

Comments on CNSC Regulatory Document

REGDOC-2.3.1

Commissioning of Reactor Facilities

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Summary of Key Points of Feedback

1. The generation of a document focused on the Commissioning aspects of Nuclear Reactor in Canada is an important one and will fill an existing gap. I am fully supportive of either a CNSC REGDOC or CSA Standard or a combination of the two, which covers the commissioning area. The draft is a good first pass and is useful to generate discussion and feedback to further develop the document. Once fully developed, it will fill a void in the current framework.
2. The document suggests it is intended to cover power reactors, small reactors, and research reactors and can be applicable to modification testing in existing power plants. The document is almost entirely focused on new power reactors and gives little guidance in the other areas.
3. The document uses shall and should language. It is my view that the use of 'shall', ought to be used for the principle to be met or the fundamental requirement to be met and then should to apply to supporting information about how that might be met. The language appears to be mixed in some places in the document.
4. The document refers to CSA N286.12 as the basis of the quality management aspects of commissioning. It repeats some of the management and organizational thinking in the CSA N286 Standard yet does not cover the connection to design. In the area of organizational structure, it appears to be based on an assumed structure as opposed to establishing what an organization must accomplish. As such it is overly restrictive in this area. It does not recognize that current licences use CSA N286.05.
5. The terms validation and verification are used throughout. They are not defined in the document. If the definitions used in the CSA document series (or similar) are the basis, then it appears the terms are intermixed in several places.
6. Some areas that have caused historical problems in the execution of nuclear project commissioning aren't really addressed in the current version. Interface with design, rigor in the dispositioning of areas where commissioning testing is thought to be too demanding or risky to

execute, compliance with the written program and adequacy of documentation all need additional emphasis.

7. Some practices like wire by wire checking, use of type testing, analysis or 3rd party review in lieu of testing are not mentioned or addressed.

8. The document seems to be slightly contradictory in places with respect to the need to test for design Basis event response. In some places it indicates testing is not required for events that may pose risk to the facility. In other places specific tests like loss of offsite power are specified.

9. The appendices seem to cover initial commissioning of a CANDU power reactor. Some guidance for the approach / scope of other facilities the document suggests it is intended for would be valuable.

10. The commissioning completion assurance process is touched on in a number of areas, but needs some additional focus so requirements are clear.

11. Interface with regulatory agencies often uses terms like 'sufficient notice'. The interface requirement should be supported with what is typically expected in terms of review times – or at least a descriptor of when and how the framework is established.

12. Since the document has a lot of content focused on the management of the commissioning phase, it may make the document more readily useable if it were structured along the model of the management system required by licence for the facility – typically the N286 structure. Where a specific aspect needs emphasis, it could be amplified against the framework for all of the management of the facility.

Detailed Feedback

General

The document acknowledges IAEA NG-G-29, Commissioning for Nuclear Power Plants. In the IAEA document there is reference to IAEA NS-6-2.3, Modifications to Nuclear Power Plants. The CNSC REGDOC states that it may be applied to modifications, but does not provide references to other documents outlining the application and does not develop this aspect of application in the document. Note that some guidance on commissioning is contained in CSA N286 series documents.

Scope of the Document

The document currently does not give guidance for application in the operating and decommissioning phases of the nuclear facility life cycle. It may be that these phases could be dealt with in another document. They should either be described in more detail or excluded from the scope.

Use of Shall, Should, May and Can

The definitions are clear and aligned with the definitions used in CSA and thus the quality management programs currently in licences. There are places in the document where the application in these terms, appear to be used in a non-optimum fashion.

Use of Terms Verify and Validate

These terms are not currently defined in the document. It appears that they are used in some cases in a non-consistent fashion.

