saskatchewan chamber of commerce

FREQUENTLY ASKED QUESTIONS

ON NUCLEAR POWER IN SASKATCHEWAN

Eating one banana a day for a month or drinking a glass of milk every day for 45 days contains the same radiation dose as spending an entire year living alongside a nuclear power plant.

Source: Canadian Nuclear Association, excerpted from "*Nuclear Energy: Reliable, affordable and clean electricity*" April 2007

PREPARED BY THE
SASKATCHEWAN CHAMBER OF COMMERCE

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EXECUTIVE SUMMARY

The Saskatchewan Chamber of Commerce has for over 80 years provided information and research to the business community to ensure that decisions made by business people are based on facts and the most current information available. With the emerging opportunities in the uranium sector we are once again providing fact based information.

This document answers what we believe are the most commonly asked questions around the expansion of the uranium sector, specifically with emphasis on nuclear power, in Saskatchewan. As a business lobby group, we fully appreciate that this issue goes well beyond simple economics. It is emotional and carries a wide array of perceptions in the minds on business people and the general public. We drafted the questions but compiled the answers from a range of very reputable sources who responded with facts, not myths or unfounded speculation.

There are links to sources of information listed in the final section that offer perspectives which are not pro-nuclear or even business views. We added these pieces to ensure our members get the entire picture. It is our intent to help provide the facts and we wanted to be completely transparent in our efforts.

This is Version 2.7 of our FAQ as we have had many people review earlier versions to determine accuracy and ensure that we had asked all the right questions. We expect to add information as the process continues so if you want to see newer versions please check www.saskchamber.com in the future.

We will continue to gather information and input throughout this process and invite yours. Over the next few months, we will establish our formal position and assist the Province in capturing the full value of the uranium chain.

This FAQ paper is one element of our overall effort to provide clear communications on the opportunities and responsibilities around the expansion of the uranium sector in Saskatchewan. We see expanded exploration and mining, research and education, medical isotope production, power generation and waste management as other elements worthy of discussion.

At some point in the next months and over the next few years the Province of Saskatchewan will be making decisions on these items and as '*The Voice of Business*' we want to ensure that we fully and accurately represent the business community as we advocate a final position.

NUCLEAR POWER IN SASKATCHEWAN FAQ

The people of Saskatchewan need to make decisions on
nuclear sector enhancement based on the facts.

"Making rational decisions requires an understanding of the science behind the technologies as well as thorough analysis and objective dialogue. This is not an easy task. As our society grows increasingly complex, it becomes more difficult to keep abreast. We are living in an age of information overload. Nevertheless, objective analysis must be our goal."

Source: *Half-lives : the Canadian guide to nuclear technology* by Hans Tammemagi and David Jackson, 2009

Saskatchewan needs more power as a result of our growing economic momentum. Future sources of supply will need to conform to stringent environmental regulations, meet a range of economic requirements, and measure up to tough operational demands that include reliability, quality, safety and security. Future generation and transmission plans will also have to specifically address the growing need for electricity in northern Saskatchewan due to industrial and population growth.

Nuclear power is one of the technology supply options we can consider. The people of Saskatchewan need basic, well founded, and factual material so that we can talk about and make informed decisions on nuclear power.

Three fundamental themes come to mind when we talk about energy: safety, the environment, and economics. It is essential that each of these are addressed in a logical and considered fashion, with clear recognition of the facts.

Nuclear power plants have a superb safety record - both for plant workers and the public.

Nuclear energy is clean. It's North America's largest source of emissions-free energy, which means it emits no pollutants into the air. This keeps the air clean, prevents acid rain, preserves the earth's climate and prevents ground level ozone formation. And nuclear waste is managed in a safe, environmentally responsible way.

Nuclear power is cost competitive with other forms of electricity generation. Nuclear energy is competitive with fossil fuel for electricity generation, despite relatively high capital costs and the need to internalize all waste disposal and decommissioning costs. If the social, health and environmental costs of fossil fuels are taken into account, nuclear is outstanding.

DOES HAVING A NUCLEAR FACILITY IN YOUR AREA CAUSE HEALTH ISSUES?

Radiation is released naturally from the ground and atmosphere in all places on Earth. This 'natural background' radiation, which varies considerably from region to region, is part of the environment to which all human beings are conditioned. Like many things, radiation can be both beneficial and harmful. Large doses are dangerous. Abundant evidence indicates that small doses are harmless.

The radiation produced within the core of nuclear reactors is similar to natural radiation but more intense. At nuclear power plants, protective shielding isolates this radiation, allowing millions of people to live in safety nearby. Typically, the radiation people receive comes 90% from nature and 10% from medical exposures. Radiation exposure from nuclear power is negligible.

Source: World Nuclear Association, Facts on Radiation

Many health studies have been performed throughout the years because of the historical and current presence of the nuclear industry in the community of Port Hope, Ontario and because some residents have expressed concerns about possible health effects in the community.

The historical and current presence of the nuclear industry in Port Hope has resulted in over forty studies reporting on the health of its citizens. Although Port Hope is home to uranium conversion, waste management and nuclear fuel conversion facilities and not a nuclear power plant, these studies are the most comprehensive Canadian studies on nuclear facilities and health issues. Canadian Nuclear Safety Commission (CNSC) staff reviewed and considered all relevant, known and recognized studies before concluding that the health of Port Hope residents is not at risk. None of the studies reviewed show unusual patterns of cancer or any other diseases related to the nuclear industry, either in workers or members of the community. In addition, the health of Port Hope residents is consistent with the rest of the population of Ontario and Canada.

For additional information on the report, please consult 'Health studies done in Port Hope: The Facts'.

Source: The Canadian Nuclear Safety Commission (CNSC) "*Understanding Health Studies and Risk Assessments Conducted in the Port Hope Community from the 1950s to the Present*" April 15, 2009

WHAT HAPPENED AT THREE MILE ISLAND AND CHERNOBYL ?

Three Mile Island Unit 2, Pennsylvania, USA

The accident at the Three Mile Island Unit 2 (TMI-2) nuclear power plant near Middletown, Penn., on March 28, 1979, was the most serious in U.S. commercial nuclear power plant operating history, even though it led to no deaths or injuries.

The cause of the accident was a major loss of the cooling function for a sustained period of time. Despite the fact that a significant portion of the core melted, the safety mechanisms in place protected the local community. The off-site consequences were insignificant and the maximum off-site dose to any member of the public was substantially below levels that could cause health effects. The major consequence was a significant economic impact on the plant owner from the loss of the unit.

