| **#** | **Commenter** | **Section** | **Issue** | **Suggested Change** | **Impact** |
| --- | --- | --- | --- | --- | --- |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Overview | Industry appreciates the opportunity to comment on the proposed new REGDOC-2.4.5, Nuclear Fuel Safety. Our commentary focuses on improving the clarity of the final document, but more importantly seeks clarification on the purpose, need, application and scope of the document. Following a collective review including safety analysis, fuel handling, fuel and physics, fitness for service, inspections, and supply chain personnel; licensees have identified several areas requiring clarification as well as several areas of significant concern. The feedback is broken in to Major or requests for Clarification comments. Of note, below we highlight several themes, which are of particular importance and supported by the comments identified as Major. These include:* *REGDOC Objective and Target Audience:* The document needs a clear objective. It is very CANDU-centric, particularly in the examples provided; however; Industry questions the need for a REGDOC targeting the mature, well-established (and CNSC approved) fuel designs of existing facilities. There is an opportunity to focus this document towards the new fuel designs being developed to support advanced nuclear reactors; exempting its application to existing facilities or at a minimum ensuring there is no expectation of retroactive application on existing fuel designs.
* *Scope:* While the document numbering and title suggests this document is focused on nuclear safety analysis, it is more relevant to elements of fuel design, manufacturing (quality control) and monitoring and inspections. This document may be better served to remove the limited elements of safety analysis and focus on these other elements.
* *Duplication:*  Much of the safety analysis elements in this document are duplication from the existing REGDOCs, primarily REGDOC-2.4.1 and REGDOC-2.5.2. It would be more effective to remove the redundancy from this document and add any new safety analysis elements to the relevant existing REGDOCs.

In summary, this document has major implications on a mature well-established CANDU fuel design. It is unclear what value the application of this document will have to the existing fuel designs. Industry has implemented many successful fuel design changes and change control processes over the last many years, which have been approved by the CNSC. The document objective would better serve the future fuel designs supporting the development of advanced nuclear reactors. |  |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | General | MAJORThe documented is very CANDU-centric, essentially all with regards to the examples. As written, this regulatory document applies primarily to fuel programs of existing reactors, which are mature and well established with minimal need for this document. Although high-level concepts presented in the document may apply to other technologies, these new technologies are not specifically targeted. This seems to be a missed opportunity as a number of new reactor (and fuel) designs are being considered in Canada. The document should consider specifics of fuel safety for different types of reactors/fuels and acknowledge in more detail the specifics of the different stages of the fuel lifecycle (e.g., research, development, design, testing, operation, disposal). | Expand scope providing guidance for new fuel programs and fuel designs including fuels for advanced reactors would be more useful for advanced reactor vendors; for example, NEA’s Regulatory Perspectives on Nuclear Fuel Qualification for Advanced Reactors (DRAFT), US NRC’s “Fuel Qualification for Advanced Reactors” and Joint US NRC/CNSC reports on Tristructural Isotropic (TRISO) Fuel Qualification.  | Useful for non-CANDU utilities and vendors to have regulatory guidance for evaluating compliance with CNSC fuel requirements. It is less useful for the mature, well-established fuel programs for the existing CANDU fleet. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Preface & Section 1  | MAJORThe document title is "Safety Analysis – Nuclear Fuel Safety" and the preface says it is "*part of the CNSC's safety analysis series of regulatory documents, which also covers deterministic safety analysis, probabilistic safety assessment and nuclear criticality safety*"…."*clarifies requirements and provides guidance for the design, operation, monitoring and safety assessments of fuel for operating reactor facilities*."The title and its association with other regulatory document from Safety Control Area 4 – Safety Analysis implies it falls within the jurisdiction of nuclear safety analysis and is for analysts who perform it.  | To be consistent with the name of the REGDOC, remove requirements and guidelines for disciplines outside of the area of Nuclear Safety Analysis and Safety Analysts. Alternatively, remove Nuclear Safety analysis from the document.Requirements and guidelines in those jurisdictions or disciplines should be provided to Designers, Procurement, Suppliers, Inspectors, Fitness for Service, Operation and Maintenance personnel.There is a limited amount, if any, new Nuclear Safety Analysis requirements and guidelines that aren't already identified in REGDOC-2.4.1. If fuel aspects are important, add the new information to REGDOC-2.4.1 and have the rest of the document cover aspects outside of Nuclear Safety. | Having the same requirements in two different REGDOCs may cause future confusion and configuration management problems, particularly if they are managed by different Regulatory Directorates. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 1.1 | ClarificationChange “…clarifies the requirements..” to “…clarifies the regulatory requirements…” | Reword. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 1..  | Clarification "*The regulatory document clarifies the requirements and provides guidance for the …and safety assessments of fuel*". The words "safety assessment" are used in 1.1 and 1.2 only. They are not used again in the document. | If the assessments are design or operational assessments elsewhere in this document, then please keep consistent terminology. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Sections 1.1 & 1.2  | Clarification"*for operating facilities*" "*to new fuel designs envisioned for operating plants at the time of publication*"1.2 is wider reaching than 1.1. The subsections are inconsistent. | Clarify actual scope of document? |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | 1.2 ScopeFirst paragraph | MAJORThe REGDOC should not apply to Research and Development (R&D) facilities, which can differ greatly from CANDU reactors and rely on different safety measures. This is particularly important where risks from fuel failure are much lower, and additional requirements are not warranted.For example, the Zero Energy Deuterium research reactor (ZED-2) is a zero energy reactor and it is operated at atmospheric pressure. The source term is much lower than a CANDU station. The release from accident scenarios are very benign when compared to the power reactors that are driving this REGDOC. The ZED-2 reactor performs fuel testing and qualification activities. Requiring enhanced fuel testing and qualification for a reactor that is used for this purpose creates circular and unachievable requirements.ZED-2 and the Recycle Fuel Fabrication Laboratories (RFFL) are used for innovation of new and/or improved technologies; additional requirements for licensing fuel will inhibit the ability of R&D programs to use such facilities to address industry needs in a timely manner.  | Include in this section a statement that the REGDOC is not applicable to non-power reactor facilities; alternatively that it is to be used only as a guideline for non-power reactor facilities. | For facilities where the risk of fuel failure has been assessed to be much lower than CANDU reactors (e.g., research reactors), the application of the same requirements would increase regulatory burden with no improvement on nuclear safety. It would also hinder the use of research facilities for testing and qualifying fuel, and supporting innovation of new/improved technologies. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 1.2  | Clarification"*This document focuses on fuel design, operation, monitoring and safety assessments for operating facilities*". Similar to comment # 2, the document covers much more than its cover page title and preface denotes. | Separate the document into its constituent parts consistent with the Safety Control Areas 3 – Operating Performance, 4 – Safety Analysis, 5 – Physical Design, 6 – Fitness for Service, 7 – Radiation Protection, 9 – Environmental Protection, 11 – Waste Management, 12 – Security, 12- Safeguards and Non-proliferation , 14 – Packaging and Transport, 15.9 Criticality Program |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 1.2  | MAJOR"*This document will be reviewed as appropriate to incorporate operating experience (OPEX) with new reactor technologies*" Has the Regulatory document been assessed against operating stations and has each facility been shown to be fully complaint? If not, you'd expect OPEX would point this out. If so, the OPEX review should be included to assist users in their use and review of the document.If OPEX has shown operating stations would have not had issues meeting this document historically then the document isn't needed for operating stations. | Are operating stations going to radically change their fuel designs, such that this document is needed? If not, consider its purpose and value.Consider whether this should be for new licensed facilities only. | This document has impacts on the mature CANDU fuel designs. There is no benefit to applying this document to mature fuel design which has clearly defined and CNSC approved requirements. This document should focus on new fuel designs. The Industry has implemented many successful design changes and change control processes over the last many years which have been approved by the CNSC. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 1.2  | Clarification" *While this document focuses on CANDU fuel, high-level concepts within it may apply to other technologies…"high-level safety concepts*"“May apply" is very unclear. The high-level safety concepts are not specifically identified. The word “concepts” only arises in this subsection.  | Ensure the clause is clearer for the non-CANDU fuel user.Identify which are the high-level safety concepts by at least referring to the specific sub-clauses. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 1.4  | Clarification"*The following standards are relevant to this regulatory document….Management … QA, …. Design*" None of the references includes Nuclear Safety Analysis. The focus seems to be on design of new fuel systems, procurement, QA, and management. | Refocus the document as a Design document and specifically as a new plant fuel design document. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 2 &Appendix A: | Clarification"*the first two of five physical barriers to the release of radioactive material are the fuel matrix and the fuel cladding. The primary heat transport system, the containment, and the exclusion zone constitute the other three physical barriers*." These physical barriers are not the same as the Defence in Depth (DiD) levels espoused in REGDOC-2.5.2 and referenced in REGDOC-2.4.1. Is this meant to be a recognition that REGDOC-2.4.1 DiD barriers for operating stations are not the same as those for future facilities? | Clarify intent and remove the reference to REGDOC-2.5.2. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 2 and Appendix A | ClarificationSection 2 identifies 5 layers of Defence in Depth when determining nuclear fuel safety in water-cooled reactors. This is slightly contradicted by the Appendix A, which credits the layers differently, and also indicates that Level 5 doesn't apply to nuclear fuel safety. | Clarify if the five physical barriers are the same as the five levels of Defence in Depth, and if Level 5 applies or it doesn’t. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 2 | ClarificationThis section discusses Defence In Depth (DiD) applicable to fuel. There is another section on the topic of DiD (Section 4.3 Defence in Depth). Section 4.3 is a more appropriate place to discuss the application of DiD to fuel design.  | It is suggested to incorporate the information presented in Section 2 into subsection 4.3 and remove it from Section 2 (or only mention it briefly).Having said this, this section can fulfill an important role of defining the ultimate goal of fuel safety (say, to retain all radionuclides within the fuel system or to limit releases below established acceptable levels for all design-basis plant states), and provide discussion on fuel safety criteria. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 2  | Clarification"*Defence-in-Depth* …"This is the only section which talks about Safety while the document is called: "Safety Analysis Nuclear Fuel Safety"It appears that other Safety Analysis requirements are captured in REGDOC-2.4.1; there is no need to be repeat them in this document. The only aspect covered under Nuclear Safety in this document is DiD and the levels of DiD are not consistent with the REGDOC-2.4.1 or REGDOC-2.5.2, thus it appears this document is trying to correct mistakes in those documents since the original design basis from the Siting Guide and AECB-1059 covered the five levels discussed in this document.  | Change the title of this REGDOC; focus on a Fuel Design and Qualification requirement document.If one or two items are missing from REGDOC-2.4.1 add those to the revision of REGDOC-2.4.1. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 3.(Preamble) | ClarificationThe preamble is basically a repeat of the following requirements section. | Eliminate (or reword) text. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 3.Requirements | ClarificationThe requirements seem to be repeated in more detail in Section 3.1. | Eliminate redundant requirements. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 3.Requirements #4 | ClarificationAll five levels of DiD are not applicable as per Appendix A. Explicit limits for Level 4 DiD are problematic, as correctly discussed in Appendix A. | Revise to:“*within its safety limits at all applicable levels of DiD, where each safety limit is explicitly taken into account in the fuel design basis, where practicable*.” |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Sections 3.1, 3.5, 5 | MAJORThe document frequently refers to fuel qualification; however, it could benefit from defining the term on first occurrence and in the Glossary. Section 5 is an important section especially for advanced reactor designs. The “fuel qualification process” is not explicitly described in regulatory documents, but frequently alluded to. | For newer designs, consider:Adopting or adapting definitions from US NRC NUREG-2246 Fuel Qualification for Advanced Reactors for “Qualified fuel” and “Fuel qualification”.Also for the benefit of new advanced reactor designs, consider adding relevant subsection on regulatory basis and the assessment framework for fuel qualification similar to the joint US NRC – CNSC reports concerning Tristructural Isotropic (TRISO) Fuel Qualification) and NUREG-2246 - Fuel Qualification for Advanced Reactors.It would also be beneficial to add a systematic and holistic outline of fuel qualification goals and requirements. | The definition for fuel qualification and the requirements for a fuel qualification process are being discussed within industry and it would be a benefit to have these defined for the Canadian nuclear regulatory space. