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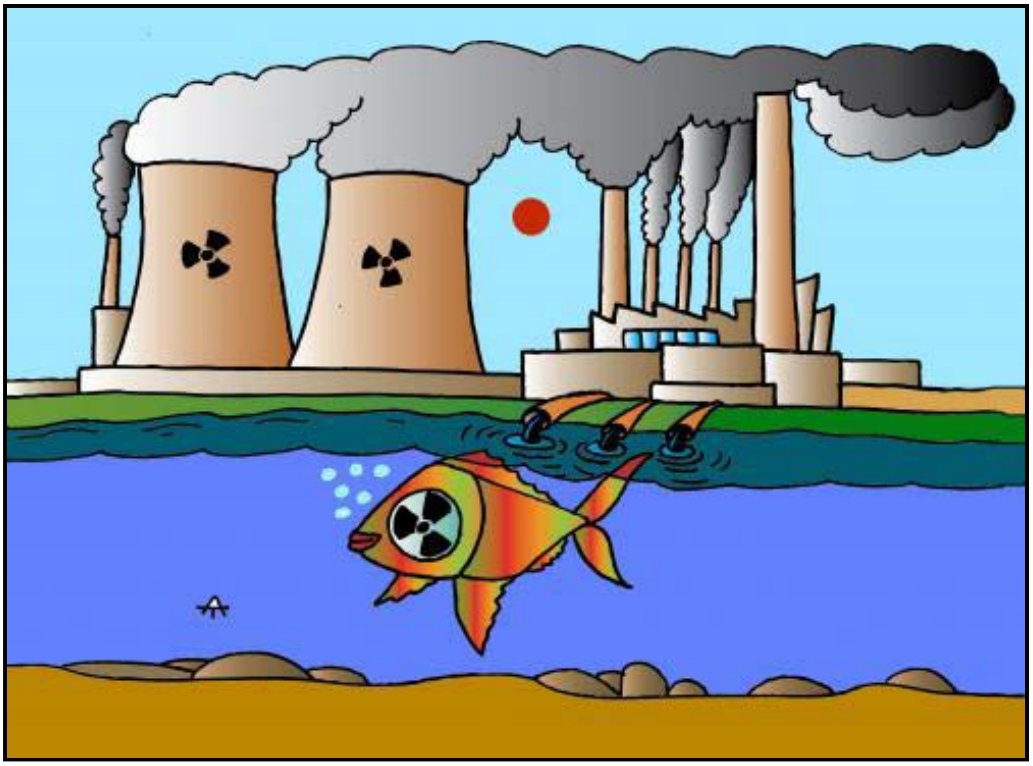
ASSOCIATION D'ELOCUTION ET DES DEBATS DE LA SASKATCHEWAN

Nuclear Energy

This house should develop nuclear power as Saskatchewan's primary energy resource.



Research prepared by Janessa Weir
Summer 2009

www.saskdebate.com

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SEDA

The Saskatchewan Elocution and Debate Association (SEDA) is a non-profit organization that promotes speech and debate activities in English and French. The Association is active throughout the province from grade 5 through grade 12, and at the University of Regina and the University of Saskatchewan. The Association co-ordinates an annual program of speech and debate tournaments and other special activities, including a model legislature.

SEDA's staff, along with printed and audio-visual materials, are available to assist any individual or group interested in elocution and debate.

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Title: Nuclear Reactors: Are they really safe? (Part one of five)
Author: Joanne Paulson
Source: Regina Leader Post
Date: May 19, 2009
Web site: http://www.leaderpost.com/entertainment/movie-guide/PART+Nuclear+reactors+they+really+safe/1607385/story html.

If you have plans to stop the construction of a nuclear reactor on Saskatchewan soil, you're about 30 years too late.

A reactor, albeit a tiny one, has been harnessing thermal energy from nuclear fission in Saskatoon for research and environmental testing at the Saskatchewan Research Council since 1981.

"Not many people know this," says SRC president and CEO Laurier Schramm during a tour of the reactor. "It's been working safely and quietly for years, if for anything to show it can work here. It's one of Saskatchewan's best-kept secrets."

It's a nuclear reactor made small. The same physics apply, but it's about 1/10,000th the size of a typical reactor that companies like Bruce Power want to build in Saskatchewan.

But it's here, in Saskatoon. And if reactor proponents get their way, Saskatchewan will see the technology made large.

Yet, despite the minuscule reactor and rhetoric from both sides of the issue in the long history of movements for and against uranium mining and nuclear power in Saskatchewan, the technology surrounding the physics and construction of a reactor is often misunderstood.

This week, the Leader-Post and Saskatoon StarPhoenix are publishing a series examining issues surrounding a nuclear reactor and what the massive project could mean for Saskatchewan.

It's prudent, then, to establish just how a reactor works and if smashing together atoms of uranium is safe.

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At the Saskatchewan Research Council's (SRC) analytical laboratories in Innovation Place, a reactor called SlowPoke II has been testing water, soil, vegetation and animal tissue for businesses and governments from around the world since March 1981.

When Nova Scotia wanted to test lead levels in school drinking water, samples were sent to SRC for testing. The reactor can be used to process several hundred samples every day.

Outside the subdued, one-storey brown brick SRC laboratory, one wouldn't expect it houses a nuclear reactor. In the actual reactor room, disbelief won't subside.

Uranium atoms are smashed together in a shoe box-sized reactor submerged in water six metres below the ground. The concrete covering sits in the middle of a room that resembles a beige and orange high-school gym storage room rather than Lex Luthor's hidden lair. Old boxes and file cabinets sit haphazardly around the edges of the room and on shelves alongside containers of old floppy computer disks.

Jeff Zimmer, SlowPoke II operator and senior supervisor, guides a small group of SRC managers and two guests around the room. He's asked if the group of men will go sterile after the tour.

"This room as you stand here has the same radiation levels of anywhere in Saskatchewan," he says. Sixty-five people work in the lab.

The reactor produces about 20 kilowatts of power.

Once the public consultations on nuclear reactors are done in June, the Saskatchewan Party will set out to pick a winner. Either a nuclear reactor is built, most likely in northern Saskatchewan in the Prince Albert area, as Bruce Power wants, or it isn't built and the government continues burning dirty coal or investing in renewable energy.

A small research reactor in Saskatoon in one thing; building a $10-billion reactor that produces 1,000 MW of electricity is entirely different.

"There aren't a lot of ways to make huge amounts of reliable energy -- hydro, nuclear and non-renewable," says Jeremy Whitlock, a reactor physicist at Atomic Energy Canada Ltd., where he's manager of non-proliferation and safeguards.

Essentially, a nuclear reactor is "just another heat source," a steam engine that runs electric generators, like a coal plant, says Whitlock.

The process begins with splitting uranium atoms to release energy. Imagine a uranium nucleus as 235 Ping-Pong balls held together, says Whitlock.

"If you take another Ping-Pong ball -- the nucleus was OK with 235, not 236 -- and smash it into the nucleus, nature doesn't like it and tends to get rid of it," he says.

By smashing atoms, neutrons fly off and hit other uranium atoms. This happens roughly billions of times every second. The chain reaction heats the heavy water in the reactor core, which in turn creates steam to move turbines.

The CANDU reactor, created by Atomic Energy Canada Ltd. and used by Bruce Power, uses uranium pellets, a mix of natural uranium and uranium dioxide.

The pellets are placed in a fuel rod and the rods are bundled together and pushed through hundreds of separate pressure tubes with cooling water. Each tube holds a single string of uranium fuel bundles about half a metre long.

The heavy water -- a sort of enriched water -- is used as a moderator to slow down rapidly moving neutrons. Once the fuel bundles heat the water to 300 C, the water moves to a steam generator and then into a turbine to generate electricity. The steam is condensed back into water and starts from the beginning.

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Chernobyl and Three Mile Island are like trigger words used by hypnotists. Once spoken, it's difficult to not think of nuclear meltdowns, deformed babies and skyrocketing cancer rates.

Thirty-one people died almost immediately when a meltdown nearly completely destroyed the Soviet plant in 1986. The World Health Organization estimates another 9,000 people died or will die from the resulting radiation poisoning. Other organizations like Greenpeace put that number in the hundreds of thousands.

The reactor at Chernobyl was essentially encased in cardboard compared to today's reactors. At Three Mile Island, the meltdown was contained to a structure surrounding the core. Nobody died, but employees were exposed to higher levels of radiation.

North American reactors are surrounded by steel-lined concrete 1.5 metres thick. To test the strength, the Pentagon once flew an F-4 fighter jet into such a wall at 800 km/h. It crumpled on impact, leaving a 15-centimetre dent in the wall.

"If there was a terrorist flying a plane into a reactor containment or an office building, the terrorist would choose an office building every time," says Whitlock.

Bob MacLeod knows about the stringent safety protocols of nuclear reactors. The Saskatoon resident supervised a crew at one of the AECL reactors in Ontario.

"There's always a dust bunny somewhere in the corner, but we're always on that," he says in a downtown cafe. "I have a great respect for radiation. It's dangerous."

As a new employee, MacLeod and his then-pregnant wife took a tour of his new nuclear-powered office. She was worried that walking across the top of the reactor would harm the baby. MacLeod's boss whipped out a radiation monitor that showed no rise in levels.

"We went across," says MacLeod. "Our daughter was very healthy, and so were our subsequent children."

Humans and computers strictly monitor CANDU reactor operations, with two different backup systems.

"To deliberately sabotage would be extremely difficult," says MacLeod.

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Safety of the whole process is built around stopping the chain reaction and cooling the fuel, says Whitlock.

Control rods, which absorb uranium atoms to slow the nuclear reactions, are raised or lowered into the water depending on how much energy is required. In case of an impending catastrophic meltdown, all the rods can be lowered to stop the reaction.

Once stopped, reactors rely on the natural physics of water convection to cool the fuel. Like a steaming cup of coffee, hot water swirls to the top and cool water moves down to the core.

"You can buy yourself hours, if not days, to fix the rest," says Whitlock.

If there wasn't adequate safety measures inherent in the operation of a nuclear reactor, he wouldn't work in or live near one.

"It's essential to my well-being, my family's well-being," he says.

"I'm either lying and endangering my family or I know something about how reactors work."

At the SlowPoke II laboratories, behind cameras and a series of locked doors -- SRC declined to give details about its security practices and policies -- management says it's a secure facility. Earlier this year, Global News sent reporters to nuclear reactors big and small across the country and assigned them to gain access. While some were successful, at SRC the local news station failed twice.

With SRC's work in the nuclear power field, it is positioned to offer its expertise to the debate heating up in the next two weeks of government public consultations.

But don't expect management to takes sides.

"We're on the unbiased science side of the debate," says Joe Muldoon, SRC vice-president of environment and forestry.

SRC sees itself as an information source for interested parties, not just for nuclear power. A division of the council is focused on alternative fuels such as solar, wind and clean coal.

"We are at a starting point and have a track record with the issue," says Schramm. "We've got a position where we have experience and the facilities that can be an asset. We're not trying to pick a winner."

Title: Nuclear Reactors: Nuclear reactors increase worldwide (Part two of five)
Author: Joanne Paulson
Source: Regina Leader Post
Date: May 22, 2009
Web site: http://www.leaderpost.com/entertainment/movie-guide/PART+Nuclear+reactors+increase+worldwide/1611345/story.html

On-the-ground nuclear power may be a new idea for Saskatchewan people to wrap their minds around, but in many parts of the world, it's already quite commonplace.

As of mid-April, there were 436 operating reactors, producing approximately 370 gigawatts of electricity (GWe). That's about 16 per cent of global electrical demand.