Source: *United States Nuclear Regulatory Commission Fact Sheet on the Three Mile Island Accident*, March 2009

Chernobyl

The 1986 accident at the Chernobyl nuclear power plant in Ukraine, then part of the former Soviet Union, is the only accident in the history of commercial nuclear power to cause fatalities from radiation. It was the product of a severely flawed Soviet-era reactor design combined with human error.

Source: *The Chernobyl Accident and Its Consequences Published by the Nuclear Energy Institute (NEI),* Washington D.C., United States, April 2006

Chernobyl Quick Facts

- The Chernobyl accident in 1986 was the result of a flawed reactor design that was operated with inadequately trained personnel and without proper regard for safety.
- The resulting steam explosion and fire released at least five percent of the radioactive reactor core into the atmosphere and downwind.
- 28 people died within four months from radiation or thermal burns, 19 have subsequently died, and there have been around nine deaths from thyroid cancer apparently due to the accident: total 56 fatalities as of 2004.
- An authoritative UN report in 2000 concluded that there is no scientific evidence of any significant radiation-related health effects to most people exposed. This was confirmed in a very thorough 2005-06 study.

Source: World Nuclear Association, ***Chernobyl Accident***, April 2009

In other countries, including United States and Canada, over 400 reactors are operating safely and reliably. Canada's reactors have been operating safely since the 1960's.

The accident, caused by a sudden surge of power, destroyed the reactor and released radioactive material into the environment.

The health of these residents also has been monitored since 1986, and to date there is no strong evidence for radiation-induced increases of leukemia or solid cancer (other than thyroid cancer). An exception is a large number of children and adolescents who in 1986 received substantial radiation doses in the thyroid after drinking milk contaminated with radioactive iodine. To date, about 4,000 thyroid cancer cases have been detected among these children. Although 99% of these children were successfully treated, nine children and adolescents in the three countries died from thyroid cancer. Fortunately, no evidence of any effect on the number of adverse pregnancy outcomes, delivery complications, stillbirths or overall health of children has been observed among the families living in the

most contaminated areas.

Apart from the increase in thyroid cancer after childhood exposure, no increase in overall cancer or non-cancer diseases have been observed that can be attributed to the Chernobyl accident and exposure to radiation. However, it is estimated that approximately 4,000 radiation-related cancer deaths may eventually be attributed to the Chernobyl accident over the lifetime of the 200,000 emergency workers, 116,000 evacuees, and 270,000 residents living in the most contaminated areas. This estimate is far lower than initial speculations that radiation exposure would claim tens of thousands of lives, but it is not greatly different from estimates made in 1986 by Soviet scientists.

Source: *United States Nuclear Regulatory Commission Fact Sheet on Chernobyl*, April 2006

WHAT ABOUT STORIES ABOUT BIRTH DEFECTS FROM RADIATION?

Some people are against the use of nuclear power because they are afraid of radiation. However, radiation is a fact of life – we are all exposed to radiation from natural sources every day – and the various uses of nuclear energy contribute only a small addition to that natural radiation. Radiation is natural and everywhere. Radioactivity has been in all rocks, soils, waters and air since the earth was formed, and is responsible for the formation of mountains.

The radiation dose to the public as a result of radioactivity from all nuclear power plants in Canada is much less than regulatory limits and the radiation dose from naturally occurring sources.

Source: Canadian Nuclear Association, excerpted from "*Nuclear Energy: Reliable, affordable and clean electricity*" April 2007

A study on the incidence of childhood cancer around nuclear power plants in Great Britain by the Health Protection Agency for the committee on Medical Aspects of Radiation in the environment concluded that there has been no increase in childhood cancers for children living less than 25 kilometres from a nuclear power plant. The report was published in 2005.

Source: *Committee on Medical Aspects of Radiation in the Environment*, Produced by the Health Protection Agency for the Committee on Medical Aspects of Radiation in the Environment, 2005

As most ores in the Earth's crust, coal also contains low levels of uranium, thorium, and other naturally-occurring radioactive isotopes whose release into the environment leads to radioactive contamination. While these substances are present as very small trace impurities, enough coal is burned that significant amounts of these substances are released. A 1,000 MW coal-burning power plant could release as much as 5.2 tons/year of uranium (containing 74 pounds (34 kg) of uranium-235) and 12.8 tons/year of thorium. The radioactive emission from this coal power plant is 100 times greater than a comparable nuclear power plant with the same electrical output; including processing output, the coal power plant's radiation output is over 3 times greater.

Source: *Coal Combustion: Nuclear Resource or Danger*: Alex Gobbard, ORNL Review, 1993 Vol 26, Nos 3 and 4

The biological effects of heavy particle ionising radiation are measured with a quantity called Absorbed Dose. However, while two differing particles may have the same amount of energy, they may have very different responses from our living, biological cells, so a factor called Relative Biological Effectiveness (RBE) is also used. RBE is a measure of the amount of cell damage a given type of particle causes as compared to a dose of x-rays with the same energy. The combination of RBE with Absorbed Dose is measured in units called Sieverts.

This chart shows typical doses of radiation from a variety of sources:

Estimated dose (Micro-Sieverts)	Activity
5	sleeping next to your spouse for one year
10	a year of watching TV at an average rate
10	a year of wearing a luminous dial watch
10	a year of living in the USA from nuclear fuel and power plants
10	a day from background radiation (average, varies a lot throughout the world)
20	having a chest x-ray
65	flying from Melbourne to London, via Singapore
300	yearly dose due to body's potassium-40
460	maximum possible offsite dose from Three Mile Island Accident
400 - 1000	average annual dose from Medical sources
7,000	having a PET scan
8,000	having a chest CT (CAT) scan
50,000	off-site dose from accident at Chernobyl Nuclear Power Plant (estimates vary widely)
2,000,000	typical single dose to Cancer region from Radiation Therapy
700,000 - 13,000,000	staff and firefighters at the Chernobyl Nuclear Power Plant during and immediately after the accident
65,000,000	typical total dose to Cancer region from Radiation Therapy

Source: www.nuclearinfo.net

WHAT DO PEOPLE WHO LIVE A NUCLEAR POWER PLANT NOW THINK ABOUT HAVING ONE IN THE AREA?