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Sections 3, 3.1, 3.2 | MAJORIt states a fuel design program is required. However, programs have a very specific meaning within each licensee’s management system, and the new program described may not meet the licensee’s requirements. Fuel Design would be captured by the Engineering Change Control (ECC) process.  | Revise.Don’t over prescribe requirements for new programs. Instead, state the “high-level” performance requirements and let the industry demonstrate compliance.This should apply to new fuel designs only. | Adding new administrative requirements without any added benefit to nuclear safety.  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 3.3 | ClarificationCSA N286-12 and CSA N299.1 are already requirements for Bruce Power. They don’t have to be repeated here.  | Remove redundancy. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Sections 3, 4, 4.5 | Clarification"...*the fuel design is properly qualified for the subset of all facility states.*.."Was "facility states" used instead of "plant states" to apply to a broader class beyond nuclear power plants? Use of plant states would be consistent with REGDOC-2.5.2 and REGDOC-3.6. If facility states is distinct and intentional suggest to define at the first occurrence and in the Glossary.  | Replace with “plant states” or define “facility states”. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 3.5 | ClarificationBullet 1: Could benefit from expanding on requirements for “*establishing a knowledge base*”.  | Revise to:“*establishing a fuel design knowledge base that allows the licensee to understand and predict fuel behaviour for all plant operating states with established uncertainties*” |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4 | ClarificationThe sequence of subsections would make more sense if subsections 4.7 Design requirements and 4.8 Design safety objectives are the first two subsections. The two steps of the design process described in these subsections set the stage for the reminder of the design process.  | Reorder section.Sections 4.1 Notification and 4.2 Design change are better placed later in Section 4, after the subsection “Degradation mechanisms”. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Sections 4.1, 4.2 | MAJORAny changes to fuel design, specification or manufacturing methods would be covered by licence conditions, e.g. G.1 Licensing Basis for the Licensed Activities and G.2 Notifications of Changes. This is a duplicate requirement. | Remove any requirements that are defined in other REGDOCs.  | Adding new administrative requirements without any added benefit to nuclear safety. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.3 | Clarification"*For the fuel design process, the licensee shall take into account the core principles of level 1 DiD (see appendix A), through...9. due consideration of site characteristics*."Suggest to expand 9 to "*due consideration of facility design parameters and site characteristics.*" (definition of bounding envelope from REGDOC-3.6). | Revise definition to be consistent with REGDOC-3.6. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.3 | MAJORDiD is duplicated from REGDOC-3.5.3. | Just reference REGDOC-3.5.3, instead of making it another requirement.  | Adding new administrative requirements without any added benefit to nuclear safety. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.3 Bullets 5 & 8 | ClarificationThe list is more of “guidance” rather than “requirements” while the latter need to be defined with rigor and criteria. | Revise to “Guidance”. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.4  | ClarificationRegarding “*confirmatory analytical activities*”, suggest including this is to be supported by experimental testing and qualification, not by analytical approaches only. | Revise to:*“The licensee shall commence safety analysis at an early point in the fuel design process, with iterations between design activities and confirmatory analytical activities, supported by experimental and qualification testing.*” |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | 4.4 Safety Analysis – Requirements | ClarificationSecond sentence of this requirement should be guidance pertaining to the first sentence. Specific SSR-2/1 clauses are not provided, making the applicability of this IAEA document ambiguous (e.g., are all clauses of SSR-2/1 required under this document?). | Make this sentence Guidance and not a Requirement: “*The objective is the demonstration of an increase in scope and level of detail as the design process progresses in accordance with IAEA SSR-2/1: Safety of Nuclear Power Plants: Design [3].*” |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.6 | ClarificationSuggest changing bullet 5 to “waste management, storage and minimisation”. | Revise to:“waste management, storage and minimisation”. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.7 | Clarification"*As part of the fuel design process, the licensee shall identify: 1. functional requirements; 2. performance requirements*;"Although commonly understood suggest to define in Glossary as not defined in this document or REGDOC-3.6. Could adopt/adapt definitions from Systems Engineering Fundamentals referenced in Additional Information. | Add definition. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.8 item 1b | Clarification“*fuel pellet, element and bundle dimensions will remain within operational tolerances described in TECDOC No 1926*…”This TECDOC does not describe operational tolerances. | Suggest clarifying if this guidance item is referring to a specific set of criteria within the TECDOC as it pertains to operational tolerances. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.8item 2b | Clarification“*For accident conditions considered in the safety report”**Demonstration of “minimum*” as a design objective may not be achievable in all circumstances. Zero failures is the actual minimum number of failures, which is not achievable for all accident conditions, considered in the safety report. The safety report includes both Design Basis Accidents and Beyond Design Basis Accidents. An ALARA approach may be more appropriate, i.e., fuel sheath failures shall be as low as reasonably achievable. | Clarify if this guidance is intended to apply to both DBA and BDBA? |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.8 item 2a & Section 9 | MAJOR“*the fuel elements will not fail*”Some Anticipated Operational Occurrences (AOO) may involve failure of the sheath, e.g., if the AOO involves debris in the heat transport system.Per REGDOC 2.4.1 Section 4.3.2 the AOO acceptance criterion is 0.5 mSv (dose to public). This allows for some fuel failures (or pre-accident fuel defects) for more severe AOOs, as long as the dose acceptance criteria can be shown to be met. Preclusion of fuel failures, however, may be used as a derived acceptance criterion for many if not most AOOs.Qualifiers in these sections are warranted. | Remove:“*the fuel elements will not fail*”Revise to:“*fuel damage or degradation during AOO does not invalidate safety analysis assumptions*” or some such statement. | Establishing a requirement that fuel failure is precluded for all AOOs, including the most severe AOOs, may be equivalent to changing the AOO dose limit in REGDOC-2.4.1 to zero. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.8 item 2c | Clarification“t*he fuel assembly and its component parts will remain in position…*”In some accidents such SBLOCA/LBLOCA, the fuel string will move following reverse flow. So the fuel will not remain in position unless the definition of “position” means inside the channel.For DBAs is it not necessary for fuel to remain in position; effective cooling of the fuel bundle is important irrespective of its position or relocation. | Clarify whether “position” means inside the channel? |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.9  | Clarification*“Fuel degradation mechanisms and associated limits that may challenge the fuel design.”*In this context, does “limits” refer to design limits associated with the fuel design itself or operating limits associated with the use of the fuel design? For example, Section 3.1 refers to “fuel design and fuel design limits”. Are these the same limits? | Suggest clarifying if limits are design limits, licence limits, operating limits, or something else; this suggestion applies throughout the draft REGDOC. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 4.9 item 5 | ClarificationWhat constitutes an “*a verified and auditable knowledge base*” in the bullet *“… fuel damage and failure mechanisms and associated limits shall reflect a verified and auditable knowledge base.”*  | Unclear, clarification required. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 5.2  | Clarification*“demonstrates the adequacy of”* may lead to a situation of undefined level of *“adequacy”* or undefined methodology for *“demonstration”.*  | Need clear acceptance criteria and process guideline. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 5.3 | MAJORThis is a repeat of other clauses and requirements. No value added.  | Remove requirements on management system and quality assurance. | Adding new administrative requirements without any added benefit to nuclear safety. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 6 | MAJORThis seems a repeat of the Engineering Change Control process /licence conditions G1 & G2 requirements. | Remove or refer to the licence.  | Adding new administrative requirements without any added benefit to nuclear safety. |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 6 lead in paragraph | ClarificationIs the following paragraph intended to refer to the loading of bundles associated with a Demonstration Irradiation (DI) as well? *“Before loading a new or modified fuel design into a reactor core, the licensee shall submit, to the CNSC, the following information and obtain CNSC staff’s confirmation that the design is within the licensing basis and is qualified for use…”* | Unclear, clarification required if DI is included.If so, then revise to include a note indicating the graded approach can be applied. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 7 | ClarificationTypically, FFS is used in the presence of a defect or flaw in the fuel, in the presence of a degradation mechanism or for anticipated degradation mechanisms. For example, thinning of sheath wall thickness due to corrosion or fretting wear can be anticipated and included at the design stage as a FFS criteria. FFS assessments and established FFS criteria justify the safe operation of the plant (i.e., defect or flaw will not grow to an unacceptable size, the rate of the degradation mechanism is monitored and assessed to be acceptable) until the next plant outage. | Add additional information within the body of the document on the two essential aspects of fuel FFS which are 1) understanding fuel and fuel bundle degradation mechanisms to the extent that degradation rate(s) is predictable and 2) having monitoring systems in place that enable monitoring the rate(s) of degradation(s). These aspects are not explained well in this section although there are two unreferenced Appendices B and C included in the report related to failure and degradation mechanisms. Appendix D is also not referenced in main body either.  |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 7 | Clarification*“…fuel parameters to remain within the initial conditions assumed by the Safety Analysis Report…”*The various analyses in the safety report (physics, thermal hydraulics, fuel performance, etc.) use different models of the fuel bundle, some more detailed than others. The initial conditions for the fuel bundle assumed by these different analyses can vary as appropriate for the specific analysis, and may not translate to parameters the fuel bundle can be confirmed to be within during operation. | Suggest rewording as *“…fuel parameters to remain consistent with the initial conditions assumed by the Safety Analysis Report…”* |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 7.1 & 7.2 | ClarificationFFS criteria are dispersed throughout various documents and sometimes stated implicitly. This is considered acceptable for an operating plant with extensive operational history. | Add clarity to the guidance section that FFS criteria can be stated implicitly. Also consider adding clarity regarding approaches to establishing FFS criteria to the guidance section (e.g., graded approach and risk-informed decision making). |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 7.1 item 5 | Clarification*“requirements for return to service after an accident.”* It is not clear if “accident” includes AOOs or is only DBAs. Fuel return to service is not an acceptance criterion applied to DBAs. | Suggest rewording as “*requirements for return to service after an AOO*.” |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 7.3 | ClarificationThe need to perform fuel FFS assessments is expected to be rare and the usefulness of having an explicit FFS criteria and FFS governance is questionable.  | Make this part guidance only. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 7.4 | ClarificationUndefined term “*assessed fuel condition”*. | Include clarification on the term “assessed fuel condition” and when it applies. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 8 2nd Paragraph | Clarification“*Monitoring and fuel inspection activities play an important role in ensuring the License’s acceptable safety performance in a number of safety and control areas (SCA’s), including operating performance, physical design, safety analysis and waste management*.”.This is the first mention of waste management in the document. There is no guidance concerning waste management in the design portion of the document. Will waste requirements require any change to the fuel design (for instance cladding material specifications, are there any particular test requirements for the fuel due to waste requirements, and are there non-destructive tests required during the manufacturing phase to ensure fuel integrity when transferred to waste? | Consider adding information on the identified issues to appropriate sections of the REGDOC.  |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 8.1 | Clarification*“The licensee shall establish a monitoring and inspection program that ensures that the fuel is fit for service.”