Rook I Project

Environmental Impact Statement

TSD XIII: Upstream Greenhouse Gas Emissions and Carbon Intensity Discussion

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UPSTREAM GREENHOUSE GAS EMISSIONS AND CARBON INTENSITY DISCUSSION TECHNICAL SUPPORT DOCUMENT FOR THE ROOK I PROJECT

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Abbreviations and Units of Measure

Abbreviation	Definition
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
CNSC	Canadian Nuclear Safety Commission
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
EIS	Environmental Impact Statement
GHG	greenhouse gas
Project	Rook I Project
Proposed CNSC Path	Proposed CNSC Path Forward for Assessing Total GHG Production from Nuclear Facilities
SACC	Strategic Assessment of Climate Change

Unit	Definition
%	percent
°C	degrees Celsius
g	gram
km	kilometre
kt	kilotonne
CO_2e/kWh	carbon dioxide equivalent per kilowatt hour
CO_2e/yr	carbon dioxide equivalent per year

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1 INTRODUCTION

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon. The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Access to the Project would be from an existing road off Highway 955, with on-site worker accommodation serviced by fly-in/fly-out access.

The purpose of this technical support document is to provide a discussion of the relevance and requirement to conduct an upstream assessment of greenhouse gas (GHG) emissions for the Project. Upstream GHG emissions are domestic and non-domestic emissions from all stages of production, from the point of resource extraction or utilization to the project under review (Government of Canada 2020). The discussion is separated into two portions:

- A review of applicable legislation and policy to provide context for when an assessment of upstream GHG emissions is required as part of an Environmental Assessment.
- An overview of how the uranium concentrate produced from the Project can contribute to the nuclear energy sector and how nuclear energy is expected to contribute to the Government of Canada's ability to meet its environmental obligations and its commitments in respect of climate change and other international jurisdiction's GHG reduction plans. Specifically, how nuclear energy can improve the carbon intensity of electric grids.

This document was developed to inform and support the assessment of the climate change valued component in the Environmental Impact Statement (EIS) Section 7.4, Climate Change, but is not included in the assessment of significance. The discussion relies on both professional experience and published information.

2 REVIEW OF APPLICABLE LEGISLATION AND POLICY

This subsection summarizes applicable legislation and policies considered to identify whether an upstream GHG assessment is required for the Project. The applicable legislation and policies are the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), the *Strategic Assessment of Climate Change 2020* (SACC; Government of Canada 2020), and *The Proposed CNSC Path Forward for Assessing Total GHG Production from Nuclear Facilities* (Proposed CNSC Path; CNSC 2017).

The nuclear fuel life cycle consists of various industrial processes that describe uranium throughout its life cycle, from mining to electricity generation to waste disposal (World Nuclear Association 2021). The *Life Cycle Analysis of Greenhouse Gas Emissions from the Mining and Milling of Uranium in Saskatchewan* (Parker 2014) and the Proposed CNSC Path (CNSC 2017) have identified the core elements within the nuclear generational life cycle, which starts with mining, milling and fabrication, and are followed by the construction, operation, and decommission of nuclear plants along with waste management (World Nuclear Association 2021).

According to the Canadian Nuclear Safety Commission (CNSC) 2017 guidance, the core elements of a nuclear fuel life cycle include:

- mining-milling (construction, operation, decommission);
- refining/conversion (construction, operation, decommission);
- fuel fabrication;
- nuclear power plant (construction, operation, decommission); and
- waste disposal (low, intermediate, and high-level radioactive waste disposal).

The proposed Project activities are associated with the mining and milling of uranium. As outlined in EIS Section 7.4.2.4, Temporal Boundaries, the Project timelines and phases include Construction (4-year duration), Operations (24-year duration), and Closure (15-year duration).

Based on the CNSC guidance, the mining-milling activities associated with the Project are the most upstream activities of the nuclear fuel life cycle. The CNSC 2017 definition of upstream assessment is consistent with the CEAA 2012 and SACC 2020 guidance, as described below.

2.1 Canadian Environmental Assessment Act, 2012

The Project is being assessed under CEAA 2012, and therefore, the Environmental Assessment needs to meet the requirements of CEAA 2012 (EIS Section 1.3, Regulatory Context). Under CEAA 2012, there is no requirement for an upstream assessment; rather, the GHG assessment under CEAA 2012 focuses on the direct and indirect emissions (Scopes 1 and 2)[1] from the project itself.

