

NUCLEAR REACTION, or NUCLEAR RESURRECTION

by Elaine Dewar

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NUCLEAR POWER is a child of war. Its fortunes rise when conflict erupts and sink as it dies down again. So it was not surprising to see the nuclear prodigal slink back to the political table in 2003, only months after George Bush II launched Gulf War II. But this time, I thought that Ontario, owner of one of the biggest networks of nuclear reactors in the world, would turn it away.

Choking on a \$38 billion debt left over from past dealings with the nuclear power industry Ontario seemed to have written a requiem for nukes when it shut seven of its 13 operating reactors in 1998, split Ontario Hydro into five provincially owned companies and, in 2002, opened its electricity market to competition. Ontario Power Generation (OPG), which inherited the old Crown corporation's coal, hydro and nuclear stations, even leased its Bruce nuclear facilities to a private company. And why not? It's a fact of life, noted in the Atomic Energy of Canada Limited (AECL) 2002-03 annual report, that nuclear power costs more than electricity made by water, coal or gas. Without an energy crisis to drive up prices, nuclear can't compete.

Even before the invasion of Iraq, with the nuclear plants off line, energy prices spiked up nicely in Ontario's unregulated electricity market, leading the government to impose a cap in November 2002. Since new natural-gas plants can be built in three years for millions of dollars, while nuclear plants take up to 12 years and cost billions and since the National Energy Board says Canada has at least a 60-year gas supply, it seemed likely that Ontario would convert to gas to meet the demand. Instead, the province seemed to be intent on a "nuclear renaissance," a phrase which also appeared in AECL's report, along with the claim that it could build a new reactor for 40 percent less than current models. This suggested that the economic failure of nuclear power was due to mismanagement at OPG, which was in the spotlight then as a reactor at Pickering limped back into service, more than two years late and three times over budget. The province had hired former federal energy minister Jake Epp to find out what went wrong. As Epp investigated, the provincial government called an election. The opposition Liberals, who promised to shut all of OPG coal plants by 2007, won. They fired the chairman, the chief executive officer and the chief financial officer of OPG and created an instant energy crisis. Without coal, could Ontario keep the lights on?

Build natural-gas plants, environmental groups urged the government. But reports saying natural gas is unreliable soon fluttered down from on high. A government-appointed task force, with nuclear executives on board, said gas is too volatile in price

and in too short supply. Epp, newly appointed as OPG chairman, was placed on a panel to opine on whether the companies other three laid-up nuclear units at Pickering should be refurbished. Yes, the panel determined, because natural gas is too volatile in price and in too short supply. A paper produced by energy analysts and paid for by the Canadian Nuclear Association, the country's nuclear lobby group, agreed.

Almost as interesting as this sudden consensus on the scarcity of natural gas was the environmental spin in these reports: although gas burns more completely than oil or coal, there is a residue of carbon dioxide (CO₂) released. Canada, as a signatory to the Kyoto accord, has to mind its CO₂. Nuclear reactors, we were told, emit nothing.

As Gulf War II burned bright last summer, the Ontario government permitted refurbishment of a second laid-up Pickering reactor. And nuclear power seemed poised to be born again -- as the clean solution to a bipartisan Ontario energy crisis.

THE FIRST URANIUM ATOM was split in 1932. But it wasn't until the Second World War that physicists focused their attention on the vast energy released by the fission of atoms of atomic weight and on how it might be harnessed to make bombs and limitless electric power. George Laurence, working on aircraft radiography at the National Research Council, tried to build an atomic pile in his spare time. However, it was Enrico Fermi toiling under a stadium at the University of Chicago who got the job done first. French researchers who filed patents on a process to get a sustained reaction from neutron-bombarded uranium smuggled 26 canisters of heavy water out of their German-occupied homeland to Britain's Cavendish Laboratory in 1940. The British then moved their atomic research team to Canada, hoping the Americans would include them in the Manhattan Project. That didn't happen. Hopes dashed, a British-Canadian-European group worked, instead, at Université de Montréal and then at Chalk River, Ont., 200 kilometres northwest of Ottawa, to build the ZEEP (Zero Energy Experimental Pile) 10-watt research reactor, in just 14 months.