2. Commissioning Program

- In essence, this section can be distilled to a statement that the Licensee shall establish a commissioning program based on CSA N286 or equivalent. It repeats concepts and requirements outlined in the CSA N286 document already in the license. Typically a licence even at the construction stage would specify a N286 based program.
- 5th bullet indicates it *verifies* safety analysis assumptions. Is it not more correct to say underlying assumptions must be verified as part of a commissioning assurance program and that commissioning testing verifies expected performance of SSC's?
- 11th bullet uses the term verify in respect to procedures. It should indicate to the extent practical and outline how to deal with cases when it is not practical. Perhaps it is really a validation exercise or a confirmation of effectiveness and verification is done by other means.
- At the top of page 3 the document has a shall statement indicating that the program shall be submitted one year before commissioning activity commences. This doesn't reflect graded approach for varying types of facilities and appears to give some special status to the period of one year. Would it not be more appropriate to state this in a fashion such as:
 - The Licensee shall submit the Commissioning Program in advance of commissioning activities with enough lead time to ensure regulatory reviews have sufficient time and any concerns raised during the review process can be adequately addressed. The Regulator will establish a clear lead time required. The lead time will be related to the size of the facility and the extent of the

commissioning proposed. For a new build power reactor the lead time will typically be of the order of one year.

- The last bullet in the section indicates that the FSAR report shall be updated. It would be strengthened if it was accompanied by a statement of “by the milestone of XXXX unless otherwise agreed to by the regulatory authority.”

3. Management and Organization

3.1 Management System

- The first paragraph establishes CSA N286-12 as a ‘shall’ requirement. It should indicate that this version or equivalent (such as N286-05) is acceptable. It also fails to establish the linkage to the CSA N286-7 requirement for analytical support tools
- While implied, it may be important to indicate that regardless of the organizational structure and division of responsibility, QA programs of those providing design, procurement, construction or commissioning when integrated with the Licensees program must as an entity comply with the Licensees obligation for an N286 program
- Guidance provided is mixed. In part of the guidance paragraph, it indicates the concepts should be applied to a broad set of objectives beyond safety and environment. It also indicates graded approaches can be used but provides no guidance. This may be an area in the document where additional guidance could be provided based on type of facility. While I agree that the CSA N286 management practices have application in all aspects of the business, it is not clear that this statement adds clarity in this document that is primarily focused on assurance of safety and environment protection.

3.2 Organizational Responsibility

- In paragraph 2 in this section, design and procurement organizations are omitted (I think in error). It is important to establish the expectation that commissioning results shall be agreed as adequate by the design organization. The term responsible needs to be carefully defined and used. The Licensee can hold other organizations responsible (accountable) for various activities BUT must always hold overall accountability for the safety of the facility
- The second last bullet on page 3 could benefit from a statement of what needs to be done when commissioning testing cannot be done to demonstrate all aspects of design are in fact met. Elsewhere in the document, it indicates facility safety would not be jeopardized for purposes of testing. I agree totally with that principle. A clear statement of what is expected when there are gaps needs to be made (gaps need to be dispositioned, typically with a barrier in place of the absence of effective testing such as third party review)

Guidance

The last bullet on page 4 indicates a 'should' for the area of minimum staffing requirements. It might be clearer to state that 'the basis for minimum requirements for facility staffing as defined in the licence shall be documented and demonstrated as adequate. Methods employed should be reference to the CNSC guide documents or equivalent.

3.3 Transfer of SSC's and the reactor facility

- This section establishes 'shall' requirements for walk-downs and for ownership once turned over. The statements do not appear to follow the risk informed principle established earlier in the document. For example, walk-downs of conventional plant systems not significant for safety might have a different process defined. If Operations found a system with many deficiencies, they may decide to hand it back to commissioning in totality. As long as the interface and ownership is rigorously controlled it is not clear why hand-back should be prohibited.

3.4 Qualifications and training

- If the licence is based on a CSA N286 program, the requirement for systematic basis for competency is already clear. Perhaps all that is needed is a statement that this shall apply to the commissioning phase. The list provided does not list quality management structure, organization etc.

