CASE STUDY

Strengthening trust in the sustainability of nuclear energy

CSA Group standards help improve the environmental performance and transparency of this low-carbon power source

At COP28 in December 2023, Canada was one of more than 20 countries that committed to triple the use of nuclear power to help meet climate change targets. In their declaration, the countries cited nuclear energy's capacity to provide large amounts of baseload power while also being a "good partner" for other energy sources, including renewables. At the same time, the signatories noted nuclear power strengthens energy security and has "additional flexibilities that support decarbonization beyond the power sector, including hard-to-abate industrial sectors," all of which points to its importance in meeting global climate and the United Nations' sustainable development goals, including Goal 7: Affordable and Clean Energy[1].

Achieving net zero is critical in addressing climate change. Without nuclear power in the mix, it could become much harder and more expensive[2]. That creates an urgency to site and construct new reactors, refurbish existing plants, and invest across the value chain - from research and uranium mining to effective waste management.

[1] Sustainable development – The 17 Goals, https://sdgs.un.org/goals

[2] Nuclear Power and Secure Energy Transition, IAE, https://www.iea.org/reports/nuclear-power-and-secure-energy-transitions

As countries look to scale nuclear power exponentially, several conditions will need to be met in both the short and long term, not the least of them being investor, political, Indigenous, host community, and public confidence.

That social license requires nuclear facilities to demonstrate sound environmental performance and stewardship. But how do operators or the public know what "sound" looks like when it comes to environmental performance?

Perhaps more than any other industry, the nuclear sector's environmental performance is strongly connected to public trust.

Earning that trust requires effective and responsible environmental management, regular, transparent reporting, and public engagement. These objectives are supported by a series of inter-connected CSA Group standards developed and updated over 40 years through collaborative work between the nuclear regulator, utility operators, industry and academic experts, and communities.

This case study outlines the standards, their development, and the value they provide to support safe, sustainable, transparent nuclear operations.

Promoting environmental management throughout a nuclear facility's life cycle

The CSA N288 series of Standards on environmental management for nuclear facilities provides a framework, implementation guidance, and action levels for nuclear facility environmental protection.

The CSA N288 standards address nuclear and hazardous substances and physical stressors in airborne emissions and waterborne effluents, fugitive emissions, and other physical impacts on human and non-human biota over the life cycle of the facility, including site preparation, construction, commissioning, operation, decommissioning, and abandonment.

The series covers several types of full life-cycle nuclear facilities and activities, including power production, uranium mining and milling, research, and fuel processing and fabrication.