The radioactive emissions from nuclear power plants in Canada remain far below the limits allowed by law. On average, people living in the vicinity of nuclear power plants in Canada receive approximately 1 per cent of the legally allowable radiation dose per year. All releases are monitored and, should a problem arise, action would be taken to reduce releases to within legal limits.

Source: Canadian Nuclear Safety Commission, *Regulating Nuclear Power Plants*, 2003

Frustrated by anti-nuclear sentiments, Lloydminster resident Melissa Letkeman recently wrote a letter to her local paper touting the benefits a nuclear power plant can bring to an area and challenging some negative claims.

"I thought a lot of the negativity was false. It seemed more out of fear that people were voicing their opinions," said Letkeman in an interview.
The 31-year-old is from Kincardine, Ont., near Bruce Power's nuclear plant — where her father has worked for years. The company kept close tabs on the surrounding environment and its workers to ensure there were no issues with radiation levels, said Letkeman, who now resides on the Alberta side of Lloydminster.
"We always felt very safe," she said of the area where she grew up.
"The majority of the town, almost one parent from every family works at the nuclear power plant so it was very familiar for us," she said.

Source: By Angela Hall, Leader-Post April 16, 2009

HOW MANY NUCLEAR POWER PLANTS ARE THERE IN CANADA NOW? IN THE WORLD?

There are 436 nuclear reactors worldwide. There are 18 operational nuclear power plants in Canada, 4 in long-term shutdown and 3 in permanent shutdown.

Source: Power Reactor Information System, www.iaea.org

“France, which started to invest heavily in nuclear energy in 1974, derives 75 percent of its electricity from nuclear energy. There are more than 20 nuclear power plants less than 200 kilometres away from Paris. Japan, which has 53 nuclear reactors, is building two new reactors and plans to build more than 12 reactors in the next decade. India has 17 reactors, plans to build 10, and has proposals for 15 new reactors.”

Source: The Star Phoenix, *Sask. knows safe use of nuclear energy*, Dr. Chary Rangacharyulu

HOW CAN WE BE SURE THAT A NUCLEAR POWER PLANT IS SAFE?

Every day, millions of Canadians use nuclear products, though we may not always be aware of how it contributes to our lives.

Nuclear energy’s enormous potential has been harnessed for a variety of activities - to heat and light our homes, to perform valuable research at universities, to diagnose and treat illnesses, for use in scientific instruments, and even in everyday household products like smoke detectors. Our lives are improved because nuclear facilities, processes and products are made safe through stringent regulation.

At the Canadian Nuclear Safety Commission (CNSC), nuclear safety means protecting Canadians.

CNSC has both national and international nuclear safety and control responsibilities.

National nuclear safety responsibilities focus on regulating nuclear facilities and activities to protect the public, people who work in the nuclear sector, and the environment. International responsibilities involve working to ensure that Canada's international nuclear non-proliferation obligations are upheld.

CNSC keeps nuclear materials safe. In Canada, all nuclear facilities and activities are governed by the Nuclear Safety and Control Act and associated regulations. CNSC makes sure these laws and regulations are followed.

CNSC also works in collaboration with other government departments and agencies such as Natural Resources Canada, Environment Canada, Health Canada, Transport Canada, and the Department of Foreign Affairs and International Trade to effectively regulate nuclear operations and activities.

Source: Canadian Nuclear Safety Commission

WHAT HAPPENS IF THERE IS A TERRORIST ATTACK ON THE POWER PLANT?

Nuclear power plants are designed not only to provide high levels of safety from events and accidents that occur within the plant itself, but also to ensure safe operation following challenges from external events.

An external event could be some natural phenomenon with the potential to cause damage, such as tornados, hurricanes, earthquakes and flooding, or some deliberate hostile act committed by persons or groups. These latter events, which have become of increased importance since the September 11, 2001 attacks in the U.S., are generally termed security events. Specific measures have been taken world-wide to address these security threats. For obvious national security reasons the nature of specific measures are not publicly available; however, as a result of them, nuclear power plants are not attractive targets for hostile actions.

Nuclear power plants are designed to be very robust against naturally occurring external events. This is achieved by a variety of means, such as the physical separation of important groups of safety functions to prevent simultaneous damage.

Nuclear power plants cannot explode like an atomic bomb. This is a direct consequence of the manner in which fissile material is arranged in a nuclear reactor and the physics of fission chain reactions. It is physically impossible to generate the extremely rapid large fission chain reaction characteristic of a nuclear explosion without the reaction being terminated by inherent physical changes within the reactor.

Source: Nuclear Power Expert Panel, *Report on Nuclear Power and Alberta*, February 2009

WHAT HAPPENS IF THERE IS AN ACCIDENT AT THE POWER PLANT?

Canadian nuclear power plants have numerous safety and security features to protect the health and safety of the public. Nuclear power plants have redundant safety systems, such as separate cooling systems, to provide continuous cooling of the reactor in the event of an incident. Separate reactor shutdown systems are also in place, designed to respond quickly to a wide range of incidents. The containment buildings are extremely resistant structures, designed to withstand events such as earthquakes and tornadoes.

The Canadian Nuclear Safety Commission (CNSC) requires licensees to demonstrate that they are capable of preventing unauthorized access to their sites. All operators of Canadian nuclear power plants are required to have security measures in place to protect the security of the plant from all reasonable threats and to prevent the theft of nuclear materials and information. Security plans and measures are reviewed by CNSC staff and must be approved by the CNSC before an operating license is granted or renewed. CNSC staff monitors the status of security plans and regularly reviews the adequacy of the security measures in consultation with Canadian security agencies.

CNSC maintains a comprehensive Emergency Response Plan (See the PDF at http://www.cnsc-ccsn.gc.ca/eng/). Their role during a nuclear emergency is to:

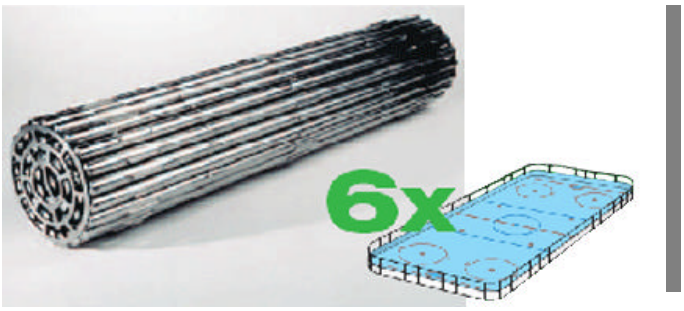
- ✓ monitor the response of the licensee
- ✓ evaluate response actions
- ✓ provide technical advice and regulatory approval when required
- ✓ provide field response to assist local authorities as needed
- ✓ to inform the government and the public on its assessment of the situation

To continually evaluate and improve its emergency response capabilities, CNSC participates in simulated incidents in coordination with its licensees and government agencies. CNSC's Emergency Response Plan is revised regularly to incorporate new elements as a result of lessons learned from exercises and drills.

