WNA Discussion Paper

Benefits Gained through International Harmonization of Nuclear Safety Standards for Reactor Designs

World Nuclear Association

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INTRODUCTION

Increasing worldwide recognition of nuclear power as a major future energy source - providing benefits for national energy independence as well as global environmental preservation - is reflected in recent declarations by the G8 and the OECD's International Energy Agency, in the policies of many governments, and in creation of the Global Nuclear Energy Partnership.

For potential investors, however, global expansion of nuclear power continues to be viewed primarily through a financial and economic prism that focuses particularly on nuclear power's competitiveness vis-à-vis other sources of base-load power such as coal and gas.

A major factor in this equation is the potential for economies of scale achieved by building plants in series. Currently, national variations in safety regulations present an obstacle to internationally standardized nuclear reactor designs, which would foster these economies.

The achievement of harmonization of nuclear safety standards could overcome this obstacle, facilitating the emergence of a global market that offers a choice of a small number of reactor types that are recognized by regulators as safe and technologically mature. This important step could kick-start serial reactor construction worldwide.

The regulatory setting

The **nuclear safety standards** referred to herein are set up by competent national authorities to govern the safe design, construction, and operation of nuclear power plants. A national regulator uses these standards when assessing licence applications or when evaluating whether to take supervisory and enforcement measures. When these standards are aligned internationally, by way of the relevant national authorities making them more similar, **convergence** is achieved. When the essential elements of the requirements are fully aligned, **harmonization** of safety standards is achieved.

On the industry side, every reactor vendor offers one or more **standard designs**. Experience to date has shown that, if a standard design is to be deployed in a particular country, it normally has to be adapted to comply with the national safety standards. However, if the differing national safety standards are harmonized, the standard design may be entered into the licensing process without major changes (other than those dictated by site specific circumstances) and could thus become an internationally **standardized design**.

Thus, harmonization of **safety requirements** leads to **standardization of reactor designs**. This by no means implies that there will only be one standard design in the world. The concept of standardization applies to individual vendors. With several vendors, there would be several internationally standardized designs.

WNA Working Group on Cooperation in Reactor Design Evaluation and Licensing (CORDEL)

The World Nuclear Association established the CORDEL Working Group with the aim of stimulating a dialogue between the nuclear industry and nuclear regulators (national and international) on the benefits of achieving a convergence of safety standards globally.

To support such a dialogue, the CORDEL group has begun by analysing the benefits that could be realized from internationally accepted standards for Generation III and III+ reactors. Achieving a degree of convergence in that area could lay the foundations for developing harmonized standards for future Generation IV reactors.

The CORDEL group fully recognizes and respects that national regulatory authorities will continue to hold a sovereign responsibility for reactor licensing in their respective countries. This paper simply seeks to demonstrate the advantages of the deployment of internationally standardized designs. This entails a discussion of the benefits of harmonization of various regulations, codes and standards, and of safety evaluations of reactor designs available for construction today and in the future.

1. The benefits of standardization for nuclear safety

The nuclear industry, with safety as its core principle, envisages that standardization of designs will lead to even higher levels of safety.

These benefits derive from being able to draw on design and operational experience in all phases of a plant's life cycle: construction, commissioning, operation, and decommissioning, with actual fleet experience and reliability databases providing the underpinning for enhanced safety.

In the **design phase**, new plant designs incorporate the latest technology and lessons learned from the current operating fleet.

During **construction**, each subsequent plant of the same design will benefit from the experience accumulated in the construction of previous plants. This will also yield benefits in terms of the quality of construction through repeated application of the same construction methods and techniques.

In the **operational phase**, a global fleet of standardized nuclear plants offers the potential for increased operational excellence, better availability and capacity factors, and improved maintenance efficiency. Feedback from operational experience will apply directly to all plants of the fleet, thus offering the possibility to strengthen safety in a continuous and uniform fashion. Operation of a fleet of standard plants allows operational support to move easily between plants and provides a clear focus for technical, maintenance, and procurement support.

Clearly, if a company fleet is part of a wider national or international family of plants, even greater benefits can be derived from shared experience, internal benchmarking and best practice assessment. This possibility points to an enhanced role for 'owners groups' - groups uniting the vendor of a specific design and the operators running this design.

Can standardization lead to detrimental effects on safety?

One theoretical worry is that, in a scenario of worldwide deployment of a limited number of standardized designs, a belatedly detected design shortcoming would affect the whole fleet of a particular design. But the deployment of a large number of reactors of one design produces a countervailing effect - because the probability of early detection of any design flaw is much higher due to rapid accumulation of experience and knowledge exchange during evaluations (e.g., in the framework of a Probabilistic Safety Assessment), testing and operation.

