Canadian and United States Regulatory Cooperation for New Nuclear Deployment

RECOMMENDATIONS FOR IMPLEMENTATION OF THE INTERNATIONAL REGULATORY EFFICIENCY FRAMEWORK

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EXECUTIVE SUMMARY

Successful large-scale deployment of new nuclear energy is needed to meet the nation's energy, climate, environmental, economic and security goals. Efficient regulatory pathways are needed to achieve this goal.

In the report, "A Framework for International Regulatory Efficiency to Accelerate Nuclear Deployment," released in September 2023, the World Nuclear Association, Canadian Nuclear Association, Nucleareurope and Nuclear Energy Institute outline essential actions necessary to improve efficiency in international regulatory design review activities. The goal is a streamlined approach to international regulatory cooperation that seeks to minimize the duplication of design reviews by multiple national regulators.

The purpose of this report is to apply the international framework to the Canadian and U.S. regulatory cooperation to streamline licensing between these two countries. Canada and the U.S. are already embarking on regulatory cooperation, and this paper articulates the industry's perspective on the long-term goals for such cooperation, and additional near-term actions that our nations can take to achieve these goals. To be clear, regulatory cooperation extends beyond the national regulators, Canadian Nuclear Safety Commission (CNSC) and U.S. Nuclear Regulatory Commission (NRC), to include other government agencies, the nuclear industry and standards development organizations.

Strategic regulatory cooperation between Canada and the U.S. will help enable both nations to achieve the large-scale deployment of new nuclear power plants and enable both countries to achieve their national energy, climate, environmental, economic and national security goals.

The recommended goals and actions are presented through a framework of five proposed workstreams that achieve the regulatory cooperation needed to enable large-scale advanced reactor deployment.

Aligned around the international regulatory efficiency framework, this report recommends 13 near-term actions that are necessary to achieve the following five longer-term goals for international regulatory efficiency in Canada and the U.S.

Goal 1: Domestic Preparedness

The goal of domestic preparedness is to regulate safe nuclear energy as efficiently as possible to meet climate change and energy security targets.

Goal 2: Regulatory Cooperation Agreement

The goal of regulatory cooperation agreements is to provide immediate benefits to near term applications to cooperating regulators, while pursuing a plan for increasing levels of cooperation that provide greater international regulatory efficiency benefits.

Goal 3: Assistance to Host Countries

The goal of Canadian and U.S. assistance to potential host countries is to accelerate the safe deployment of nuclear energy in host countries.

Goal 4: Align Codes and Standards

The goal of codes and standards alignment is to minimize the differences between codes and standards endorsed by cooperating regulators.

Goal 5: Design Standardization

The goal of design standardization is establishment of a stable standard design, for the portion of the plant that requires regulatory approval, that benefits from requirements that are streamlined between two or more regulators to the extent practicable.

Achievement of these long-term goals for international regulatory efficiency will help enable Canada and the U.S. meet their energy, climate, environmental, economic and security goals. It will also spread our high standards for nuclear safety, security and non-proliferation internationally, as the world pursues widespread use of nuclear energy to mitigate the worst effects of climate change and provide energy security.

INTRODUCTION

In Canada and the U.S. there is an ever-increasing urgency for reduction in use of greenhouse gas emitting energy sources for both electric and non-electric use (e.g., heat for industrial applications). As our countries, electricity producers, and end-users establish their climate change plans, it is essential that the path to net-zero carbon be affordable, reliable, and timely.

The solutions to meeting the carbon reduction challenge in the next decade will include energy generated by advanced nuclear reactors. The Department of Energy (DOE) Liftoff report for Advanced Reactors estimates that the U.S. will need an additional 200 GWe of new nuclear by 2050, and the Advanced Reactor Roadmap led by the Electric Power Research Institute (EPRI) and Nuclear Energy Institute (NEI) referenced a study that identified a potential need of 300 GWe of new nuclear by 2050. Both of these reports identified the regulatory pathways for new nuclear plants to be a potential barrier to large scale deployment.

The NEI in a June 2022 letter to the NRC (Ref 1) has identified that the NRC could receive 12 or more new reactor applications per year by 2025; that there could be in the range of 22 plants coming on-line per year by 2040; and that 60 applications could consistently be in the regulatory process at one time by 2030.

In Canada there is no current published estimate for license application numbers. Unpublished estimates are in the range of 60 applications for nuclear facilities between present and 2050 which would mean as many as 20 in process at one time with the current review/approval duration.

