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Exploring a Coal-to-Nuclear Transition: Repurposing of Legacy Coal Assets to Locate Small Modular Reactors in Alberta

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TABLE OF CONTENTS

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EXECUTIVE SUMMARY

Climate change mitigation and the search for alternative energy are spurring a growing interest in repurposing decommissioned coal power plants into sites for small modular nuclear reactors (SMRs) which produce minimal greenhouse gas emissions. With power ranging between 10- to 300-megawatt electric, SMRs take up a fraction of the size and have approximately one-third of the generating capacity of a conventional large-scale nuclear reactor.

Saskatchewan plans to locate its first SMR on the site of a combined coal-fired power station near Estevan, and it is inevitable that SMRs will eventually be proposed for Alberta. These small reactors offer greater efficiency, safety and flexibility of deployment compared to large nuclear plants; however, uncertainty surrounds the regulatory framework that must be in place before any proposals are made to site SMRs in Alberta.

Both the provincial and federal governments have jurisdiction over coal-to-nuclear transition projects and given the current lack of a nuclear regulatory framework in Alberta, this paper discusses the rules, regulations and procedures that will be required for approvals. Instead of building from scratch, repurposing of decommissioned coal-fired power plants using the existing infrastructure — water storage systems, desalination plants and wastewater treatment systems — and improved technology, offers a way to streamline the approval process.

Any SMR proposal would first require an impact assessment which would consider the project's social, environmental and economic effects as well as waste management, safety and other factors, culminating in the question of whether the project would be in the public interest. Coal plant owners and the owners of extant infrastructure such as transmission lines would need to be consulted, along with Indigenous people and other area residents. Among the regulatory agencies tasked with various stages of the approval process are the Canadian Nuclear Safety Commission and the Impact Assessment Agency of Canada at the federal level and Alberta Environment and Protected Areas and the Alberta Utilities Commission at the provincial level.

Given the inevitable complexities inherent in a lengthy approvals process, this paper argues that, despite the fact no coal-to-nuclear transitions are on the Alberta horizon, a regulatory framework for nuclear energy generation must urgently be established in the province. Best practices can be gleaned from the processes Ontario and New Brunswick used to collaborate with the federal government on their proposed nuclear reactor sites and strategies for Alberta can be developed from lessons learned in those provinces. Proceeding with a coal-to-nuclear transition means that harmonizing the key regulatory players and their respective processes — including public participation and determinations as to the public interest — is a priority.

Laying the groundwork for nuclear energy generation in Alberta can begin now by preparing a detailed scoping of potential coal-fired power plant sites, including an inventory of the technical

infrastructure that can be repurposed for SMRs. Power plant owners and owners of infrastructure such as transmission lines will need to be consulted about siting nuclear power plants on their properties with regard to future environmental and decommissioning liabilities, licence transfers and site closures, because those processes would likely be carried out by a different owner/operator.

With potential sites located, a regulatory framework in place and a streamlined approvals process, Alberta would stand ready to benefit from nuclear energy's ability to mitigate the effects of climate change and provide a stable, affordable supply of energy.

POLICY RECOMMENDATIONS

The authors make the following policy recommendations to accompany the research undertaken in this paper:

1. As part of coal-to-nuclear repurposing, it is recommended that a detailed scoping of potentially available coal-fired power plant sites in Alberta be prepared, including an inventory of technically available infrastructure suitable for repurposing with SMRs.
2. Coal power plant owners and owners of ancillary infrastructure such as transmission lines must be consulted as to their willingness to facilitate the siting of nuclear power plants on their legacy assets as the nuclear plant will likely be owned by a different entity/operator than that for the coal-fired plant. This has direct implications for long-term environmental and decommissioning liabilities, licence transfers and site closures.
3. The paper identifies that there is no distinct regulatory framework for nuclear energy generation in Alberta. This must be urgently addressed, regardless of C2N projects.
4. If C2N projects are to proceed, the key regulatory players and their respective processes (including public participation and determinations as to the public interest) must not only be aligned but harmonized as a priority, with the caveat that inherent complexities arise from federal and provincial jurisdiction related to nuclear energy generation.

