Implementation and Sustainability of a Full Scope Nuclear Power Generator Pressure Boundary QA Program

John Charles Krane, P Eng.

Bruce Power Inc., P.O. Box 1540, B10, Tiverton, Ontario, Canada, N0G 2T0
john.krane@brucepower.com

Abstract

In 2009 a new Power Reactor Operating License (PROL) was granted to Bruce Power, Canada's largest independent nuclear power generator. The PROL required the adoption of a large, multi year revision to one of the cornerstone referenced national standards, Canadian Standards Association (CSA) N285.0 and also introduced a new approach to the licensing process and structure. This paper will describe the basis of the new regulatory structure and required pressure boundary related PROL changes and will provide details of the resultant impacts, successful transition, implementation and sustainability of Bruce Power's PBQA Program.

Keywords: Bruce Power, pressure boundary, certification, quality assurance, nuclear

1. Introduction

Bruce Power, Canada's largest independently-owned nuclear power producer has developed, implemented and independently certified a full scope nuclear pressure boundary quality assurance program. This paper will discuss changes in the licensing process and the Power Reactor Operating License (PROL). It will also explore the impact of the transition and implementation of a new multi year revision to one of the corner stone pressure boundary standard, CSA N285.0-08 Update # 1 General Requirements for Pressure Retaining Systems and Components In CANDU Nuclear Power Plants.

2. Regulation and Standards

Prior to November 2009, Bruce Power had numerous regulatory conditions related to the control of pressure boundary work specified in its Power Reactor Operating License (PROL). Some of the more significant listed conditions required Bruce Power to: design, manufacture, fabricate, procure, install, modify, repair, test, examine and inspect or otherwise perform work to vessels, boilers, systems, piping, fittings, parts, components and supports according to the requirements of CSA N285.0-95, etc. The PROL also stated that, where indicated by the Standard(s), the licensee shall obtain regulatory approvals for registered designs, accepted

overpressure protection reports, standards and code classifications, registered welding and brazing procedures, qualified welders and brazers and examination personnel, quality assurance (QA) programs, etc..

The Canadian Nuclear Safety Commission (CNSC) is responsible to the government of Canada to provide regulation of pressure boundary activities at the Bruce Power eight unit nuclear reactor site. As part of previous PROL's, the oversight of these regulatory conditions was delegated by the CNSC by appointment of the Technical Standards and Safety Authority (TSSA) to act as their agent for the purposes of:

- Certifying the Bruce Power Pressure Boundary Quality Assurance Program and;
- Performing Authorized Inspection Agency (AIA) duties.

Changes to the regulatory structure for the November 2009 PROL renewal were significant in a number of ways. Specific detailed requirements listed above were removed from the PROL. Instead, two main conditions were listed: that Bruce Power maintain and implement a pressure boundary program in accordance to N285.0 and that Bruce Power enter into a formal agreement with an AIA and provide the CNSC with a copy of the agreement.

This was a fundamental shift in the licensing structure in a number of ways:

1. details of implementation and control were removed from the formal license
2. a new License Condition Handbook was established to provide the details of implementation and control, including applicable pressure boundary standard revisions and effective date listings.
3. control of the LCH resides with CNSC staff and the LCH is available for quarterly review and revision.
4. the relationship with the AIA is now directly with Bruce Power (by way of contract) instead of with the CNSC (acting as their agent).

The establishment and control of the LCH by CNSC staff enables more timely revisions and enhancements as implementation circumstances vary. It is no longer required to go to a formal CNSC hearing to ask for a PROL revision when implementing a more current revision of the CSA N285.0 standard (i.e. such as a change from CSA N285.0-08 Update # 1 to CSA N285.0-10). This allows the nuclear utilities to implement new improved standards in a more efficient and timely fashion.

The change in the relationship with the AIA as detailed in the LCH is also seen as an improvement. One of the fundamental changes involves the dispositioning of nonconformance reports (NCR's). The new LCH structure allows Bruce Power to approach the CNSC directly in the dispositioning of code related NCR's. Although the CNSC have asked that the AIA provide input to any code related NCR's, Bruce Power is now allowed to

directly position and provide explanation of any variance. This provides for a much improved and timely process that enhances understanding and resolution.

Additionally, a LCH condition specifies that the AIA be accredited by ASME. Through discussion with the CNSC it was determined that the accreditation to the ASME QAI-1 standard, Qualification for Authorized Inspection was deemed satisfactory to meet this condition. Bruce Power has implemented this by making the accreditation a contract condition for the AIA The accreditation details of the approved vendor are documented on the Approved Suppliers List database.

