

Country-Specific Safety Culture Forum Canada



Country-Specific Safety Culture Forum: Canada

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Forewords



William D. Magwood, IV
Director-General, NEA

As global interest in nuclear technology grows, the OECD Nuclear Energy Agency (NEA) finds itself strategically situated to work with its member countries to ensure the safety of nuclear energy programmes and facilities.

Over the years, improvements to the safety of nuclear power plants have been a focus of regulators and industry members alike. During the COVID-19 pandemic, the nuclear sector endured with resilience and adaptability, once more underpinning the importance of human factors in nuclear safety as staff at nuclear organisations and facilities managed their responsibilities while navigating mandated lockdown measures.

It is evident that despite the deeply technical nature of the nuclear sector, experts have come a long way over the past decades in recognising the critical importance of the non-technical aspects of nuclear safety and the role they play in ensuring the optimal functionality and performance of nuclear facilities.

In this context, the NEA has made the human aspects of nuclear safety a point of focus in its work. Under the purview of its Division of Radiological Protection and Human Aspects of Nuclear Safety (RP-HANS), the Working Group on Leadership and Safety Culture supports the exchange of best practices and challenges between experts and senior managers across its member countries. The work of the NEA, along with that of partner international organisations such as the World Association of Nuclear Operators (WANO), has supported a deeper and more comprehensive understanding of nuclear safety culture around the world.

The present report, *Country-Specific Safety Culture Forum: Canada*, looks at how the national context can influence nuclear safety culture and day-to-day operations across the nuclear community. The manifestation of cultural aspects, such as communication and decision-making styles, into organisational behaviours varies between countries. It is therefore imperative to reflect on country-specific characteristics, and their nuanced impacts on nuclear organisations, in order to develop a healthy safety culture. With this in mind, the NEA is pleased to provide a framework for advancing dialogue and for offering an in-depth analysis on such issues. I hope that the outcomes of the Country-Specific Safety Culture Forum (CSSCF) in Canada will encourage regulators and operators to explore their national contexts so as to evoke and strengthen activities that lead to substantive

enhancements in safety culture. As this activity is a joint endeavour, a number of dedicated individuals contributed to making the forum a success. This achievement was only possible through the excellent contributions of our partners at WANO and the exceptional support of the host organisation, the Canadian Nuclear Safety Commission (CNSC). The various members of the Canadian nuclear community were also instrumental in enabling the success of this project; without their participation, it would not have been possible to gather so much information and cover such a range of perspectives. The overarching commitment of all actors to nuclear safety through the delivery of the CSSCF Canada is undeniable and they should be proud of this accomplishment.



Ingemar Engkvist
Chief Executive Officer, WANO

Nuclear safety culture is one of the pillars of the safe operation of nuclear technology. The safe design of a nuclear unit is essential but even with the highly automated systems in new units, there is always a human factor. This must never be ignored, and the importance of human factors is becoming even greater as new units are operated with younger crews who have perhaps not learnt the painful lessons the pioneers did.

This third successful CSSCF in which WANO participated displayed how national culture influences nuclear safety culture. It becomes clear that although WANO has published a document, “Traits of a Healthy Nuclear Safety Culture”, which is applicable to all cultures, the attributes are displayed in different ways depending on national culture. We must recognise that “different is not wrong” as long as the fundamentals are maintained.

For me, being a Swede, it became clear how closely the Canadian and Swedish cultures are related. The situations played out at the workshop are representative of similar situations in Sweden. This supports the fact that similarities in culture are more frequent than differences and supports the ongoing work with human factors and nuclear safety culture. All nuclear countries around the globe will benefit from it.

After being involved in the operation of nuclear power plants for almost 30 years it remains evident that there is so much more to learn. It was an honour to be invited to this successful workshop where everything so well organised. Great thanks to all!



Rumina Velshi

President and Chief Executive Officer, CNSC

With more than 75 years of experience overseeing nuclear safety and security in Canada, the Canadian Nuclear Safety Commission (CNSC) is one of the most mature nuclear regulators in the world. Over the past several decades, the nuclear community has collectively learnt many important lessons about nuclear safety and, more specifically, that human aspects – behaviours, attitudes and values – are as important to safety and security as any technical issues. These lessons have also taught us the importance of self-reflection and the need for continuous improvement to ensure our readiness for whatever may come. That is why the CNSC was pleased to host Canada’s first Country-Specific Safety Culture Forum (CSSCF), which provided an opportunity for self-reflection on how our country’s culture and behaviours can influence safety across the nuclear sector. Focused discussions on national traits enabled open and honest discussions between the regulator and the licensees, outside of the traditional regulator-regulated setting.

What does it mean to be Canadian? We are polite, often apologetic, and modest. We care about our neighbours, value one another and stand up for equality. We ensure that the many diverse voices in our country have an opportunity to not just sit at the table, but also to be heard. We respect the natural environment and, just as the seasons change, we adapt quickly. We are a diverse nation – and our nuclear sector is also diverse. The Canadian nuclear sector is comprised of a range of industries, technologies and participants: from uranium mining and mills and nuclear power generation to medical isotope production and research reactors. The CSSCF enabled us to gather representatives from across the nuclear sector to better understand both how safety culture is a part of our collective work and how national characteristics play a role in influencing our shared culture for safety.

Canada’s sector-wide CSSCF brought greater awareness of our distinct national characteristics and their potential influence on our nuclear safety culture. Defining and understanding these traits helped everyone in attendance to better understand how they can potentially impact actions and decisions. The Forum resulted in many useful findings, outlined in this report. One observation was that cultural strengths also have the potential to be a weak point. For example, the politeness that Canadians are known for is something we must be mindful of in our work. Such characteristics have the potential to lead to a tendency to avoid conflict or difficult conversations. We must empower employees at all levels and in all sectors to speak up regardless of their position. While a positive attribute, when it comes to nuclear safety and security, politeness is a potential shortcoming.

While the forum has identified new opportunities for our organisation, it has also confirmed that many of our ongoing efforts are taking us in the right direction. We will continue to focus efforts on increasing staff access to management to enable them to provide feedback and address concerns. We will also continue to leverage opportunities such as the CSSCF, and look at ongoing assessments available to the CNSC to identify areas for growth. Our Culture for Safety Working

Group continues to support the organisation with its work, and our Regulatory Safety Culture Policy provides a framework and guidepost for future actions.

I would like to thank the Nuclear Energy Agency (NEA) and World Association of Nuclear Operators (WANO) for developing the CSSCF and for all the support we have had in conducting the forum. I cannot overstate how valuable this forum was, and I encourage all nuclear countries, regardless of their maturity, to take advantage of this important programme. I would also like to thank CNSC staff for their hard work in making the forum happen in collaboration with the NEA and WANO, who were vital to its success. Finally, I want to thank Canadian and international attendees for their honest, open and active participation. We look forward to continuing our safety culture journey together.

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List of abbreviations and acronyms

AECB	Atomic Energy Control Board (Canada)
AECL	Atomic Energy of Canada Limited
CAD	Canadian dollars
CANDU	Canada Deuterium Uranium
CNL	Canadian Nuclear Laboratories
CNSC	Canadian Nuclear Safety Commission
CO₂	Carbon dioxide
CSSCF	Country-Specific Safety Culture Forum
DGR	Deep geological repository
GDP	Gross domestic product
ZED-2	Zero Energy Deuterium
IAEA	International Atomic Energy Agency
INPO	Institute of Nuclear Power Operations (United States)
NEA	Nuclear Energy Agency
NRX	National Research Experimental
NWMO	Nuclear Waste Management Organization (Canada)
OECD	Organisation for Economic Co-operation and Development
OPG	Ontario Power Generation
RP-HANS	Division of Radiological Protection and Human Aspects of Nuclear Safety (NEA)
SLOWPOKE-2	Safe LOW-POwer Kritical Experiment
SMR	Small modular reactor (nuclear)
USD	US dollars
WANO	World Association of Nuclear Operators

Units of measure

GWe	Gigawatts of electricity
MWe	Megawatts of electricity

Executive summary

Background

Throughout the history of civilian nuclear technology, one common goal of the global nuclear community has been to ensure a robust and sustainable approach to safety within the nuclear organisations using the technology and those who regulate it. Although the goals towards achieving safety in countries with nuclear power programmes are similar, the operational realities vary, depending, among other factors, on the different cultural frameworks. The national context in which each nuclear organisation operates can influence the nuclear safety culture of a given country. For this reason, it is essential for the nuclear community to identify what influences are present within their individual cultural contexts and reflect on how these influences may have an impact on their overall nuclear safety culture.

The Country-Specific Safety Culture Forum (CSSCF) is an interactive process established by the OECD Nuclear Energy Agency (NEA) and the World Association of Nuclear Operators (WANO) to provide individuals working in a country's nuclear sector an opportunity to reflect on national characteristics and engage in exercises to assess the influence those characteristics could have on the overarching nuclear safety culture.

A healthy safety culture is essential to the overall safety performance of any organisation. Also, it is important to recognise that safety culture is influenced by many factors. Among these factors are the elements of the national characteristics and their context. Those national cultural characteristics can have either a negative or a positive impact on a healthy safety culture within nuclear organisations. Further, a clear understanding of these impacts can lead to the strengthening of safety culture fundamentals, such as ensuring that safety is a precisely recognised value, having explicit accountability for safety, or ensuring safety is integrated into all activities in the organisation (CNSC, 2018). For this reason, the CSSCF has proven to be an instrumental tool and approach in raising the awareness among a national nuclear community to the attributes that can influence their organisations, particularly through the behaviour of individuals at all levels of these organisations.

The CSSCF does not strive to make a comparative analysis of national contexts. Instead, it offers an opportunity for a given country to reflect and assess the influence of its national culture on the nuclear safety culture and consider, within the national context, methods (where applicable) for sustainable improvements to its safety culture. In this regard, across a range of nuclear activities in a given country, the CSSCF analyses the cultural traits of a country's nuclear sector and

identifies how they might influence assumptions, values, beliefs and behaviours within nuclear organisations. To achieve this, the CSSCF comprises a series of steps: data gathering and analysis, development of a scenario script, the conduct of a multi-day Forum, detailed analysis, and development of the final report.

The NEA and WANO implemented CSSCF Canada in close collaboration with the Canadian Nuclear Safety Commission (CNSC), which hosted the event and provided invaluable support at every step of the process. With the conclusion of the CSSCF Canada, it is the responsibility of each host organisation and participant organisations to determine its next steps upon reflection of the NEA CSSCF Canada Report. Without prescribing specific follow-up activities, the NEA can play a role in post-Forum support as needed or requested by host country organisations.

CSSCF Canada

The CSSCF Canada was initially launched at the start of 2020, with the NEA, WANO and CNSC establishing a core project team and planning the initial step of the data-gathering exercise. As per previous forums, the intent was to carry out the data collection in person. However, beginning in March 2020, health and travel restrictions arising from the COVID-19 pandemic forced a delay in the planned data collection mission. It was then determined that a shift to video-conferencing data collection over a longer period of time would be used. In the summer of 2020 (over a period of eight weeks), the NEA proceeded to conduct virtual interviews and convene virtual focus groups among the various organisations within the Canadian nuclear community. In total, the first data collection team conducted 18 interviews and convened 11 focus groups across 14 organisations, gathering perspectives and information from 57 participants. The organisations included nuclear power plant operators, uranium mining companies, fuel processing companies, science and technology/technical support organisations, research reactors, academic institutions, medical facilities, waste management organisations, and the Canadian nuclear regulator.

Delays due to COVID-19 resulted in the need to reschedule the Forum on multiple occasions. Ultimately, recognising the importance of in-person research to secure comprehensive and robust data, in June 2022 (when travel restrictions had been lifted) NEA staff travelled to Canada to carry out a complementary data collection mission. With the objective of validating and expanding upon the previous data-capturing exercise and ensuring that final results included the observations from in-person dialogues and other non-verbal indicators, the NEA team visited four of the principal nuclear licence holders in Canada for interviews and focus group discussions. The participants interviewed represented various levels within the organisations, including middle management and operational staff. A total of 9 focus groups were convened, with 60 participants offering their perspectives during the second data collection exercise. Due to time constraints, an additional focus group and two interviews were conducted in a virtual format with another licensee and CNSC staff, allowing the NEA to hear from 11 additional interviewees. In the end, the combination of in-person and virtual data gathering initiatives was deemed an overall comprehensive and robust exercise and allowed NEA staff to carry out a fulsome analysis of all data received.

The data collected across all activities resulted in an overview of specific national characteristics, themes and relevant concepts in safety culture reflective of the Canadian nuclear context. These findings supported the development of a scenario script that was used as a basis for discussion at a two-day forum held on 7-8 September 2022 in Ottawa, Canada. The Forum was attended by a large and diverse group of representatives (around 80 persons) representing senior to more junior levels of the national nuclear organisation that took part in the data collections exercise, including a number of international guests. The Forum allowed for an in-depth exploration of the Canadian national characteristics and themes and their potential impacts on nuclear safety culture.