Canada's first private nuclear generating company, Bruce Power operates a plant 250 kilometres northwest of Toronto. The size of a small town, it employs 3,000 workers, including nuclear operators for its control rooms (PREVIOUS PAGES) and turbines (OPPOSITE, top floor). Six of its eight CANDU reactors are on line, and the company reached a tentative agreement with the province in March to restart the remaining two.

By 1947, when Chalk River's first large research reactor, NRX, came on line, most of the foreigners had returned to Britain to start its bomb/reactor program, leaving Canada with the only reactors in the world outside the United States. NRX produced plutonium as a by-product of its heavy-water-moderated fission. Because Canada could not afford its own heavy-water plant, it shipped the plutonium to the United States for the

American bomb program in exchange for heavy water. The swap made Canada's reactor program morally questionable but viable.

Canada's biggest utilities sent their top engineers to a secret conference at Chalk River in 1953. The following year, when nuclear power was first mentioned in Ontario Hydro's annual report, plans to build a 20-megawatt demonstration power plant near Chalk River were well under way. Nuclear power seemed worth a steep entry price because industrial Ontario had no large untapped hydro sites close to its population centres and no oil, gas or coal to speak of. But it did have uranium. The province could pay a high price for imported power or build nuclear reactors and get an industrial strategy and cheap power all in one blow.

Canada's prototype CANDU reactor (BELOW) was built at Douglas Point, near Kincardine, Ont., in the 1960s and operated for 16 years before being shut down in 1984. Around the world, there are now 440 commercial nuclear power reactors in 31 countries, supplying 16 percent of all electricity.

The cheap part never materialized. The CANDU nuclear-reactor system was designed to be the world's most efficient, because it is refuelled while the reactor is on line -- a feat achieved first in 1957 with the NRU (National Research Universal) reactor. And for their first few years, CANDUs were the best. But as they aged, they became reliably unreliable until, by the late 1990s, Ontario's reactors were ranked dead last in that regard among the 30 member countries of the Organisation for Economic Co-operation and Development. The longer it takes to build or fix a reactor, the higher the interest mounts on money borrowed, which cannot be repaid unless reactors generate power to sell. When construction began on Ontario's four-unit Darlington station in 1984, for example, it was to cost \$4 billion. Interest rates were high when the money was borrowed, and the project was put on hold, then restarted. Consequently, when Darlington came on line in the early 1990s, the price was a staggering \$14.4 billion.

While scientists knew reactor metals would degenerate over time, politicians were not prepared for corrosion in the boilers, pressure tubes that sagged or grew or burst. There were no assembly-line economies either. No Canadian reactor is exactly like any other. Variations were supposed to incorporate improvements, but Gentilly-1 in Quebec, for example, which featured a new cooling design, never worked at all.

Federal and provincial governments were in a conflict of interest as both nuclear owners and regulators. They did neither well but avoided public scrutiny until the late 1970s, when concerned legislators and environmentalists used hydro rates, supply and demand and legislative committee hearings to ask pointed questions. They uncovered unmarked radioactive nuclear dumps, unsafe uranium mining practices, unacknowledged radioactive spills and a general failure to prepare for a serious accident. The partial meltdown at Three Mile Island in Pennsylvania in 1979 and the

disaster at Chernobyl in 1986 further rocked shaky public trust. Eventually the federal government overhauled its regulatory system. In 2000, it replaced the old Atomic Energy Control Board, which never held a public hearing in 50 years, with the Canadian Nuclear Safety Commission, which posts its hearing record on its web-site. The latter, however, was soon accused by a Senate committee of being too cozy with the industry it polices.

In 1998, a federal panel reported that while AECL spent \$575 million planning the burial of all Canada's intensely radioactive nuclear-fuel waste deep in the Canadian Shield, the public wouldn't accept it. (Manitoba actually passed a law against it.) And no nuclear operator had set aside enough to pay for it. In 2002, the federal government passed a law mandating that operators create adequate waste-disposal funds and a Nuclear Waste Management Organization to find a scientifically, socially and politically acceptable option for permanent waste disposal by the fall of 2005.

