returned to service this Fall.
- Provincial governments, shareholder and public support – particularly by the local community – are also key drivers in making these major projects a success.
- As well, refurbishment projects enhance CANDU IP and our delivery know-how – the necessary building blocks for launching the new generation ACR from Canada..

Slide 8 - CANDU Reactor Technology

- Turning now from refurbishment to new build CANDU technologies, let me first talk a bit about the CANDU 6.
- In terms of proven reactor technology, the 6 is both a workhorse and a world beater.
- CANDU 6 reactors have been operating very successfully in Canada – in Quebec and New Brunswick, with a lifetime capacity factor of over 80%.
- The average lifetime capacity factor for the ten CANDU 6 units worldwide is 88% – one of, if not the highest performance of any class of reactor.
- Three of the top reactors worldwide last year were, in fact, CANDU 6 reactors designed and built by Team CANDU.
- CANDU 6 technology has evolved, as evidenced by the recently completed Qinshan project, where new construction and modular techniques were successfully deployed. Off this huge success, China is considering 2 more 6 units to replicate the Qinshan project as a step towards an ACR 1000 program.
- Last January, Prime Minister Martin opened the door even further in China to CANDU ACR 1000 technology with the signing of the Canada-China Energy Statement, supported by the CANDU (MOU) on next generation Nuclear Energy Cooperation between AECL and key Chinese government agencies.

- We are also completing the second CANDU 6 in Romania, and we will likely be starting Unit 3 in the near future.
- CANDU 6 is also an immediate and attractive potential capacity solution for Ontario.
- It's cheaper than gas and alternatives, and can be built in Canada in even shorter time than we did in China.
- In fact, the people in this room know how to deliver CANDU 6 power plants on time and on budget – and they have proved it by delivering six reactor projects in three countries over the past ten years
- Very simply, CANDU 6 offers Ontario certainty on price, schedule and risk – and could serve as a strategic bridge between the refurbished CANDU fleet, and the deployment of the ACR. Some have mentioned CANDU 9 series.
- But let's talk more about this future approach – launching the Advanced CANDU Reactor. The ACR takes the best features of CANDU 6 and improves upon them – reducing capital cost, construction time, footprint and waste, while simplifying design and construction via modularity.

Slide 9 - Advanced CANDU Reactor Technology

- The ACR 1000 has superior economics and is fully competitive against other reactor designs, and it will be one of the first Gen 3 PLUS reactor in the world to be project ready within the timeframe for new build commitments.
- ACR 1000 can be project ready for utility customers by 2008 – assuming a reasonable EA and licensing process
- We are well into the licensing process for the ACR in both Canada and the US, and after two years of pre-licensing work no show-stoppers have been identified by either licensing authority.
- With respect to our marketing efforts in the US, obviously we were disappointed that Dominion did not continue with its proposal to the US Department of Energy. However, we do understand the reality that the first reactor built in America will now be US technology. Perhaps we were too successful in being out front as the most likely first build project.
- But AECL and Hitachi are still active in the US. This is because the US market, like China, is big enough to support more than one reactor technology. We are also encouraged by the fact that the ACR has been well received by the US regulator, and endorsed by the US DoE for technology and superior economics.

- But when it comes to smaller nuclear markets, such as Canada, France and Japan, where considerable public investment has been made in a single domestic reactor technology, there is less potential for more than one technology. It's just not practical for small markets.
- Looking farther down the road, beyond ACR, the future of Canadian nuclear energy technology is very promising. The CANDU-based Super Critical Water Reactor is one of two leading international contenders for deploying Generation IV technology. And, as you heard the Minister say last night, Canada has signed an international treaty to support the SCWR.

Slide 10 - Nuclear Services Technology

- In support of our current and future CANDU Utility Owners, we are making investments as the vendor in order to deliver essential reactor support services in a more integrated way, with partners such as SNC-Lavalin, B&W and NNC.
- We are getting ready to deliver new and more services to meet the growing needs of the refurbished CANDU base, as well as those of the expanding fleet of new builds.
- We want to leverage for the benefit of all customers, our international services model where we have long-term, preferred supplier relationships.
- If the supply chain knows it has a key long-term role to play in the services business, they will continue to make investments in resources and supporting technology.
- The role of vendor based services, with any piece of sophisticated machinery, be it an aircraft or a CANDU reactor, is to contribute to the maintenance and life cycle support of the product to sustained high performance.
- CANDU customers give us high marks for our emergency support capabilities, and the fact that our Lab scientists and design engineers will work 24/7 to address a technical or operating problem until it is resolved.

- We have also developed new technologies to stay ahead of the maintenance curve, whether retro-fitted into existing units, or designed into ACR and Gen IV.
 - For example, we have developed sophisticated technology, to monitor plant water chemistry or component performance for multiple reactor sites from a central location using world experts.
- Regarding spin-offs of our services R&D, I'm pleased to tell you that AECL has been successfully selling its technology beyond the CANDU fleet.
 - For example, our reactor safety technology has been back-fitted into reactors in France, the US, Switzerland and Finland. (Pump, Emergency Core Cooling Strainers, Passive Hydrogen recombiners.)