Overview of outcomes

After two highly successful CSSCFs, in Sweden in 2018 and in Finland in 2019, CSSCF Canada was the first Forum conducted in North America. This report documents the process, outcomes, observations and self-reflections collated throughout the process, including the conclusions of the two-day Forum.

CSSCF Canada outlined several noteworthy national characteristics that are reflected in the Canadian nuclear sector. The following traits were considered to be the most significant, based on the discussions and resulting analysis:

- strong commitment to social contract – creates an environment marked by collaboration and consideration albeit it could lead to individuals assuming that all co-workers are performing to the highest standards, which may not always be the case;
- inclusivity and having a collective approach – allows for all voices to be heard although the need to reach consensus may make it difficult for colleagues to go against the overarching opinion of the group;
- being achievement-oriented – creates a positive sense of striving for excellence within the organisational culture while the goal of continuous improvement could lead to a tendency to produce an excessive number of procedures and processes, which could hinder addressing urgent and important matters in an efficient manner;
- collective pride and personal humility – allows for acceptance of constructive criticism and openness to continuous improvement but at the same time the absence of a directive attitude can allow outside influences to impact the Canadian work method in a way atypical to the Canadian approach;
- trust and respect for personal boundaries – allows workers to have a healthy level of autonomy and responsibilities while this carries the risk of implying that co-workers are not cognisant of each other's work or performance, so cross-checking may not necessarily take place without explicit peer-to-peer validation or verification instituted;
- conflict avoidance – prompts co-workers to seek a middle ground and avoid provocation and arguments while at the same time could undermine a questioning attitude among peers as staff avoid potential conflict.

The national characteristics outlined play out in a variety of organisational behaviours associated with a healthy safety culture. The discussions held during CSSCF Canada identified the following relevant areas:

- inclusive and facilitative leadership and management;
- adherence to processes and planning;
- collaborative decision making;
- strong sense of responsibility and accountability.

The observations outlined in this report highlight Canadian cultural attributes that the participants recognised could influence assumptions, values and organisational structure and processes, and consequently impact nuclear safety culture. The objective of CSSCF Canada and this report is to offer the Canadian nuclear community tools which they may use in order to continue to strengthen safety culture within their nuclear organisations and collectively. This report can be used by the hosting country to reflect on national attributes and to consider any potential “blind spots” in their safety culture and address these through further dialogue and training, when appropriate.

Findings from CSSCF Canada demonstrate the strong emphasis that the Canadian nuclear community places on safety. The data identify national characteristics of Canadian culture that contribute positively to operational safety and promote a strong nuclear safety culture, but also reveal areas in which the national safety culture can be further strengthened.

The discourse and reflections from the snapshot study (the findings from the interviews and focus groups identifying national characteristics), and the two-day Forum resulted in the NEA team collecting and analysing a substantial amount of data. The qualitative and thematic analysis of this data encompasses the core of this report. The wide representation of the Canadian nuclear sector in this process highlights the commitment of the country to the improvement of nuclear safety culture.

Direct feedback from CSSCF Canada participants highlighted the positive impact of the exercise in encouraging open and constructive dialogue, particularly across divisions and organisations. The Forum enabled profound exchanges among regulatory officials and industry representatives and stimulated insightful reflections from all parties. Within the individual Canadian nuclear organisations, these discussions raised new perspectives and prompted actors to consider advancing the conversation on how national attributes influence nuclear safety culture.

The report authors invite the Canadian nuclear community to contemplate the CSSCF Canada findings and determine the most effective way to apply them to further enrich their national nuclear safety culture. In light of this, the report offers a matrix with exploratory questions to prompt dialogue and to support measures that might lead to improvements.

Safety culture in a national context

Background on nuclear safety culture

Safety culture is understood broadly as the set of beliefs, perceptions and values that employees share with regards to risks within an organisation, such as a workplace or a community (NEA, 2016; 2018; 2019; 2020). The Canadian Nuclear Safety Commission (CNSC, 2018) defines safety culture as the characteristics of a work environment, such as values, rules and common understandings, that influence worker perceptions and attitudes about the importance that the organisation places on safety. The nuclear community recognises that a healthy safety culture across the full range of nuclear actors in a given country is necessary to support the safe operations of nuclear facilities. It also helps maintain collaborative relationships among the nuclear stakeholders in support of such operations.

To this end, many organisations have developed reports and guidance to identify best approaches for achieving the highest standards of nuclear safety, highlighting the relevance of safety culture. While it is understood that a safety culture is a prerequisite for an effective interplay between human, technical and organisational factors (NEA, 2022), NEA work has also highlighted that the national context in which nuclear operations are carried out adds a layer of complexity (NEA, 2018).

The general concept of “nuclear safety culture” originated from international reviews and analysis following the Chernobyl nuclear accident in 1986. The International Nuclear Safety Advisory Group (INSAG) of the International Atomic Energy Agency (IAEA) concluded that the accident was not attributed mainly to technical aspects alone, but instead pointed in large part to the behaviour of operations staff who failed to prioritise safety. The term “safety culture” thus came to prominence within the global nuclear environment as a result of the publishing of the 1991 report “Safety Culture” (IAEA, 1991).

Since then, a number of organisations, including the World Association of Nuclear Operators (WANO), have developed written frameworks that describe the kinds of behaviours, attitudes and principles necessary for the safe operation of nuclear facilities (WANO, 2013). In an effort to support organisations seeking to sustain high levels of safety and continuously improve their safety culture, the nuclear industry has invested substantial time and resources in considering optimal frameworks for defining safety culture. The Institute of Nuclear Power Operations (INPO) released in 2012 *Traits of a Healthy Nuclear Safety Culture*, which sets out a framework for open discussion and enhancement of safety culture within the industry (INPO, 2012).

In a world seeking to reduce carbon emissions to address climate change, global interest in nuclear energy as a reliable source of clean baseload energy is on the rise. Policymakers are looking for ways to diversify and decarbonise their country's energy portfolios and boost energy security and many view nuclear energy as a key component of their future plans. In this context, societal expectations have increased for assurances from the nuclear community of the highest levels of nuclear safety. Within the nuclear sector, successful efforts (made over many years) to improve nuclear safety have prompted a deep focus on the human and organisational aspects of safety – particularly on nuclear safety culture. Analyses of the nuclear accidents at Three Mile Island, Chernobyl and Fukushima Daiichi stress the importance of human and organisational factors, each of which provided important lessons on nuclear safety culture. A common theme across these events was that the culture of operators and regulators – which comprises shared assumptions, values and beliefs within an organisation or across an industry – was a main contributor to the issues leading to each accident.

Before the 2011 Fukushima Daiichi Nuclear Power Plant accident, safety culture focused almost entirely on nuclear operators. Investigation of the accident in Japan highlighted the importance also of a healthy safety culture within the nuclear safety regulator. This finding revealed the need to better understand the regulator's role in safety culture, acknowledging that it includes both the interactions between the regulating body and licence holders as well as the safety culture within an effective regulating body (see also NEA, 2016b).

In response to this increased focus on safety culture, the NEA developed and published several reports (or “green booklets”) within its series of regulatory guidance documents. Included among these green booklets are:

- *The Characteristics of an Effective Nuclear Regulator* (NEA, 2014): describes the characteristics in terms of roles and responsibilities, principles and attributes that lead to an effective nuclear safety regulator, which can be applied to both mature regulators as well as those of newer, embarking countries.
- *Implementation of Defence in Depth at Nuclear Power Plants* (NEA, 2016a): provides insights into the implementation of Defence in Depth (DiD) by regulators and emergency management authorities after the Fukushima Daiichi accident, with the objective of enhancing safety through global harmonisation. The report also identifies areas relating to DiD where further work may be beneficial.
- *The Safety Culture of an Effective Nuclear Regulatory Body* (NEA, 2016b): outlines five principles and their associated attributes that underpin and support the safety culture of an effective nuclear regulatory body. This report highlights the importance of the national context – including a country's cultural attributes – and how it can frame, support and influence an organisation's safety culture.
- *Methods for Assessing and Strengthening the Safety Culture of the Regulatory Body* (NEA, 2021a): provides both an overview and practical information on the methods and tools used by regulatory bodies to assess their own safety culture and to build safety culture competence and awareness.

Deeper understanding of the multi-layered facets of safety culture – such as the nuanced and pronounced ways that values and assumptions influence individual and organisational behaviours – has substantially evolved since the Fukushima Daiichi Nuclear Power Plant accident. To encourage regulatory bodies to assess and enhance their own safety culture, *Methods for Assessing and Strengthening the Safety Culture of the Regulatory Body* (NEA, 2021a) includes a section on effective methods and tools, specifically proposing ten considerations for managers to develop and sustain such efforts.

General considerations related to culture in a national context

When exploring behaviours and how they relate to national culture, determining which behaviours are typical across a country is challenging. Behaviours may differ between geographical regions within a country, as well as between rural and urban environments, for example. Cultural differences may also emerge between various sub-groups in society linked, for example, to social class, economic income, ethnicity, political preference or profession. In this context, the Canadian nuclear culture can have differing characteristics than the broader Canadian culture. Also, when considering cultural aspects on national (macro), organisational (meso) or group (micro) levels, imperceptible boundaries may exist even within the culture of a specific industry.

Another consideration is that culture is often situational and individuals behaving one way in a given circumstance and environment may behave differently when that situation changes. An individual may, for example, address or manage risk differently in personal versus professional settings; he or she may be carefree and daring in non-professional contexts while being extremely conservative and even risk-averse in a formal capacity, such as at a nuclear reactor site. In most cases, people are generally not aware of the cultural context in which they operate.

Referring specifically to culture, analysis (Schwartz, 2004) shows that values and norms differ significantly across regions within specific nations. In turn, this changes how people communicate, interact with one another, make decisions, and much more. For this reason, it is important to probe how the national context influences the nuclear safety culture across the regions of a given country for the nuclear organisations in question.

With that in mind, it should be noted that this study and the findings highlighted in this report are not representative of the broader Canadian culture. The snapshot study and observations derived from the two-day forum depict a set of significant cultural traits and behaviours that informed and supported the exercise. These common cultural elements were recognised by the Canadian participants of the forum and are henceforth referred to as national characteristics. Eliciting these characteristics enabled deep and detailed discussions and reflections to drive the CSSCF process.

International normative frameworks

Multiple normative frameworks have been the basis for the international nuclear sector's definition of a healthy safety culture, with the NEA, WANO and IAEA each having contributed to the global understanding of what is fundamental in sustaining a healthy safety culture. Countries can use these international normative frameworks to build the foundation of a healthy and effective safety culture.

Organisation	Representative publications and framework features
NEA	<i>The Safety Culture of an Effective Nuclear Regulatory Body</i> (NEA, 2016b), organised into 5 principles and 21 attributes for regulatory bodies
WANO	<i>Traits of a Healthy Nuclear Safety Culture</i> (WANO, 2013), comprising 10 traits along with examples of corresponding attributes and behaviours.
IAEA	<i>IAEA Safety Standards for Protecting People and the Environment</i> (IAEA, 2006), similar standards arranged in a framework of 5 characteristics with 37 underlying attributes

NEA work, in particular, has highlighted the importance of the national context when considering the foundation for an effective safety culture. As highlighted in the NEA report *The Safety Culture of an Effective Nuclear Regulatory Body* (2016b), distinct national characteristics can serve as strengths to be leveraged and further developed and should not be considered a barrier to safety culture. It is in this spirit that the NEA and WANO developed (in 2017) the CSSCF process, aiming for it to be carried out in countries around the world. At that time, the NEA and WANO agreed on the need to address the sensitive and important issue of national context. They made the decision to create the CSSCF to support member countries in analysing their own local cultures and national contexts in relation to a nuclear safety culture. The NEA Division of Radiological Protection and Human Aspects of Nuclear Safety (RP-HANS) leads in this effort.

Evolution of safety culture in the Canadian context

With the emergence of the concept of safety culture in the late 1980s and into the early 1990s following the Chernobyl accident, the Canadian nuclear industry established a set of safety culture principles which stressed the importance of open communication, continuous learning, and a robust safety culture in support of safe and reliable operations of nuclear facilities.

Leading into the 2000s, the idea of safety culture started to be explored and applied in other sectors in Canada, such as the oil and gas, transportation and healthcare industries. With initiatives from national authorities like the Transportation Safety Board of Canada in releasing reports on the importance of safety culture in aviation and maritime industries, awareness of the concept of safety culture was enforced across sectors (Transport Canada, 2021).

