

The Canadian Approach to Nuclear Codes and Standards

A CSA Forum for Development of Standards for CANDU: Radioactive Waste Management and Decommissioning

Contributors:

Ted Shin

Canadian Standards Association
5060 Spectrum Way
Mississauga, ON L4W 5N6
ted.shin@csa.ca

Saleem Azeez

Atomic Energy of Canada Ltd
2251 Speakman Drive
Mississauga, ON L5K 1B2
azeezs@aecl.ca

Shami Dua

Atomic Energy of Canada Ltd
2251 Speakman Drive
Mississauga, ON L5K 1B2
[duas@aecl](mailto:duas@aecl.ca)

Abstract

Together with the Canadian Standards Association (CSA), industry stakeholders, governments, and the public have developed a suite of standards for CANDU nuclear power plants that generate electricity in Canada and abroad.

In this paper, we will describe:

- CSA's role in national and international nuclear standards development;
- the key issues and priority projects that the nuclear standards program has addressed;
- the new CSA nuclear committees and projects being established, particularly those related to waste management and decommissioning;
- the hierarchy of nuclear regulations, nuclear, and other standards in Canada, and how they are applied by AECL;
- the standards management activities; and
- the future trends and challenges for CSA and the nuclear community.

CSA is an accredited Standards Development Organization (SDO) and part of the international standards system. CSA's Nuclear Strategic Steering Committee (NSSC) provides leadership, direction, and support for a standards committee hierarchy comprised of members from a balanced matrix of interests. The NSSC strategically focuses on industry challenges; a new nuclear regulatory system, deregulated energy markets, and industry restructuring.

As the first phase of priority projects is nearing completion, the next phase of priorities is being identified. These priorities address radioactive waste management, environmental radiation

management, decommissioning, structural, and seismic issues. As the CSA committees get established in the coming year, members and input will be solicited for the technical committees, subcommittees, and task forces for the following related subjects:

1. Radioactive Waste Management

- a) Dry Storage of Irradiated Fuel
- b) Short-Term Radioactive Waste Management
- c) Long-Term Storage and Disposal of Radioactive Waste

2. Decommissioning

Nuclear Power is highly regulated, and public scrutiny has focused Codes and Standards on public and worker safety. Licensing and regulation serves to control design and operation of Nuclear Power Systems, while ensuring effective exploitation of this vital energy source. The regulatory system includes federal requirements, provincial inspections, and a suite of Nuclear standards. These standards provide tools for technical guidance, management processes, operation, assessment, and regulation.

Future CSA plans will address the regulatory environment, standards harmonization, and enhanced public and international input, in a competitive industry. Stakeholders and governments; however, need to support SDO viability by addressing nuclear liability protection, member availability, and funding support. Opportunities for synergies with other nuclear related industries and international activities should be considered.

Introduction

This paper describes the Canadian approach in applying nuclear codes and standards to CANDU nuclear power plants. It is intended to share how the suite of CSA, nuclear standards, have a direct and important impact on the safe and reliable operation of CANDU nuclear power plants; and to show the importance of the roles of expert volunteers at all levels of the process.

The CSA Nuclear Strategic Steering Committee (NSSC) provides leadership, direction, and support to the program, and is considering the reconstitution of several committees. These committees will develop new standards to address important issues for the industry, government, and public. Members from industry and society will be solicited to participate.

New committees and task forces are being proposed to address identified waste management, decommissioning, structural and seismic issues.

Specific Topics Include:

1. Radioactive Waste Management

- a) Dry Storage of Irradiated Fuel
- b) Short-Term Radioactive Waste Management
- c) Long-Term Storage and Disposal of Radioactive Waste

2. Decommissioning

CSA has participated in the NWMO public consultation workshops, and CSA industry stakeholders have recommended that their committees be re-established to begin evaluating the need to develop new or updated standards. Such standards would address new nuclear waste

technologies, current and future industry waste management practices, new related regulatory requirements, and impacts on storage technologies for new options coming out of the NWMO recommendations.

- Dry Storage of Irradiated Fuel, in particular, will need to incorporate AECL MACSTOR, OPG DSC's, and potentially other methodologies for the dry storage of irradiated fuel.
- Short-Term Radioactive Waste Management will provide waste management practices for all players, including nuclear power plants, and other nuclear handling facilities such as universities, research, and health care facilities for management of radioactive waste (not bulk form or irradiated reactor fuel) for periods up to 2 years.
- Long-Term Storage and Disposal of Radioactive Waste will provide guidance for nuclear power plants and other nuclear handling facilities, for management of radioactive waste for periods of time greater than 2 years. The short-term and long-term waste management projects will need to be coordinated, as there is intended to be a consistency of approach to facilitate movement from one phase to the next.