3.5 Performance Measurement, assessment and improvement

- As in 3.4 the requirement in this section is already explicit in CSA N286.
- Use of should and shall in this section are not consistent with the use in CSA N286. For example, CSA indicates records shall be retained. It needs to be reviewed for consistent use of terms.
- The term 'as applicable' used in the last paragraph of this section does not provide guidance. It is a should statement so non mandatory. Perhaps the statement should tie OPEX reporting for the Commissioning phase to the licence requirement as defined in CSA N286 series to make it clear that there is an expectation of sharing of significant events.

3.6 Emergency management

- The second paragraph ties the emergency management requirement to the arrival of nuclear fuel on site. It may be more appropriate to tie it to something like nuclear regulated substance on site. There may be cases where D2O or other regulated substances arrive on a site prior to nuclear fuel. It seems that the principal would need

to be that emergency provisions are in place to deal with potential impacts of nuclear substances on people and/or the environment at all times, commensurate with the risks posed by the nuclear substances.

- The last paragraph in the Guidance part of this section, puts forward the idea that the emergency response provisions should be able to protect personnel in parts of the plant that are still in the construction and/or commissioning phase. I absolutely agree with that point. The converse is also true: the emergency provisions must take into consideration hazards related to the construction activity. Perhaps this should be explicitly stated as well.

4. Commissioning Tests

- In section 4.1, it is important to establish expectations around what has to be done if safety system functionality cannot be fully tested. This has been the cause of some events in the nuclear sector over time. Something like:
 - Where it is deemed impractical to fully test the functionality of a safety related SSC for all design basis events, gaps in testing must be clearly identified and documented. Additional compensatory measures (such as computer simulation, additional verification or third party review, etc.) shall be documented to compensate for the gaps in the commissioning assurance provided by testing.
 - For passive components where testing is not practical or possible, additional focus must be placed on the rigour of manufacturing and procurement and construction conformance to demonstrate adequacy for service
- In section 4.2, the last sentence on page 7, states “The commissioning program shall have provisions to ensure that there have been no emissions in testing complex systems.” This seems contradictory to the idea that it is impractical to test all aspects of system performance as some will place the reactor at risk. It might be better if this were stated something like:
 - The combination of commissioning testing and other means of assurance where testing is impractical, together, shall be such that risk to the public and environment is assured to be within the licencing envelope of the facility. A means of providing assurance that the collective commissioning program meets that requirement shall be provided (This might be a report or a third party assessment or a series of audits or other means)
- In section 4.2 on page 8, the concept is put forward that a full suite of testing shall be performed for each reactor at each facility. In some cases historically ‘type tests’ have been accepted on a first unit and then a sufficient set of lesser complexity tests were programmed to demonstrate the outcome of the ‘type testing’ remained valid.

Perhaps the concept here should be that full testing shall be conducted on each unit at each facility unless it can be demonstrated to the regulatory authority that either the testing benefit is out-weighted by the impact of the testing, or that the required assurance can be provided by a combination of smaller tests and / or other means

Section 4.3 Acceptance criteria

- At the top of page 9, the document indicates that CNSC acceptance criteria important to safety “may” need CNSC approval. It does not provide rationale or criteria as to when this would be expected. It seems to me, that, the more important aspect of the program is that the Design Authority must agree to the criteria and accept the results. This appears to be a missing concept in the document. My view is that the regulatory body should accept or approve the program and inspect and audit for compliance and adequacy and not be active in the process of approval of specifications. Requirements must be clear in the REGDOC.
- In the second paragraph on page 9, the last sentence focuses on the need to ensure that the analytical tools used in support of the design and commissioning program have to be in compliance with regulatory requirements and this “should” be documented. It seems to me that the Facility Licence will contain the Licence requirement that analytical tools “shall” be compliant with CSA N286.7 (or equivalent). It appears that this sentence is redundant and uses “should” where it is really a “shall” requirement of the typical licence.