Following the Fukushima Daiichi Nuclear Power Plant accident in March 2011, CNSC, Canada’s nuclear regulatory authority, began a process of formalising its regulatory approach. It set forth a review of all major nuclear facilities in Canada and developed a four-year Action Plan to apply key lessons learnt from the accident to Canadian nuclear facilities. Within this process, new safety regulations and standards were developed and there was an increased investment in safety training and associated programmes. The development of REGDOC-2.1.2 (Regulatory Document) on Safety Culture made the CNSC one of the first nuclear regulators to publish and begin the implementation of enforceable measures related to safety culture for the nuclear sector. Requirement 1 of REGDOC-2.1.2 requires licensees to reflect their commitment to fostering safety culture in their governing documentation, and to ensure ongoing monitoring of their safety culture (CNSC, 2018). The CNSC collects data which gives an overview of how a particular licensee fosters a healthy safety culture. It also assesses the methodologies used by licensees (including all nuclear power plants) to ensure that “comprehensive, systematic, and rigorous safety culture assessments are conducted by the licensee at least every five years” (Requirement 2 on Safety Culture Assessments).

Today, the Canadian nuclear community has adopted a deep understanding of safety culture and the concept is strongly considered and applied throughout the country’s nuclear institutions.

The Canadian cultural context

It is evident that nuclear facilities operate within a national cultural context. The societal context and the history of nuclear development in a country impact nuclear operations in a deep and pervasive fashion. These aspects have some commonalities from country to country, but are, in sum, entirely unique. Thus, when considering the cultural context in which nuclear activities are conducted, an understanding of this background is essential to analysts. This section provides a broad overview of this societal and historical backdrop in the case of Canada and its nuclear sector.

As of 2022, Canada had a population of 38 929 902, with 1.8% population growth per year (World Bank, 2022). In 2022, life expectancy was 82.96 years (Macrotrends, 2023). With a total surface area of approximately 9.9 million square kilometres (km²), Canada is the world's second-largest country by area (Trading Economics, 2023). Canada has the world's longest coastline, vast maritime terrains and thousands of islands. Inland, it comprises a wide variety of land regions, lakes and inland waters (more than any other country in the world) (World Atlas, 2023).

Several factors have helped shape the Canadian culture as it is today. With the exploration and permanent settlement of Europeans in Canada beginning in the 16th century, the influence from French and British powers, as they battled over control of Canadian territory, had an impact on native English and native French speakers' interactions. It also, to a different scale, had a significant impact on the Indigenous peoples that had inhabited the land prior to their arrival. The culture and traditions of Canada's Indigenous peoples, including First Nations, Inuit, and Métis, have likewise moulded the Canadian culture, particularly influencing the country's art, music, food and spiritual practices.

Bilingualism (English and French) plays a large role in the Canadian identity, originating from the influx of European settlers in the 1500s, and instilling in the country a bilingual language policy that is administered both at the federal and in some cases provincial levels. The Northwest Territories' unique Official Languages Act recognises six Aboriginal languages along with English and French (Kymlicka, Norman, 2000). The duality of identity was also evident in the political framework of Canada, with the Constitution Act of 1867 uniting the provinces of Canada (previously Upper and Lower Canada) with the colonies of Nova Scotia and New Brunswick into the new Dominion of Canada, and then further dividing the province of Canada into Quebec and Ontario. On 11 December 1931, the Statute of Westminster was passed, which established Canada's state of independence from the British Commonwealth and granted it full legal autonomy (Canada's History, 2011).

It is important to note the effect that colonisation and the implementation of the residential school system had on the Indigenous peoples in Canada, and the imprint it has left on Canadian society as a whole. The hardships endured by the Indigenous populations are now being addressed through national and regional reconciliation efforts. Reconciliation refers to the repairing of the relationship between Indigenous people and non-Indigenous Canadians, and is founded upon the objective of building a new relationship based on mutual respect, understanding and camaraderie. The Indigenous and treaty rights of First Nations, Inuit and Métis peoples are officially recognised and protected in Canada's Constitution Act of 1982 (Justice Laws Website, n.d). As a result, the government, when making decisions, has the responsibility of consulting potentially affected Indigenous peoples before moving forward with any actions or decisions that could impact their rights and interests.

Democratic values broadly define Canadians. The Constitution of Canada reaffirms Canada's dual (common and civil law) legal system and includes Aboriginal rights and treaty rights. It further states the basic principles of democracy in Canada based on their executive, legislative and judiciary branches of government (Government of Canada, 2021). Interestingly, law-making powers are assumed by both the Parliament of Canada and the provincial and territorial legislatures, giving clearly defined governance to the different layers of authority, and showcasing the high level of autonomy also granted to local and municipal governments.

The Canadian federal government has pledged its commitment to the concept of multiculturalism within the bilingual framework of the country (Fleras, 2021). The formalisation of multiculturalism in Canada signifies that it is one of the few countries in the world with multicultural jurisdiction at policy, constitutional and statutory levels.

Canada's economy is one of the most prosperous in the world. The country is a member of the Organisation for Economic Co-operation and Development (OECD) and the Group of 7, an organisation of leaders from the world's largest economies. Nationally, Canada has a gross domestic product (GDP) of CAD 1.99 trillion, according to latest data from the World Bank, with per-capita GDP at CAD 52 051.40 (World Bank, 2022). In recent years, it has enjoyed an average annual growth rate (AAGR) in GDP of 4.6%. Recovery from the COVID-19 pandemic was notable alongside nearly record low unemployment rates in Canada (OECD, 2023).

In Canada, education is highly valued. Ninety-two percent of adults aged 25 to 64 have completed secondary school, higher than the OECD average of 79%. The quality of the education system is high, as reflected in an average score of 517 in reading literacy, mathematics and science in the OECD Programme for International Student Assessment (PISA), notably higher than the OECD average of 488. In 2018, expenditure in Canada per student at primary, secondary and post-secondary non-tertiary level amounted to USD 11 854, which was USD 1 400 higher than the OECD average. Among OECD countries, Canada ranked eighth in terms of its GDP expenditure on primary to tertiary educational institutions (OECD, 2019).

A notable gender difference exists in the distribution of tertiary entrants to specific fields of study. For example, although females represent 78% of new entrants to the field of education, they constitute only 26% of new entrants in the fields of science, technology, engineering and mathematics (STEM) and 20% in information and communication technologies (ICT), as reported in 2017 (OECD, 2021). The current Canadian administration has placed gender and diversity and inclusion as high priorities on its political policy platform (Government of Canada, 2020).

Regarding quality of life as measured by the OECD Better Life Index (OECD, 2020), Canada performs well in many dimensions of well-being relative to other countries. Specifically, Canada outperforms the OECD averages in income, jobs, education, health, environmental quality, social connections and life satisfaction. On average per capita, the household net-adjusted disposable income in Canada in 2020 was USD 34 421 annually, more than the OECD average of USD 30 490. In terms of employment, about 70% of people aged 15 to 64 in Canada have a paid job, above the OECD employment average of 66%. Regarding health, life expectancy at birth in Canada (82.81 years) is one year higher than the OECD average. Concerning the public sphere, Canada is noted for a strong sense of community and moderate levels of civic participation: 93% of people believe that they know someone they could rely on in time of need (more than the OECD average of 91%). When asked to rate their general satisfaction with life on a scale from 0 to 10, Canadians gave a 7 grade on average, higher than the OECD average of 6.7.

History of the Canadian nuclear industry

Nuclear research in Canada commenced in the 1940s with the formation of the National Research Council of Canada's Atomic Energy Project. When the ZEEP (zero energy experimental pile) reactor went critical (achieved self-sustaining nuclear fission) in September 1945 in Chalk River Ontario, Canada became the second country in the world after the United States to achieve this feat. One of the early initiatives of the federal nuclear energy programme was the construction of the National Research Experimental (NRX) reactor at the Chalk River Nuclear Laboratories in Ontario. The NRX reactor went critical in July 1947, and it quickly became the centrepiece of Canada's nuclear research programme (CNS, 1989). A decade after NRX, the National Research Universal (NRU) reactor went critical and ensured ongoing research and development as well as medical radioisotope production until it was finally shut down in 2018.

In the years that followed, Canada continued to develop its nuclear capabilities, with a focus on developing peaceful applications of nuclear energy. Alvin Weinberg, a nuclear physicist who had worked on the Manhattan Project in the United States, was recruited to Canada in the early 1950s, and he played a major role in the design of the CANDU (Canada Deuterium Uranium) reactor, which was first demonstrated when NPD (Nuclear Power Demonstration Reactor) went critical in Rolphton Ontario in 1962 (NAE, 2008).

In line with these efforts, the Canadian government established Atomic Energy of Canada Limited (AECL) to launch the development of a peaceful nuclear energy programme. In co-operation with Canadian industry, AECL began constructing the first CANDU reactor, with its first commercial reactor commencing operation in Pickering (Ontario) in 1971 (World Nuclear Association, 2023). The CANDU design and technology has been exported to other countries including Argentina, China, India, Korea, Pakistan and Romania. The design and technology of CANDU reactors has evolved over the past decades with the Enhanced CANDU 6 (EC6) as one of its newest models.

The CANDU reactor was a significant achievement for Canada, as it was the first nuclear reactor to use heavy water as a moderator, rather than the more commonly used graphite. Because the CANDU reactors can use natural uranium as fuel, rather than the enriched uranium required by other reactors, it has become an attractive option for countries without access to, or interest in, enrichment technology.

In addition to the CANDU reactor, Canada has made other significant contributions to the field of nuclear science and technology. Specifically, Canadian scientists played a leading role in the development of medical isotopes, which are used in the diagnosis and treatment of cancer (Noakes, 2020).

A range of operating research reactors that exist in Canada today include:

- two SLOWPOKE-2 (Safe LOW-POwer Kritical Experiment, Canadian AECL design) reactors at the Royal Military College of Canada, and École Polytechnique Montreal;
- a pool reactor located at McMaster Nuclear Research Reactor; and
- a ZED-2 reactor located at Chalk River Laboratories (World Nuclear Association, 2023).

Regarding regulatory development, the Atomic Energy Control Act in Canada was enacted in 1946, under which the Government of Canada established the Atomic Energy Control Board (AECB) as the regulatory body to control the development, application and use of atomic energy in the country. On 31 May 2000, the Nuclear Safety and Control Act replaced the AECB and established the Canadian Nuclear Safety Commission (CNSC), which was given a more robust mandate and legislative basis to carry out its work and uphold its responsibilities. Among the responsibilities and powers provided to the CNSC under the new Act was the authority to control and regulate the development, production and use of nuclear energy, which included all facets of the nuclear fuel cycle, security, safeguards and non-proliferation obligations.

Presently, Canada has 19 reactors in operation, 18 of which are situated in Ontario and one (Point Lepreau) in New Brunswick. The 18 units in Ontario include Bruce Units 1-8, Darlington Units 1-4, Pickering Units 1, 4, 5, 6, 7 and 8. These units combined supply the electricity grid with 13.6 GWe of power, constituting approximately 15% of Canada's electricity production. The Canadian nuclear fleet also includes six nuclear reactors in permanent shutdown and/or decommissioning and dismantlement, which previously supplied a total of 2 143 MWe.

A new climate plan is in place in Canada with a revised 2023 target to accelerate the country's transition to net zero by 2050 (OECD, 2023).

Recent developments in the Canadian nuclear sector

The Canadian government has lent its support for nuclear power projects in the country as part of its carbon emissions reduction strategy. Two major developments mark recent activity in the nuclear domain in Canada. First, in the province of Ontario, lifetime extensions were approved for four nuclear units in Darlington and for the remaining six units at Bruce. At present, this is one of the largest clean energy projects in North America, with a time frame of 15 years and a budget of CAD 26 billion. The first unit in Darlington started its lifetime extension in October 2016 and was returned to operation in 2020. The first unit in Bruce started its lifetime extension in January 2020 and is expected to return to service in 2024 (World Nuclear Association, 2023).

In addition, Canada is demonstrating international leadership in the development and deployment of small modular reactors (SMRs). SMRs are nuclear reactors with power outputs between 10 and 300 megawatts electric (MWe) (NEA, 2021b). This emerging energy technology is expected to play a meaningful role in reducing global greenhouse gas (GHG) emissions as it addresses global low-carbon energy needs – providing a large range of on-grid and off-grid applications, and options for sites that do not require or may not support gigawatt-scale power generation.