Further, in the unlikely event of a significant generic shortcoming, remedying and backfitting measures could be organized and implemented in a very efficient manner across all plants. Operators, vendors and regulators involved could easily cooperate on the basis of internationally harmonized regulations, voluntary initiatives, and reporting requirements.

In such a case, the civil aviation industry offers a model. If a shortcoming is detected, the competent authority (for example, the U.S. Federal Aviation Administration, FAA) will, after a consultation with the affected vendor, issue an "airworthiness directive" which will be taken on by the authorities in all countries concerned. In this model, backfitting measures are taken quickly and uniformly, offering maximum benefit for safety internationally. Such an approach offers potential benefit both for nuclear regulators and the nuclear industry.

Conceivably, a significant generic shortcoming could impose a heavy economic cost on operators. For example, backfitting a large number of reactors simultaneously could involve shut-downs and underproduction of electricity, and cause a bottleneck in industrial capacity for the procurement of necessary replacement components. This would not, however, be a safety-related issue. The low probability of incurring this expense must be weighed against the much greater economic benefits of standardization.

2. Benefits of standardization for regulators

A greater convergence and harmonization of national standards would allow for increased international cooperation among regulators. Regulatory design reviews, which are central to the national licensing processes, would be improved, in both effectiveness and efficiency, by **sharing methods and data arising from safety evaluations**.

Moreover, knowledge transfer on all regulatory issues, including regulatory practice, could greatly facilitate the development of civil nuclear energy in emerging nuclear countries, which have yet to develop well-established and independent regulatory regimes. Such collaboration will be possible, however, only if a high degree of convergence of rules and standards is achieved internationally.

An area where closer collaboration based on harmonized safety requirements is urgently needed is in **quality inspections in construction and component manufacturing**. Given the large number of contractors and sub-contractors from all parts of the world that now become involved in a new-build project, collaboration among regulators is essential to an efficient handling of manufacturing oversight issues.

The process of harmonization in itself can lead to better national regulations because the regulators can obtain insights into why different solutions have been chosen by overseas counterparts. This harmonization may lead to a **common choice of the most reasonable and convincing solutions**.

Finally, the harmonization of safety standards can have a positive impact on **public confidence** in regulatory decisions. For example, if a certain safety requirement is perceived to be more stringent in another country, a national regulator might be seen as being less focused on safety. Moreover, safety goals will be better understood and more readily accepted if they are internationally aligned.

The Multinational Design Evaluation Programme (MDEP)

Recognition of the benefits of standardization on the part of leading national regulatory authorities is reflected in the creation of the Multinational Design Evaluation Programme (MDEP). As individual regulators review new nuclear reactor designs, MDEP aims to enhance cooperation among them through sharing resources and knowledge, thus improving efficiency and effectiveness of the licensing process.

Stage 1 of the MDEP was established in 2005 by the nuclear regulators of France, Finland and the USA in order to assist them in the exchange of technical data during certification of the European Pressurized Reactor (EPR).

The ultimate goal of MDEP's Stage 2, which is currently administrated by the OECD's Nuclear Energy Agency, is to achieve a degree of convergence of codes, standards and safety goals in participating countries, namely Canada, China, Finland, France, Japan, South Africa, South Korea, Russia, the UK and the USA. The IAEA also participates in MDEP meetings.

During Stage 3, it is expected that the lessons learned in the first two stages will be used to facilitate licensing of new reactors, including Generation IV designs.

The nuclear industry seeks through the CORDEL group to share its experiences and resources with regulators in order to achieve the timely delivery of progress in this area. The CORDEL group has already had preliminary discussions with MDEP representatives, and these discussions will continue in more detail in the future.

3. Benefits for the industry

Standardized designs will **reduce the overall engineering and construction time and cost** compared to the non-standardized approach used in the past, which involved a significant degree of customization. Standardization can reduce licensing risk and increase predictability of construction, improving the financial feasibility of nuclear new-build.

Seen from a **vendor perspective**, the gain lies in the ability to sell a reactor to any customer (electricity company) in any country without the need for design changes, unless justified by site-specific circumstances.

Seen from an **electricity company (owner-operator) perspective**, the gain is the ability to choose any design for any country and to order that design without major changes. This efficiency does not imply that an electricity company would necessarily seek to have a fleet of plants with a single design. For a variety of reasons, including those connected to country-specific political circumstances, technical and cultural background, preferences of national regulators, the need to match the plant's output to the grid capacity, and the ability to follow demand, an operator (and in particular a multinational operator) may prefer to run a diversified portfolio of reactor technologies.

However, standardization does offer a "fleet" operational concept whether an electric utility operates in only one country or operates only one plant of a particular design in one country as part of a larger international "fleet" of that design. Of course, a utility may achieve greater benefits of standardization as fleet size grows.