*Is above reference to a monitoring and inspection program referring to both fresh fuel and irradiated fuel monitoring/inspections? If yes, then as written the sentence is lacking information since it only refers to fitness for service and fitness for service applies to fuel that will be irradiated or is in the process of being irradiated. Once a bundle is irradiated and discharged to the fuel bay, being fit ceases to be a hard requirement; unless, “fit” in this context means something more than “fit for in-core operation”. | Unclear, clarification required. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 8.2Bullet 1 | Clarification For existing power plant facilities, technicians complete fuel inspection training at Stern labs; however, there are no formal qualifications for fuel inspection or associated training at this time. | Clarify what is “qualified personnel” and the requirements will be defined by the licensee’s training program and management system. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 8.2 | Clarification "*The licensee shall ensure that the monitoring and inspection program includes onsite and in-bay**inspections of fresh and irradiated fuel and, if necessary, hot-cell examinations.*"This seems to imply that power plants will be responsible, at least partially, for assisting labs in maintaining their hot cells and PIE capabilities. | Remove reference to: “…hot-cell examinations.” |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 8.4 | Clarification If the document is to cover Class Ib reactor facilities the appropriate reporting requirements should be referenced.  | Include a reference to ‘REGDOC-3.1.2, Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills”, which would be applicable to research reactors. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 8.8 | Clarification "*For CANDU reactors, the minimum number of in-bay inspections for a normally operating**reactor with no identified active degradation mechanisms is 20 bundles per year per reactor*"Would it be possible to refine the language of this requirement so that the utilities are free to prorate downward the inspection numbers for years with outages of significant length? Additionally, when a reactor is newly fueled (either a new reactor or a reactor recently refurbished) no fuel will be discharged for at least 90 days or longer. Would it be possible to refine the language of this requirement so that this reality is acknowledged and the utility can accommodate this operational phase in its fuel inspection numbers? | Revise wording to allow for licensees the flexibility to determine appropriate number of fuel inspections to accommodate the operational phase. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 8.10 | Clarification "*The licensee shall minimize failed fuel residency times, as fission product release into the coolant and its deposition on the primary heat transport system piping may result in higher worker doses*."Note, that current US BWR fleet practices for small fuel failures are to detect failure, identify failed fuel cell, mitigate continued fuel degradation and reduce FP release via power suppression; replace fuel at next planned outage. | Suggest using similar verbiage from Section 8.8 Inspection "*For reactors of other designs, the licensee shall seek acceptance from CNSC staff on.*.." |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 8.10 | Clarification What does immediately mean in the context of removing failed fuel? It usually takes a few days to remove failed fuel after it has been located. | Unclear, clarification required. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 7.3 | Clarification Guidance section duplicates REGDOC-2.4.1 | Remove duplication. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 8.10last sentence | Clarification The wording could be changed to highlight the intent of applying the ALARA principle is to minimize dose to personnel being assigned to failed fuel detection and removal; **not** to keep the financial cost of assigning such personnel low, as one could erroneously infer with the current wording. | Revise to:“*The licensee shall apply the principle of ALARA (as low as reasonably achievable) when determining the resources and efforts being put towards failed fuel detection and removal. Radiation doses received by personnel consequent to such efforts shall be kept ALARA.*” |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 9  | Clarification "*When used in conjunction with the operations program, the fuel program shall ensure that fuel is operated within its design and operating envelope.**In conjunction, these programs set operational limits and conditions (OLCs) to ensure that fuel is not damaged….fuel remains with the design and qualification envelope*." REGDOC-2.4.1 clauses 4.1, 4.4.2.5, 4.5, 4.6.1 already include the need to consider operating limits and permitted operational states. | Remove this section; consider what is missing from REGDOC-2.4.1 and add those to the next revision of REGDOC-2.4.1. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 9.1 | Clarification*‘Fuel OLCs shall have the largest safety margins practicable’.*The word *practicable* is subjective.  | Revise to remove subjectivity. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 9.2  | Clarification Guidance is required to address existing plants that are licensed on different criteria; i.e., probability-based initiating events like the current AOO regime of REGDOC-2.4.1, and use of graded approach to establish REGDOC-2.4.1 compliance. Not all AOOs affecting fuel are addressed by safety analysis to the extent that explicit FFS criteria can be developed. | Guidance required to address existing stations with legacy analyses regarding fuel FFS and AOOs. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 9.3 | Clarification "*The operational modes for normal operating conditions should include:..*."Suggest using the term "operating configurations" to align with REGDOC-2.5.2 as well as to align with the configuration definitions listed in REGDOC-2.5.2 Version 2 Section 5.3.1 Normal Operation. | Revise to align with REGDOC-2.5.2. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 9.3 | Clarification What do transitional states mean? How is life extension different to refurbishment? How is maintenance/outage different to shut down? In the guidance, why are heat transport (HT) pressure tests mentioned? This is for HT requirements, not fuel requirements.  | Provide more information on operational modes.Remove reference to PHTS pressure tests. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Section 9.5  | Clarification "*The licensee shall take into account the impact of aging of the PHTS*" This is already covered in REGDOC-2.4.1 clauses 3.2, 4.4.3. | Given it is already covered by REGDOC-2.4.1, remove the clause. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix A | Clarification Appendix A is a duplicate of REGDOC-3.5.3, so it doesn’t need to be included.  | Reference REGDOC-3.5.3, instead of making it another requirement. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix A | Clarification "*Level 3 & 4 DiD is achieved by having documented and understood failure mechanisms and safety criteria in conjunction with a robust fuel deisgn, such that if a design basis accident did occur, the fuel behaviour would be understood and the barrier protected as per the fuel design basis…. For beyond DBAs … to the extent practicable*"Appears to be a large expansion of documentation for Analysis Reports. | Clarify this would not apply to the already licensed fuel designs. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix A | Clarification Discrepancy on the applicability of the DID Level 5 to fuel safety between Appendix A and Section 2.  | Statements must be aligned.  |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix A, Level 2 DiD | Clarification The FFS limits like those for failure mechanisms in Level 3 DiD, are functions of bundle design, composition, testing and code/knowledge base to support simulation of those figures of merit. Level 2 DiD FFS criteria are the same but tied to damage mechanisms. Safety analysis demonstrates the criteria are met, but the criteria aren't necessarily designed to support safety analysis for either DiD level. Safety analysis instead demonstrates that established FFS requirements are met for applicable Level 2 DiD assessed AOO events. | Add clarifying statements after “*Level 2 DiD is achieved by having appropriate fitness for service limits to support level-2 deterministic safety analysis.*” to address comment. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix B - D | Clarification No reference is made in the text to Appendices B, C or D.  | Make reference to these appendices in the body text. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix B | Clarification Missing degradation mechanisms. | Add to table:1. Under "*Deformation with Material Loss*", add "*Endplate Wear*" to “*Observable effect*” column.2. Under "*Change in Material Properties*", add "*Oxide or crud depositions*" to “*Observable effect*” column. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix B | Clarification Excessive fuel deposits should be added to the table; key influencing parameter would be coolant chemistry; impact relevant to safety would be heat transfer and sheath thinning. | Add *excessive fuel deposits* to table. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | AppendixesB, C , D | Clarification Appendixes B, C, and D are very CANDU-centric.  | Should include information and examples for other reactor fuels. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix C | Clarification Excessive fuel deposition should be added to the table. | Add *excessive fuel deposition* to list. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix C | Clarification Fuel degradation mechanisms under AOO conditions should include all of those from Appendix B. For example, fuel stuck in crossflow may be considered an AOO, resulting in excessive spacer wear causing a bundle to no longer be fit for service. Fuel-induced defects could also be considered AOOs according to a failure of level 2 defence in depth, and defects incorporated degradation mechanisms from Appendix B as well. | Consider eliminating this Appendix and identifying Appendix B as (possibly) applicable to AOOs. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix D | Clarification*“This appendix shows examples of acceptance criteria for design-basis accidents.”* Given REGDOC-2.4.1 clause 4.3 and Appendix B, B.1 and B.2 are extensively about acceptance criteria including examples, is it necessary to have the same, yet fewer examples here?Furthermore, for DBAs the acceptance criterion is licence limits for public dose. The acceptance criteria identified in Appendix D are derived acceptance criteria, applicable to design basis accidents.Lastly, as written, this is very restrictive in terms of dose. Short duration of fuel dryout does occur in several DBAs (< 60 seconds) and fuel sheath is assumed to remain **intact** (no dose) until reactor is tripped.  | Remove Appendix D and add any missing information to the revision of REGDOC-2.4.1.Alternately, if kept then suggest rewording as:“T*his appendix shows examples of derived acceptance criteria applicable to fuel design for design basis accidents*.” |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix D | Clarification Confusing table label, "D-A", also in Appendix B. | Use "D-1", etc. to be clearer. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix D4th bullet | Clarification “*Fuel elements (fuel rods) that exceed the critical heat flux (CHF) or depart from nuclear boiling (DNB) criteria are assumed to rupture and contribute to offsite dose.*” is not really an acceptance criterion, but more like a conservative bounding assumption should criteria for this barrier not be met or current knowledge state/code capability not judged sufficient for the conditions.  | Recommend removing it. If needed, recommend including a second table that identifies means to conservatively treat shortcomings in knowledge state or simulation capabilities for select fuel behaviours, responses, and failure/damage modes. This will offer guidance on alternative or graded approaches. |  |
|  | OPG, Bruce Power, NB Power, CNL, CNA | Appendix D,last bullet | Clarification Examples of acceptance criteria of CANDU fuel contain an example from LWR design. | Remove reference to LWR in the last bullet. |  |
|  | Global First Power | General  |  MAJORThe draft REGDOC contains requirements for concepts that appear to better fit within different SCAs including design (2.5.X series REGDOCS), Fitness for service (2.6.X series), Reporting (3.X series) and elements of operational performance, as there is very little discussion directly tied to safety analysis/assessment. While it is recognized that it may be pragmatic to group fuel related requirements together in one document, clarification is requested as to how these requirements interface with other requirements in the other SCAs. For example, the connection between this document and REGDOC 2.5.2, Design for Reactor Facilities: Nuclear Power Plants is not explained even though that document has requirements pertaining to design and qualification of fuel. There is no requirement in REGDOC 1.1.3 for a specific "Fuel Design Program", only what is contained in section 4.5.8 Design of Fuel System. It is recognized that systematic programmatic elements are necessary but whether it is called a Fuel Design Program remains a subject of discussion. Clarification is needed as to why the focus of the document is primarily on "the licensee". Fuels are not designed by a licensee and, for modern designs may not even be designed to any specific licensee's specifications. The fuels are designed by fuel vendors to be 'mated' to a reactor vendor's technology. There may be some operator discussions (with a stakeholder group of operators) during the generic design process of the fuel, but a specific licensee has a role to decide whether the reactor or fuel design will meet their own requirements. The procurement process establishes this acceptance criteria. As currently written, the Operators who will use this fuel will find it difficult to convince the vendors to put effort in ahead of time to ensure the fuel will be sufficiently qualified. | The draft document requires additional work and would benefit from one or more technical workshops with stakeholders, including the developers of fuels for new reactor technologies.Stakeholders should include future new licensees, existing licensees AND reactor vendors who are developing and qualifying new fuel. GFP proposes that a first workshop focus on documenting pertinent information about the lifecycle of fuel design from first principles and cover all of the steps of who does what as the fuel goes through qualification and is proposed to be introduced into any reactor facility (test reactor and power reactor).With this information in-hand, the objective of the document can then be clarified to take account of:* the designers who exist before a licensee (many of whom are engaging with CNSC staff as part of the VDR Program)
* transition from a design and qualification program into a licensing basis for a facility (i.e., how the REGDOC will be used in the crafting of the license and LCH)
* Fundamental responsibilities/accountabilities of a licensee when accepting and using a fuel design.