CNSC also maintains a Duty Officer program to receive reports on actual or potential incidents, and to respond to those seeking emergency information and assistance. The Duty Officer is available on a 24-hour basis, and is the first point of contact in the event of an emergency."

Source: Canadian Nuclear Safety Commission, *Regulating Nuclear Power Plants*

HOW LONG DOES NUCLEAR WASTE REMAIN AT HIGH LEVELS OF RADIOACTIVITY?



Stacked like cordwood, all of Canada's used nuclear fuel from the last 56 years of power generation could fit into six hockey rinks.

The radiation from high-level radioactive waste can be dangerous. That is why it is handled remotely and stored in suitable, monitored facilities. The danger is no worse than that from the toxicity of many chemicals and heavy metals, many of which are just thrown away into municipal dumps. Some people are concerned about the long-term radioactivity of used nuclear fuel. However, most of the radioactive fission products in used fuel have shorter half-lives; because of this the radioactivity of spent fuel decays to the same level as that of the original uranium ore in about 500 years. In contrast, toxic heavy metals such as mercury and arsenic, which are emitted from coal-fired plants and various industrial processes, last forever.

Many industries produce hazardous waste. The nuclear industry has developed technology that will ensure its hazardous waste can be managed appropriately so as to cause no risk to future generations.

Source: Canadian Nuclear Association, *Nuclear facts: What about nuclear waste? What is it?*

WHERE WOULD THE NUCLEAR WASTE BE STORED?

The small amount of waste produced by Canadian nuclear power plants to generate huge amounts of electricity is controlled and stored in carefully managed facilities. Used fuel is initially stored in water-filled bays at the site of the nuclear power plants for 5 – 10 years and then placed in large concrete canisters safely stored on site. Designs have been developed for a large underground storage facility, but no decision has yet been made to construct one. The total amount of used fuel from Canada's nuclear power plants could be stored in six hockey rinks up to the height of the boards.

- ✓ The CNSC regulates licensees' management of waste.
- ✓ Spent nuclear fuel is managed onsite at nuclear power plants.

Source: Canadian Nuclear Safety Commission, *Presentation to the Association of Professional Engineers, Geologists, and Geophysicists of* Alberta, April 2009

Source: Canadian Nuclear Association, *Canada's Best Kept Secret*

In June 2008, the Nuclear Waste Management Organization (NWMO) published its first five-year plan describing how it will implement Adaptive Phased Management (APM), Canada's plan for the safe long-term care of used nuclear fuel. The plan is a living

document that is regularly assessed, strengthened and redirected in the face of new information, advances in technology and science, changes in societal values and evolving public policy. Technically, APM has at its end-point the containment and isolation of used nuclear fuel in a deep repository constructed in a suitable rock formation.

Source: Nuclear Waste Management Organization, *Implementing Adaptive Phased Management 2009-2013*

The storage of nuclear waster over the long term will have costs associated with it. NWMO, which was established in accordance with the Nuclear Fuel Waste Act, is tasked with ensuring that the nuclear industry has the necessary monies set aside to pay for the long-term care of used nuclear fuel. This practice of financial surety has the objective of determining what costs can reasonably be expected to occur over the life of the project, along with a contingency for unexpected events, and then designing a system that collects and protects enough money to ensure that the entire cost can be covered under a variety of social and economic circumstances, and within a required time frame.

The Nuclear Fuel Waste Act assigns responsibility to the major owners of used nuclear fuel to make financial provisions for its long-term management.

Source: Nuclear Waste Management Organization *Implementing Adaptive Phased Management, 2009 – 2013*

HOW DOES THE REACTIVE MATERIAL GET TRANSPORTED BEFORE AND AFTER USE?

For more information, contact:

Canadian Nuclear Safety Commission
280 Slater Street
P.O. Box 1046, Station B
Ottawa, Ontario K1P 5S9
CANADA
Telephone: (613) 995-5894 or
1 (800) 668-5284 (in Canada)
Fax: (613) 992-2915
E-mail: info@cnsc-ccsn.gc.ca
www.nuclearsafety.gc.ca

About one million packages of radioactive material are shipped in Canada each year. The CNSC regulates the packaging, preparation for shipment, and receipt of these radioactive materials through the Packaging and Transportation of Nuclear Substances Regulations. In addition, the CNSC cooperates with Transport Canada in regulating the shipments of radioactive materials under the Transportation of Dangerous Goods Act. Shipments of radioactive materials can be made only in approved packaging or by special arrangement on a case-by-case basis. To receive approval, packaging must meet established performance standards, which for shipment of highly radioactive materials are very stringent. This type of packaging must withstand a series of tests including heavy impact, fire, and submersion in water. Some packages that have been certified in this way have survived the test of being struck by a locomotive travelling at 165 km/hour.

Accidents in which significant amounts of radioactive material are spilled are very rare. To date there have been no personal injuries due to radiation exposure in shipments of radioactive materials in Canada.

Source: *Half-lives : the Canadian guide to nuclear technology* by Hans Tammemagi and David Jackson, 2009

Nuclear Generation Worldwide

• Currently there are 436 nuclear power reactors worldwide.
• As of January 2008, there were 35 nuclear reactors under construction, another 91 being planned and 228 being proposed, mostly in Asia and Eastern Europe
(Source: World Nuclear Association).
• Nuclear power is the only large-scale generation option, other than hydroelectric, that does not release greenhouse gas emissions that contribute to global warming.
• Nuclear power produces 15.2% of global electricity and is the world's fourth largest source of electricity (Source: (OECD/IEA), World Energy Outlook 2007).
• Around the world scientists in more than 50 countries use nearly 300 research reactors to investigate nuclear technologies and to produce radioisotopes for medical diagnosis and cancer therapy.

Source: Canadian Nuclear Association, *Canada's Nuclear Energy: Reliable, Affordable and Clean Electricity*, 2008

WHY ARE WE TALKING ABOUT NUCLEAR WHEN SOLAR AND WIND CAN ALSO PRODUCE POWER?