3. Classification

The relationship between the PROL, CSA N285.0 standard and ASME code is primarily developed through the classification process which is described in CSA N285.0. Classification definition can be simply summarized as follows:

- Class 1 systems remove heat directly from the nuclear fuel;
- Class 2 systems penetrate the containment structure and;
- Class 3 systems contain radioactivity and are not Class 1 or 2;
- Class 4 are containment system components.

In Canada, we also have a unique Class 6 designation for design and fabrication/installation of non radioactive system/components in nuclear power plants. Class 6 system/components will not be discussed in this paper as many of the controls and requirements are described in a different standard CSA B51, Boiler Pressure Vessel and Pressure Piping Code. CSA N285.0 defines the code class of the system and ASME Section III provides the requirements for the components of these systems as they take on the same classification.

The new LCH requires CNSC involvement in production of the Bruce Power Classification procedure and notification of changes (this is also specified in the LCH referenced version of CSA N285.0-08 Update # 1). Changes to the CSAN285.0 requirements removes the requirement of classification approval submissions to the CNSC for all modifications as long as the licensee has regulatory approval of their classification process. The CNSC will now receive only classification approval requests for changes from existing classifications to less stringent classification or modifications that involve the penetration of containment or for any new self contained or stand alone system. This again represents a significant change to the classification requirements and provides for regulatory control of the process while allowing a significant reduction in classification approval submissions to the CNSC. Emphasis and specific regulatory review and approval control remains for classification changes that have a safety significance.

4. Registration

CSA N285.0-08 Update # 1 also contains the detailed administrative requirements specific to Canadian regulators and the AIA. One of the key administrative requirements is registration of designs and use of Canadian Registration Numbers (CRN's). Application, approval and assignment of CRN's are the responsibility of the AIA. The LCH over rides the N285.0-08 Update # 1 informative Annex C requirement that the AIA must be from the Canadian province of installation. The LCH specifies that registrations be from an AIA designated by the CNSC as authorized to register designs and in the case of Bruce Power in Ontario, this is the TSSA. The LCH also requires CNSC involvement in production of the Bruce Power registration procedure and prior notification of changes.

Component and system designs that require registration and submittals must be approved by the TSSA. This requirement is factored into the Bruce Power design control process.
These generic registration process requirements is still valid, however temporary modifications now have some exceptions as follows:

- For recurring modifications, registration update shall only be required for the first occurrence and the System Classification List updated.
- For non- recurring temporary modifications (one time use), the registration need not be updated provided the materials used in the modification are equivalent to the original materials and all other requirements for reconciliation (registration not required) is completed (more about reconciliation late in this article).
- Also for non recurring modifications the over pressure protection must be evaluated and documented but the report update is not required. Also the SCL does not need to be updated.

Additional conditions for exemptions from registration are also listed in Annex F of N285.0-08 Update # 1 as well portable assemblies of pressurized items (i.e. tools) are exempted from N285 Standard requirements.

5. Reconciliation

Reconciliation statements are used to demonstrate and document for modifications or as-builts to existing systems or components that the differences between the existing design and the modification have been reviewed and reconciled. If any differences in the design as classified or registered affect the basis for classification or affect the over pressure protection report (OPPR), reconciliation must occur and the necessary documents updated and

resubmitted for registration prior to a system pressure test. Records must be kept of this analysis and a reconciliation statement must be submitted to the AIA.

During the reconciliation process evaluation the following additional specific requirements are also required to be met or submission for re-registration is required:

- No changes to service loadings
- Maximum calculated stress or stress intensity shall meet requirements
- All fitting ratings, thickness of material and schedule of fittings shall be the same or higher that those required in the registered design and the material shall be the same as the registered design
- Energy sources must not change
- All new items must have required valid Canadian Registration Numbers (CRN's)
- Fatigue requirements must be met

The new LCH requires CNSC involvement in production of the Bruce Power Reconciliation procedure and prior notification of changes.

6. Over Pressure Protection Reports

The LCH requires that Bruce Power provide written notification to the CNSC of new or revised OPPR after final registration approval has been received by the AIA. The notification will be provided periodically (yearly) in the form of a formal letter. This is an improvement in the efficiency of the process (as detailed in CSA N285.0-08 Update #1) as it is no longer a requirement to submit the OPPR to the CNSC for approval prior to registration submission to the AIA.

7. Code Effective Date

CSA N285.0-08 Update # 1 specifies a 2007 ASME code effective date for all new modifications. This represents a significant change to the previous requirements of using the most recent CED. The change allows for more stability in ordering material, control of procedural updates and qualification requirements for inspection and test staff.

8. Non Permanent Records and Nameplates to align with ASME requirements

In order to become more pragmatic and efficient, the CSA N285.0-08 Update # 1 standard has reconciled and aligned the requirements for non permanent records and nameplates with the ASME requirements. This allows for a more streamlined approach and a reduction of potential non conformances when specifying and receiving items from ASME certificate holders.