The large-scale deployment of new nuclear power plants will be enabled by some key enhancements. One of these is the time and cost that it takes to license new reactors. Nuclear energy has considerable safety regulation, and necessitates knowledgeable regulators. While rigorous independent regulation of nuclear safety is a core value, there are still opportunities to increase the efficiency with which the regulations are implemented. Furthermore, not all countries have regulators experienced with nuclear energy. Nuclear is a relatively complex technology and if regulators do not have sufficient understanding of the technologies they need to regulate, or the sufficient capacity to do so, there will be delays in achieving the necessary approvals to advance projects in the timely manner the world needs. Likewise, if there are a wide range of differing safety codes and standards from country to country, vendors seeking to sell their nuclear technology need to address different requirements in different countries, which drives up cost, introduces delays, and perversely, may negatively impact on safety.

Nuclear deployment can be lower-cost, faster and more effective if these challenges and barriers to nuclear deployment are addressed and eased. Such efficiencies would strongly benefit climate change strategies to reduce carbon generation and enable the world to reach net-zero more easily at lower cost.

[1] For clarity, note that this paper considers “advanced reactors” to cover both light water reactors (LWRs) and non-LWR designs. The term SMR refers to reactors of typically less than (about) 300 MWe and includes LWR and non-LWR.

NEED FOR INTERNATIONAL REGULATORY EFFICIENCY

If regulators keep operating in the same way while trying to deploy the number of plants the world needs, their regulatory capacity is likely to be a limiting factor.

It is a given that nuclear power plants are required to be licensed and regulated. Safety requirements are developed either by national regulators or are based on those established by the International Atomic Energy Agency (IAEA). National laws establish the sovereignty of national regulators within their borders and the mandates for regulatory requirements. These laws are enacted to protect the public health and environment. However, regulators can do many things to improve the efficiency in achieving their mission and mandates.

The goal is to regulate safe advanced nuclear technologies measurably more efficiently than has been done in the past, and as efficiently as possible while still ensuring safety and accepting national regulatory sovereignty. Such efficiency can be discussed both in terms of domestic (that which is completely within the nation's borders) and international (that which interfaces with regulators in other countries) activities.

Domestic Regulatory Efficiency

Licensing costs and durations vary from nation to nation. In the western world, licensing durations are invariably long. To give a sense of the licensing costs and durations in the U.S., please see historical data in Table 2. While not precisely the same for other western world countries, this data is indicative.

Table 2: Typical US NRC Licensing Durations and Fees for Nuclear Power Plants

U.S. Licensing Durations and Costs		
Type[1]	Duration[2]	Cost[3]
DC	3 to 4 years (4 to 9)	$45M to $68m
Col	2.5 to 3.5 years (4)	$28M to $30M
ESP	2 year (3 to 6)	$6M to $19M
OL	3 to 3.5 years (8)	$42M

1. DC = Design Certification, COL = Combined Operating License, ESP = Early Site Permit, OL = Operating License
2. NRC Generic Schedules: https://www.nrc.gov/about-nrc/generic-schedules.html; "()" reflects historical performance which has exceeded generic schedules, in some cases by more than double; these generic and historical schedules do not include pre-application, acceptance, commission approval and hearings/rulemakings which adds 1 to 3 years to the actual schedule
3. NRC Letter to Senator Inhofe April 7, 2015 (ML1508A361), costs of more recent reviews are even higher on an inflation adjusted basis

Assuming a base case cost of licensing the same design in multiple markets (using NRC costs), the design certification or equivalent technical review would be about $50 million (USD) per design per country, or about $1B to approve in 20 countries (a conservative estimate of the number of nations likely to license new reactors in the next 2-3 decades). A combined construction-operating license (or local equivalent) is estimated at $30M per site. It is likely that at least four to five designs will be broadly deployed in 20 countries, at 400 to 500 different sites. In this scenario, the licensing costs alone for new reactors through 2050 are on track for over $15B.

This is a substantial cost, and each such certification and license adds significantly to the overall project cost and subsequent cost of generated power/electricity, and could be an impediment to project proponents going ahead. Indeed, for microreactors where the entire project cost (other than licensing) might be under $100M, a licensing fee approaching 50% of the total capital cost would be prohibitive of advancing the project to completion.