Future plans include further adaptation to, and alignment with, the regulatory environment; harmonization with international standards where practical; and input from international CANDU plants. These plans will address new emerging technologies and disciplines, and improvements in operations. At the same time, they will serve to enhance public input and support a competitive industry. To maintain SDO viability, stakeholders and governments will need to address key issues such as protection from nuclear liability, adequate funding, and member availability.

Codes and Standards are key tools for the design, procurement, construction, commissioning, operation, and decommissioning of CANDU nuclear power plants. They are also important for use by regulators for licensing and regulation in the countries and jurisdictions where the plants are located. Industry stakeholders and public interest groups have developed a suite of voluntary CSA standards for CANDU nuclear plants that are used in conjunction with other industrial and international standards, and licensing and regulatory requirements. The program has published a suite of 38 standards; and 12 new projects have been under way. Committee members address key identified issues that can be resolved by common solutions in new or updated standards.

CANDU reactors comply with Canadian licensing requirements, and a set of codes and standards over their entire life cycle. Since the early 1960's, evolutionary improvements have continuously updated these codes and standards. The Canadian Suite of codes and standards includes both regulatory and jurisdictional documents that are produced by governmental licensing bodies, and standards that are produced by industry stakeholders. Specific codes and standards generated to address the unique design features of CANDU specify the application of, and complement, other industrial and internationally accepted codes and standards.

The CSA Nuclear Strategic Steering Committee (NSSC) consists largely of senior management from industry. It directs and supports an extensive program structure that consists of 11 technical committees, and some 50 subcommittees and working groups. The technical committees require membership to obtain a balanced matrix of experts and interests that represent a cross-section of stakeholders for the field, including:

- Owner/operators
- Government/regulatory authorities
- Service industries
- Suppliers
- General interest groups (including the public)

The standards development process is described to show the extent to which CSA works to assure that: one, the necessary people and interests contribute to the standards; two, the right process is taken such that all necessary input is presented and properly considered; and that three, consensus is reached according to recognized national standards accreditation requirements.

The CSA committee structure and process are key elements in considering, adopting, adapting, and influencing international standards, as appropriate for the nuclear stakeholder community in Canada. CSA is an integral part of the national, regional, and international standards systems.

CSA'S National / International Role

CSA is the largest Standards development and certification/registration organization in Canada.

CSA develops standards according to a process that is nationally accredited, and that is broadly recognized and aligned internationally. CSA Nuclear Standards are used internationally.

CSA is an independent, not-for-profit, voluntary, member-based association that has developed some 2500 national and other standards in over 40 fields. Its American Division is responsible for development of gas and fuel cell technology standards in the USA. CSA's other divisions include: CSA International, which provides testing and certification to CSA, US, and international standards; and Quality Management Institute (QMI), a highly respected registrar of quality and environmental management systems.

CSA is part of the international standards system, and has participated on regional, ISO, IEC, and other international standard organisations. On behalf of the Standards Council of Canada, CSA provides the secretariat for the ISO9000 and ISO14000 standards programs for Quality and Environmental Management Systems. CSA has long been an innovator in the international standards community, as shown by its Z299 series of quality assurance standards that served as one of the seed documents for ISO9000.

Recent Key Issues Drivers for CSA Nuclear Standards

The CSA suite of nuclear standards program is addressing fundamental changes in the nuclear environment. The new standards support and reflect: the new federal nuclear regulatory system, deregulated energy markets, and industry restructuring. They capture the resulting changes in technology, assessment tools, operation, management processes, licensing, and regulation.

To facilitate the strategic allocation of industry resource support, the NSSC developed a comprehensive program and plan. The objective of the program is to contribute to a safe and reliable Canadian nuclear power industry and to have a positive influence on the international nuclear power industry.

The action plan involves:

- Providing industry leadership in identifying national, international and public strategic needs for nuclear standards covering all life cycle activities for nuclear power reactors
- Developing and executing a nuclear standards program to meet identified needs

The NSSC resolved to provide Canadian nuclear standards leadership to assist the nuclear industry in achieving its goal for safe and reliable use of nuclear power. The committees were directed to be responsive to the needs of stakeholders, be solution-oriented, achieve consensus, provide clear value for investment, and to develop standards that are dependable and user-friendly. The program committees were realigned to support the plans and available resources.