• Adoption and leveraging of information/results from other jurisdictions outside Canada (pedigree and relevance of information to the specific reactor the fuel will be used in) - The draft document should incorporate a specific section that sets requirements on what 'intelligent customer' traits a licensee must have in place to systematically assess and accept a new fuel design. For smaller SMRs, a licensee may be a very small organization who will rely heavily on the vendors. Would a third-party independent review procured by the licensee be acceptable in lieu of the licensee having dedicated and very costly internal capabilities? Similar to how REGDOC 2.5.2 is written, requirements for the design and qualification of fuel should be written in such a way that it is clear that fuel vendors and reactor developers know that they are expected to address them in their design activities. (i.e. this is examined in Focus Area 4 of the VDR Program). | This draft REGDOC will require significant interpretation when applied to new build nuclear facility projects where there is a new prospective licensee working with a new reactor technology developer (especially if originating from outside Canada) and referencing fuel that has been designed in advance for that reactor design. |
|  | Global First Power | General  | MAJORExisting reactor operators in Canada (NPPs and research reactors) have to comply with extensive regulatory requirements that are documented in licence conditions, various REGDOCs and LCHs. In this context, the objective of the proposed draft document is unclear. If it is to document and reflect OPEX and existing practices, then it should say so and could be commented on accordingly. If new requirements are introduced, these should be clearly identified and justified. As a high-level comment, the document does not appear to reflect in all cases current practice and introduces new terminologies and requirements.  As a licence applicant and future operator of an advanced reactor technology, GFP is very interested in availability of documented regulatory requirements on all aspects of reactor fuel, from design, qualification, procurement, safety assessment, operation, fitness for service, reporting, change control, transport, disposal, etc… As such, GFP is not opposed to expansion of the scope of the document, or creation of a series of documents addressing fuel and fuel related regulatory requirements and guidance.   | Clarify document intent.    | The current scope and objectives of the document are very ambitious, and in its present state, does not adequately address scope and objectives, creating uncertainties of expectations for existing licensees and applicants.  |
|  | Global First Power | General – SCA  1.1 Purpose  1.2 Scope  | ClarificationThe REGDOC number 2.4.5 suggests that the document focuses on safety analysis.   * Sections 2, 3, 5, 5, 6 and 9 are more related to SCA #5 on design, including interfaces with safety analysis and operational programs (definition of OLCs). Note that there are many overlaps with various sections of REGDOC 2.5.2,  suggesting that this information would be better placed as supplementary information or appendices to REGDOC 2.5.2.

 * Sections 7 and 8 provide information that may be more related to SCA #6 on Fitness for Service.

In general, the current framework has been sufficient to provide guidance on design (including design changes) to fuel for the existing fleet of CANDU reactors, and to address operational programs and measures to address procurement, operation, and waste management considerations.  Consideration of new fuel in a reactor core is by itself a major decision. The essential work related to fuel development, design, R&D and qualification will not likely be carried out by the licensee, but by fuel vendors and subject to procurement and verification activities by the licensed operator as per industry practice (N286, CSA standards). This goes well beyond normal operational considerations.  | Suggest that two or more documents could be developed under the appropriate SCA for the subject matter: * One that would address fuel design generically, including both existing LWR/PHWR practice, and advanced reactor fuels. This could reflect best practices in some areas such as in fuel qualification (NEA “Regulatory Perspectives On Nuclear Fuel Qualification For Advanced Reactors”)
* One addressing operational considerations including engineering change control process and measures to assure continued for fitness for service of fuel in reactor cores.

 Creation of a single document to address all aspects and interfaces with other SCAs may be overly ambitious.   |  |
|  | Global First Power |  2 and Appendix A | MAJORIt is not clear why the Defence in Depth section caters to only traditional fuel and cladding models. A regulatory document should speak more broadly to the role of fuel, regardless of reactor design, in supporting Control/Cool/Contain safety functions. The proven-ness and effectiveness of fuel design and performance will impact the provisions needed for all 5 levels of DiD. New fuels may require some additional conservatisms to address uncertainties until sufficient OPEX has been gathered; however, the draft document is unclear as to when this appropriate level of proven-ness has been achieved.Level 5 DiD provisions are very much influenced by the proven-ness of the fuel under accident conditions. | Revise Appendix A to be technology neutral and include introductory text such as “The design of fuel, and how it is configured in a nuclear reactor system, plays a primary role in supporting multiple successive barriers to releases of radionuclides under various plant states. For example, any design of a fuel element, whether a ceramic, metallic pellet or next generation fuel such a TRi-structural ISOtropic (TRISO) particle fuel must be able to demonstrate predictable confinement performance when the fuel is maintained within its specified operating conditions. Subsequent physical barriers such as cladding or carbon layers are designed to further support the performance of the fuel element. The design of the fuel also plays a significant role in the predictability of the physics and heat generation in the core which are also integral to maintaining control and responding to operational transients.Regardless of the robustness of the fuel, a defence in depth approach does not solely rely on the fuel but requires that other layered design and control measures be implemented to support the critical safety objectives of Control, Cool and Contain. However, design of fuel elements is increasingly receiving more design attention by fuel designers in order to increase safety performance and justify reduced need for operator and offsite intervention during events. This means that the fuel design and qualification program must be of particularly high quality in order to receive credit for claims of stronger safety performance and any uncertainties in performance of the fuel will need to be addressed through conservative design measures until these uncertainties are resolved to the extent practicable.” | Lack of clarity in the draft document on the benchmarks being used to judge ‘sufficiently proven fuel’ to support DiD provisions. |
|  | Global First Power | 2. Fuel Safety  | ClarificationThe following statement: “Other reactor designs achieve the same requirements and level of safety for these latter three physical barriers by other means” may be confusing.  | Suggest: “Other advanced reactor designs may propose different design provisions and measures to achieve the DiD safety objectives and safety requirements”.   |   |
|  | Global First Power | 3. Fuel design  | ClarificationThis section includes many requirements on licensees that are in practice executed by the fuel vendor. The licensee is responsible to ensure requirements are met through its procurement process.  The licensee is responsible for the engineering change control program to ensure acceptability of design changes and compatibility with the reactor design and operational measures.  | If the section is on fuel design, the “shall” statements should not be directed to the licensee, but state generically that requirements should be met.  If the section is to focus on engineering change control, specific requirements could apply to the licensee.  |   |
|  | Global First Power | 3.1 Fuel design and fuel design limits  | ClarificationPoint 1 states “all facility life cycle”. Clarify if this includes all the fuel life cycle from receipt, handling, irradiation, storage in pool, dry storage and ultimate disposal, including compatibility of fuel for permanent disposal.  | Self-explanatory. Clarify.  |   |
|  | Global First Power | 3.5 Fuel Design Authority  | MAJORAlthough the section requires a fuel design authority to be identified, the draft document is unclear as to how much information or what types of information a licensee MUST have regular access to and control over to support their ongoing safety case.  | A future licensee of a reactor facility would benefit from a specific requirement or guidance in this draft REGDOC to use as a lever in establishing fuel (and supporting information) agreements with supplier organizations, ie, the appropriate requirements to address potential risks when fuel is procured from international vendor organizations should be added.Globally, fuel vendors are increasingly restricting access to critical information. The vendor has the primary role to support the long-term fuel design and the licensee needs to be able to get reasonable access to this information.An international origin design authority can place long term Canadian plant operation at risk if they restrict licensee access to information necessary to support their safety case or decide to modify the fuel without considering the operating fleet in each jurisdiction. Although the primary effect is commercial viability and not safety, in the case of a large NPP facility, any decision made by a fuel vendor can introduce undesirable provincial/national energy security risks.  | Licensees must maintain some form of legal control over the design of the fuel they are using. The smaller reactor facilities will have less influence over international fuel design vendors. |
|  | Global First Power | 4.8 Design Safety Objectives | MAJOR*“If the fuel design is for a reactor other than a CANDU, the fuel design safety objectives shall be defined following international best practices, but might differ significantly from the guidance provided for currently operating CANDU reactors.”*To reduce regulatory uncertainty for non-CANDU reactor fuel types, specifying best international practice would be prudent. | The draft document is currently CANDU oriented. For international best practices for advanced fuel types, NUREG-2246 provides a useful framework that could be adapted into the document to help make it more technology neutral. | This will go a long way in clarifying the regulatory uncertainty for new SMR designs that use TRISO fuel. |
|  | Global First Power | 5.2 Technical Basis | MAJOR*“The licensee shall ensure that the technical basis for the qualification program:**1. is based upon OPEX or is demonstrated through a program of experimental testing and analysis, or a combination of both, where:**a. the referenced OPEX must be documented and auditable; and**b. operating experience may be with the same or similar fuel design in the same or a similar reactor design. For any technical basis that is based upon OPEX with similar designs, the licensee shall document and assess the differences between the two designs.**2. demonstrates the adequacy of:**a. qualification analysis and modeling;**b. qualification testing regime; and**c. the documented design and operating envelope of the fuel.”*This section is low on the prescriptive details on what would signify a successful fuel qualification program in the eyes of the regulator vis-à-vis Fuel Qualification, Modelling, data, and QA | A) Consider adding the following statements to the draft document to make explicit or rather clarify the intent of what is being requested, as the document is low on the “details”, particularly in the fuel qualification section:- fuel is qualified for use, evaluation model is acceptable, and the experimental data used for the assessment are appropriate-- either physics based, or empirical models be used, with the latter requiring more fuel irradiation tests and data- identify uncertainties and limitations of the evaluation model-- cliff edge effects should be identified- demonstrate that assessment data are available over the entire fuel performance envelope and any gaps be justified - radionuclide retention requirements of the fuel should be specified.- appropriate fission product transport models be developed - fuel performance code and the various deterministic safety analysis codes be V&Ved in line with CSA N286.7 QAB) A potential 'licensee applicant' for a new build may have a plethora of irradiation tests and post irradiation examinations (PIE) in plan, some may extend beyond initiation of construction of a demonstration plant. Guidance is required in the draft document on what would constitute sufficient testing of fuel for a demonstration plant prior to construction. C) Regulatory guidance in the draft document detailing generic performance objectives for robust fuel would be beneficial on the lines of EPRI TR-110689. | This will go a long way in clarifying the regulatory uncertainty for new SMR designs that use non CANDU fuel. |