Forecasts point to more reactors coming on stream, not fewer. Whether that's a good thing or a bad thing is a matter of highly divergent opinion, but it's definitely a coming thing. In the United States for instance, applications are in for 26 reactors.

Jonathan Hinze, vice-president of international operations for Ux Consulting Co., foresees 491 reactors producing 426 GWe by 2015. Ux

Consulting provides a wide range of consulting services to the entire nuclear industry.

By 2020, however, there will be a large increase in reactors and electrical production.

"Given the massive growth in China, India, South Korea and Russia, we're looking at 553 units and 509 GWe by 2020," said Hinze, who is based in Lynchburg, Virginia.

For the uranium mining sector, that's an excellent forecast, he noted. New reactors require "massive amounts" of uranium for the first core installation, he said. Refuelling a reactor requires about a third of the original amount.

"The demand for additional uranium from new reactors is going to be quite significant," said Hinze. "Canada still does not export too much to China but that is likely to change. In India, they're now negotiating a deal which will support uranium production and open up new sales there.

"Much of Canada's uranium already goes to the major demand sources in the U.S. and France and Japan. That won't stop either. All these new reactors will very much support expansion and demand for uranium and uranium fuel components."

Nuclear power use varies widely among the 30 nations that rely on it. Little Lithuania, for instance, has one reactor, producing 70 per cent of its power.

By comparison, France receives nearly 80 per cent of its power from 59 nuclear reactors. The United States is the biggest user of nuclear power, with 104 reactors generating about 20 per cent of its electricity. The U.S. has a much larger number of reactors but produces a much smaller percentage of power compared to France, because the U.S. is a bigger country and a bigger energy user.

"No one compares to France in the level of its commitment to nuclear," said Hinze. "As for other users of nuclear power, the big ones out there are Japan with about 30 per cent, South Korea with 35 per cent, and Germany is still quite reliant although they do have plans to phase out."

Germany has 17 reactors, representing a significant portion of total power -- 27 per cent. The present government is less anxious to phase out nuclear power than previous governments have been.

"If they were to shut them down it's hard to see how they would replace it," said Hinze.

Germany still generates 50 per cent of its energy from coal, and seven per cent from green renewable power.

Italy seems poised to bring its first reactor on stream by 2020, after a 21-year, post-Chernobyl ban on nuclear power. Finland is building a fifth reactor, and despite strong opposition, Sweden's government continues to back nuclear power.

CHINA AND INDIA

The big future users of nuclear are China and India, where a very small proportion of electricity is generated by reactors today.

"Those two are obviously where the future is in nuclear, at least in a future production expectation (regard)," said Hinze.

China generates less than two per cent from nuclear, from 11 reactors producing nine GWE. China's total power production is 625 GWe.

"Basically it's a drop in the bucket for them right now," said Hinze. "They want to grow that to about five per cent (70 GWe) by 2020, but that means more than quadrupling their nuclear reactors. It's on a massive scale that they're trying to expand.

Additional energy sources will be part of China's economic growth, said Hinze. "There was a time where China was adding 500 megawatts of new coal-fired power every day. They were expanding very rapidly. And it's dirty coal; they don't use the more up-to-date technologies."

India has 17 reactors, but some of them are as small as 200 megawatts, providing only four GWe. India produces about three per cent of its power needs from nuclear, and 70 per cent from coal.

India is a bit behind the curve, because from 1974 until last year, there was a ban on any nuclear market trade with the country. However, India has recently been given special treatment. Several countries including Canada are now negotiating bilateral agreements on both reactors and uranium supply, said Hinze.

When they begin to build reactors, they will likely import many of them, he said. India does not have a large domestic supply of uranium, and will require an imported source of fuel.

Meanwhile, in Canada, there are 18 operating reactors in Ontario, Quebec and New Brunswick.

"We don't consider all the plants in Canada currently operational," said Hinze. "You could say there are 18 operating and two under refurbishment."

The 18 plants create just over 14 gigawatts, or 15 per cent of Canada's power.

"In Ontario specifically, it's very important. They're one of the bigger load demand centres of the country. Ontario is moving to phase out most or all of its coal; there's no way that can be done with out adding nuclear."

One gigawatt equals 1,000 megawatts, which puts the Bruce Power reactors in some perspective. The company hoping to build a reactor in Saskatchewan is proposing one or two 1,000 megawatt plants, depending on the economics of exporting power to other jurisdictions.

SAFETY RECORD

People concerned about nuclear power often point to the accidents at Three Mile Island in the U.S. and Chernobyl, Ukraine.

"The track record has been quite good since the Chernobyl accident. Obviously there's been some bad history to it, but in recent years we have not had any major accidents," said Hinze. "Reactors are operating around the world with high safety levels.

"That has helped to allay public concern in places where it exists. In a place like Saskatchewan which is not familiar with it, you're going to have different reactions by different people."

New reactors in the U.S. are, however, being greeted with a fair amount of optimism, said Hinze.

"Almost all those projects are proposed at sites where reactors already exist. The utilities there will do their public opinion polling and see what the locals think, and nine out of ten times the locals are very supportive," he said.

"Because they're familiar with it, they've seen the revenue coming from that, the tax base, and the good jobs -- steady, long term jobs. A nuclear engineer or technician will earn much higher than an engineer in another area."

That being said, few nuclear advocates would recommend anyone "becoming France," said Hinze.

"Having a good, diversified portfolio (of energy sources) is truly the best way to go."

But nuclear power is an option for countries wanting to reduce greenhouse gas emissions, he noted.

"There are a number of key drivers for nuclear power around the world, including reliable baseload power needs, diversified uranium fuel sources from many stable countries, low operating costs, strong track record (both economics and safety), and the need to find non-emitting power sources in the face of climate change."

A DIFFERENT DIRECTION

Peter Prebble, director of energy and water policy for the Saskatchewan Environmental Society, says not all developed countries are adding nuclear power.

Some European countries are winding down their nuclear industries, or have not embarked on the nuclear path.

Countries with no reactors include Austria and Denmark, while Germany decided in 2000 to shut down its reactors by 2020, and have closed

down two so far. Spain will phase out its eight operating reactors.

Austria has a lot of hydro, and Denmark has a "great wind resource, just like we do in Saskatchewan," said Prebble. "They've taken the approach of developing their wind power in conjunction with Norwegian hydro."

Denmark has built more than 4,700 wind turbines, and encourages its communities to work toward total reliance on renewable energy, said Prebble, who has visited the country to study its energy system.

Prebble is also doubtful whether the many licence applications in the United States will actually result in the construction of nuclear plants.

"The thing to watch carefully is where construction is starting, which of course is very real. That's quite different from a licence application," said Prebble.

"The United States passed a new law in 2005 that said the first 6,000 megawatts of nuclear power built in the United States would get special tax credits and all kinds of financial assistance. All kinds of companies put in licence applications."

One issue that will give the nuclear companies pause is that Yucca Mountain, the much-studied waste repository, will not open, leaving companies to store waste on their plant sites, said Prebble.

Other issues are the expenses of building, operating and decomissioning nuclear plants, he noted, but the nuclear-focused policy of George W. Bush changed the profit picture for many private electrical generators. Prebble believes the Barack Obama administration may level the playing field for all generating companies.

"By that I don't mean there won't be new reactor construction ... but perhaps less than was projected a few months ago."

Finland's reactor is also behind time and above budget, which may affect decisions in other European nations, added Prebble.

Back in Saskatchewan, Prebble is convinced the province can save 300 to 500 megawatts of power through efficiency programs, and can also increase reliance on wind power.

The Danes get 18 per cent of their electricity from wind, and the Spanish 21 per cent from wind.

"Meanwhile we're at three, and we have a better wind resource than the Spanish," said Prebble. "There are lots of other legitimate avenues to go, and they don't generate radioactive waste."

Title: Reactors never on time or budget (Part three of five)
Author: Jeremy Warren
Source: Regina Leader Post
Date: May 21, 2009
Web site:
http://www.leaderpost.com/entertainment/movie-guide/PART+Reactors+never+time+budget/1614787/story.html

We've all been late for an appointment or spent a few more dollars than our home budgets allow. Expect a nuclear reactor project in Saskatchewan to exponentially exaggerate these personal foibles if world-wide experience holds steady.

Nuclear reactor construction will fall behind schedule by a few years and go over budget by billions of dollars, say experts.

"None of the reactors have ever come in on time or on budget," said Michal Moore, professor of economics with the University of Calgary and senior fellow at the Institute for Sustainable Energy, Environment and Economy.

"Cost overruns are consistent across the world," said Peter Prebble, director of energy and water policy at the Saskatchewan Environmental Society and former provincial NDP cabinet minister. "We will pay for these cost overruns on our electrical bills."

French nuclear giant Areva is building the Olkiluoto 3 reactor in Finland, the world's only third-generation reactor. The project is three years behind schedule and is 50 per cent over its $3.3 billion budget.

"There are just two 800 MW reactors, but it shows how costs can spiral out of control," said Prebble.

A Bruce Power project to refurbish a reactor in Ontario is $300 million over budget. A deal struck with the provincial government for the project requires taxpayers to cover half the cost of budget overruns up to $3.05 billion.

Financial risks are mentioned in the 121-page report by the Saskatchewan Party-commissioned Uranium Development Partnership, which recommended the construction of a 3,000 megawatt nuclear reactor in the province.

The government is holding province-wide public consultations on the report next week.

Moore calls the partnership's report thoughtful, but said if Saskatchewan wants to add value to the uranium industry, the province is more suited for fuel upgrading -- processing and reprocessing -- rather than a reactor.

The partnership rejected upgrading as an option for Saskatchewan.

"Energy demand has to be very substantial," said Moore. "I doubt the base load requirement (in Saskatchewan) is sufficient to carry a traditional nuclear reactor. The likely hood of getting enough people ... is low."

At best, Saskatchewan could build a series of small 200 MW reactors in different parts of the province, but even then it's a stretch, said Moore.

"Mining and upgrading is probably a good idea," he added.

To set out and build a reactor is a costly and time-consuming endeavor. In addition to costs of planning and engineering, upwards of $10 billion is required for construction for the proposed Bruce Power reactor.

That's not to mention the cost of integrating nuclear power into the province's electrical grid, which could cost upwards of $1 billion.

But once it's running, the cost to purchase and use the fuel is low -- about two-tenths of a penny per kilowatt, said Moore, and zero of carbon emissions during operation and a consistent electrical output makes a reactor attractive to governments.

"Once a reactor is built, there's a long life ahead of it -- about 40 to 60 years," he said. "But it takes a long time to get there."

Moore believes Saskatchewan should also look at increasing its reliance renewable energy.

Instead of mixing wind with nuclear power, in Saskatchewan it makes could invest in wind power to offset the emissions of coal plants, he added.

"Wind power makes sense economically if it's twinned with another source that provides base load energy," said Moore.

Saskatchewan's economy would receive almost $240 million annually when the project is operating, according to Bruce Power.

The nuclear energy industry annually contributes about $5 billion to the Canadian economy, providing 20,000 direct jobs, according to the World Nuclear Association.

Bruce Power estimates thousands of skilled labourers will be required for construction of a reactor. Once the job is done, though, a lot of people will be out of a job, said Moore.

"Once that thing is constructed and online, the number of jobs it take to run is in the tens, not the hundreds," he said.

In Canada, nuclear power contributed about 14.7 per cent of total power generated in 2007, compared to 58 per cent from hydro, 17 per cent from coal and six per cent from gas. Solar and wind contributions are still minimal.