'Renewable' sources of electricity such as wind and solar power require large areas and are intermittent, producing electricity only when the sun is shining or the wind blowing. Therefore, these systems require that a full-time backup method be available for power generation if we are to enjoy electricity when we want it.

For wind generators to produce all the electricity needed to supply a city of 3 million people, such as Toronto, the land required would be about 40 times the area of Metropolitan Toronto. This is more than four times the area of Prince Edward Island. Apart from the vast land requirement, and the visual and noise effects of the wind generator towers themselves, there would be considerable environmental impact [erosion, bird and bat deaths, fragmented animal habitats]. If that same city's electricity were to be supplied by solar collectors, a land area twice the size of Metropolitan Toronto would be needed. In both cases backup generation systems would be required for periods of little wind or no sun.

Source: Canadian Nuclear Association *"Nuclear Facts: Is nuclear energy a good choice for the environment?"*

With the amount of wind power currently in service in Saskatchewan – approximately 172 megawatts – SaskPower is experiencing grid operating challenges due to the natural variability of wind power as an energy source. In response to these challenges, SaskPower formed the Wind Power Integration and Development Unit (WPIDU) to study and assess the effect of wind power on the provincial system.

Source: SaskPower
Power Generation Procurement, Add Sustainability to the Mix

In comparing the cost of nuclear and renewable energy sources we need to consider all costs. For nuclear energy that would include assessing the possibility of cost overruns, and the costs of waste management and facility decommissioning. For renewable energy

sources, we need to include the cost of additional sources of energy for use when the wind does not blow or the sun does not shine and their operating costs. We can also consider the possibility of storage of energy from renewable energy sources for use when the wind does not blow or the sun does not shine, or the cost of joining a large grid that would allow energy from intermittent renewable energy sources to be sold into the grid and brought back from the grid when not available in Saskatchewan. We should also note that the cost of solar energy is gradually decreasing.

Nevertheless, when all of these issues are given careful consideration, nuclear energy still costs considerably less than renewable energy.

Source: Nuclear Power Expert Panel, *Report on Nuclear Power and Alberta*, February 2009

Did you know that:
- Nuclear science and technology has changed and improved our lives.
- Canada is a leader in nuclear science including medicine, manufacturing, agriculture and electricity generation.
- Canada's nuclear industry is for peaceful purposes only.
- Canada is a signatory of the Non-Proliferation Treaty which prohibits the trade of nuclear technology for nuclear weapons.
- Canadian designed CANDU reactors safely provide clean electricity, enough to supply 7.5 million Canadian homes every year.
- Canada is the world's major supplier of radioisotopes used in 45,000 daily medical diagnostic procedures worldwide.
- Nuclear technology improves the production and quality of global food supplies.
- Nuclear techniques are used in many fields of research from aeronautics to cosmetics, smoke detectors to medical supplies and sterilization.

WILL SASKATCHEWAN NEED MORE POWER?

All forecasts for world energy demand for the next 50 years point to very significant increases in consumption. The planned decommissioning of the aging Boundary Dam generation facility, as well as the future decommissioning of existing capacity, coupled with a growing demand in Saskatchewan is expected to result in a baseload supply-demand deficit. Ultimately, electricity need will be determined by population and industrial growth, but even under a conservative 1 percent growth scenario, 1,200 additional MW of baseload power will be required by 2020.

Source: *Uranium Development Partnership, Capturing the full potential of the uranium value chain in Saskatchewan,* March 31, 2009

As a result of Saskatchewan's growing economic momentum, SaskPower is facing an unprecedented demand for electricity from its customers. Future sources of supply will need to conform to stringent environmental regulations, meet a range of economic requirements, and measure up to tough operational demands that include reliability, quality, safety and security. Future generation and transmission plans will also have to specifically address the growing need for electricity in northern Saskatchewan due to industrial and population growth.
Source: SaskPower website

WHERE WOULD THE POWER PLANT, IF BUILT, BE LOCATED?

The provincial government has made no decisions as to whether a nuclear power plant will be pursued or where it would be located if it were to go ahead.

Source: *Editors Note*

However, the Bruce Power Saskatchewan feasibility study suggests a region spanning from Lloydminster to Prince Albert, including the Battlefords region as the most viable host for a nuclear facility. It is estimated that a new plant would create 3,000 jobs during construction and between 400 and 700 permanent jobs.

Source: *Uranium Development Partnership, Capturing the full potential of the uranium value chain in Saskatchewan,* March 31, 2009

Consideration was also given to Lake Diefenbaker and possible locations near Estevan, where coal facilities currently operate. Sites near Lake Diefenbaker were excluded because of the lack of infrastructure and population. Although Swift Current has considerable infrastructure that could support a facility, the most viable sites were located a significant distance from the city reducing the viability of this location. Estevan was promising because existing facilities that use water and require infrastructure are already located in the region. However, Bruce Power excluded the Estevan option because the role that region will play in terms of future clean coal generation will be considerable. To locate a nuclear facility, in addition to such a significant amount of coal, would have concentrated too much electricity in the province in a single location. The Estevan region currently has 1,000 MW of generating capacity and the available water resources are used extensively. If the coal plants were to be shut down in Estevan a nuclear facility would have been more viable. However, given the government's investment in clean coal technology, Bruce Power concluded that region will continue to provide a significant amount of Saskatchewan's electricity for generations to come.

Source: Bruce Power, *Saskatchewan 2020*

WHAT ARE THE EFFECTS ON LOCAL AGRICULTURE AND GROUNDWATER?

Simply put, there are no effects on local agriculture and groundwater.

The nuclear industry is the most regulated industry in the world. In Canada, nuclear power is regulated by the Canadian Nuclear Safety Commission (CNSC). Protecting the environment is an important part of CNSC's work. During the license application review process, CNSC determines whether an Environmental Assessment is required for the applicant's proposed project. Environmental Assessments are used to predict the environmental effects of proposed initiatives before they are carried out.

CNSC then works with applicants throughout their Environmental Assessment process. For a project to proceed, CNSC must be satisfied that a project will not unduly harm the

environment on which all life depends, taking into consideration the needs of both current and future generations.

Once a power plant has been built there is continuous testing done to ensure that safety standards are being met. The CNSC has staff onsite at all nuclear power plants to ensure that testing, reporting, and safety measure are being adhered to.

Source: Canadian Nuclear Safety Commission

WHAT ABOUT THE USE AND POSSIBLE CONTAMINATION OF THE RIVER AND/OR WATER SOURCES?