INTRODUCTION

There is an increased focus on nuclear energy for its potential role in a low-carbon energy transition, including interest in small modular reactors (SMRs) technologies for potential deployment on the Prairies. This is driven by the heightened urgency to mitigate the effects of climate change while addressing the continued challenges of stable energy supplies and affordability. Nuclear energy could play an important role in this transition, due to its minimal greenhouse gas emissions (Haneklaus et al. 2023, 128169; Hansen et al. 2022, 86; World Bank Group 2021). In this focus on nuclear energy, repurposing of decommissioned coal-fired power plants (CPP**s**) to locate SMRs has received significant attention. With the recent announcements in Saskatchewan that the first SMR will be located near Estevan at SaskPower's Boundary Dam location, the site of a 531MW combined coal-fired power station (SaskPower n.d.a, n.d.b.; World Nuclear News 2024), there is growing interest in a coal-to-nuclear (C2N) transition, which is this paper's main subject of inquiry.

SMRs take up a fraction of the size and have approximately one-third of the generating capacity of a conventional large-scale nuclear reactor (Nuclear Energy Agency 2021, 15). They are sought after given their higher efficiency, more flexibility and greater levels of safety over conventional

nuclear plants (CORDEL Working Group of the World Nuclear Association 2015, 6; World Nuclear Association 2024b). For instance, the Alberta government is investing $7 million in Cenovus Energy's study into assessing the feasibility of deploying SMRs on pre-existing oil sands sites to support oil production on site (Government of Alberta 2023).

Despite the level of interest, proponents of a C2N transition in Alberta face several uncertainties as to the existing regulatory framework.[1] This is partially because the provincial regulatory regime has not yet had to deal with the repurposing of a decommissioned CPP site, let alone contemplate the introduction of nuclear energy to Alberta and the siting of a nuclear power plant (such as an SMR) on, for example, a former CPP site.

This paper aims to identify challenges in the regulatory framework and to suggest ways to bring some clarity to the regulatory regime to advance the C2N discussion on the Prairies. The paper proceeds as follows: Section 1 provides a general outline of what is involved in a C2N transition project. Section 2 canvasses the regulatory framework surrounding a C2N transition project in Alberta, focusing on major regulatory bodies in the federal and provincial regimes. Considering that Alberta has not yet seen a C2N transition project, Section 3 raises several issues facing the current regulatory framework. First, we concluded that it remains unclear as to how earlier approvals of regulatory bodies would impact subsequent regulatory bodies' approval mechanisms; second, the current public consultation program under the provincial licensing regime may be insufficient to adequately address the unique risks created by SMRs and C2N projects.

1. THE POTENTIAL C2N TRANSITION IN ALBERTA

1.1 COAL-FIRED POWER PLANTS AND SMALL MODULAR REACTORS

CPPs generate energy by combusting coal as a fuel, through which significant amounts of greenhouse gases (GHGs) are emitted (Shukla et al. 2022, 25). To reduce GHG emissions, there has been a global push to phase out CPPs (International Energy Agency 2021, 57–63). For instance, CPPs in Alberta have been closed progressively since 2012, with Capital Power's Genesee 2 facility going offline in June 2024 (Jayakumar and Noel 2023). SMRs are designed in size to generate power between 10- to 300-megawatt electric (MWe) (Shukla et al. 2022, 15). Compared to traditional large-scale nuclear reactors, SMRs take up a fraction of the size and have approximately one-third of the generating capacity to reactors such as the CANDU programs in Ontario (Nuclear Energy Agency 2021, 15).

1.2 THE C2N TRANSITION IN A REGULATORY CONTEXT

Retrofitting in the energy context describes replacing equipment in the existing infrastructure to reduce carbon output, change the energy source or increase the power plant's efficiency (Government of Canada 2019). Besides using a CPP's built infrastructure, such as transport access or electricity transmission lines, much equipment and systems used in operating CPPs may be repurposed for future nuclear electricity generation, including water storage systems, desalination plants and wastewater treatment systems (Hansen et al. 2022, 31–33). Retired CPPs have also been repurposed/retrofitted to rely on natural gas to produce electricity, as well as to site solar energy or battery storage projects (Jindal and Shrimali 2022, 112912).

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[1] C2N stands for coal-to-nuclear and typically has a broader meaning of siting a nuclear plant, not specific to SMRs, in a retired coal plant site. However, C2N transition more narrowly refers to a CPP-to-SMR transition for the purpose of this paper.