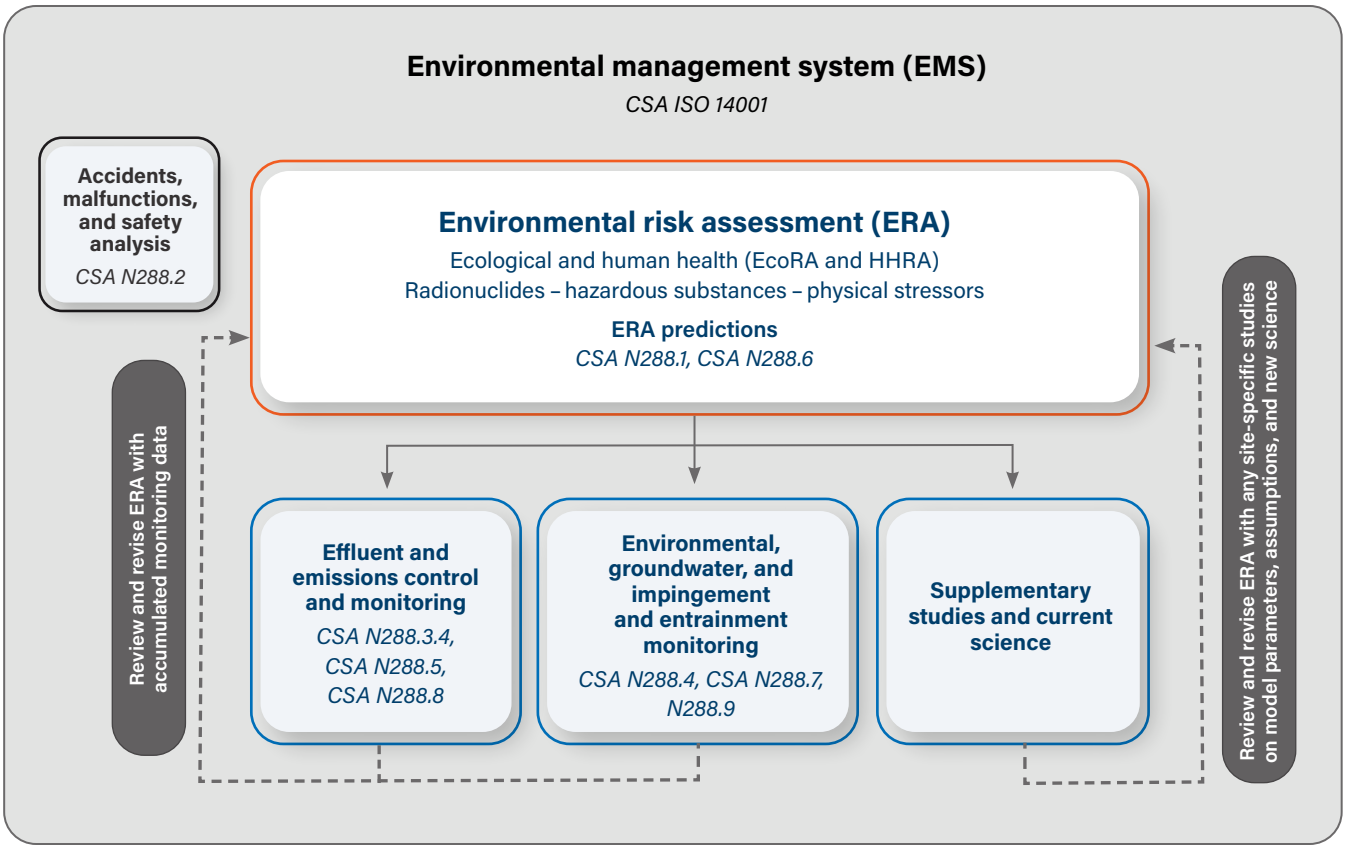
An overarching standard, CSA N288.0, *Environmental management of nuclear facilities: Common requirements of the CSA N288 series of standards,* provides the framework for several specific standards for cohesive implementation within an environmental management system (EMS).

Nine additional standards complete the series:

- CSA N288.1, *Guidelines for modelling radionuclide environmental transport, fate, and exposure associated with the normal operation of nuclear facilities;*
- CSA N288.2, *Guidelines for calculating the radiological consequences to the public of a release of airborne radioactive material for nuclear reactor accidents;*
- CSA N288.3.4, *Performance testing of nuclear air-cleaning systems at nuclear facilities;*
- CSA N288.4, *Environmental monitoring programs at nuclear facilities and uranium mines and mills;*
- CSA N288.5, *Effluent and emissions monitoring programs at nuclear facilities;*
- CSA N288.6, *Environmental risk assessments at nuclear facilities and uranium mines and mills;*
- CSA N288.7, *Groundwater protection and monitoring programs for nuclear facilities and uranium mines and mills;*
- CSA N288.8, *Establishing and implementing action levels for releases to the environment from nuclear facilities;* and
- CSA N288.9, *Guideline for design of fish impingement and entrainment programs at nuclear facilities.*

As shown in Figure 1 below, under the CSA ISO 14001 Environmental Management System (EMS) framework, the CSA N288 modelling and environmental risk assessment standards (CSA N288.1 and CSA N288.6, respectively) inform the other standards in the series that relate to specific monitoring and testing programs and provide direction for action levels.

Figure 1: Interrelationships between environmental monitoring and other activities within an environmental protection framework for a nuclear facility or activity



Note: Figure adapted from *CNSC REGDOC-2.9.1*

Conducting environmental risk assessment reviews and updates

When an Environmental Risk Assessment (ERA) is a regulatory requirement for nuclear power plants and uranium mines and mills, it is conducted in accordance with CSA N288.6 and reviewed at least every five years. The standard provides a foundational basis to inform the ERA. CSA N288.6 also helps guide the operators' activities to validate that the facility and program performance meets the requirements of the CSA N288 series and, consequently, related regulatory requirements.

Kevin Nagy serves as Chair of the CSA Group Technical Committee on Environment Management of Nuclear Facilities (CSA N288). He is also Director of Compliance and Licensing at Cameco Corporation, a global provider of nuclear fuel that mines, mills, and processes uranium, fuel for nuclear energy production.