Nuclear power plants, like fossil-fuelled power plants, require cooling to condense the steam exiting the large turbines. This cooling is provided by cold water flowing through the tubes of the turbine condenser.

The volumes of water required by various cooling systems and the environment impacts are similar to those for fossil-fuelled plants. Cooling water is not in contact with the nuclear fuel and so cannot release radioactivity into the environment.

Source: Nuclear Power Expert Panel, *Report on Nuclear Power and Alberta*, February 2009

THE POWER OF
NUCLEAR TECHNOLOGY

1 URANIUM PELLET IS EQUIVALENT TO THE ENERGY PROVIDED BY:

807 KILOGRAMS OF
COAL

OR….

677 LITRES OF
OIL

OR…

476 CUBIC METRES OF
NATURAL GAS

NUCLEAR POWER stations are able to produce tremendous amounts of electricity from a very small amount of fuel. In fact, *about eight fuel pellets*, like the one shown above, can provide the average home with enough electricity for an entire year.

WHY CAN'T WE SIMPLY KEEP RELYING ON COAL, NATURAL GAS AND HYDRO POWER LIKE WE ARE?

The renewed interest in nuclear power is being driven by a number of factors – most notable, given growing concerns regarding climate change, is its very low carbon profile, similar to the cleanest forms of renewable energy. Other drivers of this resurgent interest in nuclear energy include: the growing global demand for electricity; nuclear power's cost competitiveness over the full life cycle; the abundant and secure supply of uranium; and the industry's greatly improved reliability and safety record.

Nuclear is the lowest greenhouse gas emission-source of baseload power generation

available today. In comparison, a coal power plant has 100 times the emissions of a nuclear plant and an equivalent natural gas plant will emit just under 50 times the emissions.

With regards to coal, major environmental issues relate to air pollutant emissions, carbon dioxide emission, water use and coal extraction.

Natural gas has a higher energy and lower carbon content than coal. The 'on-off' flexibility of natural gas units has traditionally made this technology particularly useful in meeting peak load. Recently, natural gas-fired generation has been used more frequently to meet base load. However, cost considerations driven by natural gas prices may limit future developments to peaking applications.

Hydropower converts the natural flow of water into electricity. It works by capturing water as it flows and falls from a height. The energy is produced by the falling water turning the blades of a water turbine, which in turn drives a generator to produce electricity.

Hydro projects are emissions-free, except from a life-cycle perspective due to plant production, transmission and construction, and use a renewable resource. However, they may affect water regimes and fisheries significantly and may require flooding or affect downstream environments.

Source: Nuclear Power Expert Panel, *Report on Nuclear Power and Alberta*, February 2009

DOES SASKATCHEWAN CURRENTLY HAVE A NUCLEAR REACTOR?

Saskatoon has been home to a nuclear reactor since 1981. The SLOWPOKE-2 research reactor, a 20 kilowatt reactor, has been located at the Environmental Analytical Laboratories in Saskatoon. The SLOWPOKE-2 reactor is an analytical tool and is a very useful complement to the wide array of more traditional chemical and instrumental techniques available for environmental testing.

WHAT HAPPENS TO DECOMMISSION A POWER PLANT?

At the end of a nuclear plant's useful life it is decommissioned and over a period of time the site will be returned to "Greenfield" conditions. A license from the CNSC to perform this decommissioning work is required. Information on decommissioning plans and financial guarantees for funding decommissioning must be provided at all stages of licensing to provide assurance that all necessary activities can be completed.

For example, Ontario Power Generation (OPG) is responsible for the decommissioning and nuclear waste management associated with all nuclear stations in Ontario. The CNSC has approved financial guarantees totaling $9.999 billion related to these plants. Every year contributions are made to segregated accounts to fund future decommissioning and waste management activities and, as of the end of 2006, OPG had accumulated $7.5 billion for these purposes.

Source: Canadian Nuclear Association

The design life of a nuclear power plant is typically 30–40 years, However, with advances in technology, it is quite feasible that many plants will be able to operate in excess of their design lives, provided that nuclear power plant engineers demonstrate by analysis, trending, equipment and system upgrades, increased vigilance, testing and ageing management that the plant will operate safely.

Source: International Atomic Energy Agency, Second International Symposium on Nuclear Power Plant Life Management, October 2007

WHY IS THERE A PRIVATE SECTOR BUSINESS INVOLVED VERSUS JUST RELYING ON SASKPOWER TO SUPPLY THE POWER WE NEED?

Whether it's the result of Saskatchewan's growing economy, or the age of SaskPower's generating fleet, SaskPower expects multi-billion dollar capital expenditures will be required through to 2018 to ensure they can meet the electricity needs of the province. Through the development of partnerships or third-party investments, the company may be able to reduce the need to finance projects up-front. However, regardless of the amount of partnership or third-party investment, SaskPower's liabilities are expected to grow substantially.

As SaskPower evaluates a wide range of future supply options to meet this growing demand for electricity it is pursuing new business models – including private ownership of generating facilities – to provide the electrical infrastructure required for Saskatchewan.

Source: SaskPower website

ARE BRUCE POWER'S CURRENT ONTARIO OPERATIONS GOVERNMENT SUBSIDIZED?

No. In Ontario, Bruce Power leases the facility at Kincardine from the Ontario Power Generation (a provincial crown corporation), sells some of its power to the province at agreed upon rates (about ¼ the rate of what the government is charged for solar power), and receives no public money. Should Bruce Power proceed with expansion in Saskatchewan they are likely to use this model as guidance.

Bruce Power also provides wind power to Ontario from wind generators around the nuclear site.

Source: Bruce Power

WILL OUR POWER RATES GO UP IF NUCLEAR POWER COMES TO SASKATCHEWAN?

It is anticipated that SaskPower, like all electric utilities, will require substantial rate increases over the next decade, as costs increase to meet the new demand from customers. SaskPower will strive to set its rates so that, compared to other electrical

utilities in the region, the company matches the average rates being charged.

Source: SaskPower website

GHG Greenhouse Gases per Kilowatt Hour of power (grams of CO2)	
Hydro	4
Nuclear	6
Wind	3 – 22
PhotoElectric	60 – 150
Natural Gas	430
Coal	800 – 1050
Source: Presentation at EnerCan West Conference, March 16/17, 2009 Regina, SK, by Tom Porter, Research Facilitator, University of Saskatchewan, "*Critical Elements for Assessing the Economics of Nuclear Power*"	

Given that the cost of electricity in Saskatchewan will increase regardless of the choices for new development, it seems important that we choose energy sources that will minimize these increases. The information that is available suggests that the use of nuclear power as a baseload power source is consistent with the goal of minimization of rate increases.