Against this brief technical background, a potential C2N transition, viewed through a legal lens, would most likely involve several key regulatory phases, including:

- Decommissioning and reclaiming of the CPP site;
- Assessing the CPP site's viability and infrastructure for potential SMR deployment; and
- Applying for all regulatory approvals, transfer or extinguishing of current licences and granting of new licences to construct and operate an SMR on the former CPP site.

In Alberta, site reclamation, which involves returning the site to the state prior to development, is the CPP operator's responsibility as part of closing the plant (Alberta Energy Regulator n.d.). Reclamation includes reducing land disturbance, cleaning up the contamination and salvaging, storing and replacing the soil.[2] Even a reclaimed CPP site, however, may be unfit for a nuclear plant due to safety considerations such as nearby population density and the site's geological makeup (Haneklaus et al. 2023, 8–23), including as a result of higher socio-environmental standards than were in force when the CPP was originally granted approvals. Where components of the CPP are to be reused, the operator must consider the compatibility of technology, equipment and infrastructure between the retired CPP and the incoming SMR (Haneklaus et al. 2023, 31–33). If the CPP's site and components are deemed compatible for retrofitting, the project plan must then undergo various regulatory assessments for approval.

Although discussed extensively in energy policy, C2N transition has not yet been implemented as a strategic energy transition project. This is primarily because SMRs are still largely in development, with only a handful operating in China and Russia (World Nuclear Association 2021, 2024a). Many countries are, however, actively exploring a C2N transition, with several having selected preferred locations for SMR deployment including France, India, Poland, Romania, the United Kingdom and the United States (Watson and Morelova 2022). Canada has investigated the feasibility of deploying SMRs in general, and proposals for SMR deployment on greenfields in Ontario, New Brunswick and Saskatchewan are currently undergoing regulatory approval processes (SaskPower et al. 2021, 3).[3] The authors are in the process of undertaking a comparative report on decommissioned CPPs and the potential for C2N transitions in the U.S., Canada and the European Union.

2. REGULATORY FRAMEWORK GOVERNING C2N TRANSITION PROJECTS

In Canada, nuclear energy falls under federal jurisdiction and is chiefly regulated by the Canadian Nuclear Safety Commission (CNSC) (Government of Canada 2017).[4] However, non-nuclear aspects of a nuclear plant are overseen by various federal, provincial and municipal bodies.[5]

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2 Given the scope of this paper, the regulatory framework outlined herein assumes that the CPP site has been decommissioned and reclaimed pursuant to applicable legislative requirements.

3 Furthermore, the governments of Alberta, Saskatchewan, Ontario and New Brunswick have collaborated in creating a shared vision for SMR deployment. For more information, see Government of Ontario, "A Strategic Plan for the Deployment of Small Modular Reactors," last modified January 25, 2023, https://www.ontario.ca/page/strategic-plan-deployment-small-modular-reactors.

4 *Ontario Hydro v. Ontario (Labour Relations Board),* [1993] 3 SCR 327 (SCC) at para 56.

5 This paper does not discuss a municipal regulatory framework as it is contingent on the municipality in which the SMR plant will be located.

2.1. FEDERAL REGULATORY REGIME

As the federal jurisdiction encompasses nuclear energy, federal regulatory agencies will play an integral role in regulating C2N transitions. The two major federal agencies in this context are the CNSC and the Impact Assessment Agency of Canada (IAAC) (Hatch Ltd. 2023, 85–88).[6]

2.1.1 Licensing Scheme Under the CNSC

The CNSC is the key regulator in the use of nuclear energy, with the objective of preventing unreasonable risks to national security and the environment and to human health and safety.[7] SMRs, classified as a Class IA nuclear facility, require project proponents to obtain five licences throughout the plant's full life cycle: site preparation, construction, operation, decommission and abandonment.[8]

2.1.2 Impact Assessment Under the IAAC

Before obtaining licences from the CNSC, applicants must first undergo an impact assessment (IA). An IA systematically examines the development's potential positive and negative implications for the environment, economy, social, health and gender factors, Indigenous rights and sustainability prior to project approval by the IAAC.[9] A project is approved if the IAAC is satisfied that commissioning it is "in the public interest."[10] Given the overlapping roles in assessing nuclear developments, the CNSC and the IAAC signed a Memorandum of Understanding (MOU) in 2019 that nuclear plant applicants will undergo an integrated IA governed by the IAAC in co-operation with the CNSC (2023).