Delays and ballooning budgets of nuclear facility projects is responsible for $15 billion of a $20

billion debt left by Ontario Hydro. Residents now pay a tax on electricity bills to pay off the debt.

"That's quite a legacy to leave," said Prebble.

The actual costs of a nuclear reactor go beyond its normal operations.

If the system is shutdown, replacement energy has to be found, said Prebble. "You have to have a back up system to replace the lost base load power. That starts to get expensive, especially if you import additional power."

When a reactor is too old it has to be decommissioned, another expensive project with costs anywhere between $200- and $600 million. "You're dealing with a very radioactive core that has to be robotically cut up and shipped away with thousands of trucks," said Prebble.

Finally, the disposal of nuclear waste, of which the industry has yet to find a safe and environmentally sound way to do, has to be paid for while a reactor operates for up to 60 decades, he added.

"This all adds up to an expensive package," said Prebble. "We will pay for all this costs in our electrical bills."

With the high costs and risk associated with nuclear reactors, private industry will only invest in projects with the financial backing of governments -- taxpayers -- guarantee profits and markets and assume the risk and liabilities for cost overruns, waste disposal, decommissioning and accidents, according to the Pembina Institute.

The partnership's report and a 2007 SaskPower draft report on nuclear power concluded the financial risks associated with reactor construction are too large for the industry to bear alone and governments would be involved in any successful project, although the partnership didn't specify the financial details of public-private co-operation.

The provincial could guarantee the cost and insure the project. That could lead to public-private partnership.

"The only way Bruce Power goes ahead with a nuclear project is if it makes money," said Prebble.

When a wave of electrical privatization hit the US, nuclear power seemed less attractive to big business. In 2007, a company filed application to build a new commercial reactor in the U.S. in almost thirty years.

The new flood of projects started with a federal government program of tax incentives and loan guarantees created by the Bush Administration. Now there are applications to build 26 reactors.

Saskatoon-based Cameco, the world's largest uranium miner, owns 31.6 per cent of four Bruce Power reactors. Cameco dropped out of another joint venture of restarting and refurbishing of another four reactors when the company cited inadequate returns, despite government involvement.

Title: Nuclear Power is the answer for Saskatchewan and the rest of the world
Author: Jeremy Warren
Source: Regina Leader Post
Date: May 22, 2009
Web site:
http://www.leaderpost.com/entertainment/movie-guide/PART+Nuclear+power+answer+Saskatchewan+world+advocate+says/1619218/story.html

To save the earth and reduce carbon emissions -- an issue swallowing political energy and environmental policy efforts -- build nuclear reactors, proponents say. Build a lot of them.

"It's the only solution we have right now," said Bruno Comby, founder and president of the international Environmentalists for Nuclear Energy. "Burning oil and coal and gas is like treating the sky as a garbage can."

A reactor emits zero carbon pollution and compared to dirty fuel like coal and oil, that's an attractive selling point for nuclear energy.

The Saskatchewan Party-appointed Uranium Development Partnership mentions the zero carbon emissions in its 121-page report that

recommended Saskatchewan welcome a nuclear reactor.

Bruce Power cites it in its Saskatchewan 2020 feasibility report on building a reactor in Northern Saskatchewan.

SaskPower estimates a reactor would immediately reduce carbon emissions in Saskatchewan, the worst polluter per capita in Canada by 11 per cent based on 2007 levels, according to a 2007 draft report on a nuclear energy in the province.

But opponents of nuclear power are quick to point out that while a reactor itself is zero-emission, the entire life-cycle of a reactor -- from mining, fuel refining, reactor construction, operation, decommissioning and waste storage -- contributes much more pollution than equivalent energy sources.

"Nobody outside the orbit of the nuclear industry is recommending going nuclear," said Jim Harding, author of Canada's Dirty Secret: Saskatchewan Uranium and the Global Nuclear System.

"They're giving people the false notion that nuclear power is a fix for environmental problems. This is not science. It's a public relations gimmick. It's called greenwashing."

Mining the uranium, building the reactor and decommissioning it are all horrible carbon emitters, he added.

Harding advocates better energy demand policies like shifting to LED lights, green engineering and conservation for a real reduction in carbon emissions.

Estimates of future power needs assume people will use power as they have in the past, without a change in mentality about conservation, he said.

Nuclear advocates still don't buy the life-cycle argument.

In its Saskatchewan 2020 report, Bruce Power compares life-cycle carbon emissions based on a University of Wisconsin-Madison study.

Nuclear emits 17 tonnes of carbon dioxide per gigawatt-hour, compared to 1,041 for coal, 39 for solar and 14 for wind, according to the report.

Comby, an Alberta-born nuclear engineer and author who lives in France, founded the 9,000 member Environmentalists for Nuclear Energy in 1996.

France uses nuclear power for 80 per cent of its electrical needs and renewable energy for 20 per cent, mostly from hydro power. But the best prospects for hydro in France, as in most developed countries, are developed.

"So strike it out, because the best opportunities are gone," said Comby.

France's neighbour Germany is often cited as an example of dedicated renewable energy policies. Germany uses windpower for 20 per cent of its electricity needs. But it still burns a lot of coal. France produces six tones of carbon dioxide per person every year, compared to 10 tonnes in Germany, said Combry. "The difference is exactly nuclear energy-produced electricity."

Wind power alone isn't developed enough to satisfy the needs of an industrial society, said Berol Robinson, Comby's American counterpart in the organization.

"We have no gas, we have no oil, we have no choice," he said.

Wind turbines only turn roughly half the time, and solar can't produce enough energy because "by definition the sun only shines half the time," he said.

Even if those problems were fixed, storing electricity is expensive and difficult, added Robinson.

The life-cycle of nuclear power still doesn't make it dirtier than fossil fuels, said Robinson.

The entire cycle emits only five per cent of carbons compared to coal, he said.

A Bruce Power proposal to build four reactors in Alberta estimated a $10-billion price tag -- $2,500 per kilowatt produced -- but later had to

be revised to $36 billion, tripling the cost per kilowatt, said Harding.

"At that price, wind power is about half the capital costs of nuclear power per kilowatt," he added.

Saskatchewan has three wind farms southwest Saskatchewan. Near Swift Current, the Centennial facility -- Canada's second largest -- produces 150 MW at peak operation, enough power for 69,000 homes. The other two wind farms at Cypress Hills and near Gull Lake produce 11 megawatts each. For every 1,000 MW of possible wind power about half is usually generated.

And as the nuclear industry expands, the supply and therefore the quality of uranium is eroded. The estimates have quality uranium disappearing in Saskatchewan in 45 years, the world in 80 years.

The carbon footprint of the nuclear industry, then, increases as mining harder-to-reach uranium and lower-quality fuel for reactors is used.

One problem with alternative energy is that proponents make forward-looking statements about future possibilities. The costs of solar power will decrease, eventually. The batteries for storing electricity are expensive and not large enough will eventually be made feasible. Of course, the same hopeful statements are made about storing nuclear waste.

All nuclear waste is still stored on the reactor site, said Harding.

"You can't destroy radioactive waste elements so why create a burden for future generations," he said.

The Pembina Canadian storage facilities hold more than 213 million tonnes of uranium tailings and, using 2003 numbers, the Pembina Institute said there are 1.7 million spent fuel bundles in storage at reactor sites, and another 85,000 are added annually.

Canada once considered burying nuclear waste containers 500 to 1,000 metres deep in the rocky Canadian Shield, but the Nuclear Waste Management Organization said a final site would be in Ontario, Quebec, New Brunswick or Saskatchewan, depending on which province volunteered.

Waste consists of spent fuel bundles or the remains of reprocessing them and seal in titanium or copper containers.

"The nuclear waste (issue) has been blown up into a problem by political considerations," said Robinson, a retired nuclear physicist and writer.

Fuel is often recycled through reprocessing plants, and what can't be used is welded shut into concrete bins, he added.

The organization believes waste should be stored in glass, then a steel container, and then buried deep in stable ground. But Cromby said the need for such a system is far into the future, at least for France

"The amount of waste generated from reactors can be stored in an area the size of football field one metre deep," he said.

Title: The Nuclear Debate (Part five of five)
Author: Jeremy Warren
Source: Saskatoon Star Phoenix
Date: May 22, 2009
Web site:
http://www.thestarphoenix.com/Business/nuclear+debate+Part+five/1621375/story.html

PRINCE ALBERT — A hair salon is an unlikely place to stage a war.

It’s the morning after the grassroots group opposed to building a nuclear reactor in the province, Renewable Power — the Intelligent Choice (RPIC), waged its latest campaign, an April 27 rally outside Prince Albert City Hall, and already members are planning their next move.

Janis McKnight and Richard Swanby, owners of the Blunt hair salon, haven’t seen their first client for the day, except for local environmentalist and professional photographer, Thomas Porter.

But he's not here for a trim. This is strategy. This is a war for public opinion.

"We're going to keep playing good cop/bad cop," he tells the couple. They're the bad cops. Already a local businessman has been disparaging McKnight with nasty names. Anti-progress, is how the man described the long-time entrepreneurs.

They're unfortunate sentiments and unfair, says McKnight.

"The more this city grows, the more business we get," she says.

Porter, who just came from an early morning meeting at City Hall, says he'll play the good cop and visit the local chamber of commerce; smooth talk the business crowd.

Their argument is simple: nuclear reactors are expensive, harm the environment (and their expansion induces more harm through increased mining), and renewable energy is more economically viable then ever before.

This morning they talk about speakers that should visit Prince Albert, and briefly conduct a post-mortem on the previous nights rally, which preceded several presentations to city councilors in front of a large audience.

An open mic policy that evening allowed a few unknown people to grab the spotlight and ramble on over a small wave of snickering.

"We can't be too careful about the other side — these people could have been plants to discredit us," says Porter.

The salon doesn't resemble a den where conspiracy theories are hatched. Plants line the light wooden walls in this bright room. Except for a hair washing station, two barber chairs are about the only furniture in the sparse space. It's here that daily plans are made to stop the construction of a nuclear reactor in the north.

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Bruce Power, an Ontario nuclear power company partly owned by Saskatchewan's Cameco Corp., wants to build a 1,000 megawatt reactor on the North Saskatchewan River, possibly in the Prince Albert area.

The company released a feasibility study in November 2008 titled Saskatchewan 2020 that makes a case for a reactor in the Prince Albert economic corridor, which stretches from that city to Lloydminster.

The plan was boosted earlier this year when the Saskatchewan Party-appointed Uranium Development Partnership recommended the province build a 3,000 megawatts of nuclear power to meet future energy demands and sell to Alberta.

Like Prince Albert, communities across Saskatchewan are debating the nuclear issue. Already, ratepayers of the rural municipality of Britannia, near Lloydminster, voted with 95 per cent of support for a motion opposing a nuclear power. Locals reported Bruce Power officials approached them to gauge interest in selling land.

The government is taking a tour of Saskatchewan starting this month to host a series of public consultations. Communities that have yet to receive answers will get a chance to ask questions.

There's a lack of information about how a deal for nuclear power will be made, and with whom, says Larry Marshall, a founding member of RPIC and organic farmer of 1,800 acres near Shellbrook.

"It's unfair to the public not to be given information or to be able to respond in an equitable way," he says, several hours before the city hall rally.

Questions like, who is paying for what, and the province's role are still unclear for Marshall and his wife, Meryl Wood.

"If this is such a great deal for Bruce Power, why won't they build it themselves?" he says, sitting around the kitchen covered with coffee mugs and stacks of paper about the nuclear industry.