Subsequent to the release of CEAA 2012, Environment and Climate Change Canada clarified on 19 March 2016 through a posting in the Canada Gazette that an assessment of upstream GHG emissions will be required for certain oil and gas projects (Government of Canada 2016). As defined by Environment and Climate Change Canada in the methodology proposed in the Gazette announcement, upstream GHG emissions include all industrial activities from the point of resource extraction to the project under review. The specific processes included as upstream activities will vary by resource and project type, but in general, they include extraction, processing, handling, and transportation. The assessment of the upstream emissions is separated into two parts, consistent with the Environment and Climate Change Canada methodology. Part A is a quantitative estimate of the range of GHG emissions released upstream of the project (Government of Canada 2016). Part B discusses the conditions under which the Canadian GHG upstream emissions estimated in Part A could be expected to occur even if the project were not built (Government of Canada 2016).

Based on the requirements of CEAA 2012, the Project does not require an upstream GHG assessment to be conducted.

[1] Scope 1 emissions are ones occurring from sources that are owned or controlled by the proponent (e.g., emissions from fuel combustion in owned or controlled boilers). Scope 2 emissions are the ones occurring at sources that are not owned or controlled by the proponent but are accounted in the proponent's GHG inventory as they are a result of organization's energy use (e.g., carbon emissions from the generation of purchased electricity, or heat).

2.2 Strategic Assessment of Climate Change

Under the SACC 2020 (Government of Canada 2020), an upstream assessment is required for all projects (not just oil and gas) that are likely to exceed the upstream GHG thresholds based on different timelines; the current threshold is 500 kilotonnes (kt) of carbon dioxide equivalent (CO_2e) annually. The SACC 2020 retains the Part A and B approaches as outlined in the Canada Gazette (Government of Canada 2016). The definition of upstream assessment in SACC 2020 is consistent with the definition from CEAA 2012.

For a project proceeding under the *Impact Assessment Act*, the Tailored Impact Statement Guidelines (IAAC 2020) will confirm if an upstream GHG assessment is required in the impact statement (i.e., the Environmental Assessment) based on preliminary calculations conducted by the Impact Assessment Agency of Canada along with expert federal authorities. The SACC does allow proponents to discuss how a project can contribute to Canada's ability to meet its GHG reduction targets and how a project may help displace emissions internationally and result in global emission reductions (Government of Canada 2020).

Based on calculations in Section 7.4 of the EIS, the Project upstream emissions are expected to be below the threshold provided by the SACC (Government of Canada 2020), and therefore, an upstream assessment would not be required for the Project — even if it were conducted under Impact Assessment Agency of Canada 2020.

2.3 Proposed Canadian Nuclear Safety Commission Path Forward for Assessing Total Greenhouse Gas Production from Nuclear Facilities

The Proposed CNSC Path (CNSC 2017) guidance proposes a path for assessing total GHG production from nuclear facilities, including the upstream assessment (CNSC 2017). The assessment outlined in Section 7.4 of the EIS follows this guidance. The guideline outlines that GHG emissions for nuclear facilities start with the mining and milling of uranium. The guideline suggests following a cradle-to-gate analysis to include emissions from upstream processes of a nuclear power plant (i.e., mining, milling, refining/conversion, and fuel fabrication). For example, a project for a refinery will include GHG emissions assessment associated with both the mining and milling activities. A project for fuel fabrication will include GHG emissions assessment associated with the mining, milling, and refining of the uranium.

For the Project, the proposed activities included are on-site mining and milling of uranium, which are the most upstream activities of a nuclear fuel lifecycle according to the guidance. Considering that the Project is the most upstream of the nuclear fuel lifecycle, an upstream GHG emissions assessment is not required to be conducted for the Project based on the cradle-to-gate framework (CNSC 2017). The CNSC 2017 suggestion for upstream assessment is consistent with the suggestion for upstream assessment from CEAA 2012 and SACC 2020.

2.4 Summary

Based on CEAA 2012, the SACC (Government of Canada 2020), and Proposed CNSC Path (CNSC 2017), an upstream assessment would not be required for the Project. The requirements for an upstream assessment based on relevant acts and regulations and how these requirements may relate to the Project are summarized in Table 2.4-1.