ALLAN KUPCIS was a materials scientist fresh from the University of Toronto and Oxford when he entered Ontario Hydro's research division in 1973 as Pickering came on line. Twenty years later, when he became Hydro's president, 70 percent of the province's electricity was being generated by nuclear reactors. But as Darlington drove rates up 30 percent in three years and demand dropped, Kupcis' job became a matter of keeping the lights on as Hydro got rid of 10,000 workers -- one-third of its workforce. "I was the guy who said we need an external review of our [nuclear reactor] performance against the world experience," he recalled late last summer. Though CANDUs were said to be top of the heap, Kupcis knew they were too often shut down for repair. He was also concerned about their safety. He had a peer review done by the regional centre of the World Association of Nuclear Operators (WANO) in Atlanta, Georgia. The results weren't pretty. He requested another in 1995 after he became CEO. The second review showed that many of the problems identified by the first had not been resolved.

But what really kept Kupcis up nights was the matter of the kludge, an engineer's word for a system changed so much that it bears no relationship to the original blueprints. Both reviews made clear that as things had broken and been fixed at nuclear plants, some changes weren't recorded. "This technology requires real discipline and attention," he says. And yet there was apparently laxity and inattention at Hydro's nuclear stations, along with a huge backlog of work orders. The industrial safety record was going down alongside performance ratings. Some of the Pickering reactors, for example, had sunk to 60 percent availability to produce power. Kupcis tried everything he could think of to make his managers perform. He even hired people to shadow top personnel at reactor sites to find out why things weren't getting fixed, why workers were being injured. Finally, he sought out American nuclear engineer Carl Andognini, who had turned around troubled nuclear plants in the United States.

Kupcis hired Andognini and his team on a three-year contract to do a U.S. Nuclear Regulatory Commission-style review. By the spring of 1997, Kupcis knew where the report was headed. His nightmare had been that the safety margins had all but disappeared. But the team found all Ontario's reactors to be minimally acceptable -- the lowest rating before mandatory shutdown. It recommended, however, that three units at the Bruce station be mothballed (joining one shut down in 1935) and the four oldest Pickering units laid up (with fuel inside) until Hydro pulled itself together. The team concluded the fault lay with management, which had failed to create the appropriate "culture." Before it announced these findings at a Hydro board meeting in August 1997, Kupcis resigned because, as he had told staff for years, managers must be accountable.

Though he had tacitly admitted failure as a nuclear manager. Kupcis' career moved to a bigger stage. He had just been elected president of WANO and offered his resignation, but it was refused. For two years, with Hydro paying his expenses, Kupcis toured world reactor sites as a WANO ambassador and, in 2001, became an adviser to the Institute of Nuclear Power Operations and chairman of the Canadian Nuclear Association. "Before anyone becomes a chief nuclear engineer," says Kupcis, "they should go to Prypiat, to see the meaning of their responsibilities." Prypiat is the town of 40,000 that was permanently abandoned after Chernobyl vented radioactive gases into the atmosphere in 1986. "It's an 'On the Beach' situation," he says, "swings empty, weeds everywhere."

At Atomic Energy of Canada Limited's reactor assembly plant in Mississauga, Ont., mechanical technologists John Rabiszas (left) and James Deane work on a fuelling machine. It operates remotely to insert new fuel rods and remove spent ones.

Duncan Hawthorne, chief executive officer of Bruce Power, says his company is already making money from the nuclear reactors it operates on the rocky shore of Lake Huron (BELOW), just two years after it restarted the mothballed units.

As Kupcis travelled, one-third of Ontario's nuclear generators were shut and coal burned in their stead, making Hydro insolvent and Ontario air quality worse. He says the shutdown provided "a burning platform" for provincial politicians to break up Hydro. "It was April 1, 1999, when it ceased to exist. A 90-year-old institution that electrified the province, and its passing was only perfunctorily acknowledged. A non-event."