Natural Resources Canada (NRCan), which works with other agencies on energy-related matters, published its SMR Roadmap in 2018, setting a plan for nuclear technology development based on SMRs (Canadian Small Modular Reactor Roadmap Steering Committee, 2018). As showcased in *The NEA Small Modular Reactor Dashboard* (NEA, 2023a, 2023b), Canada is at the forefront of pursuing this new technology, with a number of SMR projects already endorsed by provincial and federal governments and undergoing various phases of regulatory review. A number of provinces and utilities are further actively involved in SMR siting and development. For example, the provinces of New Brunswick and Saskatchewan initiated co-operation with Ontario in moving forward with development and deployment of SMRs. The CNSC initiated a pre-licensing vendor design review process that has evaluated around ten SMR options, ranging in capacity up to 300 Mwe (WNA, 2023). Additionally, after inviting expressions of interest, Canadian Nuclear Laboratories (CNL), Canada's main nuclear science and technology organisation, received almost 20 proposals for siting an SMR at a CNL-managed site. CNL aspires to have a new SMR by 2026 at its Chalk River site.

In December 2022, Ontario Power Generation (OPG) began a construction project on a new build Darlington SMR (Darlington B) project. The unit(s) will be of GE BWRX-300 design and the first unit is expected to be operational by 2028 (WNN, 2021).

Nuclear waste management in Canada

Canada currently stores its nuclear spent fuel in interim storage facilities at nuclear power plant sites, as well as at the central storage facility at Chalk River Laboratories (CNL) in Ontario. CNL is planning to build a near surface disposal facility for low-level radioactive waste, and currently public hearings (which offer the opportunity for Indigenous and public interventions) are underway in this process.

In addition to interim storage, Canada is developing strategies for the long-term management of spent nuclear fuel, including to safely isolate and contain its nuclear waste in a deep geological repository (DGR), at least 500 metres below ground. In 2002, the Nuclear Waste Management Organization (NWMO) of Canada launched a three-year study to investigate potential approaches to address the long-term management of Canada's used nuclear fuel. The preferred approach (called Adaptive Phased Management) was endorsed by the Government of Canada and is being administered through NWMO.

NWMO is currently in the process of selecting a site for the DGR from two potential siting areas, and in doing so, is engaging with the local communities and incorporating new knowledge and international best practices. Consultations with the Indigenous Nations and communities has been pursued extensively to ensure trust is fostered and maintained to support this long-term programme.

NWMO is planning to identify a single preferred site for the DGR in 2024. Once a site is identified, a site characterisation report will be issued to provide detailed information on the suitability of the site for the DGR and will be subject to a regulatory review and public comment period. Once the Canadian government approves the site, the NWMO can proceed with the construction and operation of the DGR. According to the NWMO timeline, it will take approximately ten years to construct the DGR, and the facility could begin accepting waste around the late 2040s. The timeline is subject to adjustment based on the outcome of the site selection process, subsequent regulatory approvals and other influencing factors.

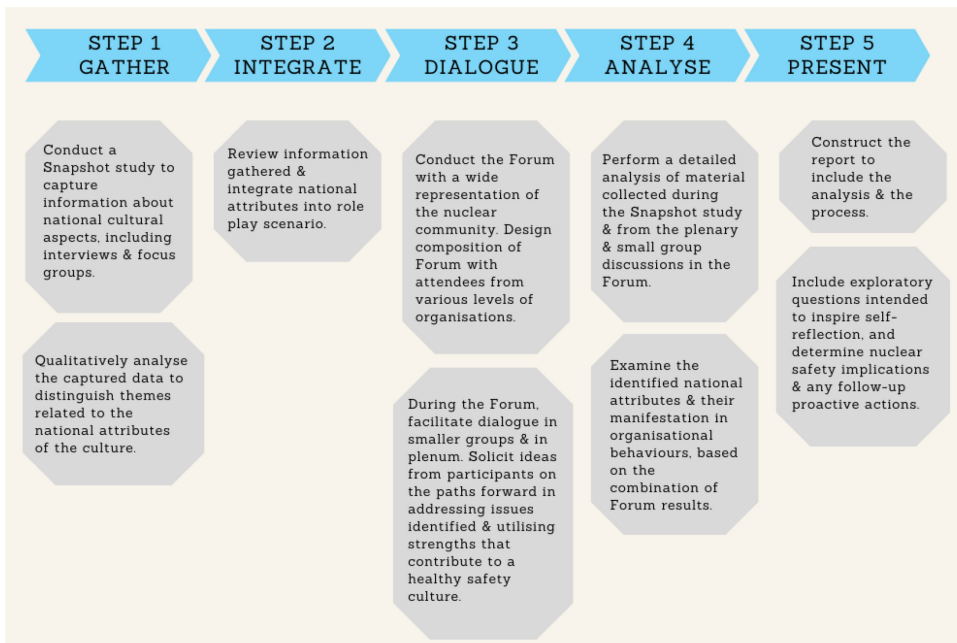
With regards to SMRs, NWMO will be responsible for eventually managing their used nuclear fuel and has therefore been consulting with SMR developers to determine the types of used nuclear fuel that may be generated. NWMO considers its approach to be adaptable to new technologies and as such intends to bring a flexible approach to its DGR repository design in view of SMR and/or advanced fuel requirements down the road (NWMO, 2023a)

The methodology of the Country-Specific Safety Culture Forum

Purpose of the forum

The CSSCF offers a structured framework and is designed in such a way that it can be tailored to a country's specific needs and circumstances. Typically, it is conducted in co-ordination with the nuclear safety regulatory authority of the host country. The general structure of the CSSCF methodology consists of five steps, as displayed in Figure 1.

Figure 1: **Structure of the CSSCF methodology**



During the first phase of data collection, a range of discussions are carried out through interviews and focus groups with diverse stakeholders in the nuclear sector. This process is designed to collect insightful information about underlying characteristics of the national culture.

The data collection for the CSSCF Canada constituted exchanges both through teleconferences and in person with individuals from Canadian nuclear organisations who were both seasoned professionals and newer members of the sector. All participants in the data collection interviews and focus groups were given the opportunity to consider and discuss which national attributes could influence their nuclear safety culture. The environment created for these exchanges was designed to be informal and inclusive in order to allow for open and constructive dialogue.

For the subsequent Forum, the CSSCF team, through the host organisations, invited members (at varying levels) of the country's current licence holders and the nuclear regulator to participate to ensure strong cross-functional representation across the nuclear sector. During the Forum, the plenary dialogue was facilitated by a moderator from the NEA. In the group sessions, national participants facilitated the discussions and a number of participants collected notes from the discussions. They were also asked to give feedback from their group discussions to the broad plenary sessions. Notably, the participants were instructed to contribute to the discussions in their personal capacity as opposed to representing their organisation or particular position. As participants offered their personal views throughout the two-day Forum, the exercise created a positive opportunity for members of the country's nuclear sector to join together in the sharing of ideas, experiences and perspectives. The extent of representation at all levels of the country's nuclear organisations, which was achieved through a planned approach, was a clear indication of the importance placed on this topic by all parties.

Conducting CSSCF Canada

To commence the CSSCF process in Canada, the NEA worked with the Canadian Nuclear Safety Commission (CNSC) to schedule a mission to carry out initial interviews in March 2020. When the COVID-19 pandemic hit, the partners had to quickly devise an alternative plan and agreed that NEA experts would conduct remote interviews during the summer of 2020.

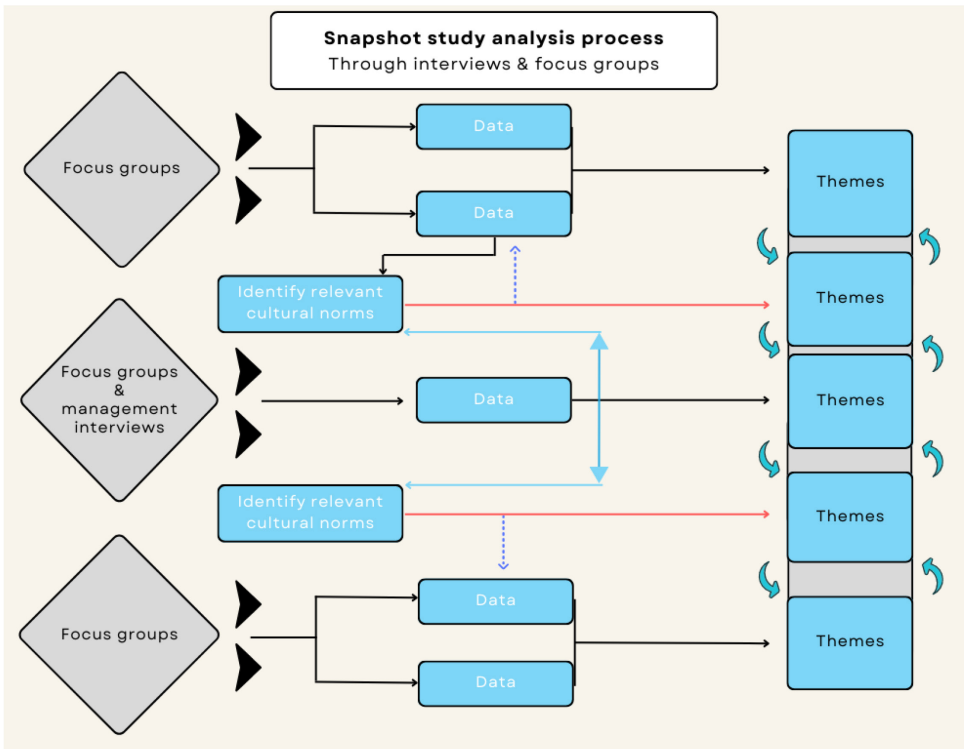
The first data collection exercise comprised 18 interviews and 11 focus groups with representatives from 14 organisations, ultimately gathering perspectives and information from 57 participants. The organisations included nuclear power plant operators (licensees), uranium mining companies, fuel processing companies, science and technology/technical support organisations, research reactors, academic institutions, medical facilities, waste management organisations, and the Canadian nuclear regulator.

Time delays due to COVID-19 and the need to reschedule the Forum on multiple occasions meant that the NEA and host agreed on the need for a second in-person data collection mission to validate and supplement the earlier data

collection. The NEA thus conducted a second data collection exercise in June 2022 that included 9 focus group interviews with working-level staff of four of the principal nuclear organisations in Canada. Additionally, due to time constraints, one focus group and one interview were conducted virtually after the June 2022 mission. A total of 60 participants were interviewed in person and virtually during this exercise.

Figure 2 details the process used by the NEA team to extract data findings via the focus group discussions and interviews. What resulted from this process was the snapshot study, which highlighted the emergent characteristics from the series of interviews and focus groups and identified potential areas in which those traits can influence organisational behaviours. In the Canadian CSSCF, two snapshot studies were produced based on the two sets of interview and focus group exercises. A total of 128 individuals participated in the two data collection exercises.

Figure 2: **Snapshot study analysis process**



Canadian nuclear organisations that participated in the two-tier snapshot study (consisting first of the virtual, and secondly the in-person, interviews and focus groups) included:

- Atomic Energy of Canada Limited (AECL), Ontario: a fully integrated nuclear technology and services company providing services to nuclear facilities worldwide. AECL developed the CANDU (Canada Deuterium Uranium) reactor technology.
- Bruce Nuclear Generating Station: Canada's sole private sector nuclear generator, annually producing above 30% of power in the province of Ontario. It is also a leading supplier of medical isotopes used worldwide. Bruce Power operates eight CANDU reactors for a total installed capacity of 6 232 MW.
- Cameco Corporation, Port Hope, Ontario, comprising two facilities:
 - Conversion Facility, one of only five uranium conversion facilities in the world (and the only uranium conversion facility in Canada). It is responsible for producing uranium hexafluoride and uranium dioxide, which are essential for the production of fuel for light water and CANDU-type heavy water nuclear reactors.
 - Fuel Manufacturing Inc., a nuclear fuel fabrication facility that manufactures nuclear fuel bundles for power reactors in Canada, specifically, and is the largest Canadian-based supplier of in-core reactor components for the CANDU reactor design fleet worldwide.
- Canadian Nuclear Laboratories (CNL): Canada's premier nuclear science and technology organisation, it is contracted to manage and operate AECL sites and facilities across the country. Operating under a government-owned, contractor-operated model, CNL is responsible for the day-to-day operations and maintenance of facilities, which include but are not limited to, the Molten Fuel Moderator Interaction Facility, the Zero Energy Deuterium (ZED-2) reactor, the X-Ray Diffraction Laboratory, the Van de Graaff Accelerator Facility, the Tritium Facility, the Transmission Electron Microscopy Facility, the Thermalhydraulics Laboratory, the Surface Science Laboratories, the Strainer Test Facilities, and the Small Scale Burst Test Facility. In addition to its operating facilities at Chalk River Laboratories, CNL manages the permanently shut-down Whiteshell Reactor 1, the Douglas Point Waste Facility, the Nuclear Surface Disposal Facility Project, the Nuclear Power Demonstration Closure Project, the Port Granby Project, the Port Hope Project, and the Gently-1 Waste Facility, all of which are in varying states of decommissioning, remediation and shutdown.
- Canadian Nuclear Safety Commission (CNSC): the federal regulator of nuclear power and materials in Canada, responsible for ensuring the safety of nuclear activities, including the life cycle activities of nuclear facilities, the regulation and licensing of all uranium mining and milling operations, and management of radioactive waste disposal activities in Canada.