Rather than focus on upstream GHG emissions, Section 3, Nuclear Energy and Carbon Intensity, discusses how the Project can help displace emissions internationally and result in global emission reductions by providing mined material to the nuclear energy sector.

Table 2.4-1: Upstream Assessment Requirements in Relation to the Project

Act/ Regulation	Requirement	Project Upstream Assessment Description
CEAA 2012	Not a requirement within CEAA; however, was a 2016 Gazette requirement for oil and gas projects.	Considering the requirement is only for oil and gas projects, upstream assessment is not required for the Project.
SACC	An upstream assessment is required for projects that are likely to exceed the upstream GHG thresholds. The current threshold is 500 kt of CO_2e annually.	Upstream GHG emissions are expected to be well below the threshold provided by SACC (Government of Canada 2020). Hence, an upstream assessment is not required.
Proposed CNSC Path	Upstream assessment should follow a cradle-to-gate analysis with nuclear fuel cycle starting with mining and milling.	The guidance states that nuclear fuel cycle starts with mining and milling, which are the most upstream activities. The Project activities include mining and milling activities. Emissions associated with mining and milling have been analyzed in EIS Section 7.4, Climate Change. Hence, an upstream GHG assessment would not be required as the emissions that have been analyzed are the most upstream.

CEAA 2012= *Canadian Environmental Assessment Act, 2012*; SACC = Strategic Assessment of Climate Change; CNSC = Canadian Nuclear Safety Commission; Proposed CNSC Path = Proposed CNSC Path Forward for Assessing Total GHG Production from Nuclear Facilities; GHG = greenhouse gas; EIS = Environmental Impact Statement; CO_2e = carbon dioxide equivalent; kt = kilotonne.

3 NUCLEAR ENERGY AND CARBON INTENSITY

According to Section 2.2, Strategic Assessment of Climate Change, upstream emissions associated with the Project are negligible compared to the threshold listed in the SACC. The results also discuss how the uranium concentrate produced from the Project can contribute to the nuclear energy sector and how nuclear energy is part of Canada's and other international jurisdiction's low carbon plans.

3.1 Emissions Associated with the Project

The proposed activities associated with the Project only include mining and milling operations, in relation to the nuclear fuel lifecycle. Based on the nuclear fuel lifecycle, mining-milling activities associated with the Project are at the front-end and are the most upstream activities of the nuclear fuel lifecycle. There are limited upstream activities to the Project; these could include emissions embodied in resources required for the construction materials, and emissions associated with transportation of personnel, materials, and equipment. Even though construction activities can be energy and resource intensive, the emissions associated with Scope 1, Scope 2, and Scope 3[2] upstream activities are approximately 4.8% of the emissions from a nuclear fuel life cycle (Parker et al. 2016). The Scope 1, Scope 2, and Scope 3 emissions associated with the mining and milling stage attribute to approximately 30% of the emissions of the nuclear fuel life cycle (Parker et al. 2016). The Scope 1 emissions for the Project have been reported in EIS Section 7.4. There are no Scope 2 emissions associated with the Project. As per EIS Section 7.4, Table 7.4-12, the Project's maximum annual GHG emissions are estimated to be 171 kt CO_2e/yr (carbon dioxide equivalent per year) during Construction, 82 kt CO_2e/yr during Operations, and 69 kt CO_2e/yr during Closure. These emissions are well below the upstream emissions threshold specified in the SACC (i.e., 500 kt CO_2e annually). Therefore, based on the above percentages of the stages of the nuclear fuel life cycle, it is anticipated that the upstream Scope 3 emissions associated with the resources need for the Project would be even less than this limit.

[2] Scope 3 emissions are the ones that are a consequence of the proponent's activities but occur from sources not financially or operationally controlled by the proponent (e.g., emissions from waste)

3.2 Demand for Nuclear Energy

Under the 2015 Paris Agreement (UNFCC 2015), Canada has committed to reduce its GHG emissions by 40% to 45% below 2005 levels by 2030 (Prime Minister of Canada 2021). To meet these requirements, the Government of Canada aims to reduce its carbon dioxide (CO_2) emissions by 219 million metric tonnes by 2030 (Canadian Nuclear Society, n.d.).