Source: Bev Robertson, Past President, Canadian Association of Physicists; Fellow, Chemical Institute of Canada; Consultant on Energy and Risk issues; Lecturer on Biological Effects of Radiation; Researcher on natural radiation in Saskatchewan; Past Chairman Saskatchewan Health Research Board

WHO ELSE IN CANADA GENERATES NUCLEAR POWER?

The operators who generate nuclear power in Canada are Ontario Power Generator (OPG), Hydro Quebec, New Brunswick Power (NB Power), and Bruce Power. Bruce Power is the only private company.

WHAT ARE THE ECONOMIC BENEFITS OF A NUCLEAR POWER PLANT IN SASKATCHEWAN?

A new power plant would have a significant impact on Saskatchewan's economy, contributing approximately $12 billion in discounted GDP to the Province over its life ($1.2 billion during construction and $10.6 billion during operation), as well as employing 3,000 people during construction and providing between 400 and 700 direct jobs during operation for every unit built.

Source: *Uranium Development Partnership, Capturing the full potential of the uranium value chain in*

Saskatchewan, March 31, 2009

- ✓ Nuclear power is cost competitive with other forms of electricity generation, except where there is direct access to low-cost fossil fuels.
- ✓ Fuel costs for nuclear plants are a minor proportion of total generating costs. Capital costs for nuclear power plants are greater than those for coal-fired plants and much greater than those for gas-fired plants.
- ✓ In assessing the cost competitiveness of nuclear energy, decommissioning and waste disposal costs are taken into account.

Source: World Nuclear Association, *The Economics of Nuclear Power*, January 2009

WOULD THE PROVINCIAL GOVERNMENT NEED TO CONTRIBUTE TO THE COST OF BUILDING THE POWER PLANT?

Capital cost overruns and schedule delays are key risks in any new nuclear build project, and they would need to be carefully mitigated in the project development process. To date, the cumulative risks of a new nuclear build have been too large for the private sector to bear alone and governments have played some form of facilitation in the implementation of nuclear power projects in all jurisdictions.

Source: *Uranium Development Partnership, Capturing the full potential of the uranium value chain in Saskatchewan*, March 31, 2009

New nuclear power plant developments have high capital costs and require several years to construct. As such, there are always risks of capital cost overruns and delays. This is true of any project of this scale, including new coal plants and hydro dams. However, recent international experience indicates that the major vendors of nuclear power plants have significantly improved budget and scheduled performance.

Should the provincial government decide to move forward with a nuclear power plant, it will need to undertake a process to determine what, if any, public dollars are invested and how best to manage and share any potential risks to private parties.

Source: *Editor's Note*

WHAT TYPE OF COST OVERRUNS HAVE BEEN EXPERIENCED BY NUCLEAR POWER PLANT BUILDERS?

Historically, the requirement for significant upfront capital investment, the long development timelines, and the uncertainties of licensing and cost overruns have resulted in the need for cooperation between public and private sector players to ensure nuclear new build projects are successfully executed. The most important roles of government are to provide strong and effective regulation of the nuclear power industry to ensure public safety and to provide policy stability to allow efficient licensing, construction, and operation.

Saskatchewan could reduce licensing and first-of-a-kind risks by drawing on the recent experiences of other Canadian provinces that have developed nuclear generation capacity.

Source: *Uranium Development Partnership, Capturing the full potential of the uranium value chain in Saskatchewan,* March 31, 2009

WOULD THE POWER PLANT BE UNIONIZED?

Yes, the power plant would be unionized. The two unions Bruce Power currently works with are the Powerworkers Union and the Society of Energy Professionals.

The International Brotherhood of Electrical Workers Local 2067 is the union representing employees at SaskPower's coal-fired power plants.

Earlier this month, the union sent its members a copy of an agreement signed by Bruce Power president Duncan Hawthorne and IBEW Local 2067 business manager Neil Collins.

The union says the letter of agreement indicates that if Bruce Power builds a nuclear power plant in Saskatchewan, IBEW members would operate and maintain the facility.

Source: www.cbc.ca "*Saskatchewan union signs pro-nuclear agreement with Bruce Power*," April 9, 2009

A new nuclear facility of just over 1,000 MW would have the same reduction on greenhouse gases as taking half of Saskatchewan's vehicles off the road today.
Bruce Power, Saskatchewan 2020, http://www.brucepower.com

WHAT ARE THE TIME FRAMES TO BUILD A PLANT AND WHAT AND WHO WILL DECIDE IF IT GOES AHEAD?

Before any decision is made to proceed with building a nuclear facility, an Environmental Assessment must be conducted as a planning tool to predict the effects of the project on the environment.

The regulatory process for licensing a new power plant, starting from the initial site application to commercial operation, requires that the applicant receive three separate licenses: one to prepare the site, the second to construct the plant and the third to operate the plant. The CNSC has estimated that the approximate duration of licensing activities from receipt of an application for *License to Prepare Site* to *License to Operate* is approximately nine years.

In Canada, the Federal Government has the authority and responsibility for approving and regulating all nuclear facilities and nuclear-related activities.

In the case of a nuclear power plant for the generation of electricity, the normal

provincial approvals that are required for any major project would also be required. These required approvals flow from the Province's constitutional responsibility for land and resources and cover the broad range of issues related to land use.

Source: Nuclear Power Expert Panel, *Report on Nuclear Power and Alberta*, February 2009

In October 2008, the Government of Saskatchewan established the Uranium Development Partnership to examine uranium resources. The UDP report - submitted March 31, 2009 - analyzed the areas of: exploration and mining; upgrading; power generation; used fuel management; research, development and training.

On April 8th, Dan Perrins was appointed Chair of the Future of Uranium in Saskatchewan Public Consultation Process by the Government of Saskatchewan. Mr. Perrins was appointed to lead an independent consultation process, focused on the recommendations made by the Uranium Development Partnership.

Mr. Perrins' goals for this consultation process are to listen to people through an inclusive process, and to reflect on what he heard in the report. A report will be submitted to the government in August. His role as Chair is not to be an advocate for the Uranium Development Partnership report, but to provide an opportunity for Saskatchewan people to respond to the report.