Tall, grey haired and clad in a flannel shirt and jeans, the affable Marshall has farmed in the

Shellbrook region with Wood for thirty years. They harvest lentils and vegetables and hemp.

He believes Premier Brad Wall has done a lot of good for this province, but on the nuclear reactor file, Marshall is cautious with praise.

"(Wall) might blow it," he says. "I hope he doesn't underestimate the public."

Their involvement began with a petition against nuclear power circulated among local owners of large, "mainstream" farms. Marshall and Wood saw signatures of farmers they believed would have been on the other side of the issue. They knew then that momentum was on their side.

"Sometimes it's hard to stand up and speak, afraid of what neighbours might think," says Wood. Coffee done, Marshall puts on some coveralls and heads out to finish chores before the rally that RPIC expects to be their largest yet.

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Overcast and cold this evening, and people outside Prince Albert city hall are bundled up and, though the organizers are upbeat, attendance is smaller than the previous rally. Still, roughly a hundred people are here.

Signs poke up above the crowd — "Hell no, We won't glow." Swanby brought a large box filled with thick packages of stories about problems with the Hanford nuclear reactor site in his home state of Oregon.

The stories had headlines like, "Radiation has reached groundwater,' and "Handford's radioactive tumbleweeds."

McKnight speaks. Marshall speaks. Then the mic is opened up for anyone to speak. Sheldon James, a farmer from the Deer Ridge area, is the first. This is his first time speaking publicly, and his stilted speech confirms it. There are better opportunities in renewable energy, he says.

A Second World War vet who was stationed in Japan after the bombs dropped, Luther Anderson speaks next. "As we travelled through Japan, we passed an area totally devastated by the nuclear bombs," he says. "There were no people. The place was empty of life.

"The powers that be said we had nothing to worry about." But as the soldiers grew older and were diagnosed with cancer, he understood the devastating effect of radiation. The cancer rates among those soldiers in Japan was 25 per cent higher compared to civilians, he says.

Ironically, they also needed that radiation. "Nuclear energy caused this, and nuclear energy can cure it," he says.

One man takes the stage and rants about flying fighter jets in Pakistan and bombing children with nuclear bombs before he's gently escorted off-stage. Another speaker talks about some sort of nuclear rapture before the crowd moves into City Hall and fills the atrium as Swanby and McKnight address council.

A stern looking Mayor Jim Scarrow listens to the speakers attempt to convince city council to deny support for Bruce Power. When they finished, council members move on to their usual business about smoking bylaws and funding for service groups as the protesters file out.

Later, in his office, Scarrow speaks about the issue that was forced onto his city.

"Bruce Power chose Prince Albert, Prince Albert didn't chose Bruce Power," he says.

Not yet, anyway. Bruce Power is making a big push for a reactor on the North Saskatchewan River. While it's not up to the city to approve such a project — that's up to the provincial government and the RM of the chosen location — but the province's third-largest city will have a big role is brining a project to fruition.

In a city hit hard by the closure of the pulp mill, there's an appetite for development. Prince Albert would be a base for any reactor, sending labourers for construction, local business supplying construction and the city offering housing.

Already, the local economy is boosted by the uranium industry, which flies out mine labourers from their homes in Prince Albert, says Scarrow.

"We're already in the industry," he says. "We have been for 30 years. Uranium is paying for a lot of families' well-being."

The Prince Albert Tribal Council is closely watching the development of a project Bruce Power says will bring thousands of jobs to the area.

“You can imagine the opportunities for anyone involved in the project,” said tribal council economic development director Andrew Douglas.

“In all honesty, we’ll need more resources to respond more adequately assess the whole situation.”

Scarrow doesn’t take a stance on the reactor issue, though he did tour a Bruce Power plant with the local chamber of commerce — at their own expense.

Officials from Bruce Power have met with city officials, but Scarrow says they aren’t applying any pressure.

“Without entering the fray, each of use has to look at the questions and answers surrounding a nuclear reactor,” he says.

“Every city could use a project like this. We’re certainly willing to take a look at it.”

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The salon’s war room also acts as a confessional.

Talking nuclear reactors is not uncommon when customers pass through the couple’s chairs, and they often confess a creeping fear of bringing the controversial development to the area.

“We talk all day to our clients and that pushes them to get more information,” says McKnight, who moved back to Prince Albert eight years ago with Swanby.

It probably helps that she and her husband often hold a pair of scissors over their clients’ heads.

Not that the two resort to intimidation tactics. Their case is made for them, they say, through the countless examples of nuclear reactor projects gone wrong around the world.

They moved away from their Tri-City home in Oregon to get away from the nuclear reactor that was fraught with shutdowns and leaks. From their peaceful cabin just outside Prince Albert, they’re fighting an issue that followed them across the border.

“This isn’t a hobby,” says Swanby. “We’d rather not be doing this.”

They don’t want to move again. They’re protecting their home, and the future of Saskatchewan.

“We’re not looking to our children’s generation or grandchildren’s generation,” says McKnight.

“We have to start looking past our own lifetime.”

Title: Ontario Power Generation
Author: Stanley Kurtz
Source: Ontario Power Generation
Date:
Web site: http://www.opg.com/power/nuclear/

Nuclear power meets more than 50% of Ontario's electricity needs. It has two major benefits - low operating costs and virtually none of the emissions that lead to smog, acid rain or global warming. These benefits make nuclear a very attractive option for meeting the province's electricity needs well into the future.

Ontario Power Generation owns and operates the Pickering and Darlington Nuclear Power Stations. The two stations have a combined generating capacity of about 6,600 megawatts.

Improved Nuclear Performance

Accounting for almost 30% of the electricity generated in Ontario in 2007, OPG’s 10 nuclear units generated 44.2 terrawatt hours (TWh).

OPG's nuclear production benefited from the outstanding performance of the Darlington generating station. The station achieved a capability factor of nearly 90 per cent. It also received its best ever peer review from the World Association of Nuclear Operators and was recognized by the Institute of Nuclear Power Operators for improved performance in nuclear operations. In addition, Darlington’s two major planned outages were completed ahead of schedule.

Safety

The number one priority at each of OPG's nuclear stations is to ensure that there are no public safety concerns as a result of our operations. Our nuclear stations are designed with multiple safety systems and are staffed by station personnel who are extremely well trained.

In the four decades that nuclear energy has served Canada's energy needs, no member of the public has ever been harmed as a result of a radiation emission from a nuclear power plant or waste storage facility. An excellent measure demonstrating that the public is protected at all times from radiation emissions is provided by the continuous monitoring of radiation exposure at the perimeter of our stations.

Title: The Great Sustainability debates – Nuclear Energy
Author: Stanley Kurtz
Source: LifeSiteNews
Date: September 25, 2006
Web site: http://www.naturaledgeproject.net/TheGreatSustainabilityDebates-NuclearPower.aspx

As part of our commitment to '*Communicating existing and emerging concepts to a contemporary audience, raising awareness and understanding about sustainability issues'*, The Natural Edge Project secretariat seeks to provide information on key public debates and provide the key arguments from each side with further reading resources to help you make up your own mind. The first debate in this new TNEP series is the very topical 'Nuclear Energy Debate'.

Pros and Cons of the Nuclear Energy Debate
Over the last two years there has been renewed debate about nuclear energy. To help you make up your mind on this complex issue firstly we present below the key points of both the Pro-Nuclear Case and the Anti-Nuclear Case followed by further information from TNEP that synthesise TNEP secretariat's findings to date on this important debate along with a shortlist of additional reading. These opinion pieces by TNEP secretariat are the result of detailed consideration of both sides of the argument.

The Pro-Nuclear Case
Those arguing for expanding the global nuclear energy industry argue that it is needed in order to address three things: 1) the risks of climate change, 2) increasing base load energy demand, and 3) the need for an energy source to produce transport fuels once the world reaches peak oil production. More specifically, those proposing an expansion of the nuclear industry argue that:

1. We are about to witness a nuclear renaissance of both nuclear fission and fusion.
2. Since addressing climate change requires large (60% or more) reductions in greenhouse gas emissions, nuclear energy is going to be a key part of the solution to preventing climate change.
3. An expansion of nuclear power is vital to meet growing energy demand. International Energy Agency forecasts that, 'if policies remain unchanged, world energy demand is projected to increase by over 50% between now and 2030'.
4. Other options to reduce greenhouse gas emissions, such as renewable energy, do not provide reliable base load power. The position is that only nuclear and the burning of fossil fuels provides reliable base load power and hence, unless geo-sequestration rapidly becomes technically and economically possible, we have no choice but to build nuclear power plants in the future to mitigate greenhouse gas emissions.
5. The world's oil production will peak soon and to address this nuclear power plants are a potential way to provide energy to create transport fuels such as biofuels, methanol and hydrogen fuels. Also nuclear power can help supply electricity to battery powered cars in the future.

The Anti-Nuclear Case
Those arguing against expanding nuclear power point argue that nuclear power is too expensive, too risky, too slow to build enough capacity, and too dangerous in this age of terrorism. More specifically they argue that:

1. There is little evidence to support the notion that there is a nuclear renaissance underway. Rather over the coming decades most forecast a decline of nuclear energy as a percentage of global energy supply. They point out that as of 2003 distributed renewable energy generation provided more energy globally than the world's supply from nuclear energy.
2. Nuclear power is never going to be *the* answer to climate change. Only 32% of the US 's, and 35% of Australia 's greenhouse emissions come from electricity generation, whereas in countries like Brazil and India over 50% of their greenhouse emissions come from Non-CO 2 sources. A nuclear power station cannot reduce Non-CO 2 emissions. Hence those who argue against nuclear energy point out that it is impossible for nuclear power to be the one big techno fix for climate change as well as the fact that building nuclear plants takes many years.
3. Scientists now argue that humanity has to significantly reduce greenhouse gas emissions quickly to ensure that dangerous climate change is avoided. Nuclear power plants take a significant amount of time to build. Energy efficiency and other forms of renewable energy - geo-thermal, wind, solar, tidal, cogeneration, micro-hydro, biomass, wavepower - can be implemented today. Forty three companies and over fifteen cities have already achieved significant greenhouse gas reductions without using nuclear energy.
4. Policies have, are, and will continue to change, and have the potential to dramatically reduce energy demand both for peak and base load energy. Regulations have been created that provide new incentives, and reward energy utilities for selling less energy, which have been shown to dramatically reduce demand for more energy. Thus there is still significant potential to reduce energy demand cost effectively by implementing energy efficiency through all sectors throughout the global economy.
5. Renewable energy sources can indeed provide base load electricity either directly or by also utilising energy storage. Energy from renewable sources now accounts for a quarter of the installed capacity of California , a third of Sweden 's energy, half of Norway 's and three-quarters of Iceland 's. Six fully costed modelling studies already show that deep cuts to greenhouse emissions can be achieved without needing nuclear power.

Title: Saskatchewan may beat Alberta at Nuclear
Author: Dina O'Meara
Source: Calgary Herald
Date: June 2, 2009
Web site:
http://www.calgaryherald.com/Technology/Saskatchewan+beat+Alberta+nuclear/1654282/story.html

CALGARY - Alberta has stronger market conditions than Saskatchewan, but our eastern neighbour likely will see commercial nuclear power before us, according to a Calgary analyst and academic.

The province needs more electricity than Saskatchewan, particularly in the oilsands where its byproduct of steam is used to heat up bitumen, but Saskatchewan has the desire and political will, Duane Bratt, political science professor with Mount Royal College, said Monday.

Separate reports by each province on nuclear power released in March and April underscored critical differences in Alberta and Saskatchewan.