Currently, 80% of Canada's electricity generation is from non-emitting sources and Canada aims to increase that to 90% by 2030. To meet the GHG emission reduction targets and growing electricity demands, considerable new electrical capacity will have to be installed in Canada along with efforts in decarbonization (Canadian Nuclear Association 2017). To achieve the decarbonization at the lowest possible cost in Canadian provinces, there would be a need to install a diverse set of low carbon technologies, including nuclear (Canadian Nuclear Association 2017). In Canada, various climate scenarios for low GHG economy modelling analyses indicate the importance of nuclear energy installation before mid-century to meet the Paris Agreement Targets. Studies indicate that provinces such as Saskatchewan, Alberta, Ontario, and New Brunswick would have to identify how nuclear energy can support their GHG emission reduction targets along with meeting higher electricity demands at lower costs (Canadian Nuclear Association 2017). For example, in Saskatchewan, there is a high potential to transition towards nuclear energy considering the availability of high-quality uranium reserves that will provide an opportunity to move away from oil and coal and reduce GHG emissions.

In Canada, nuclear power is the second largest source of low carbon economy, behind hydroelectricity (Canadian Nuclear Association 2021). Even though hydroelectric power is a zero-emission option in Canada, there is a limited number of locations remaining across the country that are suitable for hydroelectric power generation. For installing hydroelectricity, the geography of a location needs to be appropriate, and Canada is already near 90% of its hydro capacity (Canadian Nuclear Association 2021). Nuclear power is readily expandable in Canada as there is abundant supply of uranium. Nuclear requires a fraction of the land footprint when compared to hydroelectric, solar, and wind (Canadian Nuclear Association 2021) on a per-energy unit basis. In Canada, nuclear energy displaces approximately 50 million metric tonnes of CO_2 emissions per year compared to the same amount of electricity produced from natural gas (Canadian Nuclear Society, n.d.). Nuclear power plants, in comparison to renewable energy, could also help stabilize the electrical grids as they can limit the effects from seasonal fluctuations. In addition to increasing low carbon electricity, nuclear energy can also help stabilize electricity prices, lower levelized cost of electricity, provide reliable baseload capacities, create jobs, boost local economy, and reduce air pollution from electricity generation (ECCC 2020; Canadian Nuclear Society, n.d).

The importance of nuclear energy is also recognized at a global scale, where nuclear power is the second largest source of low carbon electricity. To achieve the international Paris Agreement targets, there would have to be an 80% increase in global nuclear power production by 2040 compared to the current levels, along with investments in renewable energy sources (International Energy Agency 2019). Based on the GHG emission policies at a global scale, nuclear generating capacity is projected to increase by 2040 in Canada and globally. In the long term, there would be a need for significant uranium resources nationally and internationally to support the use and growth of nuclear capacity to transition to low-carbon electricity generation (Nuclear Energy Agency and the International Atomic Energy Agency 2020).

Currently, Canada is the second largest producer and exporter of uranium. In 2016, 23% of the world's uranium was produced in Canada. Globally, the use of Canadian mined and milled uranium in nuclear power plants avoids approximately 300 million tonnes to 500 million tonnes of CO_2 emissions worldwide. All of the uranium that is supplied globally from Canada is mined in Saskatchewan (International Atomic Energy Agency Ministerial Conference 2017). Given the GHG emission reduction targets of countries, there is a projected expansion in the demand for nuclear power as a part of overall energy supply. To meet the increasing demand for nuclear power, the demand for uranium for fuel fabrication is projected to increase with increasing electricity demand and a need to reduce GHG emissions from electricity generation.

Based on the projected increasing demands of nuclear energy and uranium supply, the Project can help meet the demands for low-emissions power generation through supplying uranium for fuelling the nuclear reactors. Therefore, based on the projected demand for uranium, if the Project is not approved, uranium would still be mined and milled at other locations to meet the increasing demand of uranium and the national and international scale. Considering Saskatchewan has a major source of uranium, the Project would play a key role in helping to meet the demands of uranium required for the nuclear power plants.