The federal regulator, Canadian Nuclear Safety Commission (CNSC), and industry stakeholders identified priority projects to support the new federal Act, and new nuclear licensing and regulatory system. A Supreme Court ruling also shifted nuclear safety responsibility to the federal government. Provincial bodies were then contracted by the CNSC to inspect nuclear pressure retaining systems and components. This new regulatory system also required clarification of the technical requirements used as federal rules, incorporating the previous provincial jurisdictional technical. The nuclear standards in the program are currently being revised accordingly.

As work on the first priority projects previously identified by the NSSC is nearing completion, the NSSC is now embarking on updating and renewing its strategic plan. They are now in the process of identifying the next series of standards that need to be focused on and are committing to the necessary resources needed to develop said standards. The radioactivity management and waste management series of standards are part of this strategic plan.

Members and stakeholders are also reassessing their leadership and commitment to the advancement of the program. The NSSC are working to augment senior executive level commitment and resource assignment for the program to better align with regulatory needs; and to improve committee consensus development participation from industry members. There is a need for industry and stakeholders to continuously assess and improve the standards in order to meet evolving needs.

Energy market de-regulation, and industry restructuring are challenging the program and stakeholders. Restructured nuclear utilities require changes to management methods. These changes are reflected in the new standards for the CANDU community.

The following projects were identified as priorities and are well under development. Key drivers are described. Several of the projects are intended as license conditions.

Pressure Retaining Systems and Components specifies and clarifies new technical and administrative rules required for license conditions. It rationalizes and integrates inspection rules that had been previously used by various provincial authorities.

Periodic Inspection of Pressure Retaining Components provides enhanced requirements for feeders, pressure tubes, and steam generators in the draft new edition, and aligns it with the new licensing and regulatory requirements.

Material Requirements for CANDU Nuclear Power Plants provides new and updated criteria for material properties currently used for CANDU plants.

Technical Requirements for In-Service Evaluation of Zirconium Alloy Pressure Tubes provides new assessment tools based on process zone methodologies, to supplement Periodic and In-service Inspection rules. The approach adapted from the CANDU Owners Group (COG) *Fitness for Service Guidelines* now incorporates the newly developed methodologies.

Management Systems for Nuclear Power Plants integrates the older sub-tier life-cycle phases of Quality Assurance standards of a CANDU plant into a single document. This approach reflects that a nuclear operator provides management for all phases of work during the management of a nuclear power plant.

Environmental Qualification of Equipment used in CANDU nuclear power plants. This new standard will help the industry to assess equipment for nuclear power plants in the expected conditions of use, and in the event of a Design Basis Accident.

Fire Protection for CANDU Nuclear Power Plants will provide criteria for the updating of fire protection systems in existing plants, and will closely align with the latest requirements and changes in the National Building and Fire Codes.

As part of its recent assessments, industry task forces have recommended the reconstitution of several committees. Overall, 6 new Technical committees and several new projects will be initiated in the coming fiscal year.

New proposals include the activation of the following committees and projects as listed below.

Radiation Dose Management

Release Limits in Airborne and Liquid Effluent. Refinements in techniques and current methodologies that have been implemented need to be included in the next edition of the standard.

Radioactive Waste Management (Scopes are described above in this paper).

- Dry Storage of Irradiated Fuel
- Short-Term Radioactive Waste Management
- Long-Term Storage and Disposal of Radioactive Waste

Decommissioning.

A task force is established to consider needs and to develop a recommendation for a new standard for Decommissioning. They will consider all related issues to determine where standards are necessary, such as radiation management, structural, and waste management. They will also consider regulatory guides G206 and G219, and current international practices.

Structural Requirements

- Material Requirements for Concrete Containment Structures. The committee will consider new technologies available for anchors, load factors, new materials, and consideration of international standards and material testing.
- In-Service Examination & Testing for Concrete Containment Structures. The committee will consider industry operating experience and lessons learned; and the need to address plant life aging management (eg pre-stressing).

Seismic Requirements

General Requirements for Seismic Qualification. The committee will consider refinement of techniques to include current methodologies for existing plants (eg seismic margin and others).

Safety-Related Structures

A new standard is being proposed to provide requirements for safety related structures for CANDU nuclear power plants. It will consider modifications and additions to existing plants, access platforms, and how to define an interface with EQ. It would not include concrete containment and pressure boundary.

Some new projects being started by other existing committees in the next phases include the following:

Support Power Systems address technical developments in power systems, and to develop tools to include instrument air.