|  | Global First Power | 5.2 Technical basis  | Clarification Suggest that a qualification program should rely on a systematic analysis of all available data and operational experience for identification of gaps in knowledge and potential new failure modes, and the establishment/execution of a rigorous R&D program to address gaps in knowledge. This would include when necessary separate effect testing, and integral testing of fuel representative of all operational state to confirm safety limits and fuel acceptance criteria.  | Suggest expanding on expectations and requirements in this section.  |   |
|  | Global First Power | 5.4 Certification  | Clarification What does certification mean in this context? | Reword |   |
|  | Global First Power | 6 Fuel Design Submissions  | Clarification In view of the potential significance of fuel design changes to the safety case, the requirements for documentation in this section may be too succinct:   - For design changes, one would expect all the documentation related to the Engineering Change Control Process; the list may be a subset.  - One would expect completion assurance of fuel design activities including related safety case.   -Any need for in-core commissioning/confirmatory testing, and any additional provisions for monitoring should be described.  | Reword |   |
|  | Global First Power | 7. Fitness for service  | Clarification Fitness for service assessments are normally conducted when doubt exists on the actual conditions of SSCs to meet OLC limits (or consistency with the safety analyses assumptions) as a result of degradation mechanisms or following upset conditions.  For new fuel, fitness for service should be assured by fuel qualification and procurement QA.    | Suggest reconsidering statement: “FFS assessments are performed on new or modified fuel designs through the design and qualification process prior to first load”.  |   |
|  | Global First Power | 7.1 Fuel Fitness for Service Criteria | MAJORThis is a key section of the draft document and the requirements and guidance require further clarification and detail in defining the expected outcomes of a fuel qualification program. The document is unclear as to what is considered acceptable. | This section needs to be rewritten based on the documented outcomes of stakeholder workshops and should, ideally, be the backbone of the draft document. | Lack of specificity in this area presents a significant impediment to understanding what the requirements are from the fuel qualification process. This presents challenges in interactions with the CNSC as early as the VDR process where the reactor vendor is seeking feedback on the program to qualify the fuel. For a new build facility, this introduces significant regulatory uncertainties to the licensing process. |
|  | Global First Power | Fuel Monitoring and Inspection Program e.g.8.2 Capabilities | MAJORSection is not clear enough to use in a technology neutral fashion commensurate with risks to nuclear safety. For example, Section 8.10, “*Failed Fuel and Fuel not fit for service*” cannot be interpreted consistently for cores that use TRISO fuel or Molten Salts carriers.Furthermore, the requirement for inspections should be flexible in application – with a focus on outcomes, not the action itself. This is not onerous for reactors with online re-fuelling but could be quite challenged for reactors with cores that are fuelled once for their operating life. | The entire section should be written in a more technology neutral fashion to accommodate other fuel types such as TRISO and metallic fuels which can be managed differently from traditional water-cooled reactor fuels. Requirements around measures to be put in place need to be clear that measures are to be applied consistent with a Graded Approach….that is commensurate with risks to nuclear safety. Evidence, including OPEX, plays a role in addressing uncertainties. Specific to Section 8.10, delete the first two paragraphs and replace with:” *Commensurate with the FFS criteria for the design of the facility, operation of the reactor with defective or a significant quantity of failed fuel for any extended period of time shall be avoided to reduce the effects of fission product releases into reactor systems.**The licensee shall establish and maintain procedures to mitigate the effects of operation with failed fuel outside the FFS including timely removal of fuel that has been identified as defective or failed, where necessary to meet established criteria*.” | Regulatory uncertainties for advanced reactor fuels, along with potentially significant impacts on operations to meet requirements designed for reactors that conduct online re-fuelling. |
|  | Global First Power | 8.2 Capabilities  | Clarification This section does not appear to include provision for in-core monitoring (capability to identify failed fuel in core).  | Expand section |   |
|  | Global First Power | 8.3 Assessment findings  | Clarification Suggest that the section should be about a systematic assessment of fuel monitoring results, identification of causes and trends, and lead to corrective actions (e.g., removal of failed fuel in core if necessary) and identification of corrective actions.  | Suggest expanding on analysis, trending, and recommended actions.  |   |
|  | Global First Power | 8.4 Reporting | MAJORThis requirement duplicates requirements in REGDOC 3.1.1. | Delete this section | Reporting requirements should be consolidated in one REGDOC, or one risk’s introducing discrepancies between REGDOCs. |
|  | Global First Power | 8.5 Corrective actions  | Clarification “The licensee shall ensure that the fuel monitoring and inspection program has mechanisms in place to take corrective or mitigating actions”.   The focus of the requirement should not be solely on having a process in place, but on taking actions.   | Suggest: “The licensee shall ensure that the fuel monitoring and inspection program has mechanisms in place to take corrective or mitigating actions on findings that have potential impacts on fuel FFS or on the analysed condition, and that such actions are taken when assessed as necessary”  |  |
|  | Global First Power | 8.9 Maintenance of equipment  | Clarification Previous sections are relatively silent on on-core monitoring.  | Expand section |  |
|  | Global First Power | 9 Fuel Operating Limits and Conditions | MAJORSection should be interpreted consistently for cores that use TRISO fuel or Molten Salts carriers. In some SMR designs, the fuel (e.g. TRISO) can be very temperature tolerant and other reactor components (e.g. reactor vessel) may fail first. OLCs need to take this into account. | Revise second paragraph to include “…to ensure that fuel and other physical barriers to fission product releases, are not damaged…” | Regulatory uncertainties for advanced reactor fuels. |
|  | Global First Power | 9. Fuel OLCs  | Clarification The following statement is unclear: “When used in conjunction with the operations program, the fuel program shall ensure that fuel is operated within its design and operating envelope.”   The fuel should always be operated within its design and operating envelop.  | Suggest: “The operator shall ensure that the fuel is operated within its design and operating envelope. The operations and the fuel program shall set operational limits and conditions”  |   |
|  | Global First Power | 9.1 Establishment principles  | Clarification Statement: “Fuel OLCs shall have the largest safety margins practicable.” may not be realistic. Margins have to be quantified and demonstrated as met within levels of uncertainties. The largest practicable margins are when the reactor is shutdown.  | Suggest: “OLCs shall be defined consistent with CSA N290.15” Or “OLCs shall be defined consistent with section 4.3.3 of REGDOC 2.5.2”  |   |
|  | Global First Power | 9.2 FFS  | Clarification The requirement as stated is unclear. OLCs are defined, among other reasons, to ensure fuel remains fit for service.   | Is the intent to include FFS criteria in OLCs during and after all operational state transients. If so, suggest wording such as “The OLCs shall define fitness for service criteria during and following all operational states”.  |   |
|  | Global First Power | 9.3 Modes of Operation | Clarification Guidance is unclear. Prevention of fuel defect conditions should be a requirement. This is particularly important when there is either a new operating organization or there has been significant turnover of staff during the project. (for example, Human Factors issues that arise with changing demographics)  | Add new requirement along the lines of “*Planning and execution of new build commissioning, refurbishment and post-refurbishment operations shall implement preventive measure that due account of potential conditions that could result in fuel defects or damage*.”Replace existing guidance with text along the lines of:*Examples of preventive measures include:**- foreign material exclusion practices when accessing reactor structures systems and components**- PHT system operation, including pressure testing, with 'dummy' fuel to remove contaminants**- hot conditioning of the core**- chemistry control provisions* |  |
|  | Global First Power | Appendix B | ClarificationSection is not applicable to any designs beyond CANDU. However, it can serve as a high-level example. | Change title to “Key Degradation Mechanisms for CANDU facility Normal Operation”Add a paragraph below the table along the lines of:*For other reactor designs and configurations, degradation mechanisms may be similar or unique to the fuel design. The designer and the licensee will be expected to characterize the mechanisms and justify how the list of mechanisms is sufficiently complete.* |  |
|  | Global First Power | Appendix C | ClarificationSection is not applicable to any designs beyond CANDU. However, it can serve as a high-level example. | Change title to “CANDU Degradation Mechanisms”Add a paragraph below the table along the lines of:*For other reactor designs and configurations, degradation mechanisms may be similar or unique to the fuel design. The designer and the licensee will be expected to characterize the mechanisms and justify how the list of mechanisms is sufficiently complete.* |  |
|  | Global First Power | Appendix D | ClarificationSection is not applicable to any designs beyond CANDU. However, it can serve as a high-level example. | Change title to “Acceptance Criteria for CANDU facility Design Basis Accidents”Delete first sentence “*This appendix shows examples…*” and replace with:“*For other reactor designs and configurations, the designer and the licensee will be expected to derive the acceptance criteria and justify it as appropriate based on the level of available supporting evidence*.” |  |
|  | Global First Power | Glossary: Definition of Fuel Design | ClarificationFuel design and performance can support all three fundamental safety functions of Control/Cool/Contain, yet the control function is not reflected in the definition. The control function is not just in advanced reactors; use of inherent fuel physics characteristics with changes in temperature is a normal part of Boiling Water Reactor operating practice and is used, to a lesser degree, in PWRs as well. | Revise the definition to reflect that fuel can have a physics control function as well, even if it does vary from one reactor design to another |  |
|  | Jacques PlourdePresident & Nuclear Engineering ConsultantJ.A. Plourde Performance Ltd | General | The REGDOC does not seem to clearly recognize the importance of core management to fuel FFS. Core management expectations should be defined to fill the gap between new fuel and irradiated fuel inspections, that is when the fuel is in core. In addition, core management functions are facilitated by facility-managed software (eg, NUFLASH) which should be properly controlled and secured from cyber attacks. |  |  |
|  | Terrestrial Energy Inc. | 1.2 - para 1  | Clarification“It applies, primarily, to **fuel programs and designsthat are already licenced**, and to modified or newfuel designs envisioned for operating plants at thetime of publication of this document”. In ourunderstanding, the CNSC does not licence fueldesigns; the CNSC licenses activities (e.g., toprepare site, to construct, to operate, todecommission, to abandon) rather than programs,fuel designs, or facilities. | Change the sentence to “It applies, primarily, to fuel programs and designs that are already licensed **in place in operating plants**, and …”. |  |