"Part of it is the market isn't big enough for two and I don't believe there is the human resources for two," Bratt told the Herald, at the sidelines of the 30th annual Canadian Nuclear Society conference in Calgary. "Because it's one or the other, you have to look at what matters more, the market condition or the political environment."

Nuclear power falls into the rare industry category where political support matters more

than economics, he said. And in Saskatchewan, where the uranium industry has been in full form since the 1950s, governments have not wavered in their support for the industry.

In contrast, Alberta's public is far more cautious about having a nuclear reactor in their backyard.

The West's rising interest in nuclear energy has been driven by concerns about greenhouse gases and the climbing costs of fossil fuels such as oil and natural gas, said Neil Alexander, president of the Organization of Candu Industries.

The industry also is a growing one, worldwide, and could provide long-term employment opportunities, he said.

"Typically a lot of the jobs associated with nuclear power are created on site, and are long-term jobs,"he said. "A power station now is built to last for 60 years, giving people the opportunity to have a quality job in a safe environment, and expect to maintain it for their entire life time."

Nuclear reactors also are used in building medical isotopes and in university research facilities, not just for power generation, said Danean Heath, with Structural Integrity Associates Inc.

He suggested Alberta and Saskatchewan create partnerships around nuclear generation to benefit both provinces economically.

"But it's not something you can do half way,"Heath said. "It really simply takes a will, business-wise and politically to show it makes good financial sense. And I think that the natural entrepreneurial character is more present here in Alberta."

Papers released within two days of each other at the end of March, Alberta's Nuclear Power Expert Panel and Saskatchewan's Uranium Development Partnership, highlighted several key and revealing differences between each province's vision of nuclear power.

The expert panel paper focused on power generation and technical knowledge without making any recommendations, whereas the development partnership focused on the full life cycle, from mining to upgrading, generation and waste disposal.

Each received different reactions, as well. In Alberta, the ruling Conservative party and the official opposition Liberals have adopted a code of silence on its outcome, awaiting public reaction, whereas Saskatchewan politicians embraced the report, Bratt said.

"Since the political and public sup-port for nuclear power is stronger in Saskatchewan, it is likely that a reactor will be built in Saskatchewan," he told a conference audience.

"And here is where it all comes together, with the excess electricity being exported to Alberta."

Title: Zealots can’t dominate the debate
Author: Gerry Klein
Source: Saskatoon Star Phoenix
Date: May 28, 2009

Web site: http://www.thestarphoenix.com/Technology/Zealots+dominate+debate/1637768/story.html

There are many reasons why Saskatoon is the logical place to kick off a debate over the role nuclear power can play in the world, and Prof. Chary Rangacharyulu is emblematic of many of them.

It is ironic, therefore, that the polite but determined head of the University of Saskatchewan's physics department constantly is being dragged out on stage by anti-nuke zealots, to be attacked for his knowledge and accused of being part of an evil conspiracy.

I first met Rangacharyulu when I was stationed on the university campus and did stories about the institution adopting the federal innovation strategy. Although he was a renowned scientist with an expertise in one of the most complex

areas of natural science and working at a synchrotron in Japan at a time when the U of- was determined to win its own light source, Rangacharyulu preached to whomever would listen about the danger of sacrificing at the altar of innovation the university's traditional role of teaching and public service.

He hardly seemed the kind of person who could be part of an evil conspiracy or sell out to industry. In fact, although his team was chosen by Discovery magazine to have contributed to the world's ninth most important scientific innovation in 2003, perhaps his greatest claim to fame was the work he did here and across Canada to promote science fairs and to make education interesting.

Not only does Rangacharyulu know nuclear science, he cares about his community (his desire to make Saskatoon a better place saw him run for city council) and has immense compassion for his fellow humans -- so much so that it's impossible to imagine him subverting his knowledge to a risky endeavour.

This is not to say those who oppose nuclear science don't genuinely believe in their position.

Much like religious conservatives who believe in the literal version of the Bible, including its description of Creation, those who truly believe nuclear technology is evil are able to eschew the massive scientific evidence accumulated over decades of research and espouse the views of fringe epidemiological studies and consider as the norm some easily explained aberrations.

Thus, for example, Chernobyl and Three Mile Island become the standard of the nuclear industry, and leukemia counts in children born within a certain proximity to reactors -- presumably the same studies that "proved" high-voltage power lines threaten humans -- are trumpeted as proof of nuclear folly.

As is the case that it's always best to seek out the best neurosurgeon available when one needs brain surgery, when it comes to nuclear science it's hard to imagine a more informed individual than Rangacharyulu.

So when I hear or read from opponents of nuclear science about its dangers, the irresponsibility of the industry and the maliciousness of the scientists, I remember there are those who also believe that brain tumors can be healed with potions, prayers and chants. I would rather put my faith in the science.

But Saskatoon isn't the natural epicentre of the nuclear debate only because it's home to some of the best scientific minds as well as some of the most determined skeptics. It is also home to the largest uranium company in the world. That's because the most productive uranium mining fields on Earth were created in Northern Saskatchewan by geological fortunes of hundreds of millions of years ago.

As such, Saskatoon and this province have skin in the game like few other places in the world do. Yet Saskatchewan always has turned down the opportunity fully exploit its natural fortune. So, while Alberta capitalized on its natural advantage to become a major global player in the energy field, Saskatchewan, which is home to a cleaner and longer-lasting resource, chose to export its advantage in uranium to the economic benefit of others around the world.

This is not to say, however, that building a reactor was ever in the province's best commercial interests. The nuclear industry is the most heavily regulated in the world, which may make it one of the safest but also one of the most costly. By refusing to tap into nuclear power, Saskatchewan -- which takes an odd pride in keeping its utilities cheap -- no doubt was able keep its energy costs down and thereby sustain and encourage energy hungry industries such as potash mining.

All this has come with a social cost. On a per-capita basis, this province is one of the world's greatest producers of carbon emissions.

While the science of nuclear power is clear and the evidence of the deleterious impact of carbon in the atmosphere mounts daily, the economic benefits of a reactor compared with renewable or cleaner alternatives have yet to be sorted out.

Wind, solar, geothermal and biomass energy sources all are enticing alternatives, but there isn't a credible scientific source that suggests these can meet but a relatively small percentage of demand. Uncertainty of supply and lack of storage capacity, which all create the need for

back-up power, plus the costs involved, limit the viability of all these alternatives.

Fortunately, all of these sources are abundant in the province.

Likewise, Saskatchewan is a world leader when it comes to exploring the potential of carbon capture and sequestration. Here, too, the costs and the scientific uncertainty around the technology make it risky. However, if the engineering proves successful, the rewards for the province could be great.

The most credible danger identified by opponents of the nuclear industry is that if the government invests heavily in any one of these sectors, it may be dissuaded from investing in the alternatives. Governments are notoriously bad at picking winners, but when it comes to finding responsible alternatives for energy, there is no private source of funding because the risks are too high.

This makes the debate in Saskatchewan critical, once you get beyond the zealotry.

Title: Province Suitable for reactor - panel
Author: Angela Hall
Source: Saskatoon Star Phoenix/Regina Leader Post
Date: April 4, 2009
Web site:
http://www.timescolonist.com/Technology/Province+suitable+reactor+panel/1463357/story.html

Saskatchewan should incorporate a nuclear reactor into its power plans, says a panel struck to advise the provincial government on the future of its uranium industry.

"There's much more work to be done here, of course, but our recommendation is that Saskatchewan should include nuclear in its long-range energy mix," said Richard Florizone, the University of Saskatchewan vice-president who chaired the government-appointed Uranium Development Partnership.

The partnership's report, released to the public Friday, also recommended an emphasis on research and development, including construction of a research reactor that could produce medical isotopes.

The province should consider storing nuclear waste as well, the report said. But the Saskatchewan Party government was quick to say it won't pursue that idea, citing lack of public support.

The partnership said Saskatchewan needs to ensure it remains a competitive jurisdiction for exploration and mining, noting Kazakhstan could replace the province this year as the largest producer of uranium.

But Saskatchewan shouldn't get involved in the conversion of uranium or in the fabrication of fuel bundles for use in reactors, because those markets are already well-served, the report found.

"For over 30 years in our province we've been spinning our wheels, we've been going in circles, regarding uranium development in our province. A study of this magnitude is indeed long overdue," Crown Corporations Minister Ken Cheveldayoff said at a news conference unveiling the report's 20 recommendations.

Enterprise and Innovation Minister Lyle Stewart said a consultation process will begin immediately to help the government decide its next steps.

In addition to a conference for various stakeholders, community meetings will take place between May 19 and June 5 in Prince Albert, Buffalo Narrows, The Battlefords, Lloydminster, Yorkton, Estevan, Swift Current, Regina and Saskatoon. A website, www.saskuranium.ca, has been established.

"We want to encourage everyone to get informed and get involved," said Stewart.

But the limited time frame for public meetings drew immediate criticism from NDP Deputy Leader Pat Atkinson, who argued the government is trying to push through a nuclear power plant without adequate debate.

"We need to take time. This is a major report that lays out for the province of Saskatchewan some very significant change," Atkinson said.

Saskatchewan is expected to need 1,200 to 1,750 MW of new power generation by 2020.

The report suggests one scenario could be a nuclear power plant with up to 3,000 MW of capacity to supply Saskatchewan as well as export power to Alberta.

But improvements to Saskatchewan's power grid alone would likely be in the $1-billion range, while the government would also need to decide what role it would play with the plant, said Florizone.

"We're not saying that government would necessarily have to take something like, say, capital risk. The arrangement could be through something like a power purchase agreement," Florizone said.

Nuclear power has high upfront capital costs, but can ultimately be cost competitive and generates very low carbon emissions, the report said.

However, the partnership cautions further study is required to understand the "social, environmental and grid feasibility of adding nuclear power," given that it's never been done in Saskatchewan before.

One company has already expressed interest in putting a reactor in Saskatchewan. Bruce Power released a study last year indicating Saskatchewan could be a feasible location for nuclear power.

However, a group promoting a "non-nuclear future" for Saskatchewan said its voice will be heard as hearings begin on the uranium partnership's findings. Cathy Holtslander with the Coalition for a Green Saskatchewan said the report is not in the public interest, but rather in the interest of the uranium industry.

Kent Smith-Windsor, executive director of the Greater Saskatoon Chamber of Commerce, said the report is a good one and should be considered very seriously.

Smith-Windsor said an earlier opportunity, the Warman Uranium Refinery, was not pursued. The venture went elsewhere, resulting in the loss of $12 billion to Saskatchewan's GDP.

"If you say no to opportunity, you should not be surprised when opportunity says no to you," he said.

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Title: Is small the future of Nuclear power generation?
Author: Tyler Hamilton
Source: The Toronto Star
Date: January 5, 2009

Web site:
http://www.thestar.com/comment/columnists/article/561553

Distributed energy generation, hailed by most environmentalists as the future of sustainable electricity production, is about powering a country with hundreds, potentially thousands, of renewable and clean energy systems with some help from natural gas.

It's efficient because power is generated where it's used. It's flexible because projects can be built quickly when needed. It saves money in the long run because there's less need for expensive transmission lines that carry the power elsewhere. And if one generator fails, its relatively small size means it doesn't threaten the stability of the entire system.

This, of course, is the antithesis of centralized power generation that relies on a dozens or so large nuclear and fossil-fuel plants. Proponents of distributed generation cite the massive size and cost of nuclear power plants as one reason, beyond safety and waste-management concerns, and the technology is unsustainable and far too risky.

Not so, argues one start-up firm from Santa Fe, N.M., which has high hopes of expanding the definition of distributed generation to include nuclear power.