Suppliers of high-quality nuclear components will also realize benefits. Just as in construction, the supply of standard components should be at lower costs and higher quality than supply of custom-made components. This greater volume of standard supply will also encourage more suppliers to enter the supply chain, thus driving prices down through competition while ensuring availability of components to meet the needs of the nuclear renaissance.

Harmonization of national nuclear safety standards will enhance **the stability of regulatory regimes**, thus providing a major prerequisite for investment decisions. Requirements that have been aligned as the result of long and intensive discussion among regulators, leading to the conclusion that these requirements are necessary and at the same time reasonable and sufficient, are unlikely to be changed by a single regulator. Indeed, agreements among regulators could include provisions that discourage the unjustified imposition of requirements by any individual national regulatory body.

Close collaboration among regulators may also lead to a **convergence of licensing procedures as well as safety standards**. Currently, there are still major differences in licensing. For example, in some countries only one comprehensive licence is granted, covering siting, design, construction and operation, while in other countries these issues are dealt with in separate licences.

Similarly, in some countries regulations tend to be detailed and prescriptive and define what is "safe enough", so that an applicant complying with them will have reasonable assurance that the licence will be issued. In other countries, however, regulations are less prescriptive and the regulatory authority might demand additional safety features in the course of the licensing process. Such variations sometimes result from differences in overall national legal frameworks and, as such, will never fully disappear.

On the other hand, some new approaches might become more widespread. For example, the licensing process could be more efficient if there is, as a first step, a generic design review leading to a design certification. A later application for a construction licence could contain a reference to this certification,

so that the need for review would apply only to aspects specific to the site and the applicant. This approach, introduced by the U.S. Nuclear Regulatory Commission in its licensing process in the 1990s, has been adopted as a model by other countries re-designing the licensing process - for example, the UK and France. Such a common "pre-licensing" approach makes it easier for power generating companies to manage licensing applications, whether in only one country or in several.

Finally, harmonization of safety standards will enhance public confidence not only in regulators (as mentioned earlier) but also in operators, and can thus have a positive impact on **public and political acceptance** of new nuclear power plant construction.

4. Benefits for electricity consumers

Of primary importance is that the benefits for overall nuclear safety (described in section #1) as well as for regulatory and industry efficiency (sections #2 and #3) will ultimately redound to the benefit of consumers through the enhanced delivery of safe, affordable, and environmentally clean electric power.

Conclusion

The prospect of international standardization of nuclear designs provides an immensely rich and diverse opportunity for the sharing of best practices and lessons learned throughout all phases of the nuclear power plant - from design and construction to decommissioning and waste handling. Such sharing can produce benefits in safety, economics, plant quality, predictability of deployment time, and cost. International standardization can also impact positively on the perceptions of policy-makers and the general public.

Fostering the ability to deploy fleets of standardized nuclear plants can make a major contribution to reducing financial risks and accelerating investment in new nuclear power plant construction.

Electricity consumers will realize benefits in strengthened safety and lower cost for environmentally clean electricity generation.

Representing the international nuclear industry, the WNA's CORDEL group seeks to promote cooperation among all parties involved in the development of new nuclear power plants, including reactor vendors, operators and utilities, and national and international regulatory bodies. The CORDEL group hopes to contribute in all relevant forums, including MDEP, with the aim of maximizing the substantial gains - for safety, regulators, industry and consumers - offered by international standardization.

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APPENDIX

WNA Working Group on Cooperation in Reactor Design Evaluation and Licensing (CORDEL)

Created in January 2007, Cooperation in Reactor Design Evaluation and Licensing (CORDEL) Working Group seeks to identify and demonstrate the real benefits that could be realized from internationally accepted standard licensing requirements for reactor designs. In so doing, the WG will work to identify and encourage commonalities between different national regulatory philosophies. CORDEL attaches particular importance to establishing dialogue with national and multinational nuclear regulatory authorities. The WG's membership is composed of a wide range of experts within the WNA membership, representing both reactor vendor companies and power utilities that are currently involved, or are planning to be involved, in the reactor licensing process with national regulators.

Group Members

Chairman: *GE-Hitachi Nuclear Energy Americas LLC:* **Robert E. BROWN**, Senior Vice President, Regulatory Affairs

Vice Chairman: E.On: **Michael MICKLINGHOFF**, Vice President, Nuclear Regulation and Policy

AECL: **Raidis ZEMDEGS**, Director of Safety and Licensing

AREVA: **François BOUTEILLE**, Vice-President, Senior Safety & Licensing Adviser

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The World Nuclear Association is the international private-sector organization **supporting the people, technology, and enterprises** that comprise the global nuclear energy industry.

WNA members include the full range of enterprises involved in producing nuclear power – from uranium miners to equipment suppliers to generators of electricity.

With a secretariat headquartered in London, the **WNA serves as a global forum** for industry experts and as an authoritative information resource on nuclear energy worldwide.

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