|  | Terrestrial Energy Inc. | 1.2  | MAJORThis section claims that the document remains astechnology neutral as practicable and that the highlevel safety concepts and safety-managementrequirements associated will apply to designs otherthan CANDU, where applicable. While this may betrue for water cooled reactors and to a fair extent toother solid fuel designs, it is very little applicable toother type of fuels and specifically to liquid fuels. | The following change is suggested inthe text:“If a design**s** other than a CANDU reactor**, and specifically solid fuelled reactor designs,** is being**are** considered for licensing in Canada, the associated fuel design, qualification and oversight will be subject to the safety objectives, highlevel safety concepts and safety management requirements associated with this regulatorydocument, where applicable.”In addition, the CNSC staff should consider developing requirements for liquid fuelled reactor designs and append such requirements to this REGDOC or develop a separate REGDOC. | If liquid fuel designs were to attempt to apply this REGDOC, a significant number of the REGDOC’s requirements would not apply. Attempting to apply these requirements byexception and/or for the designer to find alternate approaches to each non applicable requirement, this would result in significant effort with very little value. |
|  | Terrestrial Energy Inc. | 2.0 - para 1  | MAJOR***“***Other reactor designs achieve the samerequirements and level of safety for these latter threephysical barriers by other means”. This sentence isnot clear as it could be interpreted that the first twobarriers exactly as mentioned (i.e., fuel and fuelmatrix) are barriers that are expected to exist for alltype of fuels; this may not be the case (e.g., liquidfuels). | This statement should be rephrased***“***Other reactor designs achieve thesame requirements and level ofsafety for these latter three physicalbarriers by other means”. | The potential misinterpretation could result in some new fuel designs to be excluded from consideration as potential viable fuels. |
|  | Terrestrial Energy Inc. | 3 – para 1  | ClarificationIt is not clear how fuel design is within safety limits forall levels of DiD? What would those safety limits befor levels 4 and 5 (when the fuel may be damaged)? | Please provide clarification in thetext. |  |
|  | Terrestrial Energy Inc. | 4.7 - Item 4,Environmental impact | ClarificationIt is not clear how environmental impact can providerequirements beyond the safety requirements. Maybethe chemical components of the fuel could havecertain environmental impacts during fuel fabricationor handling? Or is this about high-level wastemanagement? | Please provide clarification in thetext. |  |
|  | Terrestrial Energy Inc. | 5.2Technicalbasis | MAJORRequirement for having OPEX – this not possible fornew fuel designs that do not have OPEX or that atmost may have only some experimental researchavailable.Note that while the statement in item 1 seem to allowfor demonstration through a program of experimentaltesting and analysis, the sub-items a) and b) thatfollow both imply that OPEX is required anyways. | Please address.  | This requirement disallows development oruse of new fuel designs, and thus disallowsinnovation. |
|  | Terrestrial Energy Inc. | 5.4 and 6  | ClarificationThe requirement from Section 5.4 for the fuel to becertified by licensee’s fuel design authority does notseem to be reflected in the list of requirements inSection 6. Shouldn’t a statement regarding the fuel design certificate be included in the list? | Consider including a fuel design qualification certificate/statement on the itemized list in Section 6. |  |
|  | Terrestrial Energy Inc. | 6 Guidance  | ClarificationNew fuel designs are usually not developed bylicensees, but rather by fuel designorganizations/entities. What is the vehicle based onwhich a fuel design organization can engage withCNSC if they are not a licensee, nor engaged in aVDR for example? | Please provide a clarification regarding how a fuel design organization/entity can engage withCNSC (other than through a licensee). | Without a clarification, fuel designorganizations/entities seem to be disallowed ordiscouraged to engage directly with the CNSC. |
|  | GE-Hitachi Nuclear Energy | 3. Fuel Design | 4th bullet: “at all levels of DiD”Given the concept of DiD is general, and somewhatphilosophical in nature, it is recommended to revise “at alllevels of DiD” to more specific one. | "within its safety limits ~~at all levels of DiD~~ in all applicable facility (or plant) states (or conditions), where each safety limit is explicitly takeninto account in the fuel design basis” |  |
|  | GE-Hitachi Nuclear Energy | 3.1 Fuel design and fuel design limits | 1st bullet: “at all levels of DiD”See Comment #1 above. | “all phases of the facility’s lifecycle, and ~~all levels of DiD~~all applicable facility (or plant) states (or conditions),are taken into account” |  |
|  | GE-Hitachi Nuclear Energy | 3.4 Fuel operation and monitoring | The requirement does not well fit in the section title. | The licensee shall ensure that, as part of the fueldesign program, the fuel be designed such that therequired testing, inspection, monitoring, repair, andreplacement, is facilitated ~~successfully performs itssafety functions for the facility’s design envelope.~~ |  |
|  | GE-Hitachi Nuclear Energy | 4.3 Defence in depth | 4th item: “extensive testing”An inaccurate term “extensive” is used. | “~~extensive~~ performance testing” |  |
|  | GE-Hitachi Nuclear Energy | 9.3 Modes of operation | The label “Mode” has a specific meaning in LWR TechnicalSpecifications and governs all reactor states andoperations.• reactor operating modes refer to steady-stateand shutdown operation and testing• Testing is defined as operation with permissibledeviations• “Transitional states” refer to operationaltransients, e.g., plant heat-up and cool down,step or ramp load changes, etc.Special circumstances (e.g., life extension, refurbishment)are considered to reside outside of plant technicalspecifications that also define Modes of operation andassociated OLCs since fuel is not in the reactor core.It is recommended to remove these specialcircumstances. | The operational modes fornormal operating conditionsshould include:• Cold shutdown;• Hot shutdown• Hot standby;• power productionoperation;• refuelling;• shutting down;• starting up;• commissioning;• transitional states;• maintenance oroutage;• life extension;• refurbishment; and• testing. |  |
|  | GE-Hitachi Nuclear Energy | 9.6 Corrosion | This is addressed by maintenance of feedwater/reactor coolant purity. An acceptable method for maintaining water purity levels in the feedwater/reactor coolant, sufficient to protect the fuel, is to ensure that chemistry is optimized to minimize the potential for IGSCC of stainlesssteel reactor internals and the accumulation of activated corrosion products, which affect after S/D dose rates. The main goals of BWR chemistry controls are to prevent reactor internals damage, minimize after S/D dose rates, and prevent corrosion or excess crud deposition on thefuel. Historically, the first two are more limiting. This is achieved primarily by feedwater chemistry specifications and the condensate treatment system, and supported by the RWCS, which prevents excessive concentration of anyimpurities introduced via the feedwater system.Water chemistry guidelines to minimize corrosion and deposits are well established and formally documented in EPRI report BWRVIP-130: "BWR Water Chemistry". This aspect of reactor management is delegated to industrialpractices that continuously evolve. Water chemistryrequirements stipulated in OLCs pertain to significant activity excursions. Reactor water chemistry is continuously monitored to assure compliance to OLCs governing activity excursions as well as to assure industrial best practices are maintained.Recommend eliminating “In the fuel OLCs”. | In the fuel OLCs, the licensee shall define the operatingparameters to minimize, within acceptable limits,corrosion of the sheath and the 2022-11-08creation ofdeposits. |  |
|  | John P. S. Froats, P. Eng.Associate Professor & Nuclear Engineer in Residence, Ontario Tech University | Context of the need / scope of the REGDOC | When reviewing any document, it is helpful to understand what the objective for the document is and the drivers that influence its purpose and contents. I found it difficult to understand some of the content choices. For example:* Requirements for design, design authority and QA requirements for design are provided in REGDOC 2.5.2. When I reviewed REGDOC 2.4.5 it seemed that there is repeat of REGDOC 2.5.2 content. For example, section 3.5 speaks to fuel design authority, and design authority is covered in REGDOC 2.5.2. There may be a reason for wanting to repeat content but typically repeating content in multiple places becomes challenging for revision and configuration control. Additional information if needed on the topic of design authority might better be placed in REGDOC 2.5.2 with a pointer to it in REGDOC 2.4.5.

Note: There is an aspect of fuel design that is somewhat unique that is NOT currently addressed. Fuel design will typically be done by a company other than the licensee well before application for any licences. At that time, the prospective licensee of an operating facility will not likely be active in fuel design. Perhaps there is a need for guidance how to make the transition from a reactor designer / fuel designer focused on what is needed to address readiness for moving to licensee control and preparation for a licence application. |  |  |
|  | John P. S. Froats, P. Eng.Associate Professor & Nuclear Engineer in Residence, Ontario Tech University | Section 3.3 | REGDOC 2.4.5 Section 3.3 speaks to the `demonstration of conformance to requirements’ with respect to the management system and CSA N286 or equivalent. It might be a statement of what is obvious, but for clarity it might indicate a documented framework equivalent to CSA N286 is requires AND demonstrated evidence that execution of work conforms to what is outlined in the documented framework. As in the point above, the practicality of the evolution of new designs is that conceptual work done by vendors will not be done under this kind of framework and some form of transition is needed at the point where work is being done in support of getting a licence. It may be appropriate to be specific that all work done in support of the safety case for fuel to be submitted in support of a licence must be demonstrated to be done under the auspices of a CSA N286 or equivalent management program. |  |  |
|  | John P. S. Froats, P. Eng.Associate Professor & Nuclear Engineer in Residence, Ontario Tech University | Section 4.1 | REGDOC 2.4.5 section 4.1 uses wording `shall engage CNSC staff’. I have not typically seen that language used to define the CNSC / licensee interface nor am I aware that it has been defined. Engage has a wide range of interpretation. Typically, language like `must submit XXX for CNSC approval’ or `must submit the following documentation for CNSC review X days before fuel being loaded into the reactor’ have been used so there is absolute clarity of expectation / requirement. |  |  |
|  | John P. S. Froats, P. Eng.Associate Professor & Nuclear Engineer in Residence, Ontario Tech University | Section 4.3 | Section 4.3 lists a number of factors to be considered in the defence in depth thinking for the design process. One of the items listed is `use of proven technology’. It seems to me that this does not fit in the list. I think the message trying to be conveyed is that a lot depends on the confidence of the fuel qualification program and that the program will be influenced in terms of extensiveness depending on whether the fuel is used extensively already. Perhaps the item to be listed is a `robust fuel qualification program which takes into account….. A tenth bullet might be appropriate to added : A clearly defined safe operating envelope for the fuel supported by the ability to identify operational non-conformance with that envelope. |  |  |
|  | John P. S. Froats, P. Eng.Associate Professor & Nuclear Engineer in Residence, Ontario Tech University | Section 5.4 | Section 5.4 uses the term `certified for use’ by the fuel design authority. This is another term that I have not seen before – historically, fuel design must be approved for use. The point is that if this is some new term it needs to be clearly defined. |  |  |
|  | John P. S. Froats, P. Eng.Associate Professor & Nuclear Engineer in Residence, Ontario Tech University | Section 5.0 | Section 5.0 outlines requirements for the fuel qualification program. There are two aspects that appear to me to be mixed in the section.1. There is a Fuel Qualification program that satisfies the objective to provide confidence that the fuel will behave in a manner as described in the design submissions in support of licencing for all conditions of operation including: AOO, design basis events and beyond design basis events. This will involve analysis, testing, OPEX review etc. and needs to be done under an appropriate Quality Management program
2. There is A Fuel Qualification program that satisfies the need to demonstrate that the facilities that manufacture fuel can do so with the ability to meet all of the tolerances specified for the fuel in a highly reliable manner, detect non conformances and correct before shipping fuel to be installed in a reactor. Part of this of course is that the fuel manufacturing supplier has the required QA program and demonstrates ongoing conformance to it.