Slide 11 - Leading Waste Management Technology

- To enable an expanding nuclear power option, we must also address its "fellow traveler" the successful management of the waste aspects, and we haven't been standing still here either, we have been investing in the deployment of a full suite of low, medium and high-level waste management technologies and services.
- AECL has considerable expertise in this area, since we have been safely managing Canada's legacy wastes since the 1940s.
- In our view, waste should not be seen as impediment to expansion of the nuclear option.
- As you know, the federal government invested about \$900M over 25 years to prove up deep underground disposal at AECL's underground labs in Manitoba.
- Later this year, we will know if the Nuclear Waste Management Organization recommends permanent underground disposal, or a combination of waste management options for Canada.
- Recently, OPG broke the ice with its announcement of the planned low and medium level facility at the Bruce site.

- For its part, AECL has successfully delivered another possible solution to long-term spent fuel called MACSTOR – an above-ground, modular, air-cooled, dry-storage system, which is proven technology – renewable indefinitely.

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- In addition we have developed new technologies to manage Canada's legacy waste starting with our Chalk River facilities.
- For example, IRUS (Intrusion Resistant Underground Structure) is designed for permanent passive disposal of wastes with an active lifetime of up to 500 years. IRUS will also have active monitoring, but will work even without human intervention.

Slide 13 - Delivery Capability

- The story wouldn't be complete if we didn't talk about AECL readiness as an organization to deliver.
- First let me say that AECL has the mandate and expertise to structure deals as required – to participate in whatever commercial structure is needed and we can leverage our strength to encourage private sector partners to optimize pricing and risk sharing, as well as to capitalize on our partners' contracting and project management skills.
- At the same time we are learning from our partners and customers to be more focused on their needs and it is starting to pay off in terms of higher customer satisfaction, better quality & timeliness.
- In terms of corporate governance, we are pleased that the recent Treasury Board report on Crown governance puts AECL at the top in basically all categories.
- We have restructured AECL into Business Units on a P&L basis – to be more commercial, and transparent to our shareholder and the public.

- We have been listening to the Regulator, (especially over the past several weeks) and we are improving our internal processes to not just meet regulatory requirements, but to lead with a higher standard that becomes a way of life in our company.
- We agree 100% with the Regulator's philosophy on this very important point – that we set a high standard, and the CNSC ensures that it is met.
- To further emphasize this thrust I have recently announced the addition of key resources including the creation of a new position of Chief Regulatory Officer to integrate and improve our safety culture and regulatory process, and to accelerate the process of change.
- AECL today is very different – more accountable, flexible and responsive to its customers and the Regulator, as well as its shareholder, the Government of Canada.

Slide 14 - CANDU: Benefits to Canada

- If things unfold as we hope, with CANDU refurbishments and new build, the benefits to Canada are enormous.
- Our industry today already has a \$5 to \$6 Billion a year economic impact, with 30,000 highly skilled workers in about 150 companies.
- In the past four decades, the value to Canada from the CANDU industry has amounted to an impressive \$160B -- \$100B of that is the value of electricity generated, while the other \$60B was generated by a number of things including CANDU builds at home and abroad, R&D, uranium and nuclear medicine exports, refurbishments, CANDU equipment & components, products & services.
- In the next two decades, assuming reasonable domestic and export sales, the contribution of the CANDU industry to Canada via domestic and export business is estimated to be about \$85B, an amount of benefit no other technology can offer our country.
- In terms of Kyoto, without CANDU, Canada's greenhouse gas emissions would jump 20% overnight.
- 100 million tonnes of harmful emissions can be avoided annually by the CANDU fleet in Canada alone.
- A twin ACR will avoid up to 14 million tonnes of air pollutants every year and should be eligible for clean energy credits.

- The recent federal Budget, with its funds to promote emissions free technology, should be a boost to launching new ACRs as both major energy and environmental solutions for Canada.

Slide 15 – ConclusionsIn light of these benefits and the readiness of our industry to deliver, it is my firm believe that Canada will remain CANDU country.

- Other vendors may offer one-off localization projects – but no follow-on benefit, such as exporting a new global reactor from Canada and sustaining the strategic domestic industry.
- We Canadians have the technology and the capability to expand our proven CANDU option in Ontario and elsewhere – the benefits are clear and compelling.
- But to keep the new build option open given the long lead times for approving any project today, we must start the approvals process now. Even in advance of a final decision by the Ontario government that it is willing to support a new build program.
- Regarding a site-specific EA, the nuclear industry and its many supportive stakeholders can make a convincing public case for new build CANDU. Starting the EA now is simply an insurance policy to ensure the lights stay on during the next decade.
- Team CANDU is ready to go now.