The consultation process has been launched. Organizations with a special interest in the report have been invited to a stakeholder conference to be held in Saskatoon on May 26th.

This will be followed by two days of hearings in Saskatoon that will allow interested organizations to present directly to Mr. Perrins on Wednesday, May 27th and Thursday, May 28th. He will also hold two additional meetings for interested groups in Regina on Monday, June 22nd and Tuesday, June 23rd.

The community public consultations will be held in the first three weeks of June, and a detailed list of dates and locations are also listed on the consultation website.
This schedule will also include additional meetings with First Nations and Métis governments, and additional opportunities for northern communities are being explored.

Source: saskuranium.ca

WHAT IS SASKATCHEWAN'S INVOLVEMENT IN URANIUM MINING?

The province of Saskatchewan occupies the enviable position of being the world's largest producer of uranium. This vibrant sector attracts investments to the province from both global-scale players and junior companies. It employs approximately 3,000 people in Saskatchewan, about 80 percent of whom work at mine sites located in the province's north. This established presence creates significant direct and spin-off benefits for the local and provincial economies through wages, taxes, and local investment. Supporting this sector are mining-related programs at the province's post-secondary educational

institutions and selected Saskatchewan-based research facilities, such as the Slowpoke II reactor and the Canadian Light Source synchrotron.

Despite this strong platform and robust mining activity, Saskatchewan plays virtually no role in the rest of the uranium sector – and mining and milling represent only a limited portion of the economic value added in the overall chain. Beyond mining and milling, this value chain includes processing or upgrading uranium to convert it into fuel for reactors, generating power from nuclear energy, managing the reactors' used fuel, and associated research and development, including medical applications. Saskatchewan does not participate in these additional stages, except for limited involvement in advanced research into new techniques to extract and process uranium and future technical applications.

Furthermore, even in Saskatchewan's traditional areas of strength, its global position is slipping. Forecasts indicate that Kazakhstan will overtake Saskatchewan as the world's largest producer of uranium this year – and that Australia could overtake it next year. Moreover, at current rates of extraction, Saskatchewan's discovered uranium resources would only last approximately 45 more years without additional discoveries through exploration and development, while Kazakhstan's and Australia's would last 110 to 160 years.

Source: *Uranium Development Partnership, Capturing the full potential of the uranium value chain in Saskatchewan,* March 31, 2009

HOW IMPORTANT IS URANIUM MINING TO THE PROVINCE RIGHT NOW IN ECONOMIC TERMS?

- ✓ The uranium mining industry spent more than $188 million on salaries, wages and benefits for its direct employees. Of this, over $58 million was paid to residents of Saskatchewan's north.
- ✓ The industry's contractors paid out an additional $116.5 million to their employees.
- ✓ The value of goods and services purchased by the industry was $769 million.
- ✓ Taxes and royalties of $98.6 million were paid to the province of Saskatchewan; $107 million to the federal government; and $4 million to local governments. The total amount of taxes and royalties paid was over $209.8 million.
- ✓ Approximately $4.2 million was spent on licensing fees and $2.4 million was paid in surface lease fees.
- ✓ $2.7 million was donated to community and charitable organizations and another $270,000 was given as scholarships and other forms of support to contribute to

the education of Saskatchewan's youth.

Source: http://www.cameco.com/uranium_101/uranium_sask/economic_impact

WHAT ARE THE OTHER ECONOMIC ACTIVITIES IN THE NUCLEAR SECTOR SASKATCHEWAN IS LOOKING AT NOW?

As the world's largest producer of uranium, Saskatchewan has a strong platform to build upon. The uranium value chain extends from the mining of natural uranium through to the management of used fuel from nuclear reactors, and it includes research and medical applications of nuclear technology.

World demand for primary uranium will grow substantially over the next 10 years, creating an opportunity for Saskatchewan to rapidly expand its mining sector and to maintain its position as a leader in uranium mining.

To achieve this goal, Saskatchewan will need to renew its discovered resource base by maintaining the level of private exploration investment reached in recent years and investing in mine development.

Saskatchewan could also create and support a centre of excellence for nuclear research and training.

HOW CAN I GET MORE INFORMATION?

Canadian Nuclear Association http://www.cna.ca/

Canadian Nuclear Safety Commission http://www.cnsc-ccsn.gc.ca/eng/

World Nuclear Association http://www.world-nuclear.org/

Greenpeace Canada http://www.greenpeace.org/canada/

David Suzuki Foundation http://www.davidsuzuki.org/default.asp

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In October 2008 the Government of Saskatchewan convened a group of representatives from business, labour, academia, urban, rural, First Nations, and environmental communities to create an expert panel – the Uranium Development Partnership (UDP). The group's mandate was to "identify, evaluate, and make recommendations on Saskatchewan-based value added opportunities to further develop our uranium industry." Our efforts will parallel the public consultations of the UDP.

A PFD of the report, *Capturing the full potential of the uranium value chain in Saskatchewan*, commissioned by the Province of Saskatchewan for release in March 2009 is available for download at www.saskuranium.ca

IF I AM A SUPPORTER HOW DO I MAKE MY PERSPECTIVE KNOWN?

- ✓ Letters to the editor
- ✓ Letters to the premier
- ✓ **Attend the public consultation meetings (see schedule below)**

THE FUTURE OF URANIUM IN SASKATCHEWAN – CONSULTATION SCHEDULE

DATE	LOCATION	MEETING
Tuesday, May 26	Saskatoon	Half-day Stakeholder Conference
Wednesday, May 27	Saskatoon	Stakeholder Meetings
Thursday, May 28	Saskatoon	Stakeholder Meetings
Monday, June 1	Yorkton	Public Consultation Meeting
Tuesday, June 2	Estevan	Public Consultation Meeting
Wednesday, June 3	Swift Current	Public Consultation Meeting
Thursday, June 4	Regina	Public Consultation Meeting
Monday, June 8	Prince Albert	Public Consultation Meeting
Tuesday, June 9	Buffalo Narrows	Public Consultation Meeting
Wednesday, June 10	Lloydminster	Public Consultation Meeting
Thursday, June 11	North Battleford	Public Consultation Meeting
Monday, June 15	Saskatoon	Public Consultation Meeting
Tuesday, June 16	La Ronge	Public Consultation Meeting
Monday, June 22	Regina	Stakeholder Meetings
Tuesday, June 23	Regina	Stakeholder Meetings