An even more significant impediment is an unnecessarily long project schedule that regulatory inefficiencies pose. In older gigawatt-class nuclear projects, where the construction schedule is on the order of 6 to 10 years, an environmental assessment and licensing period in the range of 5-10 years is already a significant impediment to timely nuclear deployment. For new nuclear, with construction timelines on the order of 3 to 4 years projected for 300 Mwe class SMRs, 5 or more years for licensing basically doubles the project deployment schedule. This dramatically complicates the opportunity for nuclear to significantly contribute to fighting climate change. Such long EA and licensing periods are even more problematic for micro-reactors. If the construction period for a micro-reactor is on the order of a month to a year (depending on the design), licensing is not just one critical path, it is essentially the entire project schedule. In fact, these durations are resulting in end-users taking a different, potentially inefficient, non-nuclear pathway to decarbonization.

Success would be to modernize regulatory frameworks (regulations, key policy and technical positions, licensing and oversight) to most efficiently reflect the innovative features, safety, and simplicity of advanced nuclear technologies, and regulatory reviews that approve safe designs as efficiently as possible.

International Regulatory Efficiency

Imagine a new reactor design which has recently been certified (e.g., in the U.S. by the NRC), or licensed (e.g., in Canada by the CNSC or in the UK by the Office for Nuclear Regulation (ONR). These regulators are highly experienced with decades of licensing fleets of power reactors of varying designs, and with established safety records. If a project developer proposes to build and operate the same design in another country, it does not make sense to start the licensing process from scratch. The safety analysis has already been completed to the satisfaction of a credible regulator. Much of that analysis and review ought to be usable in the second country. Certainly, local environmental, geological, weather conditions, etc., must be reviewed against the design. The nuclear management system and safety culture of the operator in the second country must be validated. However, the design itself should be "portable" to the second country.

To date however, there is unnecessary duplication of effort in regulatory reviews for localization of previously approved designs, partly due to the lack of recognition of the safety approval in another country and partly because the regulatory frameworks between the two countries are different. This raises cost—making the cost of fighting climate change unnecessarily higher. It causes delays—pushing off carbon reduction farther into the future. And because of the current practice of each country's regulator establishing specific and varying national requirements (because of a lack of international regulatory cooperation), it pushes designers and proponents into making country-specific design changes, which also raises cost and pushes schedules.

Success would be reduced timelines and cost for a design already licensed in another country to be localized in a second country, drawing extensively on the insights and conclusions by another competent regulators.

FRAMEWORK TO IMPROVE REGULATORY EFFICIENCY

The framework to improve regulatory efficiency is built around five workstreams, with roles and responsibilities for interested regulators and industry, to initiate preliminary work towards the goals outlined above. Additional details in the implementation of this framework are included in the report, "A Framework for International Regulatory Efficiency to Accelerate Nuclear Deployment" issued by the World Nuclear Association (WNA), Canadian Nuclear Association (CNA), Nuclearеurope and Nuclear Energy Institute (NEI).

Goal 1: Domestic Preparedness

The U.S. and Canada, as leaders in first of a kind advanced reactor deployments, need to ensure their regulatory agencies and frameworks are set up for success to effectively and efficiently manage the wave of applications coming their way. This includes being prepared to license designs with the enhanced safety and innovative features of advanced nuclear power technologies. A collaborative plan could be established and executed to test that readiness, and initiate any enhancements deemed appropriate.

Goal 2: Establishing Regulatory Cooperation Agreements

A second workstream would be to establish a vision of what might be possible. Such a vision could include a "5-Star Cooperation" framework, with each step or "star" building on those before it.

A framework of bilateral regulatory cooperation between two like-minded regulators, with opportunities for immediate, beneficial, "low-risk" outcomes on design and safety reviews.

Near-term goals of more advanced cooperation and integration with efficiencies improvements, drawing on work done by the peer regulator.

Build on Stars 1 and 2, work towards mid-term goals to accept peer's validation that a design meets safety limits, and joint safety evaluation on scope of design where requirements are the same in both countries.

Longer-term goals that establish a framework for translating regulatory approvals from one country to another and defining the scope of design that needs to be reviewed locally to confirm compliance with different requirements.

The aspirational goal or the "Gold Star" would be harmonization of nuclear regulatory requirements and full reciprocity from one regulator to another.

Goal 3: Assistance to other Potential Host Countries

A third workstream would be the support by experienced nuclear regulators (e.g., NRC, CNSC) and leading nuclear industry companies for development of potential host country regulators to increase their readiness, improve international safety, and support the North American export interest.