SMR development projects are designated to undergo an IA if the reactors have a combined thermal capacity of more than 200 MWth.[11] Facilities with lower thermal capacity may bypass an IA, but they may be designated by the minister of Environment and Climate Change, exercising discretionary authority.[12] Upon designation, an integrated review panel, comprised of representatives of the IAAC, the CNSC and other relevant federal and provincial regulatory bodies, assesses the project, considering its potential environmental, health, social and economic impacts.[13] The assessment result is referred to the Governor-in-Council, who makes the final decision on whether the project is approved.[14] It is important to note that the IA process under the integrated review panel for a nuclear project is largely untested (Hatch Ltd. 2023, 98).

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6 Other relevant federal authorities include Natural Resources Canada, Environment and Climate Change Canada, Department of Fisheries and Oceans Canada and Transport Canada.
7 *Nuclear Safety and Control Act*, SC 1997, c 9, s 9 [*NSCA*].
8 *Class I Nuclear Facilities Regulations* (SOR/2000-204), ss 3–8.
9 *Impact Assessment Act*, SC 2019, c 28, s 6 [*IAA*].
10 Ibid., s 62.
11 *Physical Activities Regulations*, SOR/2019-285, s 27(b).
12 *IAA*, s 9. The Supreme Court of Canada has recently released an opinion in which this section of the *IAA* was found unconstitutional. The *IAA* will be revised in the near future to align with the Court's opinion. In the meantime, the minister has paused designating projects via the discretionary authority. The federal government has released an interim guideline for project proponents: IAAC, "Practitioner's Guide to Federal Impact Assessments," last modified October 26, 2023, https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/practitioners-guide-impact-assessment-act.html.
13 *IAA*, s 43.
14 Ibid., ss 62, 51.

2.2. PROVINCIAL REGULATORY REGIME

Although nuclear energy falls under federal jurisdiction, various provincial and local bodies will play an indispensable role in overseeing C2N transition projects. Alberta Environment and Protected Areas (AEPA) and the Alberta Utilities Commission (AUC) are two regulatory bodies involved in approving licences for the construction and operation of the SMRs respectively (Hatch Ltd. 2023, 102–104).[15]

2.2.1 Alberta Environment and Protected Areas

Alberta administers its own EIA under the *Environmental Protection and Enhancement Act* (EPEA), like the federal IA process.[16] Designated nuclear projects will be subject to an EIA administered by AEPA (2015, 1). Similar to the federal scheme, an EIA's objectives include promoting environmental protection and sustainable development while mitigating the adverse environmental, social, economic and cultural impacts of a proposed activity.[17] A proposed project is approved to proceed if it is deemed to be "in the public interest."[18]

Unlike the federal scheme, the provincial EIA scheme does not designate nuclear projects via regulations; hence, the only way a nuclear project would undergo an EIA is via the responsible minister's discretionary designation.[19] Although it is possible for a C2N transition project to bypass both federal and provincial schemes, a joint assessment would likely be conducted with both federal and provincial agencies given the lack of precedent on the type of project and the generally negative public perception of nuclear energy (Hatch Ltd. 2023, 101).

2.2.2 The Alberta Utilities Commission

Upon obtaining approval from the relevant impact assessment (federal or provincial), project proponents must undergo an approval process governed by the AUC for constructing and operating the SMR facility.[20] To obtain approval, the proponent must demonstrate that they had considered the project's impact on the environment, human health and safety and property value, among others, in addition to completing adequate consultations with interested parties, including Indigenous peoples (AUC n.d.).

2.3 AUC DECISIONS ON RETROFIT PROJECTS

As previously discussed, there is no provincial regulatory decision on a C2N transition project application. Some guidance, however, may be garnered from a small number of AUC decisions related to previous retrofit projects. Three cases are discussed here: *Genesee Generating Station Units 4 and 5, (Genesee), the coal-to-gas conversion of Sheerness Power Plant Units 1 and 2 (Sheerness Power) and the Deerfoot Solar project* (AUC 2014, 2019, 22b).