Hyperion Power Generation Inc. has developed a garden shed-sized nuclear reactor that can

produce enough heat to generate 25 megawatts of electricity for up to 10 years.

That's enough energy to power 20,000 homes, but still tiny by current nuclear standards. An Advanced Candu Reactor, for example, is 48 times larger and a next-generation Areva reactor is 64 times larger.

Hyperion, which calls its reactor as a "nuclear battery," licensed the technology from the Los Alamos National Laboratory in New Mexico. It plans to sell the reactor for about $30 million (U.S.) and says there's potential to sell 4,000 of them around the world by 2025.

The company already claims more than $2 billion worth of orders in the pipeline and more than 100 "firm" orders.

One of its first target markets: Alberta's oil sands. Hyperion chief executive John Deal is the only nuclear executive that will sit on the 2009 advisory board of the "Oil Sands and Heavy Oil Technologies" conference that will be held in Calgary in July.

The idea is that oil-sands developers, which rely heavily on electricity and steam to mine and upgrade bitumen, could purchase and operate their own Hyperion nuclear reactors as a way to virtually eliminate their controversial dependence on natural gas – that is, the use of a relatively "clean" fossil fuel as a way to extract and process one of the dirtiest fossil fuels.

By using nuclear instead of natural gas, oil-sands developers aim to dramatically lower their greenhouse-gas emissions. Atomic Energy of Canada and Areva are also marketing their reactors to Alberta, but Hyperion's reactor, because of its small size, offers a tiny bite that's much easier for industry to chew and ultimately swallow.

"It was really created for the Alberta tar sands... we have strong interest there," says Deborah Blackwell, vice-president of licensing and public affairs at Hyperion.

"It's changing the whole way of thinking about nuclear power and it goes back to this concept of distributed generation."

I can imagine some environmentalists reading this article just cringing at the very thought. Suddenly, one of their big arguments for opposing nuclear power loses its steam. At the same time, the concept could win over a few environmental allies given urgent the need to curb greenhouse-gas emissions.

"It's a very interesting idea and it has a lot of supporters," says Stephen Aplin, head of energy consulting with Ottawa-based HDP Group Inc.

"And it's not just Hyperion. Other U.S. vendors of small reactors include NuScale, Adams Atomic Engines and any U.S. firm that develops the Liftr, or liquid fluoride thorium reactor."

So how does Hyperion's atomic battery, which weighs about 15 tonnes and is about 2 metres tall, actually work?

It's based on the design of a TRIGA reactor, which stands for "Training, Research, Isotopes, General Atomics." These are small reactors first built about 40 years ago and used by students of nuclear science. About 23 are operational today around the world.

TRIGA reactors use low-enriched uranium hydride as a fuel, which can't be used to make a bomb, and they're designed to make a meltdown virtually impossible. In other words, no containment building is required.

"The secret of the fuel is that it cools itself off," says Blackwell.

When uranium hydride gets too hot, above 550 degrees Celsius, it will shed hydrogen atoms. The hydrogen flows out of the core and is stored in special storage trays within the reactor. As the fuel loses hydrogen atoms it begins to naturally cool. As it cools, it will retrieve the hydrogen atoms from the trays.

The whole process is self-limiting. A runaway chain reaction isn't possible – at least that's what the company claims.

Blackwell compares the reactor to lungs that inhale and exhale hydrogen in a natural balance that keeps the reactor at a fairly constant temperature.

This built-in safety feature makes it possible to plop one of these reactors in a remote area, like a military base, island community, or oil-sands development, without the need for massive concrete containment buildings, cooling towers or transmission infrastructure. Another bonus: no water is needed for cooling.

Still, even without the claimed meltdown risks there are the obvious concerns about tampering, attacks from terrorists and what to do with the nuclear waste. It's one thing to keep a watchful eye on a few hundreds large nuclear plants around the world, but keeping thousands of mininukes out of the wrong hands could prove challenging.

Not really, argues Hyperion. It plans to mass produce the reactors in a secure factory, seal them on site and transport them directly to customers on a flatbed truck equipped with special security. Once on a customer site, the company will bury the reactor three metres underground before it is switched on. After that, minimal human intervention is required.

"All of our units will have remote sensors on them and they're all monitored around the clock. And there's on-site monitoring as well. We will know what's going on with every one of those units at all times," Blackwell maintains.

The factory-sealed reactor would stay safely underground until the fuel is used up in five to 10 years, depending on the electricity load. In this sense, it does operate much like a battery. Hyperion will then dig up the expired unit and transport it back to its central facility for proper disposal or, if possible, refueling, resealing and resale.

TES Group SA, an energy investment company in Eastern Europe, has already signed a "letter of intent" to purchase six reactors from Hyperion and possibly 50 more in a follow-on order. The group wants to deploy the units in Romania and the Czech Republic.

Blackwell says the aim is to start commercial production of the reactors by 2013. Hyperion is in talks with the U.S. Nuclear Regulatory Commission about obtaining a manufacturing license.

"It's the first time anybody has mass manufactured a nuclear power plant, the same one over and over again," Blackwell says. ``We are forging through uncharted territory here. It's part of the reason this could take a while."

But is charting through this territory a good idea?

The fact is the units would still produce nuclear-fuel waste – a football-sized amount for each reactor – and while it would be collected by Hyperion and managed at a central location, a large part of the population believes it immoral to create and leave behind highly toxic waste for future generations.

Can a company like Hyperion be trusted to transport, collect and manage this waste from potentially thousands of sites? And how, some might ask, is it environmentally responsible to turbo boost oil-sands development with nuclear power?

These are questions deserving of wider public debate and ones that nuclear regulators in Canada and around the world will have to answer. If, however, we're comparing Hyperion's distributed-generation approach to the conventional "go big" nuclear approach, the benefits are clear.

Efficient. Flexible. Safer. Transportable. Scalable. Swappable. In the world of nuclear energy, small could end up becoming the new big.

If only it wasn't nuclear.

Title: The Benefits of Nuclear Engery
Author: Bruno Comby
Source: Environmentalist for Nuclear Energy
Web site:
http://www.ecolo.org/documents/documents_in_english/BENEFITS-of-NUCLEAR.pdf
The only clean, safe energy source capable of ensuring the continuation of our industrial civilization while protecting the environment.
by Bruno Comby
Introduction and conclusion (previous conclusion elevated to introduction)
Nuclear energy is a clean, safe, reliable and competitive energy source. It is the only source of energy that can replace a significant part of

the fossil fuels (coal, oil and gas) which massively pollute the atmosphere and contribute to the greenhouse effect.
If we want to be serious about climate change and the end of oil, we must promote the more efficient use of energy, we must use renewable energies – wind and solar – wherever possible, and adopt a more sustainable life style. But this will not be nearly enough to slow the accumulation of atmospheric CO2, and satisfy the needs of our industrial civilization and the aspirations of the developing nations. Nuclear power should be deployed rapidly to replace coal, oil and gas in the industrial countries, and eventually in developing countries
An intelligent combination of energy conservation, and renewable energies for local low-intensity applications, and nuclear energy for base-load electricity production, is the only viable way for the future.
Tomorrow's nuclear electric power plants will also provide power for electric vehicles for cleaner transportation. With the new high temperature reactors we will be able to recover fresh water from the sea and support hydrogen production.
We believe that the opposition of some environmental organizations to civilian applications of nuclear energy will soon be revealed to have been among the greatest mistakes of our times.

Present Conditions

Resources:

Our industrial civilization runs on energy and 85% of the world's energy is provided by the fossil fuels, coal, oil and gas.
Coal began to be used extensively in Britain when its forests were no longer able to satisfy the energy requirements of an embryo of industrialization. Coal is found almost everywhere and reserves should last several centuries.

Petroleum began by replacing whale oil at the end of the 19th century, and its use has grown ever since. Discoveries of new deposits are not keeping up with consumption and production of oil is about to peak. At the present rate of consumption, reserves are estimated to last a few decades, but consumption is growing rapidly. More than half the world's oil production today is located in the fragile and politically unstable area of the Persian Gulf, as is an even greater fraction of our future reserves,

Gas was at first a byproduct of oil extraction and it was thrown away. It has since been mastered to become a major source of energy. Reserves are similarly limited and estimated to last for a few decades.
These fossil fuels were laid down over geological times and it seems likely they will have been totally exploited over the few centuries from about 1850 to 2100.

Environmental Consequences:

In burning fossil fuels, we inject 23 billion tons of carbon dioxide every year into the atmosphere – 730 tons per second. Half of it is absorbed in the seas and vegetation, but half remains in the atmosphere. This is significantly altering the composition of the atmosphere and seriously affecting the climate of our planet.
We have only this one fragile planet to live on. If we want it to remain livable, to ensure the comfort of our modern lives and indeed the very continuation of our industrial civilization, then we must urgently adopt new lifestyles and find other energy sources.

What is to be done?

Conservation and renewables:

There are those who tell us we only need to conserve energy and rely upon renewable energies. Solar and wind are the major renewables.
I agree, of course, that conservation is highly commendable, even essential. But in the light of the world's growing population, widespread economic development and enhanced life expectancy on the one hand (notably China and India which account for about 35% of the world's population) and finite fossil fuel resources on the other, conservation can only delay the crisis that will arise from the penury of oil and gas.
Energy efficiency and alternate sources of energy can and must be developed.
Efficient light bulbs produce the same amount of light with 3 to 8 times less energy.
Heat pumps can provide the same amount of heat with 2 to 5 times less energy. Solar heat and geothermal energy can and should be developed to a much greater extent than they are today.
Some environmentalists are enchanted by the simplicity of solar cells and the pristine elegance of wind turbines, and they refuse to accept the fact that they are quantitatively incapable of supplying the energy required by an industrial civilization.
I do not mean to say that these renewable energies should be excluded; they are useful and have important niche roles to play – in remote locations and under special circumstances. But they can make only a marginal contribution to