In this regard, there are many support opportunities for nuclear industry and regulators, including the following:

- Assisting in establishing regulatory infrastructure (laws, regulations, technical expertise)
- Providing technical support to the host country for design reviews
- Involving the host country regulator in regulatory reviews in country of origin
- Establishing cooperation or reciprocity agreements
- Providing funding and technical expertise

Goal 4: Aligning Codes and Standards

One of the most important areas for regulatory alignment is to agree on international nuclear design and construction codes and standards. This would help enable and support international alignment of regulatory requirements through harmonization on international codes and standards. The proposed product of this workstream is a process or tool that can be used to minimize differences between codes and standards accepted by international regulators, and ultimately see regulators endorse right-sized international codes and standards.

Goal 5: Design Standardization

The industry's main contribution to the streamlining of regulatory reviews, both within a single country and across multiple nations, is to establish standard designs. These standard designs are to be stable over time so that the design approved by the national regulator is not changing from one application to another. However, a design must also be standardized between multiple countries, otherwise the regulatory cooperation may be hindered by the fact that the design is different from one country to another. It is also true that technology advances and over longer periods of time the design will evolve in response to operating experience and lessons learned. Design standardization is thus enabled when the national regulator ensures that only the appropriate scope necessary for safety decisions is required to be in the design approval, and when the requirements and expectations between two or more regulators are extensively compatible. Here compatibility avoids the summation of the most conservative requirements between multiple countries, but does not necessarily mean that the regulators must change their requirements to be identical. Longer term however, there are expected to be opportunities to achieve greater international standardization through the harmonization of nuclear regulatory requirements.

DOMESTIC PREPAREDNESS

Improving the preparedness of domestic regulatory frameworks and processes is essential to the deployment of new nuclear energy. As nuclear reactor technologies advance the requirements ought to advance with them.

As an example, the U.S. requirements were developed based upon large light-water reactors (LWR) that the NRC was regulating at the time that the regulatory framework was established, and large LWRs have been the only technology pursued in the U.S. until more recently. The result is a collection of requirements that are specific to large LWR designs, and which do not apply efficiently, or in some cases at all, to the new advanced reactor technologies that are being planned for deployment. In response, the NRC has been pursuing a modernization of its requirements for over 10 years to be more appropriate to advanced reactor technologies in a way that is technology-inclusive, performance-based and risk-informed. The situation is similar in Canada where the codes, standards and regulatory processes were designed around CANDU reactors, and will need to be updated for the new generation of technologies.

Examples of regulatory modernization for advanced reactors in both countries include the establishment of alternative approaches to emergency planning, improving the predictability of review schedules and establishing alternative pathways to establish the licensing basis, including approaches that would increase the use of probabilistic risk assessments or leverage IAEA safety approaches.

Domestic preparedness for the large scale deployment of new nuclear reactors must be defined as being able to efficiently review advanced reactor applications, which is predicated on having a clear, predictable, and flexible licensing framework. There are three areas in which preparedness is needed: 1) streamline regulatory processes to achieve much more timely and efficient application reviews and oversight of new and advanced reactors, 2) resolve key generic technical policy topics well before new and advanced reactor applications are submitted for regulatory review, and 3) revise or establish new regulations, as quickly as possible, to achieve a more modern and efficient regulatory framework.

Domestic regulatory efficiency efforts need not proceed independently. They will benefit by being informed by regulatory cooperation with other regulators and broader international regulatory harmonization efforts. For example, the CNSC and NRC have a bi-lateral regulatory cooperation agreement, so to the extent that both regulators are considering regulatory efficiency improvements in the same area, collaboration to establish compatible approaches will improve international regulatory efficiency. In fact, a lack of coordination of domestic regulatory enhancements in the same area could make regulatory cooperation more difficult, if the countries establish approaches that are incompatible with each other.

Goal: The goal of domestic preparedness is to regulate safe nuclear energy as efficiently as possible to meet climate change and energy security targets.

RECOMMENDED ACTIONS

1. Regulators:

Ensure that the regulatory mission, both nuclear safety and environmental reviews, is aligned with avoiding unnecessary burden in regulating safe nuclear energy. This includes:

A. Establishing goals and metrics for licensing schedules and costs that enable regulatory approvals in 12 months or less, from the application submittal to final approval, for designs that have already been approved by the regulator.[2]
B. Establish a special project office to increase the focus and efficiency of advanced reactor licensing.
C. Apply appropriate regulatory requirements to advanced reactors that minimize regulatory burden to achieve the statutory requirements for the protection of public health and safety.