9. Licensee Verifier

The concept of a licensee verifier as described in CSA N285.0-08 Update # 1 is not new but was described in earlier revisions to CSA N285.0 as an Owner's Appointed Representative. The new requirements are more prescriptive with respect to the training and qualification of the licensee verifier. Specific qualification requirements are detailed in Annex H of N285.0-08 Update #1 and requires an attestation of proficiency. These requirements are also subject to audit. Although Bruce Power has not yet implemented this option of providing licensee verifier services to suppliers, plans are being developed for future implementation where efficiency gains can be expected.

10. Pressure Boundary Quality Assurance Manual

To successfully implement and control activities associated with the PROL, the LCH, CSA N285.0-08 Update #1 and ASME requirements, a sizeable revision was required for the Bruce Power Pressure Boundary Quality Assurance Manual (PBQAM). It should be noted that Bruce Power was the first nuclear power utility in Canada to adopt and implement the requirements of N285.0-08 Update # 1 :

- The PBQAM has been structured to meet the requirements of ASME Section III, Article NCA-4000, Quality Assurance and;
- The Basic Requirements and Supplements of ASME NQA-1, (Nuclear) Quality Assurance Requirements for Nuclear Facility Applications.

Specific controls and requirements were also included in the PBQAM to cover the use of additional QA standards CSA N286.1 & CSA N286.2 and CSA Z299 as well as ISO (the International Organization for Standardization) 9001. The amalgamation of these standards into a single workable PBQAM formed the key component to demonstrate compliance with requirements.

Upon documentation of the required revisions to the Bruce Power PBQAM and associated procedures and acceptance of the PBQAM by the AIA, Bruce Power was prepared to move forward with its first triennial PBQA Program re-certification survey.

11. Pressure Boundary Program Re-Certification Survey

Processes were revised to align with the requirements of the CSAN285.0-08 Update # 1 standard and ASME code. A third party code expert was used to evaluate and provide feedback on the implementation. This proved to be a worthwhile exercise as some additional gaps were identified and corrected. The third party review also considered the re-certification survey demonstration job.

As required by the LCH, a pressure boundary re-certification survey was performed by the AIA (TSSA). The CNSC also acted as an observer on the survey. The pressure boundary processes were primarily demonstrated by the use of a Nuclear Class 1 Feed and Bleed system modification demonstration job constructed to the 2007 ASME code. Three minor findings were identified during the survey and all were corrected immediately to the satisfaction of the survey team. Following the survey, ten Certificates of Authorization were issued to Bruce Power from the TSSA, covering the full scope of work identified in the PBQAM.

12. Sustaining the Pressure Boundary Program

In many ways this is the start of the challenge for Bruce Power. A large scope pressure boundary program, being implemented across a large eight reactor site presents it own set of challenges. Bruce Power has set up an oversight program that observes and evaluates implementation and control of the PBQAM. Changes to the PBQAM, pressure boundary related procedures and organization manuals are routed through and controlled by the Pressure Boundary Specialist. Assignment by long term contract of full time AIA staff stationed directly at the Bruce Power site adds to the consistency of knowledge of the Bruce Power processes and staff involved in key functions (i.e. Inspection and Test, etc.). Regular dialogue between Bruce Power oversight staff and the AIA staff help to identify any developing issues and have them corrected quickly. Experienced Inspection and Test staff also perform a key role in identifying and reporting non conformances. This is helping preserve program compliance and safety at a time when new staff are coming into the company in increasing numbers. Results from oversight reports are reported and communicated to the Bruce Power management team semi annually during the Business Health Evaluation report. Corrective actions are assigned and the results are continually tracked and trended. Additionally, Bruce Power has an active focus area self assessment program. These focus area self assessments continue annually and form an input to the

Business Health Evaluation report.

13. Transition to Newer Codes and Standards

As codes and standards change, Bruce Power will be required to adopt the changes (as specified in changes to our LCH) by integrating them into our PBQAM and implementing them across site. Bruce Power is committed to ensure that all future changes are rigorously evaluated and implemented to ensure ongoing compliance.

14. Conclusion

The Bruce Power Pressure Boundary Program is a full scope nuclear pressure boundary quality assurance program that meets the requirements of the PROL, the LCH, CSA N285.0-08 Update #1 and applicable ASME code requirements. A significant effort was expended to fully incorporate the requirements into company governance, standardize and improve processes, fully implement and complete assessments of effectiveness. Challenges remain and will be ongoing as Bruce Power continues to maintain and improve processes and make necessary changes while hiring and bringing new staff into roles that affect the program. The definition and implementation of the new licensing structure and the LCH will enable a more streamlined, effective and efficient approach to enacting pressure boundary requirements at Bruce Power. Strong oversight and continued evaluation while working with our AIA will provide assurance that compliance will continue and will be sustainable.