WHEN JACK GIBBONS, a Toronto Hydro commissioner, who was also senior economic adviser for the Canadian Institute of Environmental Law and Policy, read about the shutdown, he was more convinced than ever of the need for the Ontario

Clean Air Alliance, which he had helped start two years earlier in anticipation of electricity competition. Gibbons knew Hydro would crank up its coal stations to keep Ontario's lights on. "Our focus was on the phasing out of coal," he says.

The adverse health consequences of coal combustion were generally well known. In 2000, the Ontario Medical Association published a report which calculated that air pollution -- to which coal is the biggest contributor -- was causing \$10 billion in health-related costs and 1,900 premature deaths in Ontario per year.

Gibbons knew if Ontario opened up its electricity market to competition, the cheap coal plants would be attractive to private parties. His Clean Air Alliance got interests and money together (including gifts from gas-distribution company Enbridge) and lobbied politicians to convert the coal plants to gas or shut them down. In 2001, Ontario's environment minister issued an order that Mississauga's Lakeview coal plant must stop burning coal by April 30, 2005. This was a turning point, Gibbons thought.

He and his colleagues were thrilled by the Liberals' election pledge to shut all the coal plants by 2007. The Alliance thought the 7,500 megawatts of power could be made up through energy conservation, renewables and, of course, new gas-fired plants. Gibbons was astonished by the OPG review committee's report claiming that gas generation would cost more than refurbished reactors. His organization subsequently determined that four key assumptions of the computer program used to support this claim were historically invalid. Gibbons ran the same program himself using the Alliance's numbers. The results showed Pickering's nuclear-powered electricity would cost almost double that of new gas plants. Last October, Gibbons demanded that OPG publicly answer whether or not the second Pickering refurbishment, begun in July, was already over budget and behind schedule. Both the government and OPG ducked his question.

AS DUNCAN HAWTHORNE, CEO of Bruce Power, leads the way into the lounge of the newest hotel in Kincardine, Ont., the waitresses, knowing exactly who he is, scurry before him, eager to bring him exactly what he wants almost before he can ask. And why not? Hawthorne, who worked at a nuclear power plant himself before university, saved their jobs, their town. He later tells me, in his working-class, Glasgow accent, that Bruce Power is making money from its six leased nuclear units, that its two refurbished units are performing at maximum efficiency and that the plant has passed its eight millionth man-hour without time lost to injury. All of this achieved by the same workforce that formerly toiled for Hydro/OPG.

Inside Bruce Power's immaculate plant, entry-to and exit-from zones of increasing hazard are marked by the requirement to plunge one's hands, feet or whole body into singing, speaking, musical monitors that pronounce one clean (or not). Inside the eight

reactor buildings and the turbine rooms, nothing, not even a scrap of paper, is out of place. Ontario Power Generation's nuclear-fuel waste-storage facility, which is on-site, also sets its standard at perfection. Low-level waste is either compacted and buried in concrete bunkers or burned. Depleted fuel bundles are locked in a steel lattice inside one-metre-thick concrete bins faced in painted steel, which are certified and snap inspected by workers of the International Atomic Energy Agency. Designed to last 100 years, the waste containers are stored in a secure warehouse whose epoxied floor shimmers like a skating rink.

Nuclear reactors use the fission of uranium atoms to produce heat to convert water into steam, which drives the turbines (above, in yellow) to generate electricity. The spent fuel remains highly toxic for about a million years.

As Hawthorne explains, Kincardine was on its knees after Kupcis shut down all four units at Pickering A and the three remaining units at Bruce A. When Hawthorne came looking to pick up Ontario nuclear plants for his company British Energy in 1997, the workforce, with an average age of 49, was utterly demoralized. British Energy believed it could make money selling Bruce nuclear power if it could quickly restart two of the Bruce units. Hawthorne's first meetings were with the unions, where he explained that he wanted a collaborative relationship. To create Bruce Power, British Energy ultimately partnered with Cameco -- Saskatchewan's uranium-mining corporation -- and the trade unions. It also offered bonus shares to individuals. The deal closed in May 2001, but British Energy soon got into financial trouble at home. It sold Bruce Power in 2003 to Cameco, the Ontario Municipal Employees Retirement System and TransCanada Corporation, owner of the largest gas pipeline company in North America.