- Canadian Organisation of Medical Physics (COMP), the main professional body for medical physicists practicing in Canada. It publishes scientific and technical information related to the field of medical physics.
- Canadian Radiation Protection Association (CRPA): a professional association which advances the development and communication of scientific knowledge and applicable methods for protecting people and their environment from the harmful effects of radiation, in line with using radiation for the benefit of society.
- Hydro Quebec: a public utility responsible for generating, transmitting and distributing electricity throughout Quebec, including the export of power to parts of the north-eastern United States.
- McMaster University Research Reactor (MNR): a 5-MW multipurpose reactor that provides neutrons for research and medical isotope production. Notably, it is Canada's most powerful research reactor and the country's only major neutron source.
- New Brunswick Power Corporation (NB Power): the primary electric utility responsible for generation, transmission and distribution of electricity in the Canadian province of New Brunswick. The site at Point Lepreau consists of a single CANDU nuclear reactor with a net capacity of 660 MW.
- Nuclear Waste Management Organization (NWMO): a not-for-profit organisation founded by Canada's nuclear electricity producers, with the responsibility of designing and implementing Canada's plan for the safe, long-term management of used nuclear fuel.
- Ontario Power Generation (OPG): a provincial Crown corporation which owns and is licensed to operate the Pickering and Darlington nuclear power generating stations. The Pickering station is one of the larger nuclear facilities in the world. With eight CANDU nuclear reactors in operation, it produces a total of 3 100 MW. The site also has two non-operating units that are shut down and in safe storage. The Darlington nuclear site comprises four CANDU-850 reactors that will see each reactor refurbished between 2016 and 2027. OPG is also leading the siting of the new GE BWRX-300 SMRs at its Darlington B site.
- Orano Canada: a subsidiary of the French parent company that (under various names) has been exploring for uranium, developing mines and producing uranium concentrate for over 55 years. With its headquarters in Saskatchewan, Orano Canada is the leading producer of uranium in Canada.
- Royal Military College of Canada (RMC); the military college of the Canadian Armed Forces, which houses a SLOWPOKE-2 nuclear research reactor, owned by the Department of National Defence. The facility is used for neutron activation analysis, analysis of fissile materials, neutron radiography and radioscopy, and education in radiation protection at the post-graduate level. The reactor has been in operation since 1985; its core is fuelled with low-enriched uranium.

Within each organisation, the participants of the interviews and focus groups ranged from senior level executives to mid-level managers and non-managerial operations staff.

The data from the interviews and focus groups were then collected and analysed. The interviewing team was comprised of individuals with experience across the scope of operational nuclear safety, nuclear safety culture, inspections and the social sciences. The stages of analysis included an independent examination, assessment and analysis by each interviewer, followed by exercises in which those results were shared, discussed and further developed among the interviewing group.

Across both data collection exercises and across all organisations, a standard set of questions was posed to the participants. The second set of interviews and focus groups both helped to confirm traits originally identified through virtual data gathering and pinpointed additional characteristics. Many cultural indicators emerged from the discussions that are expanded upon in the analysis below.

For the CSSCF Canada, the results of the snapshot studies were used to adapt a role-play script, which was based on a WANO-generated scenario of an operational event that occurred at a commercial nuclear power plant. The CSSCF team infused the script with Canadian traits that emerged during the process of the snapshot study. Aligning the scenario script (prior to the Forum) to correspond with the national context of the country, and tailoring it to prompt reactions for discussion, facilitated lively and informative exchanges around the safety culture themes that came to light through the role-play activity.

The CSSCF included a two-day Forum during which participants from across the broad Canadian nuclear sector, along with invited international observers, were brought together to discuss and reflect upon safety culture themes. To start the Forum, an Indigenous ceremony showcased the vibrant Canadian heritage and set the stage for a collaborative undertaking.

The Forum commenced with keynote speeches that framed the exercise, followed by a presentation by Mr Terry Fallis, a Canadian humourist and award-winning author. Following this opening session, the role plays of the Scenario began. After each Act (within which there were 2 to 3 scenes), the participants were divided into groups with around 7 to 10 participants per group. A number of international observers from other national regulators were also invited to the Forum. These participants were placed in one group and discussed their views on the safety culture-related challenges that they had observed in the scenes and compared them to their own national perspectives and processes. Towards the end of the Forum, a final group discussion collected participants into groups based on the organisations in which they work to discuss how any lessons might be addressed in their home organisations. After the group discussions, the participants had the opportunity to openly report their observations in plenary. Additionally, the international participants served on a final panel providing insights and observations from their unique international perspectives.

For CSSCF Canada, around 80 participants from the various Canadian nuclear organisations participated in the Forum and contributed to the discussions. Four international participants, representing the nuclear regulatory organisations of France, Japan, Switzerland and the United Kingdom, also joined the Forum as observers. These international observers were present at the plenary discussions and observed the exchanges between participants on what they were seeing on stage and how that translated into both national cultural traits and safety culture issues.

During the Forum, the Scenario script was divided into 3 Acts comprising 7 Scenes, with Forum participants designated to play certain roles. Following each Act of role play, participants were divided into 8 groups (with one group for the international participants) to discuss characteristics and themes arising from the scenes just viewed. Groups were asked to reflect on the aspects of safety culture embedded into the scenes and how the Canadian context influences those aspects. In turn, plenary sessions facilitated broader dialogue among all Forum participants.

Throughout the two-day Forum, a number of note takers were designated to capture the exchanges and reflective points from the dialogue among participants, during both the separate group discussions and the plenary. This information was then collected by the NEA CSSCF team, which then conducted a final comprehensive review of the qualitative data in its entirety in producing this report. Overall, the information collected through the snapshot studies and the Forum were used to undertake this extensive qualitative thematic analysis, which was validated both by the larger NEA core team and the host organisation.

Safety culture in the Canadian context: Observations from CSSCF Canada

Introduction

The two snapshot studies and the two-day Forum yielded a broad range of insights pertaining to the various facets of Canadian national characteristics. These national traits are general themes that may manifest through a range of organisational behaviours specific to the nuclear industry and its organisations.

The CSSCF Canada outcomes do not represent a comprehensive study of overarching Canadian national attributes. Rather, the CSSCF process aims to capture specific characteristics that are identifiable within the Canadian nuclear sector and therefore attributable towards the overall operational environment and safety culture reality. From observations throughout the CSSCF process, the aim was to nurture an already present dialogue among Canadian nuclear stakeholders about how to strengthen their nuclear safety culture, taking into consideration the national characteristics that influence behaviours. The CSSCF can thus directly and positively impact the safety culture of participating organisations.

The role play that facilitated conversations throughout the Forum reflected behaviours that were deemed plausible in the Canadian nuclear community while also prompting dialogue about what were the typical characteristics of the nuclear community. While the Scenario depicts a serious incident at a plant, the discussions in the context of CSSCF Canada targeted the context of day-to-day operations and overall management approaches.

Other considerations to take into account are that organisational cultures may vary across the Canadian nuclear community, even within the same organisation based on the part of the organisation or potentially on the geographical location of different facilities. For example, it was expressed that personnel that work at nuclear sites located in remote areas tend to foster a stronger community base due to their geographic isolation, which may not happen as extensively with staff at facilities that are closer to urban areas.

The following analysis therefore captures a broad perspective of these individual traits identified through the sample of Canadians interviewed and those who participated in the Forum. The data demonstrate workplace norms, as recalled and verbally captured by participants.

Overarching national traits of Canadians highlighted during CSSCF Canada

The manner in which behaviours and underlying attitudes of a national culture may influence safety culture can be explained through the process of their manifestation within organisational behaviours. In the case of CSSCF Canada, specific characteristics that emerged include the following – each of which is elaborated in the sub-sections below:

- strong commitment to social contract (valuing respect and consideration for others);
- inclusivity and collective approach (respect for diverse perspectives and ensuring equal representation of all members);
- achievement-oriented (motivation to contribute towards success);
- collective pride and personal humility (not boastful);
- trust and respect for boundaries (avoiding interference with others' work);
- conflict avoidance (tendency to withdraw from or avoid conflict).

Strong commitment to social contract

Canadians share a strong commitment to abiding by the underlying social contract of being respectful and considerate of all members of the community. Reflected in a strong emphasis on being courteous, considerate and tactful with the words used in communicating, this commitment to the social contract is often oversimplified as politeness. Canadians are generally purposeful in their communication, using factual assessments as opposed to emotionally driven language to convey messages, particularly in the workplace. However, they may not express their messages too directly if this implies conveying something negative for the receiving party. Through being considerate, Canadians may be more indirect and use careful or gentle phrasing when relaying unfavourable news, demands or messages. Overall, the communication style of Canadians might be described as “indirect but open”. Canadians are also known for apologising, even if the situation does not call for an apology, in order to abide by this sense of a strong social contract.

To a large extent, this style of being considerate and open when communicating and interacting fosters a healthy level of trust and consideration in society, and hence among staff members and between employees and their immediate supervisors (the latter is elaborated in the section on “Leadership and management”). Being courteous implies that co-workers are open to listening to their peers. Managers often establish and/or reinforce this culture by offering platforms through which all staff, including junior members, can speak openly, offer ideas and raise concerns. Staff recalled using such platforms to constructively communicate their opinions.

Canadians also exhibit a strong drive towards social responsibility. Several examples were raised during the interviews and focus groups to indicate that Canadians believe that the needs of many outweigh the needs of one. Discussions

during the Forum confirmed a strong sense of community and a natural inclination to lend a helping hand to colleagues. Teamwork is valued in the workplace and is emphasised throughout the community, exhibited in social and sports activities.

As these are deeply embedded social norms, Canadians may feel uncomfortable when they encounter more directive or intrusive forms of communication.

Inclusivity and collective approach

For Canadians, inclusivity reaches beyond being considerate towards one's peers and/or neighbours; it also implies being considerate of one's surroundings. In Canada, participants repeatedly acknowledged having a deep respect, fondness and appreciation for nature. Many who participated in the discussions identified themselves strongly and passionately as spending considerable time in nature. Others reported taking the initiative to preserve animal species near their nuclear facilities. With vast landscapes and nuclear facilities often situated in remote areas, connecting directly with nature around them appeared to be common and highly valued. The element of respect was reoccurring, demonstrating how this innate characteristic plays out on multiple levels in society and for the Canadian nuclear community.

Canadians view themselves as multicultural and openly embrace being so. Their respect for diverse perspectives and the value they place in ensuring everyone is represented equally play a role in the ease with which Canadians are able to embrace multiple cultures. However, it appeared important and necessary to Canadians that co-workers from minority backgrounds were able to assimilate, mainly with regards to speaking English. They expressed concern that communications may not run smoothly if anything were lost in translation. This might lead, for example, to a middle manager requesting that staff members learn English and practice during their off-work hours to ensure efficient communications.

Staff from many cultural backgrounds were represented in the Canadian nuclear community, though they were still the minority. Staff with minority backgrounds who participated in the discussions reported feeling welcomed into Canadian communities and being treated with consideration and flexibility. That said, at the facilities visited, on-site staff did not always seem particularly diverse and minority staff members were not as forthcoming in conversations as were the local Canadians. Generally, for those who have come from abroad, the importance of "fitting in" was deemed as important.

Achievement-oriented

Canadians are achievement-oriented in many aspects of daily life, which flows over into work environments, including nuclear operations. In fact, "achieving" was commonly indicated as a main motivator for coming to work and performing well in the workplace. A reoccurring theme was that employees at multiple levels are motivated to work by their desire to contribute to the greater good and to apply their skills and expertise to the benefit of the community. Other common indicators, such as financial gain or individual prestige, did not typically come into play as primary motivating factors for Canadians.

Because they expect everyone to be achievement-driven and have the same sense of social responsibility, workers can feel frustrated when others do not apply the same amount of effort into completing their tasks and responsibilities. Despite the ability and desire to work in teams, Canadians “keep to their own lanes”; specifically, employees take responsibility for their own tasks but do not interfere in the tasks and responsibilities of others. Rather, they expect that each person will uphold the same level of responsibility.