Prior to the development of guidance for ERA, outlined in CSA N288.6, the scope of facility review from a risk assessment perspective was narrower, and reviews were less frequent, says Nagy, who formerly worked as a provincial regulator in Saskatchewan. The breadth and scope of facility types and activities covered, the frequency of review, and the aspects of monitored operations have evolved alongside the development of the standard, he says.

Before the 2000s, "you would do an environmental risk assessment when you proposed a project, and unless you proposed another project or a significant modification that triggered another assessment, you might never have to do one again," says Nagy.

"Or maybe you wouldn't do one until you shut down the facility and decommissioned. But now, there's this process where you're reviewing the core assumptions and underlying foundation of those risk assessments every five years through the ERA. You're continually looking at the facility's performance, the basis upon which it was approved, and then that feeds into your monitoring program."

And, as science evolves, the CSA standards technical committees continue to review and update the standards, which align with the federal safety regulator's processes, he says.

Environmental scientist and aquatic ecologist Dr. Cherie-Lee Fietsch, the Environment Regulatory and Research Manager at Bruce Power, serves as Vice-Chair of the CSA N288 Technical Committee and a member or chair on several CSA N288 Technical Subcommittees. She is also the current Chair of the CSA N288.9 Technical Subcommittee. She says that when she joined Bruce Power in 2008, the standards seemed static. "We weren't working on these routine updates. I think we've come a long way." She says that regular standard updates mean the operators remain current on science, industry advances, and evolving expectations of communities and the public.

On the flip side, it does require a greater commitment from industry. With ERAs now completed every five years and ongoing revisions to the standards occurring during that period, operators can find themselves working to comply with different versions of the standards within the same reporting period.

Despite that challenge, Fietsch says she supports the principle of continuous improvement that comes with regular dialogue and updates. And, she adds, one value-add aspect is tying the standards directly to regulatory requirements, so there is consistency and clarity in compliance expectations with both.

Christine Gallagher, former Environmental Protection Program Manager at Canadian Nuclear Laboratories (CNL), recalls that in the early 2000s, the environmental monitoring program was executed but without the same level of detailed understanding of the rationale behind program decisions. She says the work by the CSA committees has given operators an evidence-based rationale for why and where program elements are implemented, in addition to what and how.

"To have the systematic approach and understand why you're monitoring, what the thresholds are, why you would stop monitoring… is very useful," she says, noting it "removes the subjectiveness of somebody's opinion of why something is important."

Standards complement and support regulations to uphold safety

Staying current with the latest information and creating collaborative solutions is beneficial but also resource-intensive. To reap the greatest benefit of that investment and best outcomes, Fietsch says, it is important that standards and regulations align and that the work done at the collaborative standards development table informs the related regulation.

The CSA N288 series plays a key implementation role in Canada's regulatory framework for environmental protection, says Dr. Elias Dagher, Canadian Nuclear Safety Commission (CNSC) Acting Director of the Health Sciences and Environmental Compliance Division and CSA N288.8 Technical Subcommittee Chair.

Dagher was involved in the early development of both the CSA N288.0 standard and the CNSC's environmental protection framework. The CSA N288 standards are embedded in required activities of key regulations and legislation within the CNSC REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures.* The CNSC REGDOC-2.9.1 measures outline the CNSC's regulatory framework for environmental protection. The CSA standards provide more detailed requirements and guidance on meeting the required activities of key regulations and legislation.

"This is a series of Canadian standards that provides tools on how to develop different monitoring programs and risk assessments essentially used to demonstrate safety," says Dagher.

"CSA N288.6 documents the process of conducting environmental risk assessment – both human health and ecological health assessment – so the output of that is literally to demonstrate whether there is or could be a potential risk to human health or the environment," he says. "And the other CSA (N288) standards stem off of that (for) monitoring to ensure those predictions are being met and how you develop monitoring programs, what is the process, and how you ensure they are going to provide you the technical information you need to make informed decisions on the site."

The ability to bring together triangulated views from various expert perspectives, codify it in a way everyone understands, reach consensus, and apply it in a common standard that both informs regulation and ensures consistency in methodology is powerful, Dagher says.

"CSA provides a very strong function for us to be able to meet with industry, private sector, and regulators to provide those technical requirements. So, out of our high-level requirements, it allows us to put those through a consensus standard that has gone through a very robust technical discussion."