Nuclear welfare

IF YOU LIVE IN ONTARIO, YOU might want to look closely at your electricity bill to see how deep you're digging into your pocket to help the former Ontario Hydro out of a 538 billion nuclear-investment hole. It's on the back and dubbed "Debt Retirement Charge" (DRC). For every kilowatt-hour of electricity you use, you're paying 0.7 cents plus GST. For a bimonthly average of 1,800 kilowatts of electricity per household, that's \$13.50 -- \$81 a year.

In 1999, when the provincial government separated Ontario Hydro's assets from its \$38 billion IOU, it was left with \$19.4 billion of so-called stranded debt, which was lifted from the successor companies and plunked into the lap of electricity users. Debt-relief fees were buried in Ontario residents' energy bills until 2002, when the DRC came out into the open. Meanwhile, an artificial price cap on electricity drove the stranded debt up to \$20.6 billion in the past fiscal year, and

the provincial government now estimates the charge could hang over Ontarians' heads until 2020.

Tom Adams, executive director of Energy Probe, says Ontario's renewed pursuit of nuclear power could mean the DRC will be around much longer than that. "The longer we stay in nukes, the more we transfer the burden of liabilities -- financial and environmental -- to our kids."

Wiping the slate clean for Ontario Hydro's successor companies also skews the competitive advantage away from other energy sources. "It's completely inequitable," says Theresa McClenaghan, counsel for the Canadian Environmental Law Association. "All the costs of the energy source should be incorporated into the price it charges so there isn't an unfair advantage for one of the worst sources versus renewable."

As for how the nuclear debt ended up as your problem, Adams says that it was, in effect, Ontario taxpayers who provided the loan guarantees, so it's no different from a parent who signs a car loan for a feckless teenager. "We co-signed the loans for irresponsible adolescent behaviour by a bunch of electricity executives, and now Ontario ratepayers are going to have to pay up."

Jodi Di Menna

Bruce Power restarted its two laid-up reactors in October 2003. Together, they cost \$750 million, 20 percent over budget, and were four months late. But Hawthorn asserts that if he can refurbish the two other idled reactors on budget, he can produce nuclear power cheaper than gas. In fact, gas generation would drive up the price of electricity. How? In a free cross-border electricity market, the price is set by the power offered to meet demand peaks, usually derived from burning coal. With cheap coal banished from Ontario, natural-gas-generated electricity would set that price. But the big market for Canadian gas is in the United States, which buys 50 percent of what we produce. Ontario gas generators would have to bid higher than Chicago buyers to get Canadian gas to Ontario. The North American Free Trade Agreement, negotiated by the Mulroney government, had cast that in stone.

JAKE EPP, chairman of OPG, stood at the window of his huge office last fall, looking down on the Ontario Legislature across the street and told a joke about how this building was designed so that the Hydro chairman could always look down on the Premier. The morning paper had reported that OPG's second nuclear refurbishment at Pickering was both behind schedule and over budget; he preferred the phrase "potentially over budget." Epp is central casting's ideal politician: convivial and bright, with a full head of white hair and an unlined face, even though he's in his middle sixties. He was the Member of Parliament for Manitoba's Provencher riding for 20

years. He served in Joe Clark's Cabinet and throughout Mulroney's two mandates, becoming energy minister after the 1988 Free Trade election.

Prime Minister Jean ChrŽtien (left) and Chinese Vice-Premier Zeng Peiyan unveil a plaque marking the official opening of a CANDU-6 reactor in Qinshan, China, in October 2003.

'IT'S NUCLEAR,' EPP SAYS SOFTLY. 'NUCLEAR NEEDS A LONG DISCUSSION BETWEEN ME AND YOU. '

The Sierra Youth Coalition protests during the Canadian Nuclear Association's fourth annual conference in Ottawa in 2004.

Nine months after he left the federal government in 1993, Epp became president of an offshore TransCanada subsidiary. He had been in line for the patronage post of president of AECL when he got a phone call from the then chairman of TransCanada, Gerald Maier, offering him a job. If Epp was ever going to make money, this was his chance. After enjoying the proverbial seven fat years after many lean, he retired as TransCanada's vice-president of government and regulatory affairs in December 2000. A year ago, he became chairman of OPG.