the energy needs of a growing industrial civilization.
Let me give an example. To replace just one nuclear reactor, such as the new EPR reactor which France is now building in Normandy, with the most modern wind turbines (twice as high as Notre-Dame, the Cathedral of Paris), they would have to be lined up all the way from Genoa in Italy to Barcelona in Spain (about 700 kilometers/400miles). And, even so, they generate electricity only when the wind blows (their average yield is about 25% of their rated capacity).
There is much talk about biofuels, ethanol from sugar cane, for example. The entire arable surface of the Earth could not produce enough biofuel to replace present oil consumption.
Mineral resources:
By 2100, oil and natural gas reserves will likely be exhausted. This leaves coal and nuclear energy.
As an environmentalist the idea of developing more coal, the most polluting energy source on the planet, and the greatest contributor to global warming, is simply not acceptable. The process of sequestration or isolating millions and billions of tons of carbon dioxide is nothing but a pleasant dream at this point, still unproven and unlikely to be put into wide-spread practice.
Nuclear power:
Nuclear power is clean, safe, reliable, compact, competitive and practically inexhaustible. Today over 400 nuclear reactors provide base-load electric power in 30 countries. Fifty years old, it is a relatively mature technology with the assurance of great improvement in the next generation.
(Hundreds of nuclear reactors furnish reliable and flexible shipboard power: military ships of course. But the technology is adaptable to civilian maritime transport.)
Clean: Nuclear energy produces almost no carbon dioxide, and no sulfur dioxide or nitrogen oxides whatsoever. These gases are produced in vast quantities when fossil fuels are burned.
Nuclear waste: One gram of uranium yields about as much energy as a ton of coal or oil - it is the famous “factor of a million”. Nuclear waste is correspondingly about a million times smaller than fossil fuel waste, and it is totally confined. In the USA and Sweden, spent fuel is simply stored away. Elsewhere, spent fuel is reprocessed to separate out the 3% of radioactive fission products and heavy elements to be vitrified (cast in glass) for safe and permanent storage. The remaining 97% – plutonium and uranium – is recovered and recycled into new fuel elements to produce more energy.
The volume of nuclear waste produced is very small. A typical French family’s use of nuclear energy over a whole lifetime produces vitrified waste the size of a golf ball.
Nuclear waste is to be deposited in deep geological storage sites; it does not enter the biosphere. Its impact on the ecosystems is minimal. Nuclear waste spontaneously decays over time while stable chemical waste, such as arsenic or mercury, lasts forever.
Most fossil fuel waste is in the form of gas that goes up the smokestack. We don’t see it, but it is not without effect, causing global warming, acid rain, smog and other atmospheric pollution.
Safe: Nuclear power is safe, as proven by the record of half a century of commercial operation, with the accumulated experience of more than 12,000 reactor-years.
There have been only two serious accidents in the commercial exploitation of nuclear power: Three Mile Island in 1979 (in Pennsylvania, USA) and Chernobyl in 1986 (in the Soviet Union, now in Ukraine). TMI was the worst accident one can imagine in a western power reactor. The core of the reactor melted down and much of it fell to the bottom of the reactor vessel. The radioactivity released was almost entirely confined within the reinforced concrete containment structure, the air-tight silo-like building which houses the reactor – it was designed for that purpose. The small amount of radioactivity which escaped was quite innocuous. As a result, no one at TMI was seriously irradiated nor did anyone die. In fact, Three Mile Island was a real success story for nuclear safety. The worst possible accident occurred, a core meltdown, and yet no one died or was even injured.
Chernobyl was different. The reactors at Chernobyl had no containment structure. The reactor’s faulty design made it unstable and Chernobyl was operated that night in a way known to be dangerous. In the execution of a test, all the security systems were deliberately bypassed. An uncontrollable surge in power occurred leading to a steam explosion. The 600-ton graphite moderator then caught fire and burned for several weeks. The smoke carried more than half the radioactive fission products directly into the atmosphere where they were swept far and wide by the winds. Fewer than 32 persons died within a few months, and about 200 more were severely irradiated but survived. The inhabitants of the exclusion zone were also

victims as they were hurriedly uprooted, evacuated and resettled elsewhere. They lost their jobs and suffered psychological and social trauma in the dissolving Soviet Union. Their lives were disrupted and shortened. Since 1986, some 4000 cases of thyroid cancer have been diagnosed in the surrounding regions, and successfully treated. Nine fatal cases have been reported. There has been some talk about long term cancers. Some organizations and journalists speculate that there might be tens of thousands of victims still to come, but it should be noted that these are mostly the result of theoretical calculations based on an unsubstantiated hypothesis, the linear extrapolation of the effect of high doses and high dose rates of radiation to the low doses and low dose rates, applied in this case to populations in millions having received only low doses. It is scientifically well established that this linear extrapolation does not apply to doses below 100 mSv, and therefore these calculations are not relevant, except perhaps for those persons who were exposed to high doses above 100 mSv. Chernobyl was the perfect example of what not to do with a nuclear reactor: a faulty design, an unstable reactor, operated in an experiment with all security systems disconnected, followed by a panicked response by the civil authorities.

In sum, far fewer fatalities have occurred in the civilian nuclear power industry in half a century (Chernobyl included), than occurred in any year in the fossil fuel industries. Coal mine accidents are common occurrences and often cause tens or hundreds of fatalities, reported one day and forgotten the next, adding up to about 15,000 per year worldwide, 6,000 of which are in China. The same may be said for oil field accidents. Oil tankers go aground or break up, accidents occur in refineries, oil and gas platforms have been lost with all hands. Accidents in high pressure gas pipelines are not infrequent. Just one example among many others is the gas pipeline accident at
Ghislenghien, Belgium on July 30, 2004, in which 21 persons died and 120 were injured.

Reliable: Nuclear reactors provide base-load power and are available over 90% of the time; intervals between refuelings have been extended and down time for refueling has been reduced. In the USA, these improvements over the years have been the equivalent of adding one reactor a year to the existing fleet. Most reactors are designed for a life of 40 years; many are reaching that age in good condition and extensions of 20 years have usually been granted.

Competitive: The cost of nuclear power is competitive and stable. The cost of nuclear fuel is a small part of the price of a nuclear kiloWatt-hour, whereas fossil fueled power, especially oil and gas, is at the mercy of the market.

Inexhaustible: Uranium is found everywhere in the crust of the Earth – it is more abundant than tin, for example. Major deposits are found in Canada and Australia.

It is estimated that increasing the market price by a factor ten would result in 100 times more uranium coming to market. Eventually we will be able to recover uranium from sea water where 4 billion tons are dissolved.

Compact: A nuclear power station is very compact, occupying typically the area of a football stadium and its surrounding parking lots. Solar cells, wind turbine farms and growing biomass, all require large areas of land.

Radiation: Fear of the unknown is the merchandise of anti-nuclear “greens”. They preach fear of radiation in general, fear of radioactive waste in particular, fear of another major accident such as Three Mile Island or Chernobyl, and fear of nuclear weapons proliferation. Their campaign has been successful only because radiation is a mystery to most people, and very few are aware of the fact that radiation is present everywhere in the environment. The anti-nuclear organizations also exploit the widespread but mistaken interpretation of the studies of the health of the survivors of the Hiroshima and Nagasaki bombing: that even a small amount of radiation is deleterious to health (the LNT hypothesis), and the related concept of collective dose.

In fact a moderate amount of radiation is natural and beneficial, if not essential, to life. Radiation has been bathing our environment since the earliest history of our planet, and it is present everywhere in nature. In fact, our sun and its planets including the Earth are the remnants of the giant explosion of a supernova. Everything is radioactive around us in nature and already was even before radioactivity was discovered. This radiation spontaneously decreases with time. When life first appeared on Earth, the natural radiation levels were about twice as high as today.

Most people are totally unaware of the fact that the human body itself is naturally radioactive. Our bodies contain about 8000 becquerels (8000 atoms disintegrating every second), about half of

which is potassium-40, a chemical element essential for health, as well as carbon-14.
Old Fashioned Attitudes: Ecological organizations such as Greenpeace have consistently had an anti-nuclear bias which is more ideological than factual. An increasing number of environmentalists are now changing their minds about nuclear energy because there are very good, solid, scientific and, above all, environmental reasons to be in favor of nuclear energy.
TO CONCLUDE, it is our position that well designed, well constructed, well operated and well maintained nuclear energy is not only clean, but it is also safe, reliable, durable and competitive.
www.ecolo.org
Bruno Comby is the founder and president of the international association
Environmentalists For Nuclear Energy (http://www.ecolo.org) which has over 8000 members and supporters in more than 50 countries. A graduate of the Ecole Polytechnique in Paris with a postgraduate qualification in nuclear physics from the National University of Advanced Technology (ENSTA), he is a well known European environmentalist. He is the author of 10 books on healthy living, ecology and energy, published in 15 languages with a million readers worldwide, and has dedicated his life to protecting the environment. (see: http://www.comby.org).
Ref. : “Environmentalists For Nuclear Energy” by Bruno Comby, published by TNR Editions, 350 pages (available at www.comby.org click on the Union Jack then on “Books”)

Title: Nuclear Power is the Problem, Not a solution
Author: Helen Caldicott
Source: The Australian
Date: April 15, 2005
Website: http://www.commondreams.org/views05/0415-23.htm
There is a huge propaganda push by the nuclear industry to justify nuclear power as a panacea for the reduction of global-warming gases.

In fact Leslie Kemeny on these pages two weeks ago (HES, March 30) suggested that courses on nuclear science and engineering be included in tertiary level institutions in Australia.

I agree. But I would suggest that all the relevant facts be taught to students. Mandatory courses in medical schools should embrace the short and long-term biological, genetic and medical dangers associated with the nuclear fuel cycle. Business students should examine the true costs associated with the production of nuclear power. Engineering students should become familiar with the profound problems associated with the storage of long-lived radioactive waste, the human fallibilities that have created the most serious nuclear accidents in history and the ongoing history of near-misses and near-meltdowns in the industry.

At present there are 442 nuclear reactors in operation around the world. If, as the nuclear industry suggests, nuclear power were to replace fossil fuels on a large scale, it would be necessary to build 2000 large, 1000-megawatt reactors. Considering that no new nuclear plant has been ordered in the US since 1978, this proposal is less than practical. Furthermore, even if we decided today to replace all fossil-fuel-generated electricity with nuclear power, there would only be enough economically viable uranium to fuel the reactors for three to four years.

The true economies of the nuclear industry are never fully accounted for. The cost of uranium enrichment is subsidised by the US government. The true cost of the industry's liability in the case of an accident in the US is estimated to be $US560billion ($726billion), but the industry pays only $US9.1billion - 98per cent of the insurance liability is covered by the US federal government. The cost of decommissioning all the existing US nuclear reactors is estimated to be $US33billion. These costs - plus the enormous expense involved in the storage of radioactive waste for a quarter of a million years - are not now included in the economic assessments of nuclear electricity.

It is said that nuclear power is emission-free. The truth is very different.

In the US, where much of the world's uranium is enriched, including Australia's, the enrichment facility at Paducah, Kentucky, requires the electrical output of two 1000-megawatt coal-fired plants, which emit large quantities of

carbon dioxide, the gas responsible for 50per cent of global warming.

Also, this enrichment facility and another at Portsmouth, Ohio, release from leaky pipes 93per cent of the chlorofluorocarbon gas emitted yearly in the US. The production and release of CFC gas is now banned internationally by the Montreal Protocol because it is the main culprit responsible for stratospheric ozone depletion. But CFC is also a global warmer, 10,000 to 20,000 times more potent than carbon dioxide.

In fact, the nuclear fuel cycle utilises large quantities of fossil fuel at all of its stages - the mining and milling of uranium, the construction of the nuclear reactor and cooling towers, robotic decommissioning of the intensely radioactive reactor at the end of its 20 to 40-year operating lifetime, and transportation and long-term storage of massive quantities of radioactive waste.

In summary, nuclear power produces, according to a 2004 study by Jan Willem Storm van Leeuwen and Philip Smith, only three times fewer greenhouse gases than modern natural-gas power stations.

Contrary to the nuclear industry's propaganda, nuclear power is therefore not green and it is certainly not clean. Nuclear reactors consistently release millions of curies of radioactive isotopes into the air and water each year. These releases are unregulated because the nuclear industry considers these particular radioactive elements to be biologically inconsequential. This is not so.

These unregulated isotopes include the noble gases krypton, xenon and argon, which are fat-soluble and if inhaled by persons living near a nuclear reactor, are absorbed through the lungs, migrating to the fatty tissues of the body, including the abdominal fat pad and upper thighs, near the reproductive organs. These radioactive elements, which emit high-energy gamma radiation, can mutate the genes in the eggs and sperm and cause genetic disease.

Tritium, another biologically significant gas, is also routinely emitted from nuclear reactors. Tritium is composed of three atoms of hydrogen, which combine with oxygen, forming radioactive water, which is absorbed through the skin, lungs and digestive system. It is incorporated into the DNA molecule, where it is mutagenic.

The dire subject of massive quantities of radioactive waste accruing at the 442 nuclear reactors across the world is also rarely, if ever, addressed by the nuclear industry. Each typical 1000-megawatt nuclear reactor manufactures 33tonnes of thermally hot, intensely radioactive waste per year.