Requirements for Equipment with Embedded Software assist operators/purchasers to assess the ubiquitous use of firmware used in almost all equipment today.

Vendor QA Requirements replace and supplement Z299 quality assurance tools.

Continuing improvements address outstanding and lower priority issues from previous projects.

OVERVIEW OF CANADIAN APPROACH

In Canada, the three main components in the suite of codes and standards for licensing and regulation of CANDU nuclear plants and facilities comprises of:

- Federal licensing and regulations
- Provincial inspection and registrations under contract to the CNSC for pressure-retaining systems and components
- Standards

The **first tier** requirements consist of federal CNSC regulation and licensing, to address the design, construction, operation, and decommissioning of nuclear reactors and facilities. Nuclear facilities must comply with regulatory rules to obtain licenses. Public scrutiny has focused on CNSC regulations that form part of the mandatory code on public and plant worker safety.

The **second tier** of the codes and standards relate to boilers and pressure vessels. For nuclear facilities, the federal government has responsibility. Inspections are contracted to provincial agencies to assess nuclear pressure retaining systems and components, and to register the designs. The CNSC ultimately issues a license to operate the nuclear facility. The requirements are specified by federal license requirements and regulations, with specific technical and management requirements detailed in CSA standards.

The **third tier** consists of a suite of Nuclear codes and standards. These standards are increasingly being referenced in mandatory license conditions, and for pressure systems registrations and inspections described above.

The CSA suite of standards have been used for some three decades, and typically determine the application of other complementary, recognized standards such as IAEA, ISO, ASME, and other CSA and industrial standards.

The standards are produced to:

- Standardize the design processes including the quality assurance aspects
- Provide a reference basis for licensing and regulatory approval
- Maintain a cooperative link among all stakeholders (regulator, licensee, designer, public, etc) in developing standards that keep pace with technological developments
- Communicate effective operating practices amongst users of the standards

Other standards applied to CANDU complement the standards produced in the nuclear suite. A breakdown as applied in the design of a typical CANDU reactor is as follows:

▪ CSA Nuclear Standards	38
▪ CSA Industrial Standards	8
▪ International Standards	146

CSA NUCLEAR STANDARDS (N-Series)

In Canada, all activities relating to the production of standards for nuclear installations are carried out under the auspices of the Canadian Standards Association (CSA).

The NSSC along with CSA management decide on the need for new standards and approve project development. CSA, through its other programs, develops other industrial, technical, and management standards, some of which are also used by the nuclear industry.

CSA's Nuclear Standards Program focuses on CANDU power plants.

50 standards have either been produced or are under development/consideration for the CANDU Reactor. These standards cover the design, procurement, manufacturing, construction, commissioning, operation and decommissioning phases. The standards committees include specialists from across the industry and other stakeholders, including the public.

Committee Memberships includes:

- Nuclear plant operators (e.g. Ontario Power Generation)
- Nuclear plant designers (e.g. Atomic Energy of Canada Ltd./AECL)
- Nuclear Regulator (CNSC)
- Provincial Inspection Agencies (contracted)
- Nuclear component suppliers
- Nuclear Contractors
- Other general interests including the public
- Research and academic staff

Experience has shown that the CSA process has been very effective. Potentially polarizing issues have, through this inclusive approach, been handled by a realistic appreciation of the dissenting viewpoints. CSA nuclear standards have been in use for close to three decades, and applied to all CANDU reactors since the early 1970's.

There are 11 function based teams organized into technical committees reporting to the NSSC, each headed by a chair and executive, and consisting of technical experts drawn from across the industry and public.

These teams cover:

- Pressure Retaining Components/Systems
- Periodic and In-Service Inspection
- Quality Assurance/Quality Management
- Concrete Containment Structures
- Environmental Radiation Protection
- Seismic Design
- Safety and Safety Related Systems
- Safety Related Structures
- Waste Management
- Fire Protection
- Decommissioning

CSA - INDUSTRIAL SERIES

In addition to the Nuclear (N-Series) of CSA standards, designers and operators of CANDU reactors have determined that it is appropriate to apply a number of additional CSA standards that are developed for other industrial applications.