Genesee involved an application to construct and operate two natural gas-fired generation units on a brownfield site next to an existing CPP (AUC 2014, at para 1). Sheerness Power involved an application to convert two coal-fuelled power plant units into natural gas-fuelled units (AUC 2019, at para 1). Deerfoot Solar involved an application to construct and operate a solar power plant on

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15 Other relevant provincial authorities include the Alberta Energy Regulator, the Historical Resources Management Branch and the Alberta Electric System Operator. How the provincial regulatory scheme will respond to a C2N transition project is speculative, as Alberta has not yet seen a nuclear project.

16 *Environmental Protection and Enhancement Act*, RSA 2000, c E-12 [*EPEA*].

17 Ibid., s 40.

18 Ibid., s 64.

19 *EPEA*, s 47; *Environmental Assessment (Mandatory and Exempted Activities) Regulation,* Alta Reg 113/1993.

20 *Hydro and Electric Energy Act*, RSA 2000, c H-16, s 11 [*HEEA*].

a former tailings pond of a fertilizer plant (Gallant 2022; AUC 2022b, at para 1). The AUC has approved all three applications.

2.3.1 Public Interest Mandate

In determining whether construction and operation of a power plant should be approved, the overarching question is whether it is in the public interest (AUC 2014, at para 13). In answering this question, the AUC must take into account the power plant's social, economic and environmental effects[21] and the goal of developing an "efficient electric industry structure and the development of an electric generation sector guided by competitive market forces" (AUC 2014, at para 15).[22] The AUC applies the same interpretation of public interest in assessing retrofit and non-retrofit power plant (i.e., plants built on greenfield) applications. The project must be deemed to "be in compliance with existing provincial health, environmental, and other regulatory standards in addition to the public benefits outweighing negative impacts" (AUC 2014, at para 55).[23]

2.3.2 The Project's Environmental Impact

There are several advantages to repurpose projects with respect to their potential to make overall positive impacts on the environment by, for example, siting an SMR on a former CPP plant site. Energy conversion from coal to an alternative source of power has been found to reduce the adverse environmental impact caused by the plant's emissions. Further, locating a proposed plant near a brownfield site and reusing the pre-existing infrastructure was held to cause fewer adverse environmental effects compared to construction on a greenfield (AUC 2014, at paras 53 and 63). Still, a regulator tasked with assessing the overall environmental viability of retrofitting must consider related environmental impacts. For example, the selected energy pathway will be critical. Is coal being replaced with natural gas (without carbon capture) or with nuclear technologies? The question of nuclear waste management is a perpetual challenge, especially given that Canada's current nuclear waste management regime has been designed, first and foremost, with nuclear waste from large nuclear power plants in mind.[24] On the theme of technological progress, the AUC has previously recommended that applicants show "improvement in technology selection over [the technology] currently in use" (AUC 2014, at para 54). In Genesee, for example, the AUC favourably considered the applicant's proposal to "use natural gas combined-cycle technology, which … would generate power with greater efficiency and lower emissions, in comparison with the technology used in other carbon-based power plants currently operating in Alberta and Canada" (AUC 2014, at para 54).

Second, the AUC considers whether a proposed project complies with requirements administered by other regulatory agencies (AUC 2014, at para 54). In this respect, if the IAAC or AEPA determines that the project is approved by, or can bypass, the respective assessment, the AUC will likely interpret such result to be that "the potential environmental effects of the project are well understood and can be mitigated to an acceptable degree" (AUC 2014, at para 54.) This consideration, in turn, will contribute to the ultimate public-interest determination (AUC 2014, at para 54).

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21 *Alberta Utilities Commission Act*, SA 2007, c A-37.2, s 17 [*AUC Act*].
22 *HEEA,* ss 3, 5.
23 Citing Re *EPCOR Generation Inc. and EPCOR Power Development Corporation 490-MW Coal-Fired Power Plant* (2001), Energy and Utilities Board, 2001-111.
24 See generally, Nuclear Waste Management Organization, https://www.nwmo.ca/.

A unique challenge of repurposing a brownfield site is ensuring that the new project does not overburden the previously disturbed land. Depending on the brownfield's makeup, this may involve avoiding disturbing the land, routing the emission of waste products to avoid further degradation of the land, water or air and monitoring for the life of the project (AUC 2022b, at para 10). For instance, the proposed Deerfoot Solar plant was sited on top of phosphogypsum stacks and the proponent submitted that they would not disturb its integrity nor conduct excavation in the area (AUC 2022b, at para 10).