Already more than 80,000 tonnes of highly radioactive waste sits in cooling pools next to the 103 US nuclear power plants, awaiting transportation to a storage facility yet to be found. This dangerous material will be an attractive target for terrorist sabotage as it travels through 39 states on roads and railway lines for the next 25 years.

But the long-term storage of radioactive waste continues to pose a problem. The US Congress in 1987 chose Yucca Mountain in Nevada, 150km northwest of Las Vegas, as a repository for America's high-level waste. But Yucca Mountain has subsequently been found to be unsuitable for the long-term storage of high-level waste because it is a volcanic mountain made of permeable pumice stone and it is transected by 32 earthquake faults. Last week a congressional committee discovered fabricated data about water infiltration and cask corrosion in Yucca Mountain that had been produced by personnel in the US Geological Survey. These startling revelations, according to most experts, have almost disqualified Yucca Mountain as a waste repository, meaning that the US now has nowhere to deposit its expanding nuclear waste inventory.

To make matters worse, a study released last week by the National Academy of Sciences shows that the cooling pools at nuclear reactors, which store 10 to 30 times more radioactive material than that contained in the reactor core, are subject to catastrophic attacks by terrorists, which could unleash an inferno and release massive quantities of deadly radiation -- significantly worse than the radiation released by Chernobyl, according to some scientists.

This vulnerable high-level nuclear waste contained in the cooling pools at 103 nuclear power plants in the US includes hundreds of radioactive elements that have different

biological impacts in the human body, the most important being cancer and genetic diseases.

The incubation time for cancer is five to 50 years following exposure to radiation. It is important to note that children, old people and immuno-compromised individuals are many times more sensitive to the malignant effects of radiation than other people.

I will describe four of the most dangerous elements made in nuclear power plants.

Iodine 131, which was released at the nuclear accidents at Sellafield in Britain, Chernobyl in Ukraine and Three Mile Island in the US, is radioactive for only six weeks and it bio-concentrates in leafy vegetables and milk. When it enters the human body via the gut and the lung, it migrates to the thyroid gland in the neck, where it can later induce thyroid cancer. In Belarus more than 2000 children have had their thyroids removed for thyroid cancer, a situation never before recorded in pediatric literature.

Strontium 90 lasts for 600 years. As a calcium analogue, it concentrates in cow and goat milk. It accumulates in the human breast during lactation, and in bone, where it can later induce breast cancer, bone cancer and leukemia.

Cesium 137, which also lasts for 600 years, concentrates in the food chain, particularly meat. On entering the human body, it locates in muscle, where it can induce a malignant muscle cancer called a sarcoma.

Plutonium 239, one of the most dangerous elements known to humans, is so toxic that one-millionth of a gram is carcinogenic. More than 200kg is made annually in each 1000-megawatt nuclear power plant. Plutonium is handled like iron in the body, and is therefore stored in the liver, where it causes liver cancer, and in the bone, where it can induce bone cancer and blood malignancies. On inhalation it causes lung cancer. It also crosses the placenta, where, like the drug thalidomide, it can cause severe congenital deformities. Plutonium has a predisposition for the testicle, where it can cause testicular cancer and induce genetic diseases in future generations. Plutonium lasts for 500,000 years, living on to induce cancer and genetic diseases in future generations of plants, animals and humans.

Plutonium is also the fuel for nuclear weapons -- only 5kg is necessary to make a bomb and each reactor makes more than 200kg per year. Therefore any country with a nuclear power plant can theoretically manufacture 40 bombs a year.

Because nuclear power leaves a toxic legacy to all future generations, because it produces global warming gases, because it is far more expensive than any other form of electricity generation, and because it can trigger proliferation of nuclear weapons, these topics need urgently to be introduced into the tertiary educational system of Australia, which is host to 30 per cent to 40 per cent of the world's richest uranium.

Helen Caldicott is an anti-nuclear campaigner and founder and president of the Nuclear Policy Research Institute, which warns of the danger of nuclear energy.
Title: Nuclear
Author: Stanley Kurtz
Source: LifeSiteNews
Date: September 25, 2006

Web site: http://www.

Nuclear Energy Fact Sheet
by Leslie Lai & Kristen Morrison

Introduction to Nuclear Energy for Civilian Purposes

- Most early atomic research focused on developing an effective weapon for use in World War II. After the war, the United States government encouraged the development of nuclear energy for peaceful civilian purposes while continuing to develop, test, and deploy new nuclear weapons.
- The Experimental Breeder Reactor I at a site in Idaho generated the first electricity from nuclear energy on December 20, 1951.
- 16% of the world’s electricity now comes from nuclear energy, 85% of which is concentrated in industrialized countries. A total of 441 nuclear power plants were operating as of February 2003. There were

also 32 nuclear reactors under construction (Nuclear Energy Institute).
- In the United States alone, there are 103 nuclear power plants, which provide about 20% of the nation's electricity.
- A new nuclear power plant has not been ordered in the U.S. since 1973.
- Today, President George W. Bush's energy policies call for a $15 billion federal subsidy to build six or seven new nuclear power plants.

1. How It Works – The Scientific Process Behind Nuclear Energy

- Nuclear energy relies on the fact that some elements can be split (in a process called fission) and will release part of their energy as heat.

- Because it fissions easily, Uranium-235 (U-235) is one of the elements most commonly used to produce nuclear energy. It is generally used in a mixture with Uranium-238, and produces Plutonium-239 (Pu-239) as waste in the process.

- A nuclear power plant generates electricity like any other steam-electric power plant. Water is heated, and steam from the boiling water turns turbines and generates electricity.

- The main difference in the various types of steam-electric plants is the heat source. Coal, oil, or gas is burned in other power plants to heat the water. Heat from a chain reaction of fissioning Uranium-235 boils the water in a nuclear power plant. Some have compared this process to using a canon to kill a fly.

2. How It Doesn't Work – Risks and Dangers of Nuclear Energy

- Proliferation Risks
    - Plutonium is a man-made waste product of nuclear fission, which can be used either for fuel in nuclear power plants or for bombs.
    - In the year 2000, an estimated 310 tons (620,000 pounds) of civilian, weapons-usable plutonium had been produced.
    - Less than 8 kilograms (about 18 pounds) of plutonium is enough for one Nagasaki-type bomb. Thus, in the year 2000 alone, enough plutonium was created to make more than 34,000 nuclear weapons.
    - The technology for producing nuclear energy that is shared among nations, particularly the process that turns raw uranium into lowly-enriched uranium, can also be used to produce highly-enriched, weapons-grade uranium.
    - The International Atomic Energy Agency (IAEA) is responsible for monitoring the world's nuclear facilities and for preventing weapons proliferation, but their safeguards have serious shortcomings. Though the IAEA is promoting additional safeguards agreements to increase the effectiveness of their inspections, the agency acknowledges that, due to measurement uncertainties, it cannot detect all possible diversions of nuclear material. (Nuclear Control Institute)
- Risk of Accident
    - On April 26, 1986 the No. 4 reactor at the Chernobyl power plant (in the former U.S.S.R., present-day Ukraine) exploded, causing the worst nuclear accident ever.
        - 30 people were killed instantly, including 28 from radiation exposure, and a further 209 on site were treated for acute radiation poisoning.
        - The World Health Organization found that the fallout from the explosion was incredibly far-reaching. For a time, radiation levels in Scotland, over 1400 miles (about 2300 km) away, were 10,000 times

the norm.
        - Thousands of cancer deaths were a direct result of the accident.
        - The accident cost the former Soviet Union more than three times the economical benefits accrued from the operation of every other Soviet nuclear power plant operated between 1954 and 1990.
    - In March of 1979 equipment failures and human error contributed to an accident at the Three Mile Island nuclear reactor at Harrisburg, Pennsylvania, the worst such accident in U.S. history. Consequences of the incident include radiation contamination of surrounding areas, increased cases of thyroid cancer, and plant mutations.
    - According to the US House of Representatives, Subcommittee on Oversight & Investigations, "Calculation of Reactor Accident Consequences (CRAC2) for US Nuclear Power Plants" (1982, 1997), an accident at a US nuclear power plant could kill more people than were killed by the atomic bomb dropped on Nagasaki.
- Environmental Degradation
    - All the steps in the complex process of creating nuclear energy entail environmental hazards.
    - The mining of uranium, as well as its refining and enrichment, and the production of plutonium produce radioactive isotopes that contaminate the surrounding area, including the groundwater, air, land, plants, and equipment. As a result, humans and the entire ecosystem are adversely and profoundly affected.
    - Some of these radioactive isotopes are extraordinarily long-lived, remaining toxic for hundreds of thousands of years. Presently, we are only beginning to observe and experience the consequences of producing nuclear energy
- Nuclear Waste
    - Nuclear waste is produced in many different ways. There are wastes produced in the reactor core, wastes created as a result of radioactive contamination, and wastes produced as a byproduct of uranium mining, refining, and enrichment. The vast majority of radiation in nuclear waste is given off from spent fuel rods.
    - A typical reactor will generate 20 to 30 tons of high-level nuclear waste annually. There is no known way to safely dispose of this waste, which remains dangerously radioactive until it naturally decays.
    - The rate of decay of a radioactive isotope is called its half-life, the time in which half the initial amount of atoms present takes to decay. The half-life of Plutonium-239, one particularly lethal component of nuclear waste, is 24,000 years.
    - The hazardous life of a radioactive element (the length of time that must elapse before the material is considered safe) is at least 10 half-lives. Therefore, Plutonium-239 will remain hazardous for at least 240,000 years.
    - There is a current proposal to dump nuclear waste at Yucca Mountain, Nevada.
        - The plan is for Yucca Mountain to hold all of the high level nuclear waste ever produced from every nuclear power plant in the US. However, that would completely fill up the site and not account for future waste.
        - Transporting the wastes by truck and rail would be extremely dangerous.
        - For a more detailed analysis of the problems of and risks incurred by

the plan, see Top Ten Reasons to Oppose the DoE's Yucca Mountain Plan

- Repository sites in Australia, Argentina, China, southern Africa, and Russia have also been considered.
- Though some countries reprocess nuclear waste (in essence, preparing it to send through the cycle again to create more energy), this process is banned in the U.S. due to increased proliferation risks, as the reprocessed materials can also be used for making bombs. Reprocessing is also not a solution because it just creates additional nuclear waste.
- The best action would be to cease producing nuclear energy (and waste), to leave the existing waste where it is, and to immobilize it. There are a few different methods of waste immobilization. In the vitrification process, waste is combined with glass-forming materials and melted. Once the materials solidify, the waste is trapped inside and can't easily be released.

3. Sustainable Energy Alternatives

There are many alternative energy sources that are sustainable and do not pose the accident risks inherent in nuclear energy production. These sources include:

- Bioenergy: biomass, such as plant matter and animal waste, can yield power, heat, steam, and fuel.
- Geothermal: renewable heat energy can be harnessed from deep within the earth.
- Wind: turbines turning in the air convert kinetic energy in the wind into electricity.
- Solar: the sun's energy can be captured and used to produce heat and electricity.
- Hydrogen: if produced by renewable sources, it can power fuel cells to convert chemical energy directly into electricity, with useful heat and water as the only byproducts.
- Tidal: using the movement of the ocean to power turbines and generate electricity.
- Many more sustainable resources could be found and current resources improved if better technology were available and if the government and utilities actively promoted their development.
- Sustainable energy links:
  http://www.repp.org
  http://www.sustainableenergycoalition.org/
  http://www.renewableenergy.com/