Fietsch supports a similar approach to other regulatory developments.

"If you're compliant with CSA N288, you're compliant with REGDOC-2.9.1, so it fits really well together," she says. "We're trying to see if that can work the same in other areas…whereas if that doesn't happen, you have to backfill the regulation into the standards," and it negates the value of the collaborative process and the efficiencies, she says.

A big tent approach to standards development

As described earlier, the ability to align standards and regulations and have them inform each other is one of the benefits of the CSA committee approach. Another benefit is the capacity to bring together many views for input on different aspects of the standards so that diverse perspectives are captured and factored into the standards (and ultimately regulation) early in the process versus after regulations are set.

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"What I really appreciate about having that conversation at the technical subcommittee level is that you do have those detailed conversations in that open forum, and you hear the different perspectives and experiences whether it's from the regulator side, the licensee side, academics or consultants, and any other [parties]," says Brady Balicki, Cameco's manager of environment and licensing, a member of several CSA N288 Technical Subcommittees.

Stacey Fernandes is a Senior Environmental Engineer at CanNorth (Canada North Environmental Services), an Indigenous-owned environmental consulting company, who works with CSA N288 Technical Subcommittees. She says one of the strengths of the CSA collaborative approach is the inclusion of another group of people, those who are ultimately most affected by the operations: local communities. First Nation and other host communities provide unique and important considerations that, when fed into standards development, bring another facet of relevance. This can include how rightsholders and other parties use the land, the information that industry and regulators might not otherwise have, she says.

"The consideration (for standards) is not just about the operations; it also considers the activity of people and animals in the local area. For example, are (the community members) hunting moose or caribou, collecting medicinal plants, and where are they collecting and hunting? These are all considerations from community input used in the assessment," she says.

In addition to insights gained through local, on-the-ground perspectives, the CSA standards development also benefits from a global perspective. The CNSC's Dagher says the work done at the committee level is shared with other regulators globally. This allows the international community to exchange information, learn from each other, and bring another layer of validation to the standards' appropriateness and relevance, which in turn can be fed back into the CSA process.

Anyone who has collaborated with multiple parties and community members knows it is not a straightforward process since perspectives are not always well aligned. Collating diverse perspectives to form a meaningful consensus takes work and skill. The roles of regulators and operators are very different, and consequently, so are the perspectives. But that only makes the early engagement process more important, says Dagher.

"We do see a lot of value in going through the CSA approach. Sometimes, it's a challenge because, as regulators, we need to ensure that the CSA standards satisfy regulatory requirements and are reflected as per their intention. But, from my experience, it's been a really good, strong collaboration. There can be differences of opinion, obviously, between the industry and the regulator, but CSA provides a really great forum to work out those differences."

Standards support transparency and trust in communication

CanNorth's Fernandes says that besides strengthening the environmental soundness of operations, the standards play an important role in supporting transparent and clear public communication. Having an agreed-upon standard of practice gives members of the public both a window into the operations and an understanding of how well the facility meets those requirements. The CSA nuclear standards, in particular, can support evidence-based communications, Fernandes says, "because CSA N288.6 and CSA N288.1 are a little bit more prescriptive than some other organizations' standards, they are more clear and helpful."

That specificity can be beneficial for transparent public communication, although depending on the facility and the operations, it is still a pretty complex communication message, suggest some of the industry participants. For example, the CNL sites have a long and complicated history, resulting in multi-faceted scenarios for monitoring and risk assessment programs across large, historical, multi-purpose sites. Translating the programs and standards into coherent public-facing communications requires additional expertise and resources. "It's not a soundbite," says CNL's Gallagher.

However, there is one audience, she says, for whom the standards and the specificity within them are really helpful. The standards support the management team's decision-making on resources because they provide a clear picture of what is needed to deliver a compliant program.

And, when communication and a common set of metrics are understood and agreed upon by the industry, regulators, and other key communities and interested parties who have some ownership in the development, that in itself can be a powerful message.

Increasing the global use of nuclear power to support a net-zero future, as recognized in the pledge at COP28, will require ambitious actions, investments, and enabling conditions. Among these requirements, the nuclear sector's safety record, environmental performance, and transparent reporting will continue to be paramount to uphold its social license. Clear, evidence-based standards that provide consistent methodologies, align with regulatory requirements, and are developed using an inclusive consensus approach are key enablers of this performance.