Section 4.4 Test procedures

- The third paragraph in this section states “The test procedures, including acceptance criteria, shall be reviewed, verified and approved by design, commissioning and operating organizations.” The statement infers a review verify and approve function in three organizations. I think this has the potential to dilute accountability and confuse the organizations (and is perhaps overly restrictive). It is more typical to see processes that have the design authority prepare commissioning requirements and approve them. The Commissioning organization typically prepares and approves the testing program and procedures. The design organization has a `review and concur` function with the commissioning activity and then a `must accept` the outcome. The operations organization more typically has a `review and concur` function. The roles may be different depending on what the licensee is doing inside the licensee company and what is external. The requirement should be established in a manner that preserves clear accountability while recognizing that role execution can be done in several different ways.

- The 5th paragraph establishes that changes to test procedures shall be addressed according to the operating organizations change control procedures. This appears to be based on the assumption that commissioning is governed by the operating organization. This might be the case, but I could see where the procedure set governing commissioning might be the design organizations. The principle is key – there must be a change control process for approval and acceptance or deviations during the commissioning phase.
- The 7th paragraph in this section again introduces the concept of in line CNSC approval for commissioning testing. As stated earlier, I am of the view that approval of the program, inspecting and auditing is appropriate as regulatory over-site. At the program level hold points requiring Regulatory approval should be clear. Having a 'shall statement' that is followed by a non-quantifiable statement such as informed in a timely manner do not lend themselves to clarity in expectations. If such a statement needs to be in the document, there should be a quantifiable aspect of it. Something like, when inspectors are stationed onsite, a minimum of 24 h notice should be provided. When inspectors are not on site, notice should typically be 24 h plus travel time would add to clarity of expectation
- The last sentence before guidance states that competent personnel and controls shall be in place to validate test procedures. The sentence does not state expectations for procedural verification – it may be that the term validation is used when verification is really what is meant.
- The guidance section in 4.4 provides content that is really focused on minimum content of the program document. If the commissioning program falls under the N286 umbrella many of the points are already covered in the management program in the licence.
- Nowhere in this section or in the document, is it explicitly stated that the licensee must establish ways to ensure that the program is being followed (complied with). Again, this is really implicit in the CSA N286 program – but if the intent is to highlight areas that warrant extra attention, this would be one that would be a good one to consider for the list

Section 4.5 Review, evaluation and reporting of test results

- The section does not currently address the need that the Design Authority shall agree (accept) the results of the Commissioning testing
- It is not typically practical to have all documents updated at the time of turnover to Operations. Perhaps a more practical, and effective requirement would be something like: the Commissioning organization shall set clear objectives for the state of documentation at the time of turnover to operations. These objectives should reflect that documentation outstanding elevates the risk of human error and as such should

be minimized. A date shall be established by which the design basis set of information and operating and training information is updated to reflect all of the results of the commissioning program.

Section 4.6 Modifications

- The second paragraph establishes 'shall' requirements for approvals for the commissioning organization. This assumes a certain organizational structure and functionality which may not always be the case. The program level will set authorities and interface requirements. Depending on the organizational structure at the facility design, commissioning and operating licence authority roles may factor into who approves changes. The document suggests commissioning organization with licensee oversight but is silent on the role of design. Licensee oversight would need to be defined – what is the scope and role of the oversight function
- In the guidance section, the last statement is a 'should' inform CNSC in advance of any major modifications to test procedures. Major is not defined. These changes often happen in real time, sometimes on weekends and during night based commissioning activity. The statement as worded is subject to wide interpretation. If the program document establishes when regulatory witnessing is required it would seem that this statement is not required.