2. Industry:

Engage the regulators on the safety enhancements of advanced reactors that enable more efficient regulatory approaches. This includes proposing alternative approaches to regulatory requirements that are more aligned with the new and advanced nuclear technologies.

3. Governments:

Provide sufficient resources to the regulators that enable them to license new reactor applications, pursue domestic regulatory efficiency enhancements, and engage in regulatory cooperation and assistance.

[2] Milestones for the first review of a design should be 24 months or less from the time of application submittal to final approval.

REGULATORY COOPERATION AGREEMENTS

Experience has shown that multi-lateral harmonization of requirements, while a laudable long-term goal, is challenging and leads to frustration and disaffected stakeholders when progress is difficult to achieve.

Technical Cooperation

- Share technical insights on designs in each country
- Perform joint technical reviews and issue joint documents of their results
- Build confidence in peer's competency (informs Stars 2 and 3)
- Understand similarities and differences in regulatory frameworks (informs Star 3 and 4)

Technical Recognition

- Near-term goals for more advanced cooperation
- Accept peer's validation of designer's design and analytical outputs
- Avoid re-confirmation that design and analysis output is correct

Safety Recognition

- Build on Stars 1 and 2, work towards mid-term goals
- Accept certain peers' validation that a design meets safety limits
- Agreed on safety evaluation on a limited scope of design (e.g., Topical Report) where requirements are the same in both countries

Partial Reciprocity

- Longer-term goals
- A "Rosetta Stone" to translate regulatory approvals from one country to another
- A "Localization Roadmap" which defines the scope of design that needs to reviewed locally to confirm compliance with different requirements

Harmonization

- Aspirational goal
- Alignment of regulatory frameworks (regulations and laws)
- Full reciprocity of approval from the other regulator

Recent experience shows that cooperation between two, or very few, regulators is more conducive to achieving near term results and can be the initial steps to achieving more ambitious long-term regulatory streamlining. Such cooperation should be pursued by regulators that have compatible regulatory goals, and the cooperation should be structured in a way that benefits near term applicants and builds a foundation for greater benefits in the longer-term.

The 2019 Memorandum of Cooperation (Ref 2) between Canada's CNSC and the U.S. NRC is a model for such bi-lateral cooperation. The MoC speaks to sharing review approaches, pre-application collaboration, research, and training. Several joint reviews have already been completed and published, on topics pertaining to reactor technologies of interest on both sides of the border (e.g., Terrestrial, X-energy, NuScale and GE-Hitachi) (Ref 3). Early work on NRC/CNSC cooperation topics such as Classification of Structures, Systems and Components; Licensing Modernization; and TRISO fuel qualification assessment are underway. Through close cooperation, the CNSC and NRC are moving from a "1 Star" technical cooperation into a "2 Star" technical recognition through sharing technical insights of their reviews of specific designs that are being pursued in both countries.

Cooperation with other regulators is consistent with the NRC Mission. In the U.S., the Atomic Energy Act (AEA) designates the NRC as the sole U.S. regulatory authority for making decisions and issuing licenses in U.S. on matters of nuclear safety. Nothing in the AEA precludes the NRC from relying on information from a regulatory authority in another country for making decisions and issuing licenses. The NRC is required to have a reasonable assurance of adequate protection of the public health and safety—thus there would need to be reasonable assurance in the information from another regulator that serves as the basis for the safety finding. There are analogies here to the NRC current practice of relying on technical work from contractors. There are already examples of this in the nuclear field, for example in transport of nuclear materials. As described in the paper "A Framework for International Regulatory Efficiency to Accelerate Nuclear Deployment," other types of regulators in the aircraft and pharma industries are able to collaborate and rely on decisions from regulatory authorities in other countries.

Such goals are also consistent with the CNSC Mission. CNSC President Velshi has spoken publicly on international collaboration and harmonization (e.g., at the April 2022 Canadian Nuclear Association conference and at the October 2022 G4SR conference), where she made note of the above-mentioned MoC, joint evaluations, and working with the IAEA on its Nuclear Harmonization and Standardization Initiative.