How did an active Conservative and retired TransCanada executive end up in charge of an Ontario Liberal government's nuclear reactors? Was he a gas man or a nuke man? Epp is happy to confirm he is an advocate for nuclear power. His Manitoba riding had included AECL's now defunct Whiteshell research station, and as energy minister he'd relished dealing with the nuclear file. Yet he was also the minister who cut AECL's budget to force it to become commercially viable (with the prospect of being privatized).

Epp echoes Hawthorne on why gas generation is not an option for Ontario, other than in downtown Toronto where OPG will partner with TransCanada on a gas plant. Do you know, he asks, that 40 percent of power in the United States is generated by natural gas? Supply is a real problem, he insists. Where are we going to get more gas? The Mackenzie Valley pipeline in the Arctic is expected to deliver about 1.2 billion cubic feet a day, he says, which is the amount used to crack the oil out of the Alberta tar sands. And, speaking of Alberta, do I know that province uses its cheap coal to make power and sells its gas elsewhere for higher returns? "This is a whole story Canada needs to understand."

In June 2003, just as Epp began investigating cost overruns at OPG, the current president of TransCanada, Harold Kvisle, told the U.S. House Committee on Energy and Commerce that he, too, was concerned that an inadequate natural- gas supply

could cause sustained high gas prices and negatively impact the North American economy over the long term. By then, TransCanada had acquired interests in both Arctic gas pipeline projects.

Ontario needs diversity of supply, Epp says. Its coal plants and hydro plants run beautifully. "It's nuclear," he says softly. "Nuclear needs a long discussion between you and me."

AECL WAS BETTER PLACED to discuss the nuclear renaissance than was Epp. After all, AECL had proclaimed it. In its Mississauga executive offices, senior vice-president David Torgerson lectures me on the virtues of nuclear power as the generator of a wave of science. A nation's wealth, he says, flows from science -- from thinking far in advance of present technology. Such forward thinking had led to the next generation of CANDUs, the clever ACR-700, which uses light-water cooling and a more compact core to increase power and safety while reducing cost. Torgerson sincerely hopes to sell these smaller and simpler reactors to American and Canadian clients. Since AECL entered into a partnership with Hitachi and Bechtel in the mid-1980s, it has been delivering turnkey nuclear plants on time and on budget in South Korea and China. Surely it can do the same in Canada.

Used fuel bundles are cooled in pools of circulating water for 7 to 10 years so that they won't overheat and rupture. Then they are transferred robotically to dry storage.

All Canada's reactors will need to be replaced or refurbished by 2018. But nuclear power's real future lies in the United States, which requires a whole new generation of reactors to meet rising demand. Due to its modular construction methods, says Torgerson, AECL can now greatly reduce the reactor construction time and, therefore, the price of nuclear power. Nuclear can lead the nation's science strategy. That's why other countries buy CANDUs -- to jump on a wave of innovation in chemistry, physics, materials science and robotics.

This nuclear science-makes-wealth argument in support of the nuclear renaissance is voiced again during my visit to AECL's research facility at Chalk River. Researchers in this tiny settlement at the water's edge exhibit an anxious desire to please, as if fearing public support for Canadian nuclear science is drying up, along with public funds to pay for it. They point out the unplaqued space where the ZEEP reactor once stood, a brilliant achievement already forgotten.

The next day, I stop for coffee with Jeremy Whitlock, the past president of the Canadian Nuclear Society, whose objective is "to foster the development and beneficial utilization of nuclear science and technology for peaceful uses." The son of a Chalk River

technician, Whitlock vowed as a boy that he would do nuclear science himself when he grew up. But his reactor physics doctorate may have been the only one granted in the entire country in 1995, and when he arrived for work at Chalk River, he found pure research gone and the nuclear industry "on its ass." Yet AECL, he asserts, can turn out CANDU-6 reactors the way Ford turns out cars. Just one thing, he says, is needed to bring reactor projects in on time and budget in Canada: no political interference.

But it is politicians running interference for the nuclear industry who keep it alive.