 |  |  |
|  | John P. S. Froats, P. Eng.Associate Professor & Nuclear Engineer in Residence, Ontario Tech University | Section 6 | Section 6 sets a requirement for documentation to be submitted to the CNSC before fuel is loaded. Clarity would be added with some expectation of timeline. I suspect on something so important to safety, the CNSC would want documents submitted well in advance but as written it is not a requirement to do so. |  |  |
|  | John P. S. Froats, P. Eng.Associate Professor & Nuclear Engineer in Residence, Ontario Tech University | Section 8.8 | Section 8.8 uses the terminology that the licensee must `seek acceptance’ from the CNSC for inspection frequency. This is another example of terminology with respect to interface with CNSC that if used needs to be defined (is it something different than approval?) |  |  |
|  | John P. S. Froats, P. Eng.Associate Professor & Nuclear Engineer in Residence, Ontario Tech University | Section 9.3 | Section 9.3 on modes of operation does not address decommissioning. Maybe this is intentional, but fuel design needs to consider decommissioning and fuel storage which seem to be currently missing from the document. |  |  |
|  | Jacques PlourdePresident & Nuclear Engineering ConsultantJ.A. Plourde Performance Ltd | General | The REGDOC does not seem to clearly recognize the importance of core management to fuel FFS. Core management expectations should be defined to fill the gap between new fuel and irradiated fuel inspections, that is when the fuel is in core. In addition, core management functions are facilitated by facility-managed software (eg, NUFLASH) which should be properly controlled and secured from cyber attacks. |  |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | General | The CNSC has not provided a suitable explanation as to why this REGDOC has been placed under the 2.4.X SCA "Safety Analysis". This should be remedied early in the document. It contains requirements for concepts that fit within different SCAs including design (2.5.X series REGDOCS), Fitness for service (2.6.X series), Reporting (3.X series) and elements of operational performance. There is very little discussion directly tied to safety analysis/assessment. It may be pragmatic to group fuel related requirements together in one document but the CNSC should explain why and include a discussion on how these requirements interface with other requirements in the other SCAs.There is no requirement in REGDOC 1.1.3 for a specific "Fuel Design Program". Only what is contained in 4.5.8 Design of Fuel System. The requirement for it to be a program in this document appears to come out of nowhere.The focus of the document only on "the licensee" in a number of areas does not make sense and needs to be re-thought. Fuels are not designed by a licensee and, for modern designs may not even be designed to any specific licensee's specifications. The fuels are designed by fuel vendors to be 'mated' to a reactor vendor's technology. There may be some operator discussions (with a stakeholder group of operators) during the generic design process of the fuel.... but a specific licensee has a role to decide whether the reactor or fuel design will meet their own requirements.Requirements for the design and qualification of fuel should be written in such a way that it is clear that fuel vendors and reactor developers know that they are expected to address them in their design activities. (i.e. Focus Area 4 of the VDR Program). As currently written, the Operators who will use this fuel will find it difficult to convince the vendors to put this effort in ahead of time to ensure the fuel will be sufficiently qualified. |  |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | General | A markup of the posted PDF was provided given that a comment table would have been too complicated to craft. The markup contains remarks and suggested changes to specific text. The draft document requires significant additional work and would benefit from workshops with stakeholders, including the developers of fuels for new reactor technologies. The CNSC has not provided a suitable explanation as to why this REGDOC has been placed under the 2.4.X SCA "Safety Analysis". This should be remedied early in the document. It contains requirements for concepts that fit within different SCAs including design (2.5.X series REGDOCS), Fitness for service (2.6.X series), Reporting (3.X series) and elements of operational performance. There is very little discussion directly tied to safety analysis/assessment. It is recognized that it may be pragmatic to group fuel related requirements together in one document but the CNSC should explain why and include a discussion on how these requirements interface with other requirements in the other SCAs. For example, the connection between this document and REGDOC 2.5.2, Design for Reactor Facilities: Nuclear Power Plants is not explained even though that document has requirements pertaining to design and qualification of fuel. There is no requirement in REGDOC 1.1.3 for a specific "Fuel Design Program". Only what is contained in section 4.5.8 Design of Fuel System. The requirement for it to be a program in this document appears to come out of nowhere. It is recognized that systematic programmatic elements are necessary but whether it is called a Fuel Design Program remains a subject of discussion. The focus of the document only on "the licensee" in a number of areas does not make sense and needs to be re-thought. Fuels are not designed by a licensee and, for modern designs may not even be designed to any specific licensee's specifications. The fuels are designed by fuel vendors to be 'mated' to a reactor vendor's technology. There may be some operator discussions (with a stakeholder group of operators) during the generic design process of the fuel.... but a specific licensee has a role to decide whether the reactor or fuel design will meet their own requirements. The procurement process establishes this acceptance criteria. The REGDOC should incorporate a specific section (e.g new Section 3) that sets requirements on what 'intelligent customer' traits a licensee must have in place to systematically assess and accept a new fuel design. For smaller SMRs, a licensee may be a very small organization who will rely heavily on the vendors. Would a third-party independent review procured by the licensee be acceptable in lieu of the licensee having dedicated and very costly internal capabilities? Similar to how REGDOC 2.5.2 is written, requirements for the design and qualification of fuel should be written in such a way that it is clear that fuel vendors and reactor developers know that they are expected to address them in their design activities. (i.e. this is examined in Focus Area 4 of the VDR Program). As currently written, the Operators who will use this fuel will find it difficult to convince the vendors to put this effort in ahead of time to ensure the fuel will be sufficiently qualified.  |  |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | Section 3,4,5. | This is all done by fuel vendors and reactor designers. The operating organization (who will become the licensee using the fuel) has an intelligent customer role to specify their own acceptance criteria to be met. Requirements should be written generically (i.e. Design changes shall be managed....) |  |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | Section 6,7,8,9 | Requirements below the blue line should be targeted to the Licensee |  |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | Section 1.1 | This regulatory document clarifies the requirements and provides guidance for the design, operation | This regulatory document clarifies the requirements and provides guidance for the ~~design~~, design or acceptance (include footnote) operation |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | Section 1.2 | CNSC does not license technologies | the requirements in this document reflect CNSC's extensive experience with Nuclear fuels from water cooled reactors, in particular CANDU reactors, but are articulated in a manner that is ~~This document focuses on fuel design, operation, monitoring and safety assessments for operating facilities, with implicit concentration on operating CANDU reactors,~~ ~~but remains~~ as technology neutral as practicable. ~~It applies, primarily, to fuel programs and designs that are already licenced, and to modified or new fuel designs envisioned for operating plants at the time of publication of this document.~~The safety principles and objectives articulated in this regulatory document generally also apply to ~~high-level concepts and technology-neutral information also apply to~~ proposed new reactor facilities, including technologies other than water-cooled reactors. ~~While this document focuses on CANDU fuel, high-level concepts within it may apply to other technologies. If a design other than a CANDU reactor is being considered for licensing in Canada, the associated fuel design, qualification and oversight will be subject to the safety objectives, high-level safety concepts and safety-management requirements associated with this regulatory document, where applicable.~~ "However, it is possible that new nuclear fuels will come with alternative approaches to demonstrate their effectiveness" Include Section 11 of REGDOC 2.5.2 here to reinforce use of alternative approaches.This document will be revised as appropriate to incorporate operating experience (OPEX) with new reactor technologies. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | Section 2 |  | ~~Fuel Safety~~The role of fuel in the integrated safety of a facilityDefence in Depth (DiD) is a cornerstone of ~~the~~ safety in the........ requirements. (there is no "regulatory Philosophy" only requirements) Canadian regulatory ~~philosophy~~. Each level of defence has its specific objectives, including the protection of relevant barriers and the essential means for this protection…Regardless of fuel technology, the makeup of fuel serves to confine radionuclides to the extent practicable with a specified set of operating limits |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | Section 3 |  | ~~Fuel Design~~Program for control of the fuel design configuration when applied to the specific facility |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **1.1 Purpose** | **First sentence**: does not provide for an operator to ‘accept’ the fuel design developed by a third party vendor**.**In a modern context, fuel developers, in association with reactor developers do the majority of the work to design and qualify fuels. Licensees set user expectations for their supply chain to meet and accept the results through procurement. | Change “*design*” to “*design or acceptance*” and include a footnote that states something along the lines of “*where a fuel developer is not associated with the operator of the facility, the operator, who will be the licensee of the operating facility, has the role to assess and accept the results of the developer’s work*.” |  |
| 1. **143**
 | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **1.2 Scope** | **First paragraph:** The CNSC has been actively conducting Vendor Design Reviews (VDR) on various water and non-water-cooled technologies since the late 2000s.The scope of the document is limited to existing plants and the rationale for this has not been provided. The scope should cover all fuels, past and future, to the extent practicable, given the importance of fuel qualificaiton to the licensing of new build projects. | Recommend rewriting first paragraph to state something along the lines of “*The requirements in this document are articulated in a manner that is as technology neutral as possible and reflect experience drawn from Canada’s CANDU fleet, research reactors and generic lessons learned from pre-licensing activities and international cooperation efforts.”*The second paragraph should be rewritten to state: *However, it is possible that new nuclear fuel designs may be designed and demonstrated using alternative approaches. In this regard, the requirements stated in Section 11, Alternative Approaches of REGDOC 2.5.2 apply to the demonstration against the requirements in this REGDOC.*   |  |
| 1. **144**
 | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **1.4 National and International Standards** | If SSR 2/1 is to be listed as an international standard, then REGDOC 2.5.2 should also be listed here as a national standard. They are equivalent documents at the level of the CNSC and IAEA safety frameworks.Non-Canadian users need to understand this up front when using this REGDOC. They are documents that contain ‘benchmark requirements and guidance’ for Canada and these expectations need to be met. | List all applicable CNSC REGDOCs here. |  |
| 1. **145**
 | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **2. Fuel Safety** | Title of section is too vague and does not correctly describe what the section is about.First sentence is inaccurate and vague. CNSC does not have a ‘regulatory philosophy’….it has a regulatory framework with requirements and guidance.Recommended enhancement… Experience shows that a fuel design has a role to support the fundamental safety functions of control/cool/contain. This should be stated. | A more correct title is: “**The role of fuel in the integrated safety of a facility**”Change to: “*Defence in Depth (DiD) is a cornerstone of safety in the Canadian regulatory framework.”*Between paragraph 1 and 2, add a new sentence:“*Regardless of fuel technology, the makeup of fuel serves to support control and cool functions but also confine radionuclides to the extent practicable within a specified set of operating limits*” |  |
| 1. **146**
 | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **New Section 3 needed to clarify role of operator.** | Rather than having "The Licensee" in every requirement throughout this REGDOC, why not have a specific section between 2.0 and 3.0 that speaks to the OPERATOR's ultimate responsibility to demonstrate safety performance of the fuel throughout the facility lifecycle? Prior to and during construction, they may not be the licensee but they need to be present and specifying their requirements because it will be their plant to operate and they have to know what they are using.... in Operation, they assume full responsibility once the design is turned over. As currently written, the use of the term Licensee is confusing outside of operation. | Add a new section 3 that addresses the areas at left. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy |  | Title of section is too vague and does not correctly describe what the section is about. | Change current Section 3 into Section 4 and give amore descriptive title such as **Programmatic Measures for Control of Fuel Design Configuration** |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Section 3: First para** | Title of section is too vague and does not correctly describe what the section is about. | Change current Section 3 into Section 4 and give amore descriptive title such as **Programmatic Measures for Control of Fuel Design Configuration** |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Section 3 Requirement** | **The use of the terms “*fuel design program*” is not justified by CNSC… what requirements specify that a *Program* is needed rather than programmatic/control measures?** | Noting that the responsibilities of licensees are now clarified in a new Section 3, requirements can be written in more neutral language as follows:“*Systematic programmatic measures shall be implemented to ensure the fuel design configuration includes..... fuel qualification information, applicable operating experience, manufacturing information”….* etc. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Section 3.1: Fuel design and fuel design limits** | **The use of the terms “*fuel design program*” is not justified by CNSC… what requirements specify that a *Program* is needed rather than programmatic/control measures?** | Noting that the responsibilities of licensees are now clarified in a new Section 3, requirements can be written in more neutral language as follows: “*measures shall be implemented to ensure that the fuel design and fuel design limits are established and supported by credible information. Such measure shall be demonstrated to be derived from proven practices*” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Section 3.2 Control of fuel design and design process** | **The use of the terms “*fuel design program*” is not justified by CNSC… what requirements specify that a *Program* is needed rather than programmatic/control measures?** | Noting that the responsibilities of licensees are now clarified in a new Section 3, requirements can be written in more neutral language as follows: “*The fuel design and design process shall be demonstrated to be documented and controlled using suitable and systematic measures.**Fuel documentation shall be updated in a systematic and timely manner.* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Section 3.3** | **First sentence**: The word “*complies*” is too strong considering that N286-12 is non-prescriptive and fairly high level. Sentences need to be rewritten to be more clear about proposal of alternatives…. And if/how they must be demonstrated to be consistent with current Canadian practice. For example, is CSA N299.1 the benchmark for acceptance and does equivalency need to be shown? Current text is not clear about this as written. | Noting that the responsibilities of licensees are now clarified in a new Section 3, requirements can be written in more neutral language as follows:First paragraph, change first sentence to “*Codes, standards and specifications on which the supply chain quality assurance is based shall be identified and shown to meet the management system requirements of CSA N286-12* *Management system requirements for nuclear facilities.”* *Paragraph 2: Change to:* *“Measures for fuel design shall include a manufacturing QA program that ensures the supply chain* *for fuel employs and justifies an appropriate standard supply chain QA* *such as CSA N299.1, Quality assurance program requirements for the supply of items and services for nuclear power plants.* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **3.5 Fuel Design Authority** | **The use of the terms “fuel design program” is not justified by CNSC… what requirements specify that a Program is needed rather than programmatic/control measures?****Note:** An international origin design authority could potentially place a Canadian facility’s long-term plant operational case at risk if they restrict licensee access to information necessary to support their safety case. This should be addressed in requirements | Noting that the responsibilities of licensees are now clarified in a new Section 3, requirements can be written in more neutral language as follows:“*A fuel design authority shall be identified who is responsible for…”*Add new paragraph or put the following new text into new Section 3:“*Regardless of who the fuel design authority is, licensees shall demonstrate that they have appropriate and timely access to design basis information for the purposes of maintaining their licensing basis over the life of the facility*” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **4 Fuel Design Process** | **First sentence: It is agreed that, for operating facilities, the licensees have a major role in fuel designs for their facilities, BUT for new builds,**1. Fuels are more commonly designed by third parties who cooperate with reactor vendors (or, in some cases, are the reactor vendor) long before licensees emerge.