Goal: The goal of regulatory cooperation agreements is to provide immediate benefits to near term applications to cooperating regulators, while pursuing a plan for increasing levels of cooperation that provide greater international regulatory efficiency benefits.

RECOMMENDED ACTIONS

4. Regulators:
CNSC and NRC should establish a plan for increasing their regulatory cooperation over time in ways that increase the benefits of international regulatory efficiency enabled by “4 Star” and “5-Star” regulatory cooperation agreements. CNSC and NRC should use their experience in regulatory cooperation to inform, and be informed by, the IAEA NHSI.

5. Regulators:
CNSC and NRC should expand regulatory cooperation by: 1) pursuing cooperation on additional designs that are common to Canada and the U.S., and 2) pursue additional bilateral cooperation agreements, or include other countries in the CNSC/NRC agreement, to bring international regulatory efficiency to more countries.

6. Regulators:
CNSC and NRC should establish a mechanism for greater discussion with industry on the long-term regulatory cooperation goals, and opportunities for near term cooperation.

ASSISTANCE TO OTHER POTENTIAL HOST COUNTRIES

Establishment of the regulatory framework for nuclear energy and the preparation for regulating advanced reactor technologies can take many years for nations to develop independently.

The IAEA has many tools to help countries with emergent nuclear energy programs and ambitions to pursue advanced reactor technologies, and these tools can be complemented with specific regulatory experience. Canada and the U.S. have decades of experience regulating nuclear energy and are at the forefront of the development, licensing and deployment of advanced reactor technologies under consideration by many other nations. Hence, the experience of Canada and the U.S. could help other nations accelerate the licensing and deployment of these designs. Thus, support from these "supplier" countries like Canada and the U.S. to potential "host" countries that might import designs licensed by Canada and the U.S. could significantly improve the world's ability to use nuclear energy to achieve carbon reduction and energy security goals. Canadian and U.S. support for other countries will increase diplomatic ties, spread our high standards for safety, security and non-proliferation, and create economic benefits in the supplier and host countries.

Goal: The goal of Canadian and U.S. assistance to potential host countries is to accelerate the safe deployment of nuclear energy in host countries.

RECOMMENDED ACTIONS

7. Regulators:
CNSC and NRC should pursue international regulatory cooperation with and assistance to regulators in potential host countries to the maximum extent possible. CNSC and NRC should prioritize this cooperation and assistance to countries that are seeking near-term deployment of designs that are being licensed in Canada and the U.S., but also ensure appropriate support for countries that seeking to build regulatory capacity to ensure nuclear safety for current plants or facilities and future potential reactor deployments.

8. Other Agencies:
Both the Canadian and U.S. governments should establish relationships as appropriate, including any necessary bilateral and multilateral agreements, with potential host countries to inform them of the regulatory cooperation and assistance available from the CNSC and NRC, understand the host country's regulatory assistance needs, and facilitate Canadian and U.S. support for the development of nuclear energy and adoption of Canadian and U.S. advanced reactor technologies in allied or partner nations.

ALIGNMENT OF CODES AND STANDARDS

Nuclear design and construction codes and standards are typically endorsed for use by national regulators and drive the design details. Thus, national regulators that endorse different codes and standards can result in different requirements and design variations in each country.

While new nuclear reactors will be able to utilize numerous codes and standards that currently exist, there are also a large number of revisions or even new codes and standards that will need to be developed. These codes and standards will be developed by standards development organizations through consensus of working members that come from industry, regulators and other stakeholders.

As codes and standards are revised and developed for new nuclear reactors, they can be developed either in a way to enable them to be endorsed by the cooperating regulators, or in a way that exacerbates differences between the requirements of each country. There are three main options for minimizing the difference between the codes and standards adopted in different countries: 1) reciprocity in acceptance of another country's codes and standards, 2) joint development of a code or standard, and 3) use of international standards. The timing of the market need for advanced reactors also necessitates that new or revised codes and standards will need to be developed more quickly than has been the historical experience.

Goal: The goal of codes and standards alignment is to minimize the differences between codes and standards endorsed by cooperating regulators.

RECOMMENDED ACTIONS

9. Standards Development Organizations:

Establish a forum for standards development organizations, industry and regulators to identify the gaps for codes and standards development and alignment and establish priorities and plans for developing aligned codes and standards. {This action is established in the Advanced Reactor Roadmap. The ANS, CSA and ASME, supported by NEI, CNA, and EPRI, have initiated an action plan to form and deploy the international group, "Nuclear Standards Collaborative (NSC) Initiative Moving Forward."}

10. Regulators:

Engage with cooperating regulators, the standards development organizations, and industry to endorse aligned codes and standards to the maximum extent practicable.