Since Canadians value achievement, they are open to learning new skills and learning from their mistakes with the intent of improving. In this respect, the COVID-19 pandemic created an unprecedented opportunity for learning within the Canadian nuclear community. Nuclear organisations had to alter their ways of communicating. Although key operational staff continued to report to work on site throughout the pandemic, the new dynamics of holding remote meetings and implementing restrictive in-person collaboration altered the once interactive landscape, and employees had to quickly adapt. Managers had to trust staff more to telework and assume a supportive role to ensure that workers were coping with the physical and mental health challenges posed by the pandemic. In addition, in some cases, newer staff did not benefit from on-the-job training and had to learn quickly. The robust processes that Canadian organisations had in place were advantageous in this respect as they offered comprehensive documentation and an in-grained understanding of established management systems. Overall, staff adapted quickly to new ways of working in a dramatically changed environment, demonstrating flexibility while being mutually supportive. This could be attributed to their overarching desire to work together to achieve common goals, particularly in adverse times, and their common strive towards achievement.

Collective pride and personal humility

Notably, Canadians express pride in their collective achievements but tend to avoid demonstrating any strong sentiments about other, more individual or personal accomplishments. While Canadians tend not to be boastful by nature, they feel proud to be Canadian, proud about being productive and proud about contributing to their communities. They also take pride in their technological achievements but even in this regard, they are not openly boastful.

Canadians do compare themselves to others (i.e. benchmark) to assess if they are progressing well. The proximity of the United States makes for a natural affiliate, and Canadians often make direct comparisons to their American neighbours, particularly indicating differences in communication, managerial and decision-making styles. Canadians also acknowledge having interdependent ties with the United States. As many Americans work within the Canadian nuclear sector, Canadians also recognise the influence that Americans have on their nuclear industry.

At the same time, Canadians exhibit humility, both through not being boastful and through an accepted openness to receive constructive criticism as positive and useful feedback. They have a desire to continuously improve and are willing to seek advice from one another.

In the nuclear sector broadly, workers do take pride in their contribution to the safe operations of nuclear facilities, but they express it only when asked. Additionally, their sense of valuing working in teams is stronger than any individual competitiveness. This allows for positive collaboration and a sense of “sharing” the successes, as opposed to seeking individual glory.

Trust and respect for boundaries

Respecting boundaries is another pronounced trait in Canadian culture and can be noted across social interactions and common practices. Canadians know their own area(s) of expertise and responsibility, and feel it is important to stay within that scope. Employees exhibit a strong sense of feeling responsible for their own area(s) of expertise and avoid commenting or advising on areas for which they feel they do not have the relevant background. It was clearly noted that employees are not inclined to intervene in an area of work that is not their own. This could even go as far as a colleague not correcting his/her peer who may not be successfully carrying out their work. Co-workers are each expected to be responsible for their own line of work and, if assistance is needed, they are deemed responsible for seeking it. This practice of not overstepping the boundaries of co-workers is believed to mitigate conflict among peers. Canadians are willing to assist but will wait to be asked.

With regards to trust, within the workplace, workers tend to have more confidence in co-workers with extensive subject matter expertise and years of experience rather than those who have a specific “title”. This may mean that technical staff tend to listen to the advice of experts over that of managers, especially if they feel that management is disconnected from the actual practicalities of facility operations.

The data collected indicated a genuine intent on the part of leadership across a variety of organisations to care about their staff and make decisions that support their well-being. During the COVID-19 pandemic, for example, the staff who were not directly needed on site were given the opportunity to work from home. This proved effective for the majority of workers in the Canadian nuclear sector. Many nuclear organisations in Canada continued to facilitate remote working, where possible, long after restrictions and remote working permissions were lifted domestically and in other countries. This demonstrated the strong sense of trust among managers and their staff.

Conflict avoidance

Canadians have a strong tendency to avoid conflict. This often influences how they communicate, particularly when conveying messages that offer critical or negative feedback. Canadians will often couple the information with extensive context and sufficient information to offer explanations and benefit the receiver. Avoiding conflict plays out also when co-workers do not share the same opinion.

Even in the case of differing views, in practice, Canadians do not provoke arguments among colleagues; rather, they will seek to mitigate conflicts by finding a middle ground. To be sure all who are present understand a decision taken, Canadians lean towards discussing issues at length and inclusively. It is unusual

for a Canadian to behave in a manner that seeks extreme dominance or to remain completely silent in discussions. In certain cases, however, to not offend others, someone might act in an overly polite manner, and refrain from offering an opposing opinion.

In fact, because the general communication style tends to be conflict-avoiding, staff in some Canadian organisations undergo “fierce conversation training” to support individuals’ level of comfort and skill in engaging in conflict-charged conversations. This training aims to ensure that any conflict that does arise is managed peacefully and professionally, while allowing communication to flow constructively and focusing on the use of effective conversational tactics. It is also instrumental in building the skills and confidence of workers and managers to engage in constructive yet direct conversation, which goes against the natural conversational style for many Canadians. Even during moments of heightened stress or disagreement in a conversation, the cultural norm is predominantly for individuals to remain calm and composed, without showing aggression all the while seeking a compromise solution.

There was a connection made within the discussions on how strongly Canadians value a rules-based approach to general situations, particularly in the workplace. There was also a connection discussed regarding following the rules stringently as a mechanism to help mitigate conflict among peers.

Manifestation of Canadian cultural traits through organisational behaviours in nuclear organisations as identified during CССCF Canada

To understand how the national traits are manifested via organisational behaviours, the following section examines four principle topical areas that were highlighted during the CССCF Canada process:

- inclusive and facilitative leadership and management;
- adherence to processes and planning;
- collaborative decision making;
- strong sense of responsibility and accountability.

Inclusive and facilitative leadership and management

Culture has clear impacts on leadership and is deeply rooted in determining what a population or community views as desirable traits in a leader. It has been agreed in the International Normative Frameworks section referenced previously in this report that safety leadership should be credible, ready to listen, encourage team spirit and cross-functional co-operation, and be present in the field to align management requirements with the reality of day-to-day operations. In the Canadian nuclear sector, leaders typically demonstrate a willingness to listen to feedback, gain understanding and communicate how conclusions are reached. During meetings all members are usually invited to speak and voice their opinions

freely. This is also the case when meeting participants are debating a topic; they address one another with composure and in an equal and open manner. This was taken to be an indication that staff work in an environment in which they feel they are at liberty to report mistakes or concerns without being reprimanded.

Although all members within an organisation can speak up, voice their opinions, and even challenge the organisational norms and decisions, not everyone can ultimately decide. Leaders are encouraged to be inclusive, which may be attributed to a desire to be accepted and respected, and to demonstrate a willingness to adhere to the social contract. Often, leaders are judged by how they behave socially and within a team context, in terms of whether they show mutual respect and a level of compassion or empathy for their staff. Leaders who act inclusively and fairly will maintain the support of their teams. Should a leader become overly directive and autonomous, their credibility and support may quickly erode. This could lead, as was mentioned in the group discussions, to staff not being as open with their supervisors as they otherwise would be.

Staff at certain facilities noted that top management does not grasp the types of challenges facing staff who actually operate and/or maintain the plant or other related facilities. If such managers were more actively present, workers would have more opportunities to raise operational details with them. Additionally, it was expressed that managers who lack the technical background and skills acquired through extensive operational experience would benefit from direct, exploratory conversations with members of the operational team who carry out day-to-day operations and oversight of nuclear facilities.

Middle managers are expected to play a strong supporting role for operations teams, including offering solution-oriented approaches. While these line managers can push requests up to their senior managers, reflections from the focus groups indicated that often the top management makes decisions that suggest they do not understand the needs of operational staff. An example of this is the inclination of decision makers to recommend additional processes and procedures when a non-safety-significant mistake occurs. Such additions create a heavier workload for middle managers and technical staff.

To avoid triggering additional processes and procedures, staff at facilities may be inclined to not report such mistakes. This could be contradictory to promoting a healthy safety culture, as an overly bureaucratic safety management system reduces the time that operational managers can spend on effective risk analysis and mitigation. A large proportion of workers reported feeling comfortable in raising concerns to their supervisors; some even indicated their willingness to reach out to their supervisor's supervisor, if necessary. Others viewed such action as "telling on" their supervisor and felt anxious about it potentially sparking conflict. Findings also indicated that certain workers were unlikely to use this approach because they felt that if their own supervisor would not be able to generate results, it would be unlikely that the next person up the chain of command would be able to either.

In terms of fostering effective systems for accountability, leaders were generally taught to encourage staff to feel safe when reporting an error. In certain circumstances, it was highlighted that managers implemented inclusive measures

to support staff after a mistake was made. In certain circumstances, the managers had their team begin using new slogans that encouraged staff to learn positively and constructively from having made an error. When an error occurred and staff members reported it, the corrective measures typically resulted in supportive training. The openness of Canadian culture towards continuous learning in the nuclear sector is evident in the many training opportunities offered to staff. Not only do managers encourage training when an incident occurs, they tend to support junior staff development on a routine basis.

This leads to the notable attention that managers pay to psychosocial health and well-being; it receives a high level of attention in the Canadian nuclear community. Attention to mental health is part of respecting the social contract and abiding by a sense of social responsibility. Maintaining and supporting a healthy work/life balance is highly prioritised. During the COVID-19 pandemic, for example, many nuclear entities organised “check-in meetings” to ensure that all staff members were coping well, particularly those working remotely.

Despite this, operations staff in some facilities noted that during the COVID-19 pandemic, leaders were not as present or visible as staff would have liked, particularly in terms of communications and direct engagement with co-workers. This raised concern among some about the need for a stronger social contract between management and employees similar to what was in place prior to COVID-19.

Canadians support one another in the workplace, exhibiting a genuine desire to want to help during an adverse situation and their willingness to rally others together to assist. Canadians are friendly and social at work but place high value on maintaining a work focus. Extensive socialising at the workplace is uncommon, which could derive from the strong sense of individual responsibility and the tendency to be achievement-oriented and remain work-focused during working hours.

As part of their drive towards continuous improvement, Canadians are self-reflective and as such, organisations often conduct a “360-degree” assessment to analyse the leadership capability of managers. Offering this type of feedback to managers enables them to better understand and improve in their approaches and behaviours.

Well aware of their style in leadership, Canadians compare their facilitative leadership style to that of Americans, which they view as more directive. However, they do feel influenced, to some degree, by the American managers who have joined Canadian nuclear organisations which could lead to some uncomfortable situations.

Overall, management within the Canadian nuclear community is quite open to receiving information, even that which goes against their views. They also encourage transparency, open communication and information exchange. Leaders (namely top management) can be receptive to considering new, innovative ways to solve problems. It was noted in several instances, however, that these leaders may face challenges when implementing approaches that their staff are not aligned with.

Adherence to processes and planning

Extensive planning is common and highly valued within Canadian culture. Competencies in planning and preparedness are considered important in the selection of leaders, reflecting how employers want leaders to model behaviour. Canadians generally spend a great deal of time in planning prior to the execution of decisions and actions, which is considered to sometimes have an impact on the timely implementation of their processes. A perception exists that every case of reporting is followed by long processes and excessive paperwork, which distracts from priority areas where resources could be more useful and more readily applied.

The need for clarity and context also contributes to the long and comprehensive processes that can be seen in all operational aspects of the Canadian nuclear sector. Canadians value having structure in processes and in interactions (such as meetings). Being prepared ensures a sense of control and predictability, which makes Canadians feel comfortable. Observations from the data-gathering exercise and reflections from the Forum indicate that Canadians are focused on mitigating risks, and thus place high value on structure and pay special attention to all aspects of nuclear safety.

While a management system is intended to strengthen safety within the nuclear facilities, the data from the interviews indicated that the excessive number of processes and procedures can have two different types of unfavourable effects. Firstly, employees can become conditioned to follow processes and procedures and as a result, they no longer are able to adapt to unexpected situations. Depending on the environment and specific situation encountered by the workers, processes and procedures might not be completely relevant, and still workers sometimes follow procedures by the book and can knowingly make the wrong decision because of that. As expressed during the interviews, a technical worker may follow the procedure of reporting a leak that he/she encounters instead of addressing the leak directly.

Secondly, employees choose not to follow all the processes and procedures because either they can feel overwhelmed by the workload that it takes to improve them or they recognise that it could result in additional processes and procedures that would result in not only increasing their workload, but also taking so long to implement that it is no longer relevant to the issue raised. These unfavourable effects lead workers to be unable at times to undertake their tasks efficiently, to suggest amending the process (knowing the long consideration and approval process that could follow), and finally not adhering to the process altogether.

Due to the numerous processes, it is often difficult for workers to complete everything they need to do. The nature of nuclear facilities is such that many employees need to manage both “urgent” and “important” tasks, typically giving priority to the former. If the burden of processes and procedures linked to urgent tasks is excessive, the risk is that there will not be sufficient time and resources to address the important ones. In addition, because planning and timelines are given such importance, managers can face difficult choices to ensure that time constraints are met.