Such standards include:

- Electrical codes and standards (C -Series)
- Quality Assurance program (Z -Series)
- Structural Steel Specification (G -Series)
- Tolerance Specifications and Pressure Boundary Standards (B -Series)
- Welding Specifications (W -Series)
- Construction and Structural Specifications (S -Series)
- Construction Materials (A -Series)
- Environmental management (CSA/ISO -Series)

OTHER STANDARDS, CODES, AND SPECIFICATIONS:

In addition to the CSA Series of standards, a number of other standards are used in the CANDU Reactor design. Depending on the specific activity that the standard refers to, appropriate equivalent substitutions are permitted under authorization by the designer and regulator. Examples of such substitutions are usually associated with equipment procured from other countries, or plants constructed offshore.

Standards, codes, and specifications in this category include the following:

- Canadian General Standards Board (Testing, construction materials)
- National Building Code (Canada)
- National Fire Code (Canada)
- Air Conditioning and Refrigeration Institute Standards (Cooling equipment)
- Aerospace Material Specifications (Materials)
- American National Standards Institute (Mechanical equipment)

- ASME codes
- ASTM Standards
- American Welding Society Standards
- IEEE Standards
- Instrument Society of America
- National Fire Protection Association Fire Code

APPLICATION OF STANDARDS IN CANDU REACTOR DESIGN

All CANDU reactors in Canada and offshore are specified to a set of regulations, codes and standards. Based on the agreed upon 'effective date' defined in contractual agreements, the appropriate revisions of the regulations, codes and standards are defined.

For CANDU plants intended for offshore, clients may specify additional codes and standards that reflect local regulatory and code requirements. Such requirements are usually factored in addition to the standard suite required for the ability to be licensed in Canada.

The approach used in applying codes and standards in the design of CANDU reactors typically involves: one, the review of all applicable regulations, codes and standards; and two, the development of organization specific documents that incorporate the intent and content of said regulations, codes, and standards.

At Atomic Energy of Canada Ltd (AECL) for example, a complete set of company procedures and guides have been prepared that reflect the above principles. Some examples of these organization specific documents are as follows:

Procedures: All of the regulatory/ inspection /registration requirements and mandatory codes (CSA N-Series) are interpreted and incorporated in a comprehensive set of operating procedures. These procedures are used by designers in their day-to-day work. There are over 200 procedures that describe practices that must be followed to assure compliance.

At AECL, staff members are regularly trained on the use and application of these procedures and audits are performed periodically. Audit findings result in identifying corrective measures with a defined plan of action to eliminate the root cause of the non-compliance.

Design Guides: In many cases, codes offer the designer alternatives in interpreting requirements or certain latitude is permitted in the design process. To address such issues, and recognize the need for a standard organizational approach, AECL produces a number of design guides as interpretive aids. Examples where such guides have been produced include seismic analysis, fire protection, shutdown system design, etc.

MANAGEMENT AND PRODUCTION OF NEW STANDARDS

Typically, the need for a new standard can be identified and proposed by anyone from the nuclear community or public. CSA's Technical Committees and/or the Nuclear Strategic Steering Committee (NSSC) then reviews these proposals. The NSSC may request a committee recommendation. This recommendation is reviewed against a set of CSA and industry criteria and the need for the new standard is either approved or rejected.

CSA assesses and approves proposals through a 'standards value' assessment to identify value to society and viability. If the development of the standard is authorized, the chairman of the appropriate technical committee forms a team drawn from industry specialists. This team always includes an expert from the CNSC. If necessary, a new technical committee may be established.

The standards are developed under CSA's accredited standards development process. The final draft standard is made available to the public for comment, and then submitted for formal ballot and approval by the Technical Committee. A second level quality review by a senior CSA management committee verifies that the required standards development procedures have been followed. Standards are continuously reviewed and edited by CSA quality and editorial staff through to publication, to assure that the final standard meets quality, format and language requirements, and is appropriate for the intended application.

The Standards Council of Canada (SCC) regularly audits CSA to confirm that it continues to operate as accredited. If the standards are to be designated as National Standards of Canada, an independent SCC council reviews the standard to verify that it meets the SCC criteria.

FUTURE OF STANDARDS

A number of influences affect how standards are developed nationally and internationally. The standards development cycle continues to address developing industry issues. Such issues involve: new technology such as ACR; aging plants that need to be managed and upgraded; licensing and regulation; and new market needs for CANDU systems related to health and safety, performance, quality, regulation, and trade. Opportunities for interaction and synergies with other related nuclear industries and international forums should be considered.

RATIONALIZATION OF STANDARDS

Unless there is a clear focus of objectives, standards can start to overlap, and add to industry complexity and cost. CSA's Nuclear Strategic Steering Committee has developed a process to avoid this potential problem.