2.3.3 Participant Involvement Program

Proponents of C2N transition projects will be required to conduct a participant involvement program (PIP), which involves notifying individuals whom the project may affect and conducting personal consultations with them (AUC 2022a, 127–128).[25] Under this program, "occupants, residents, landowners, First Nation reserves, and Metis Settlements within 2,000 metres measured from the edge of the proposed power plant site boundary" must be personally notified, and those within 800 metres must be personally consulted (AUC 2022a, 127–128). The AUC applies the same PIP for a retrofit project as non-retrofit projects (AUC 2019, at para 22; AUC 2022b, at para 9). Furthermore, retrofit facilities within the footprint of the pre-existing power plant do not require additional Indigenous consultation (AUC 2019, at para 22).

3. REMAINING ISSUES IN THE REGULATORY FRAMEWORK

A patchwork of federal, provincial and local regulatory frameworks exists to ensure that energy projects are carried out in a way that is in the public interest. However, some parts of the regulatory framework may be uncertain or prone to challenges when dealing with a C2N transition project. This final section raises two questions to strengthen and bring clarity to the current regulatory framework.

3.1 DIVISION OF ROLES BETWEEN FEDERAL AND PROVINCIAL (ALBERTA) REGULATORS

Section 2 illustrates that a C2N transition project application will likely undergo a joint IA by the IAAC, CNSC and AEPA, followed by the CNSC's licensing assessments for nuclear licences and the AUC's for power plant construction and operation. The CNSC, IAAC, AEPA and AUC, among others not discussed here, all play an important role in conducting assessments required for a project to go ahead. Each regulatory body has its own scope of assessment, with decisions partially derived from answering whether the proposed project is in the public interest. Each regulatory body has adopted a distinct interpretation of when a project may be determined to be in the public interest. Furthermore, each of the applicable regulators (both federal and provincial) will possess their own subjective technical and regulatory expertise. For an overarching project such as a C2N repurposing project, the question arises as to available capacity and experience to navigate the potential complexities of introducing nuclear to a coal site. This is a critical factor to consider in any retrofitting discussion. Given this, if the IAA, AEPA or CNSC deemed a project to be in their definition of public interest and gave approval, does the AUC have a meaningful authority to dismiss the project under its definition of public interest?

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[25] This PIP applies to thermal, hydro or other power plants with a capacity of 10 MWe or greater in both urban and rural areas.

The CNSC's licensing assessments aim to prevent unreasonable risks to national security, the environment and human health and safety.[26] The IAAC considers a variety of factors to be under federal jurisdiction, including health, social and economic effects, contribution to sustainability, potential impact to any Indigenous group and their rights, and adverse effects.[27] The AEPA interprets public interest as, at minimum, generation of an economic benefit to the project proponent and the broader community while not creating serious harm to the community, environment or persons affected by the project (AEPA 2010, 9). Finally, the AUC considers the power plant's social, economic and environmental effects,[28] as well as the goal of developing an efficient electric generation and industry sector (AUC 2014, at para 15).[29] These goals are similar to the language used in the provincial EIA and largely encompass the elements for consideration in the federal IA. Furthermore, AUC's decisions demonstrate that it considers a project to be in the public interest if it complies with regulatory standards (AUC 2014, at para 50).

One may respond that the AUC may dismiss a project by invoking the consideration of efficient electric generation and industry, which is beyond the scope of the IA/EIA or the CNSC licences. In addition, a project's compliance with other regulatory standards is not a determining factor in the AUC's decision, as the AUC also weighs potential public benefits to negative impacts. Although this argument is theoretically true, it is nonetheless worth questioning how much other regulatory bodies' decisions will shape the AUC's internal cost-benefit analysis that leads to its final decision.

3.2 PIP UNDER THE AUC'S REGULATORY FRAMEWORK

Previous AUC decisions on retrofit projects indicate that the AUC applies the same standard of requirements for constructing retrofit projects to non-retrofit projects. In response, one may question whether the PIP is sufficiently comprehensive to address the unique issues posed by SMRs. The 2,000-metre notification and 800-metre consultation standard under PIP may be appropriate for power plants where affected areas upon an accident, such as leakage or breakdown, or routine waste emission from the power plant, are near the plant. However, as nuclear reactors, SMRs pose unique risks that may call for a higher standard.