Employees also noted that when certain categories of errors occur or a new question arises, management tends to respond by adding additional processes – and may not realise that the proposed solution is impractical for workers. This could motivate workers to avoid reporting mistakes, not because they do not want to be forthcoming, but because they want to avoid having to follow additional processes that would undermine their ability to work effectively. This plays out when an employee gets hurt on-site, for example, and he/she may opt not to report the incident to avoid incurring additional paperwork. This could impact the well-being of workers who may not be fit for duty but do not report it as well as not dealing effectively with a health and safety risk.

When combining processes and planning with decision making, Canadians value the practice of risk-based decision making, which may involve several layers of processes regarding how decisions are made and by whom. This approach is particularly expected when it is necessary to make high-risk decisions.

However, regarding routine operations, staff at the nuclear facilities expressed the opinion that in some cases a clear disconnect exists between senior management and staff that are directly involved in the operation of the plant on a daily basis. Often, the procedures imposed by top management of nuclear organisations do not practically fit the actual operational situations that employees face. Although the communications within nuclear organisations tend to be non-hierarchical, based on the adherence to processes, the top management essentially decides which new procedures are to be adapted.

In a different light, some employees recognise that having an abundance of procedures can be time consuming but can also prove useful and even necessary. The value of processes, planning and having robust structures in place became clear during the COVID-19 pandemic, when new employees who had to work from home were able to rely on these mechanisms to learn and complete tasks.

Collaborative decision making

Considering Canadians' regard for abiding by a social contract, consensus is widely preferred in decision-making processes. This aligns with the tendency of Canadians to avoid conflict. Canadians aspire to ensure that all issues up for discussion are given ample consideration and try to have a comprehensive review of any decision made. This practice of listening to and assessing diverse opinions also facilitates co-operative decision making, even when full consensus is not reached. Canadians are critical of management that fails to act in accordance with national norms of inclusivity and humility. Managers who do not display valued principles of openness, inclusivity, transparency, etc., may face resistance and this can lead to a disconnect between the high-level supervisors and technical workers and operators. Because the culture is to welcome and consider all ideas, differing perspectives are unlikely to result in conflict during a discussion. When they do disagree, Canadians generally do so calmly and with consideration for the opinions of others.

In the Canadian context, most meetings are attended only by the people who need to take part. As such, roles are clear and contributions are meaningful and purposeful. Typically, the individual hosting a meeting decides who should participate.

Two layers of decision making are characteristic of Canadian nuclear facilities, as is seen in most organisations, reflecting decisions related to normal, day-to-day operations and those that must be made in emergency or urgent situations. For the former, there is time for discussion, debate and effort to reach consensus when new decisions must be taken. For the latter, the situation may call for a more “command and control” approach. These are the cases in which consensus is not necessarily sought, while the rationale is shared afterwards.

During normal operations, in line with the Canadian respect for social contracts, staff might be more inclined to follow the general direction of decisions and work processes. With safety being an area of top priority, in emergency situations, Canadians can become more directive: decision making during times of safety-significant occurrences will tend to be more top-down and would aim to result in staff rallying together to respond collectively to manage a crisis situation.

In both cases, comprehensive decision-making processes and protocols are determined well in advance, with the layers of decision making clearly defined, which has supported safe operations in both routine circumstances and in safety critical cases.

Several specific players may be involved in making a decision, particularly one of safety significance. While the social contract also sets an expectation that the platform for making a decision be inclusive, reaching consensus is recognised as the preferred outcome but is not obligatory. In the Canadian context, once a decision is made, the norm is to ensure that all actors understand the underlying rationale. Clarity and transparency are highly valued and staff expect that, once taken, decisions will be explained. It would be unusual for supervisors to make decisions without offering context and rationale.

Strong sense of responsibility and accountability

Canadians work hard because they feel accountable for their actions and defined responsibilities. Generally, operations at Canadian nuclear facilities take place in a collaborative environment, with staff acting as a unit.

This requires that each person takes responsibility for tasks associated with their roles and that measures of accountability are in place. Typically, staff members welcome taking responsibility for their own tasks. This likely reflects the earlier findings that their motivation to work is based on an orientation towards achievement and their strong sense of contributing to society and upholding social contracts.

Interestingly, managers and staff alike demonstrate an attitude of encouraging peers to take accountability for their mistakes. It was also noted that co-workers tend to feel responsible even when their colleagues – and particularly their subordinates – make mistakes. The inherently collective approach in Canadian facilities is evident in that people want to help their peers avoid making mistakes

and, in some instances, supervisors may assume the responsibility for mistakes made by individuals in their groups. Generally, management avoids attributing blame or shame to employees who report an incident, especially when the mistake was unintentional and is not reoccurring. In certain cases, new approaches are implemented to help colleagues feel comfortable to report mistakes. This is indicative of a healthy safety culture, in which workers who are encouraged and recognised for reporting concerns or suspicions, are free from reprisal.

The strong sense of being responsible, which is typical of Canadian culture, and not being shamed and blamed, means staff members are quick to take ownership of a mistake and open to follow the process of corrective action, which can involve crew training. The attitude towards staff who commit an error is not to accuse but rather to use the incident as a learning experience for all.

Because nuclear facilities are often remotely located, staff tend to form a personal rapport beyond the work environment. This has both positive and negative implications. When staff know each other on a personal level, they may be mutually supportive at the workplace. But compassion for co-workers can lead to cover up: should one co-worker be found to not be complying with procedures, the other may favour camaraderie over reporting the violation.

During the COVID-19 pandemic, managers observed good productivity overall, despite non-essential staff being permitted to work remotely. Well into 2022, even as lockdowns and restrictions were lifted, managers at Canadian facilities (as in many other countries around the world) allowed employees to continue teleworking. This both reflects and reinforces the Canadian trait of having confidence in employees' sense of responsibility to work and perform independently of supervision, as well as upholding the practice of not being intrusive in the work of others or demanding that workers return to the office.

Reflections on safety culture in the Canadian context, and paths forward

Characteristics of national attributes

National attributes are the multitude of specific and identifiable traits that, when combined, constitute the overarching local culture. These traits cannot be categorised as necessarily positive or negative. Instead, in relation to a healthy safety culture, they can be evaluated based on how their manifestation influences processes and actions that support or challenge the maintenance of a robust and stable culture of safety within an organisation or community. During CSSCF Canada, clear indications of national traits that strengthen safety culture were identified, as were others that might pose a challenge with respect to healthy behaviours and interpersonal interactions in line with an optimal and healthy safety culture.

This report can be used to further explore how the identified Canadian characteristics and their influences on organisational behaviours affect nuclear safety. Table 1 offers a sample of the various positive and challenging influences that these traits, individually and combined, can have on nuclear safety.

Table 1: **Characteristics and influences**

Single characteristics	Positive impact	Challenge requiring attention
Strong commitment to social contract (valuing respect and consideration for others)	<p>Creates an environment marked by collaboration and consideration.</p> <p>Individuals feel responsible for successfully completing their own tasks, leading to common understanding and trust.</p> <p>Fosters a collaborative spirit in which co-workers support each other.</p> <p>Open-door policy is the norm, particularly among mid-managers.</p> <p>This attribute emphasises the importance of workers' well-being.</p>	<p>The expectation of staff members that each individual is responsible for his/her own tasks could lead to those same individuals assuming that all co-workers are performing to the highest standards, which may not always be the case.</p> <p>Having a community perspective may inhibit a co-worker from reporting a colleague with whom they have a personal association.</p>

Table 1: **Characteristics and influences** (cont'd)

Single characteristics	Positive impact	Challenge requiring attention
Inclusivity and collective approach (respect for diverse perspectives and ensure equal representation of all members)	Creates space and opportunity for younger professionals to assume positions with heavier responsibilities. Allows for all voices to be heard, which is encouraged by management.	The need to have collective opinions and views encourages trying to reach consensus, which may make it difficult for colleagues to go against the overarching opinion of the group.
Achievement-oriented (motivation to contribute towards success)	Creates a positive sense of striving for excellence within the organisational culture. Motivates staff to perform their tasks diligently. Enables staff to work responsibly and without supervision for enforcement. Fosters an acceptance and desire for continuous learning to improve performance.	Based on their assumption that all staff are being achievement-driven, staff could turn a blind eye when a co-worker is not performing as they should. The goal of continuous improvement could lead to a tendency to produce an excessive number of procedures and processes, which could hinder addressing urgent and important matters in an efficient manner.
Collective pride and personal humility (not boastful)	Allows for acceptance of constructive criticism and openness to continuous improvement. Boosts consciousness of the need to maintain a favourable (inclusive, open-minded, etc.) leadership style.	The absence of a directive attitude can allow outside influences to impact the Canadian work method in a way atypical to the Canadian approach.
Trust and respect for boundaries (avoiding interference with others' work)	Allows workers to have a healthy level of autonomy and responsibilities. Encourages co-workers to respect each other's opinions and strive for constructive discussions. Makes aggression and intimidation uncommon in the workplace (psychological safe space created).	Carries the risk of implying that co-workers are not cognisant of each other's work or performance, so cross-checking may not necessarily take place without explicit peer-to-peer validation or verification instituted.
Conflict avoidance	Prompts co-workers to seek a middle ground and avoid provocation and arguments.	Could undermine a questioning attitude among peers as staff avoid potential conflict. Could discourage staff from being questioning of management or even their co-workers.

Table 1: **Characteristics and influences** (*cont'd*)

Characteristics combinations	Positive impact	Challenge requiring attention
Conflict avoidance + decision making		Could lead to complacency based on unwillingness to contradict opinions or decisions.
Commitment to social contract + achievement-oriented	Creates a healthy work environment in which peers and management co-operate respectfully and focus on common goals. Fosters an attitude in which insights from technical experts are highly valued.	

Positive influence of Canadian national attributes on nuclear safety

In an operational context within the Canadian nuclear sector, national culture prioritises the highly regarded demeanours of respect, politeness and responsibility towards society in practice, which fosters a collective approach. In nuclear facilities, the focus on nuclear safety is recognised as needing a collective effort and the entire unit is conscious of the teamwork and collaboration needed to support this. In turn, employees make deliberate efforts to anticipate and comply with expectations.

It was evident that the Canadian nuclear organisations have inclusive processes by which they welcome all perspectives for decision making. In addition, based on their commitment to a social contract that prioritises collaboration, consideration and respect for others, Canadians welcome individuals from minority backgrounds with ease within the work force, and show no discrepancies between female and male colleagues.

Despite the drive to reach consensus in decision-making processes, Canadians encourage all team members to voice their opinions. When agreement is not achieved, a sound decision can still be made, as long as the rationale for it is explained. This translates also to staff being adaptive and flexible when faced with change, as long as they understand why change is being initiated. The analysis of Canadian traits highlighted the importance of achievement as a motivating factor for good performance. Therefore, staff feel responsible in ensuring that they complete their tasks and are vigilant that the tasks and operations within their scope of responsibility run smoothly.

Canadians recognise that their safety statistics are positive; even so, they are not boastful. Instead, they embrace continuous learning, development and improvement. The opportunity for training and skills development is encouraged by managers, and peers are generally supportive of one another.

A high level of respect and trust was noted among organisations within the nuclear community in Canada, evidenced through the ways in which facilities

described their mutual support and the collaborative ways in which they benchmark against each other. Actors in the Canadian nuclear sector try to align their strategies with certain accepted values, including facilitative leadership, open and inclusive communication, and ensuring safety first.

In the nuclear sector, Canadians also place importance on technical rigour in justifying the recommended course of action. In this respect, the views of experts with technical experience and recognised credentials are regarded highly. The consideration of risk-based technical review and validation is imperative and decisions related to safety are taken strictly in alignment with accepted norms of what constitutes reasonable technical assessment reviews. The fact that technical rigour is so important to processes in the Canadian nuclear industry is related in large part to Canadians being highly conscious of risk. As a result, they also engage in extensive planning to mitigate any possible deviances from expected outcomes, as was highlighted during discussions.

Potential challenges to enhancing safety culture

The tendency to avoid conflict was a reoccurring theme that emerged from the snapshot studies and the Forum, and constituted one of the main traits of the Canadian culture. This trait can be easily recognised prevalent through the behaviours and actions of Canadians, on both individual and organisational levels.

Based on the same adherence to following the social contract, Canadians often show reluctance in sharing any negative information because confrontation is uncomfortable. The trait of openness – which is valued in Canadian society and particularly in the organisational context – fosters approachability among peers. However, it was noted that people may avoid the difficult conversations of addressing performance gaps. Initially, there is a willingness to discuss performance, but if someone continues not to meet expectations, often colleagues may be unwilling to confront the ongoing issue. Some voiced their opinion of being unwilling to engage in confrontation of any kind.