Section 5

- In the bulleted points perhaps the second bullet should be Phase B: prior to leaving the reactor GUARANTEED shutdown state
- In the guidance section, the concept of establishing regulatory hold points is clearly established. Perhaps the same clarity should be included for tests requiring regulatory witnessing (if any).
- Just prior to the beginning of section 5.1 there is a bulleted list identifying specific requirements for requesting regulatory approval to proceed beyond a regulatory hold point. As well as non-conformances, the state of documentation and outstanding work should be quantified and shown to be consistent with expectations established in the Commissioning Program (quantified, entered into the work control system(s), completion dates consistent with program expectations)

Section 5.1

- The document is silent on the requirement for wire by wire checking (or software verification and validation) of the active parts of Special Safety Systems prior to fuel load (or Guaranteed Shutdown removal). It has been typical that additional emphasis is placed on key system (essential to overall safety of the facility) configuration when first starting up. In this state, many of the processes and response dynamics have yet to be commissioned and additional assurance of functionality of Special Safety systems functioning exactly as designed is typically sought. It is my view that this concept should be embedded somewhere in the document.

Section 5.2

- The 2nd bullet on page 17 states “availability of the automatic shutdown systems shall be confirmed where possible” seems weak. Perhaps a better statement might be:
 - Availability of the shutdown systems shall be assured before a reactor state is entered that may require the system to actuate to prevent damage to the fuel and/or the facility. Where full testing of the functional part of the system and credited trips is not possible before entering a specific reactor state, the gap in assurance normally provided by a full testing program shall be compensated by other means such as; partial testing, wire by wire checking, additional analysis and modelling additional verification, etc. Testing to fill the gaps shall be scheduled at the first opportunity when plant systems enable conditions to allow testing.
- The last bullet in this section imposes a ‘shall’ requirement on who should supervise fuel loading. It is not apparent as to why this is singled out. It establishes a constraint that may not be appropriate or necessary. N286 establishes personal (and supervision) shall be competent for the work they do. The Commissioning program document will establish who has accountability to do what. I agree that fuel load is an important activity and aspects like control of foreign material entry to the PHT, damage to fuel or fuel channels must all be carefully controlled. Independent review and oversight is a normal part of this activity. The statement may be appropriate, but without a rationale for it being singled out, it is hard to understand.
- In the Guidance section some points are put forward to guide the fuel loading activity. It seems to me the principle needs to be stated clearly: Something like:

The processes for loading fuel must provide assurance that fuel and structures are not damaged in the process of fuel load and that the nuclear material in the core is in the specific configuration established by design.

Section 5.3

- The first bullet states trip set-points shall be verified. Is the statement really a verify activity, or is the concept that the configuration must be established and confirmed to be as specified? Or is the active word intended to be tested rather than verified? The statement could apply to other sections but is not included elsewhere.
- The third last bullet in this section states "it shall be confirmed that the reactor core is in a proper condition to operate higher power levels". The statement is not clear as is. Is it intended to indicate that there must be confirmation of heat sink availability to envelope the power levels that will be next in the program?
- In the guidance section, second paragraph, the first sentence contains a 'should' be done in accordance with defined procedures. It seems to me this should be a shall requirement, so needs to be moved from guidance to the main part of the section

Section 5.4

- The first bullet indicating some of the power ascension hold points and tests will require Regulatory approval is a program level requirement – it probably doesn't need to be in this section. In appendixes including what these might typically be for different kinds of reactor facilities might be useful.
- The third sub bullet of the second bullet in this section would seem to indicate tests like load rejection and loss of Class 4 power are not necessary. There are many varying views on this point. Additional clarity may be needed.

Appendixes

- With the scope of the document being large, small and research reactors with some aspects applicable to modifications in existing plants, content of appendixes that help users understand which aspects apply to their particular technologies would be helpful. At the moment the appendixes focus on large power reactors (with some CANDU specifics) with little if any guidance for other facilities.
- Appendix E currently omits the Design organization and Design Authority function both of which have key roles in commissioning.

Definitions

- Validation and verification are terms currently missing in the definitions. The use of shall, should, may and can, are presented clearly up front in the preface. It may be appropriate to include these terms in the definition list as well.