11. Developers:

Engage with standards development organizations and regulators to identify industry priorities for aligned codes and standards and approaches that result in maximum alignment for new nuclear designs.

DESIGN STANDARDIZATION

The industry's main contribution to the streamlining of regulatory reviews, both within a single country and across multiple nations, is to establish standard designs.

These standard designs are to be stable over time so that the design approved by the national regulator is not changing from one application to another. However, a design must also be standardized between multiple countries, otherwise the regulatory cooperation may be hindered by the fact that the design is different from one country to another. It is also true that technology advances and over longer periods of time the design will evolve in response to operating experience and lessons learned. Design standardization is thus enabled when the national regulator ensures that only the appropriate scope necessary for safety decisions is required to be in the design approval, and when the requirements and expectations between two or more regulators are extensively compatible. Here compatibility avoids the summation of the most conservative requirements between multiple countries, but does not necessarily mean that the regulators must change their requirements to be identical.

Longer term, however, there are expected to be opportunities to achieve greater international standardization through the harmonization of nuclear regulatory requirements. The World Nuclear Association, through its CORDEL working group, has previously done considerable conceptual thinking on this, and the IAEA Nuclear Harmonization and Standardization Initiative (NHSI) includes the goals of design standardization.

If instead of the existing different national requirements requiring unique solutions, applications and designs, we could take advantage of opportunities for sharing of regulatory experience, learning, and evaluation, deployment of large numbers of advanced reactors would be enabled while achieving the same high levels of safety and rigor in regulator reviews. In addition, countries with less established (or no) nuclear power regulators could move more quickly should they choose to deploy new nuclear technology as part of their climate change solution. If there were more consensus on the regulatory requirements between established regulators, there would be more incentive for new nuclear jurisdictions to simply "copy" those established requirements. If there were consensus on sharing regulatory analysis and reviews with the new countries, deployment costs in those new countries—which sometimes have more economic challenges—would be more practical.

Goal: The goal of design standardization is establishment of a stable design, for the portion of the plant that requires regulatory approval, that benefits from requirements that are streamlined between two or more regulators to the extent practicable.

RECOMMENDED ACTIONS

12. Cooperating Regulators:

Provide guidance on the similarities and differences between the regulatory requirements of national regulators that are cooperating to streamline their regulatory reviews between their countries.

13. Developers:

Design new nuclear reactors with safety profiles that enable the portion of the design that must be approved by the regulators, to the extent practical, to 1) be stable with no anticipated changes for site specific conditions or technology advancements, and 2) align with requirements similar across the cooperating countries, while minimizing design changes resulting from differing requirements.

CONCLUSION

International regulatory efficiency is necessary to enable advanced reactor approvals on the timeline needed to support the large scale of deployment of new nuclear implied by the market demand.

The pursuit of the 13 recommended near-term actions is necessary to put Canada and the U.S. on a path to achieve greater international regulatory efficiency benefits in the longer term. These actions are envisioned to both enable early successes in near-term licensing actions in Canada and the U.S., as well as establish a strong foundation to achieve the longer-term goals in

1. Domestic Regulatory Preparedness
2. Regulatory Cooperation Agreements
3. Alignment of Codes and Standards
4. Assistance to Potential Host Countries
5. Design Standardization

Achievement of these long-term goals for international regulatory efficiency will help enable Canada and the U.S. meet their energy, climate, environmental, economic and security goals. It will also spread our high standards for nuclear safety, security and non-proliferation internationally, as the world pursues widespread use of nuclear energy to mitigate the worst effects of climate change and provide energy security.

REFERENCES

1. NEI letter to Robert Taylor NRC, June 7, 2022, https://www.nrc.gov/docs/ML2215/ML22158A363.pdf
2. Nuclear Regulatory Commission, “Memorandum of Cooperation Between the Canadian Nuclear Safety Commission (CNSC) and the NRC.” https://www.nrc.gov/reactors/new-reactors/advanced/international-cooperation/nrc-cnsc-moc.html
3. Nuclear Regulatory Commission, “Collaborative Projects with Canada.” https://www.nrc.gov/reactors/new-reactors/advanced/international-cooperation/collaboration-with-Canada.html


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