Being achievement-oriented is another aspect of adherence to the social contract, which gives workers a strong sense of pride to strive towards excellence. While having work-related targets is a commendable practice, setting unrealistic targets can have adverse effects. To try to reach standards of excellence, pressure can be placed on operational workers and middle managers to follow lengthy processes and reporting, which might not be possible within given time frames. Additionally, adhering to lengthy processes can leave employees feeling challenged to balance implementing new processes with having sufficient time for needed attention to operations.

With regards to conflict avoidance, although fundamentally embodying a harmonious approach to communications, the desire to not offend may mean that people could either understate or refrain from actually stating their positions. This behaviour could lead to complacent behaviour – with the potential for negative impacts – if technical experts refrain from sharing their opinions in order to avoid contradicting co-workers. Likewise, as an identified Canadian trait is to not impose

one's ideas on others, the tendency for technical experts to share their opinions without being asked could be relatively low.

The objective of analysing traits in a specific cultural context is to become or remain aware of those that could negatively impact a healthy safety culture, while preserving and encouraging those that could have a positive influence.

Further considerations

Importantly, the Canadian nuclear energy programme has a strong track record in safety performance and in establishing a robust and adaptive management framework needed to make well-informed and sound safety decisions.

Canadians benefit from the inherent drive to achieve; because they are goal-oriented, they can also be very self-critical. There is the opportunity for on-the-job mentoring among peers to help workers build the confidence they need to continue improving in their tasks. It was noted that regular “hallway” discussions among co-workers were felt to be fundamental to on-the-job learning and that staff expect to give and receive accurate and constructive feedback. One consideration is that such exchanges have become less prevalent in the wake of COVID-19 pandemic restrictions. Members within nuclear organisations could consider striving to restore such exchanges.

Findings from the interviews and discussion groups reveal that staff at the nuclear sites generally felt that open and constructive dialogue that brought together members from different sections of the facility added enormous value. Common areas for reflection were deemed instrumental for addressing uncertainties and concerns. It could be worthwhile to consider using this approach to encourage ongoing open and constructive dialogue within facilities.

In the Canadian nuclear sector, the specific relationship between licensees (operators) and the regulator (Canadian Nuclear Safety Commission [CNSC]) was explicitly discussed during the Forum as elicited through the scenario enacted. The national trait of adherence to the social contract, combined with trust and respect for boundaries, facilitates an open and transparent relationship between the CNSC and its licensees. Nevertheless, it was noted that, across all Canadian nuclear entities, lengthy processes generate certain challenges to the practical achievement of work objectives in certain cases. Before introducing new procedures and processes, decision makers should ensure that the procedures put in place are practical, and bring in feedback from the operations staff responsible for their implementation. Open-door policies should continue to be encouraged for direct contact, communications and follow-up between staff and management across the nuclear sector. Noting a gap between high-level management and technical staff – based on different skills, knowledge and experience – it could be beneficial to establish processes to boost direct engagement of the technical experts who are responsible for operating the plants on a day-to-day basis, in the designing and implementation of new processes and procedures. Another suggestion is for managers to determine, through a risk-based assessment, whether a new process or procedure is really warranted in addressing arising challenges, or whether

alternatively, there could be other means that could be used, such as training or other mechanisms.

Suggestions for paths forward

The opportunity exists for nuclear organisations in Canada to build on the findings of CSSCF Canada and reflect upon actions that could support continuous improvements in safety culture. Exploratory questions can help facilitate important discussions and consider different perspectives on key safety culture issues relevant to the Canadian context.

In light of this, a set of exploratory questions is offered in Table 2 to inspire the Canadian nuclear community to further reflect, discuss and employ engagement activities. Future actions could focus on how national attributes that improve safety should be reinforced and on developing strategies to work with (or compensate for) attributes that may distract from safety.

The questions presented are high-level and are not meant to be a comprehensive checklist to address the themes and discoveries explored in this report. Rather, they aim to prompt more detailed exploration in each organisation. The table presents the linkages between the national attributes and the organisational behaviours, which have significant and distinct interactions.

Table 2: **Exploratory questions**

National characteristics	Inclusive and facilitative leadership and management	Adherence to processes and planning	Collaborative decision making	Strong sense of responsibility and accountability
Strong commitment to social contract	How does your organisation measure whether a leader is being inclusive, transparent and effective?	Do lengthy, overly complex processes hinder effective response to support operations? How to balance between sound operational procedures and flexibility when certain situations require immediate action?	How to ensure decisions are being made in an effective and efficient manner?	How to motivate staff to balance their camaraderie with strict adherence to safety protocols? How to ensure that politeness does not prevent raising concerns?

Table 2: **Exploratory questions** (cont'd)

National characteristics	Inclusive and facilitative leadership and management	Adherence to processes and planning	Collaborative decision making	Strong sense of responsibility and accountability
Inclusivity and collective approach	<p>How to ensure that senior leaders remain present and connected to the operations staff, and to exhibit “soft leadership” traits that come from “walking the floor”?</p> <p>How do you ensure that the opinions of technical staff and junior staff are reflected and addressed?</p>	Does the organisation have a protocol to ensure that all meeting attendees have a chance to offer their opinions?	<p>How to break past the conservative barriers in order to support changes and be more adaptable?</p> <p>Are there generational shifts that need to be evaluated within the organisational culture?</p>	How to ensure that everyone feels responsible for raising safety issues, regardless of whether the intervention would implicate fellow co-workers?
Achievement-oriented	<p>How to ensure attention is being given to the stress placed on front line workers due to the constant drive for performance improvements?</p> <p>Is there a strategy to monitor the mental health of staff, ensuring the optimal conditions for safe operations?</p>	<p>How to ensure that procedures are used as a supporting tool instead of replacing the skills of operational staff?</p> <p>How to ensure that risk-based reviews and options analysis are conducted in the place of routine development and implementation of new processes and/or procedures?</p>	<p>How to ensure good feedback to explain why decisions have been taken to assure staff that their needs and reality are being considered?</p> <p>Does the organisation have a strategy to communicate to staff the rationale behind decisions made?</p>	<p>How does the strive for excellence affect the sense of responsibility for safety across the organisation?</p> <p>In what way could teams ensure that all members are aligned in their objectives to achieve the highest performance outputs?</p>
Collective pride and personal humility	<p>How can leaders continue to motivate staff towards embodying organisational principles for safety?</p> <p>How can peer-to-peer coaching be used to address performance issues within the team?</p>	How can organisations ensure that staff have adequate time to balance between internalising new processes while maintaining their current workload?	How can leaders and managers continue to benchmark against international safety frameworks to ensure sound decision making?	How to empower staff who have many years of experience to use their experience to ensure safe operations going forward?

Table 2: **Exploratory questions** (cont'd)

National characteristics	Inclusive and facilitative leadership and management	Adherence to processes and planning	Collaborative decision making	Strong sense of responsibility and accountability
Trust and respect for boundaries	<p>How can extensive expectations and trust affect managements' ability to verify conformity to safety practices?</p> <p>How can your organisation improve the management of its relationships, and ensure inclusion of relevant stakeholders (i.e. vendors) in discussions that target safety culture?</p> <p>How can the lack of direct engagement from top management affect workers' ability and motivation to perform and report?</p>	Is there a mechanism in your organisation to investigate/assess whether processes are exhaustive or over-reaching, to the point of impacting safety?	How to ensure that a culture of tolerance does not inhibit organisational values from being integrated into your organisation's decision-making process?	<p>How to ensure that staff are encouraged and acknowledged for asking challenging questions?</p> <p>How can the organisation foster and maintain a collective/team approach after the strain in interpersonal communications resulting from the COVID-19 pandemic?</p>
Conflict avoidance	<p>Are there mechanisms to support managers to drive for high levels of safety and conduct the necessary follow-up all the while without creating conflict or affecting the social contract?</p> <p>How does your organisation ensure that workers have a safe atmosphere for reporting up?</p>	How to ensure that open and candid communications are nurtured towards continuous improvement of safety?	How does the desire to avoid conflicts impact voicing opinions in decision-making processes?	How does your organisation proactively support and encourage constructive criticism and voicing of differing opinions to achieve collaborative discussions that improve safety?

Conclusions

The Country-Specific Safety Culture Forum (CSSCF) Canada generated very positive feedback from participants at the two-day event and from those who took part in the data collection activities. A unique experience for the Canadian nuclear community, the Forum prompted candid discussions around critical components of healthy safety culture and considerations on how Canadian cultural characteristics influence their national safety culture. Participants found the scenario enacted in the Forum to be instrumental in promoting fruitful dialogue about potential safety culture challenges. The organisers of the Forum – the OECD Nuclear Energy Agency (NEA), the World Association of Nuclear Operators (WANO) and the host, the Canadian Nuclear Safety Commission (CNSC) – received positive feedback from the diverse and broad range of relevant stakeholders who participated in the Forum.

The outcomes of CSSCF Canada found six key traits to be characteristic of Canadian culture:

- strong commitment to a social contract;
- inclusivity and collective approach;
- being achievement-oriented;
- collective pride and personal humility;
- trust and respect for boundaries; and
- conflict avoidance.

These play out in a variety of organisational behaviours and contribute to the climate of safety culture in the nuclear industry. In addition, the discussions held by participants during CSSCF Canada identified the following relevant organisational areas for exploration: leadership and management; processes and planning; decision making; and responsibility and accountability.

Notably, the Canadian nuclear community benefits from an overall facilitative leadership approach, a shared drive towards common goals and achievements, and the promotion of open, collaborative and respectful communications.

Taking into consideration that the Canadian nuclear community places strong emphasis on nuclear safety and, as such, already manifests many attributes conducive to a healthy safety culture, six areas in which these attributes could pose challenges were identified. These include: 1) a tendency towards conflict avoidance; 2) the assumption that all co-workers are equally achievement-

oriented; 3) a tendency to tolerate errors made by co-workers known on a personal level; 4) a lack of peer-to-peer questioning and monitoring; 5) lengthy processes and procedures that are challenging to operationalise; and 6) a disconnect between senior management and operational staff. These areas are derived from the analysis of the “Observations from CSSCF Canada” on pages 37-48 of this report.

These topics are explored in this report, which aims to identify the national attributes of the Canadian nuclear community and how these traits contribute to the organisational behaviours that may influence nuclear safety. Questions that arose concerned the lengthy processes and extensive procedures that are in place at nuclear facilities, as well as how Canadians’ tendency towards being overly polite and their commitment to a social contract could deter staff from easily raising opposing views. The report is meant to serve as a reflection and an instrument for nuclear organisations to use when assessing methods to enhance their nuclear safety culture.

This continued reflection within nuclear organisations – focusing on their particular challenges based on deeply rooted assumptions – would be instrumental and necessary to continue progressing towards a strong and healthy safety culture. Periodic group discussions and direct contact and communication between different departments would be an effective strategy to carry this forward. The outcomes of CSSCF Canada, as illustrated in this report, are meant to be complementary to existing initiatives such as leadership training and development, effective teamwork practices and procedures, safety culture assessments, and other internal improvement initiatives.

Enhancing safety culture within organisations is a continuous, progressive process. Rather than to showcase a conclusive determination of Canadian culture or its nuclear safety culture, this report is meant to support that process.

As previously concurred from the CSSCFs carried out in Sweden (2018), Finland (2019) and now Canada (2022), the relevance of the national cultural context on nuclear safety culture is incontestable. As such, the NEA and WANO encourage other countries to reflect on how the characteristics of their national culture can influence the nuclear safety culture structures in place within their nuclear institutions and in their nuclear community as a whole. In this regard, all organisations involved in nuclear activities should engage in concrete action to gain awareness and understanding of how national characteristics impact their day-to-day communications and general operations. Recognising that improving nuclear safety is an ongoing process, the report authors hope the processes and tools outlined will provide concrete support for continuous self-assessment and institutional growth well into the future.

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Country-Specific Safety Culture Forum Canada

One of the many lessons learnt about nuclear safety over the years has been that human aspects of nuclear safety are as important as any technical issue that may arise. The international nuclear community regularly works together to identify, discuss and address technical issues, but examining how behaviour affects safety from country to country remains less common. Yet practical experience has shown that there are important differences across borders and even within borders in how people work together and communicate.

The Country-Specific Safety Culture Forum was created to gain a better understanding of how the national context affects safety culture in a given country and how operators and regulators perceive these effects in their day-to-day activities. The ultimate goal is to ensure safe nuclear operations. The third NEA safety culture forum – a collaborative effort between the Nuclear Energy Agency (NEA), the World Association of Nuclear Operators (WANO) and the Canadian Nuclear Safety Commission (CNSC) – was held in Canada in September 2022. This report outlines the process used to conduct the forum, reveals its findings and encourages the nuclear community to further reflect and take relevant action.

Nuclear Energy Agency (NEA)

46, quai Alphonse Le Gallo
92100 Boulogne-Billancourt, France
Tel.: +33 (0)1 73 21 28 19
nea@oecd-nea.org www.oecd-nea.org