AT QUEEN'S PARK, Dwight Duncan, House Leader and Minister of Energy, explains that the Liberal Party's policy to shut down coal plants evolved under pressure from environmentalists during the preparation of its 2003 election platform. The previous Conservative government had undertaken to get rid of coal by 2015. "Our guys said we can do better." Like Gibbons of the Ontario Clean Air Alliance, the Liberal caucus thought the alternative would be more natural gas, not new life for nuclear. "The challenge," says Duncan, "is the rising commodity price."

Successive Ontario governments, he says, all "wrestled with the nuclear demon." Nuclear provides 45 percent of the province's energy, but its reactors are old. "Darlington is the newest, and it's at mid-life." If OPG fails to bring its second Pickering reactor back on budget, Duncan says he would have to look hard at bringing back the last two, but he has already begun negotiations with Bruce Power on returning to service its two laid-up reactors. And AECL has been pitching extensively its new reactors both inside and outside government. Still, Duncan says he doesn't think Ontario will have to make a decision on new reactors until the next mandate -- if his government gets a new mandate. "By 2009, we will have to confront the question."

I left Duncan's office disheartened. The nuclear industry was like some sort of unmanageable, increasingly dangerous black hole none of us could escape. Even Epp, who credited nuclear with the economic transformation of his former hardscrabble riding in Manitoba, now watched the nuclear side of OPG the way the mongoose eyes the snake. Allan Kupcis, one of the best nuclear engineers of his generation, had tried to bring it to heel and been defeated. The smart Americans he hired to do the job had failed too. Duncan Hawthorne's former employer, British Energy, had been brought to the brink of disaster by its attempts to make nuclear perform. Regulators had tried and failed to police it. politicians had been burned and burned again. Taxpayers and ratepayers would be paying its old debts far into the future. And, yet, here was Dwight Duncan virtually admitting Ontario will have to embark on a new cycle of nuclear construction after the current reactors have had their day.

IT STARTED TO BECOME CLEAR why the Canadian nuclear prodigal will never be absent from the political table last November in a small hotel meeting room in downtown Toronto. I had answered a newspaper ad by the Nuclear Waste Management Organization, a new entity created to recommend a long-term approach for managing used nuclear fuel produced by Canada's electricity generators. It invited citizens to discuss proposals for the permanent disposal of nuclear waste. Posters explained the options, as did a DVD and a workbook. In attendance were a number of the staff, invited guests with ties to the nuclear industry and a scattering of elderly men. The options presented were deep disposal in the Canadian Shield, above-ground storage at each reactor site or storage at a single site.

Radioactive waste can be stored for up to 100 years in metre-thick concrete containers like these at the Western Waste Management Facility on the site of the Bruce nuclear plant.

When questions were at last entertained, a man asked why we couldn't just shoot this stuff out into space. Oh, no, said an organization expert, no one's about to put this kind of material on the top of a rocket. And then the discussion got to the heart of the matter, which is, of course, politics -- or, put another way, the short, unsteady course of human political history versus the long decay time of radioactive waste. As another of the organization's staffers made clear, nuclear waste can never be made 100 percent safe from interaction with the environment. If we dispose of the waste 1,000 metres below ground, it may still leak. If we store it above-ground, the containers will have to be replaced every hundred years. People with doctorates in reactor physics will have to supervise. We will have to keep permanent watch. The fact is, this waste will remain highly toxic for about a million years.

A million years is a blink in the lifespan of the universe, but it is inconceivable in the context of any human society. Canada is not yet 150 years old. The Roman Empire lasted less than a thousand years; in that time span, these containers will have to be replaced 10 times. And what if a thousand years from now, no Jeremy Whitlocks come forward to offer their skills? That's when it dawned on me that even if the price of natural gas drops to zero, we will still have to keep at least some of Ontario's nuclear generators going to provide profits for a nuclear industry which will employ the reactor physicists of tomorrow. If we want to keep ourselves, our descendants and this planet safe, the nuclear industry can't be allowed to die. It will have to be born again over and over for a thousand millennia to come.

Writer Elaine Dewar and photographer Wolf Kutnahorsky
are both based in Toronto

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