3.3 Nuclear Energy and Reduction of Carbon Intensity of Electric Grids (Displacement of National and International Greenhouse Gas Emissions)

Carbon intensity is a measure of the amount of CO_2 produced per unit of electrical energy generated. Carbon intensity of electricity depends on the fuel used in generation of electricity along with efficiency of power generation and transportation (Carbon Tracer n.d.). The current world average carbon intensity of the power sector is approximately 500 g CO_2e/kWh (carbon dioxide equivalent per kilowatt hour; Buongiorno et al. 2019). Based on the climate change stabilization scenarios developed by the International Energy Agency in 2017, to limit the global mean temperature warming to 2.0°C, the power sector's carbon intensity must be reduced to 10 g to 25 g CO_2e/kWh by 2050 and less than 2 g CO_2e/kWh by 2060 (Buongiorno et al. 2019). The New Nuclear Watch Institute study on *The Failings of Levelized Cost and the Importance of System-Level Analysis* has identified that, on a per megawatt of installed capacity basis, nuclear power is associated with 34% greater reduction in carbon intensity of a power system compared to that of renewable energy (NNWI 2020).

In many advanced economies, nuclear has been the largest source of low carbon economy. Globally, 55 gigatonnes of CO_2 emissions have been avoided over the last 50 years due to the use of nuclear power, which is equal to two years of global energy related CO_2 emissions (International Energy Agency 2019). Renewables and nuclear energy are both important resources for a low carbon economy. However, currently, renewables require back-up capacity due to seasonal fluctuations, which in most cases is supplied by carbon-emitting, natural gas-fired power plants. Because nuclear power plants do not require conventional power backup generation capacity, nuclear power is expected to have a greater affect on a system level carbon intensity compared to renewable energy (NNWI 2020).

Adding to that, nuclear power in itself, along with hydro and wind power, emits the lowest quantity of GHGs per unit of electricity throughout its life cycle. For example, a study for the Organisation for Economic Co-operation and Development countries estimates that nuclear power has one of the lowest carbon intensities, generating approximately 25 g CO_2e/kWh as compared to fossil fuel chains having carbon intensity of 450 g to 1,250 g CO_2e/kWh. Findings indicate that in Organisation for Economic Co-operation and Development countries, nuclear power has accounted for lowering the carbon intensity of energy economies in the last 25 years (Nuclear Energy Agency n.d.). In Canada in 2005, the nuclear industry produced 85 terawatt hours of electricity, which was approximately 11% of Canada's total energy use. This energy generation led to emission of 468,000 and 594,000 tonnes of CO_2 per year, which was 0.07% of Canada's total emissions for the year. Compared to that, a 500 megawatt coal-fired power plant produces approximately 0.4% of Canada's total electricity and 0.4% of Canada's total GHG emissions (Ilnyckyj 2009). In Canada, without nuclear power, GHG emissions from electricity generation would be 50% higher during the 1971 to 2018 periods (IEA 2019). In Ontario, between 2005 and 2015, nuclear energy has helped the province phase out coal by providing a clean energy option that is affordable and reliable. Ontario's nuclear stations help avoid approximately 60 million tonnes of GHG emissions, which is equivalent to taking about 12 million combustion engine vehicles off the road (Canadian Nuclear Association 2017).

Based on the SACC (Government of Canada 2020), the Project could contribute to the Government of Canada's ability to meet its environmental obligations and its commitments in respect of climate change by enabling the displacement of high GHG intensity fossil fuel electrical generation and helping the production of renewable energy.

Further, the Project could help displace emissions internationally, as the Project could likely result in reduction of global emission reductions by supplying uranium to meet the increasing demands for nuclear projects.

4 KEY FINDINGS

Based on the requirements stated in CEAA 2012, the SACC (Government of Canada 2020), and the Proposed CNSC Path (CNSC 2017), this technical support document shows that an upstream assessment is not required. Instead, the discussion focuses on how the proposed Project can help displace GHG emissions internationally, resulting in global emission reductions, by providing uranium concentrate to the nuclear energy sector.

There is a growing demand for uranium at a national and an international scale. If the proposed Project is not approved, uranium would be mined and milled at other locations to meet this demand.

The Project could assist Canada's ability to meet its GHG reduction targets. The uranium concentrate from the Project could contribute to the nuclear energy sector and influence how nuclear energy is considered low carbon plans for Canada and international jurisdictions. Nuclear energy has a low carbon intensity and helps displace tonnes of GHG emissions per year from fossil fuel electricity generation at a national and international scale.

CLOSING

Golder is pleased to submit this report to NexGen in support of the environmental assessment for the Rook I Project. For details on the limitations and use of information presented in this report, please refer to the Study Limitations section following this page. If you have any questions or require additional details related to this study, please contact the undersigned.

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