The committee takes a zero-base approach in qualifying industry needs by:

- Assessing the need for a new standard
- Evaluating consequences of not producing the standard (i.e. identifying impact on quality, costs, etc.)
- Reviewing other national and international standards that can be adapted/adopted
- Where appropriate, approving the rationalization of a series of standards into a single document to recognize changing nuclear industry structures and practices
- Specifying the scope of the standards project, and documenting information such as key drivers, boundaries, resources, and the assignment of responsibility to a committee

CSA also regularly assesses the validity of its standards. This process is carried out by way of a formal 5-year review that considers the revision, reaffirmation or withdrawal of the standard.

In one example of this rationalization, the NSSC is now considering the development of an overall integrated nuclear management project that involves issues such as quality, environment, occupational health and safety, finance, and other activities.

HARMONIZATION WITH INTERNATIONAL STANDARDS

There is an ever-increasing trend in the area of utilizing international standards. With the emphasized need for nuclear technology transfer and globally based suppliers, there are significant advantages in adopting or adapting international standards whenever possible. When starting a project for a new standard, CSA's policy is to review all available international and national/regional standards, as well as other industry guides, before developing a new national standard. In addition, economic and resource considerations associated with producing new standards requires standards writing bodies to evaluate the need for brand new standards.

Standards are also important tools to promote alignment with suppliers and customers. Harmonization or adaptation of ISO9001 can play an important role to attract new suppliers for the nuclear community. In addition, cooperation of the nuclear power sector can help to standardize unique processes and other technical requirements that are commonly used.

The NSSC has endorsed harmonization where practical. One area where harmonization is actively underway is in the adaptation of ISO9000 standards for Nuclear industry suppliers. To this end, sector guides that would identify which of the industry's needs and processes meet the intent of these standards, would be useful.

Canada has had significant input to the ISO9000 series of standards and indeed, these standards reflect a great deal of the philosophy embedded in CSA's Z299 series of standards. Future plans include the potential phase out of the Z299 standards in favour of an ISO series. Already in Canada, as in other countries, CSA has adopted the ISO standards. The nuclear sector needs to develop a strategy for its phase in. As an example, CSA has worked with many other industries to develop special sector guides for both ISO9000 and ISO14000.

CSA has adopted many IEC and ISO Standards as commercial industries have evolved, and world markets have become increasingly integrated. Canada's economic and trade links are worldwide, and emphasizes the need to harmonize, nationally, regionally, and internationally, while maintaining the financial viability and sustainability of the programs.

In the last year, several committees have evaluated international IAEA or IEC standards to consider their applicability to CANDU standards projects. There are some potential new international and foreign standards activities under development, that could have some application for CANDU in future, and that are being monitored.

In a related activity, foreign input from all countries with CANDU nuclear power plans is being planned into the development of the new draft standard for nuclear fire protection.

CHALLENGES AND FUTURE OF NUCLEAR STANDARDS PROGRAMS

It will be a challenge for Canada's and the world's governments and nuclear stakeholders to ensure that the Standards Development Organizations (SDOs) continue to be viable; able to continue to develop and publish consensus nuclear standards required by the world nuclear community.

How can the industry align its standards and guides to enhance its supplier base?

Suppliers need to be attracted to provide nuclear quality materials. Suppliers often use standards such as ISO9001 to provide standardized products and services to large global markets, and small niches are often not financially viable for them. The challenge then, is for the nuclear industry to demonstrate its special needs in linkages to these standards, and to provide sufficient market business to attract the suppliers.

SDOs and their members will need to be protected from potential nuclear liability, nationally and internationally. They typically do not have the resources or revenues to be able to accept liabilities that can be absorbed by the nuclear industry. Worldwide immunity and indemnification of the SDOs will assure that they can continue to develop the standards to build, operate, and regulate nuclear facilities.

Programs will need to attain sustainability from a financial/funding perspective, member resources, and public acceptance. Funding of SDOs by the main stakeholders need to be more substantial, particularly to match: the importance of the standards; the substantial work effort required to develop the standards; and the risks and liabilities to which the SDOs are exposed.

To achieve the above sustainability, nuclear organizations need to be adequately resourced and staffed. They must provide experts to run their business, support standards development, and identify shared solutions to key issues. In addition, the level of public participation will need to be increased in order to address public concerns and enhance acceptance.

Codes and standards are key tools that are developed, used by, and benefited by all participants in the nuclear industry and the public. They provide the forum that permits the participation and input of industry experts, stakeholders, and public to develop a common vision, strategy, and shared solutions.