3.2.1 Risk of Plant Meltdown

Nuclear power plants pose a risk of meltdown, which would create an extremely high impact on a significantly large area surrounding the plant (Natural Resources Defence Council 2022). The probability of a meltdown is extremely low, and SMRs are understood to be safer than conventional nuclear power plants due to their inherent safety features (International Atomic Energy Agency 2020). However, given the little-tested technology of SMRs and the non-zero risk of a high-impact meltdown, the current PIP may be insufficient to cover the area of impact and address the likely strong public concern.

3.2.2 Risk of Nuclear Waste Contamination

Generating nuclear energy produces high-level waste, which is thermally hot and highly radioactive (United States Nuclear Regulatory Commission 2019). Depending on its radioactive element, nuclear waste may remain radioactive for thousands of years (United States Nuclear Regulatory Commission 2019). This issue is compounded by the projection that the ratio of nuclear waste produced in relation to the amount of energy generated by SMRs may be two

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[26] *NSCA*, s 9.
[27] *IAA*, ss 22(1), 63.
[28] *AUC Act*, s 17.
[29] *HEEA*, ss 3, 5.

to 30 times more than conventional nuclear reactors (Krall, Macfarlane and Ewing 2022, 2111833119). In conventional nuclear plants, nuclear waste is stored at cooling pools in the reactor site for up to 10 years and then transferred to more permanent storage (CNSC 2017).

Given the high level of radioactivity and its effects on the environment and human health, any event that contaminates the surrounding areas may have far-reaching impacts geographically and in time. Such events may include leaks, releases, failures during the plant's operation, storage of waste and transportation to a more permanent storage facility. If nuclear waste is released into the environment, contamination of the soil, water, air, plants and wildlife will highly likely affect individuals living beyond the areas covered by the PIP (Kyne and Bolin 2016, 700). Furthermore, transportation of nuclear waste from the SMR site to more permanent storage may experience similar accidents causing contamination. This may also affect areas far beyond the boundary under the PIP.[30]

CONCLUSION

Although Alberta has not yet seen a C2N transition project, increased interest by governments and industries is driving the realization of such projects in the near future. If a C2N transition project is proposed in Alberta, its proponent will face a long and complex regulatory process. This paper has demonstrated that the CNSC, IAAC, AEPA and AUC all play an integral role in ensuring that all operations during the power plant's life cycle are carried out pursuant to the public interest, considering the project's social, environmental and economic impacts.

Project proponents will likely undergo an integrated IA by the IAAC, CNSC and AEPA, followed by applying for licences from the CNSC and AUC to construct and operate the SMRs. In the AUC approval process, proponents will likely be subject to the same regulatory standards as non-retrofit projects. Furthermore, by repurposing pre-existing infrastructure and deploying improved technology, proponents will have considerable advantages in obtaining AUC approval. This regulatory framework can be clarified by considering the impact of approvals given by the IAAC, CNSC or AEPA on the AUC's decision. Moreover, the AUC's licensing process, particularly the PIP, may be strengthened by considering the unique challenges SMRs pose, given the risk of a plant meltdown and nuclear waste contamination.

The foregoing analysis leaves us with questions that may further clarify and strengthen the regulatory framework. For instance, in devising strategies to streamline the regulatory process in Alberta, one may investigate how the regulatory bodies of Ontario and New Brunswick have collaborated with the CNSC (2023).[31] One may also turn to how the federal IA and provincial EIA regimes treat SMR projects. Currently, the IA is triggered when reactors have a combined thermal capacity of more than 200 MWth, and no nuclear project automatically triggers an EIA. These regimes leave room for project proponents to avoid assessments by project splitting or simply by virtue of involving nuclear energy. Considering the potential environmental and social impacts of nuclear projects, finding ways to adequately capture SMRs in IAs and EIAs will strengthen the regulatory framework.

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[30] One may respond that the current PIP is sufficient considering that ash produced by operating the CPP gives off up to 10 times the radiation emitted by a nuclear plant due to trace radioactive nucleotides in the coal being burnt. For more information, see: McBride, Moore, Witherspoon and Blankco (1978) and Papastefanou (2010).

[31] The CNSC has MOUs with the Ontario Fire Marshal and Emergency Management (2015), Ontario Ministry of Labour (2017) and New Brunswick Emergency Measures Organization (2012).

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