2. Fuels are being designed for use in multiple countries by multiple types of operators
3. Fuel vendors treat information about the fuel design to be intellectual property and operators must secure supporting information as part of a fuel procurement process
4. The smaller the facility, the smaller the licensee organization will be (economics) which speaks to technical capabilities with regards to fuel.

The requirement needs to speak more clearly to the licensee’s capabilities. | Rewrite the first paragraph as follows:“*The complexity of the fuel design process, including the qualification stage, is a function of the novelty of the design. The design process must take into account all applicable facility states.”***1. Where the licensee drives the fuel design process:**Keep existing text.**2. Where the licensee is procuring a fuel design from a dedicated designer** (e.g. a Westinghouse, GE, Framatome etc) *The licensee must demonstrate it has the technical processes and capabilities in place to assess and accept the requirements and limits the fuel must meet, including how the fuel is produced and how the fuel design is documented to meet the licensee’s specific requirements for their facility.* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **4.1 Notification** | **The use of this clause should only be put in place in a licence or LCH,** not in this REGDOC.The word ‘confirm’ is not appropriate as the CNSC is not, and should not be treated as an integral part of the licensee’s design program.Existing guidance is also not correct given the above. | Delete this requirement. As a compromise, it is possible to rewrite this requirement and guidance differently:*The fuel design configuration information shall be included within the licensing basis information for the facility.***Guidance:** Changes to the fuel configuration are normally subject to CNSC assessment before the change may be implemented by the licensee. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **4.3 Defence in Depth** | Need to acknowledge that a licensee may be procuring already designed fuel from a designer rather than expressly designing fuel. | Change first sentence to: “For *either the design of fuel or the assessment and acceptance of a fuel designed by another organization, the licensee shall demonstrate the implementation of the core principles of level DiD…”* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **4.4 Safety Analysis** | Need to acknowledge that a licensee may be procuring already designed fuel from a designer rather than expressly designing fuel.Also need to acknowledge how this regulatory document would be used in the Vendor Design Review process to provide feedback to a reactor vendor who is demonstrating the fuel meets Canadian requirements… | Change first sentence to “*Safety analysis shall be demonstrated to be implemented at an early point in the design process,…”* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **4.5 Design Consideration Scope** | Need to acknowledge that a licensee may be procuring already designed fuel from a designer rather than expressly designing fuel.Also need to acknowledge how this regulatory document would be used in the Vendor Design Review process to provide feedback to a reactor vendor who is demonstrating the fuel meets Canadian requirements… | Re-write both requirements as follows:“*The design of the fuel and demonstration of fitness for service shall take into account the reactor conditions for all facility states within the design envelope from commissioning to core end-of-life conditions*.” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **4.6** **Input to design process considerations** | Need to acknowledge that a licensee may be procuring already designed fuel from a designer rather than expressly designing fuel.Also need to acknowledge how this regulatory document would be used in the Vendor Design Review process to provide feedback to a reactor vendor who is demonstrating the fuel meets Canadian requirements… | Rewrite requirement as follows:“*The design process shall contain documented measures of how the following were taken into account in design decision making:”* |  |
|  |  | **4.7 Design Requirements** | Requirements and guidance should be placed into the recommended new section 3 to have one section in this REGDOC that speaks to the licensee’s responsibility w.r.t. the fuel configuration in the supply chain. | Move requirement and guidance to new section 3 which is devoted to what the licensee is expecting of their fuel design supply chain. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **4.8 Design Safety Objectives** | Requirements and guidance should be placed into the recommended new section 3 to have one section in this REGDOC that speaks to the licensee’s responsibility w.r.t. the fuel configuration in the supply chain. | Move requirement and guidance to new section 3 which is devoted to what the licensee is expecting of their fuel design supply chain. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **4.9 Degradation mechanisms** | Need to acknowledge that a licensee may be procuring already designed fuel from a designer rather than expressly designing fuel.Also need to acknowledge how this regulatory document would be used in the Vendor Design Review process to provide feedback to a reactor vendor who is demonstrating the fuel meets Canadian requirements… | Rewrite requirement as follows:“*Degradation* *mechanisms and associated* *limits that may challenge the fuel design shall be characterized and include relevant information from research and development activities and operating experience. In addition:”*Then, keep existing list as is. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **4.10 Documentation** | Need to acknowledge that a licensee may be procuring already designed fuel from a designer rather than expressly designing fuel.Also need to acknowledge how this regulatory document would be used in the Vendor Design Review process to provide feedback to a reactor vendor who is demonstrating the fuel meets Canadian requirements… | Rewrite requirement as follows:“*The* *fuel design process shall document the fuel design and describe how it* *meets the identified requirements.”* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **5. Fuel Qualification Process** | In the modern context, fuel qualification is performed by the designer (a fuel company and/or reactor designer), who is not normally the licensee. As a result, This requirement should actually have 2 parts: 1. What the fuel designer (e.g. vendor) does. (stays here) and; 2. What the licensee is expected to do (put a requirement in NEW Section 3) | Move existing requirement to new Section 3 which will cover a licensee’s responsibilities for demonstrating safety performance of fuel as part of their licensing basis.Add new requirement here along the lines of the following:“*The designer shall ensure that qualification of the manufacturing process complies with the manufacturing QA program described in section 3.3, Management system and quality assurance*.“ |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **5.1** **Qualification objective** | In the modern context, fuel qualification is performed by the designer (a fuel company and/or reactor designer), who is not normally the licensee.A new section 3 would covers off the requirements for a licensee to assess and accept the results of what the designer develops and qualifies | Change requirement to:“*As part of the qualification program, the designer shall demonstrate that the design meets all of the requirements and the associated limits.”* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **5.2 Technical Basis** | In the modern context, fuel qualification is performed by the designer (a fuel company and/or reactor designer), who is not normally the licensee.A new section 3 would covers off the requirements for a licensee to assess and accept the results of what the designer develops and qualifies | Rewrite the opening sentence to the following:“*The technical basis for the qualification program shall*:” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **5.3 Management system and quality assurance AND 6. Fuel Design Submissions** | In the modern context, fuel qualification is performed by the designer (a fuel company and/or reactor designer), who is not normally the licensee.A new section 3 would covers off the requirements for a licensee to assess and accept the results of what the designer develops and qualifies.Existing section 6 wording is vague and does not show consistency with the expectations contained in REGDOC 2.5.2 and Licence application guide REGDOCs 1.1.2 and 1.1.3.In addition, regarding the phase: “*obtain CNSC staff’s confirmation that the design is within the licensing basis and is qualified for use*” The CNSC is not, and should not be treated as an integral part of the licensee’s design program. The licensee should be obtaining independent verification/confirmation and then demonstrating to the CNSC why the design is within the licensing basis and is qualified for use | Move all requirements to new Section 3 and more clearly align fuel design submission requirements with references in REGDOC 2.5.2 and REGDOCs. 1.1.2 and 1.1.3.Remove or re-cast to be aligned with CNSC’s mandate to be independent of the licensee’s responsibilities: “*obtain CNSC staff’s confirmation that the design is within the licensing basis and is qualified for use*”The requirement should establish what CNSC will accept as appropriately conducted independent verification (internal licensee processes? Or third party?) |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **7 Fuel Fitness for Service** | This entire section does not interface or demonstrate alignment with other CNSC requirements for fitness for service and needs a significant revisit for scope in this REGDOC. Fitness for service is not just measuring fuel that is being used, but also includes the aspects of fuel qualification necessary to allow the fuel to be loaded into a reactor core. This is particularly important for new reactor designs. In the modern context, fuel qualification is performed by the designer (a fuel company and/or reactor designer), who is not normally the licensee. The licensee then receives a handoff of technical information necessary to demonstrate fitness for service over the life cycle of the fuel. | This section should receive specific focus in workshops hosted by CNSC that include new fuel developers, reactor vendors and existing/future licensees. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **7.1** **Fuel fitness for service criteria** | In the modern context, fuel qualification is performed by the designer (a fuel company and/or reactor designer), who is not normally the licensee. | Rewrite requirement as follows:“*The designer shall, in consideration of operational requirements, identify and document, to the extent practicable, the fuel FFS criteria*.” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **7.2 Technical Basis, 7.3 Fuel fitness for service assessments AND 7.4 Record keeping** | In the modern context, fuel qualification is performed by the designer (a fuel company and/or reactor designer), who is not normally the licensee. | Move existing requirement to new Section 3 which will cover a licensee’s responsibilities for demonstrating safety performance of fuel as part of their licensing basis. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **8. Fuel Monitoring and Inspection Program** | **Entire Section**: Because all of this falls under the Operator's jurisdiction, put all of this in new Section 3.This is no longer "designing and qualifying the fuel" but rather situational awareness that the fuel performs within its design specs.... | Move existing requirement to new Section 3 which will cover a licensee’s responsibilities for demonstrating safety performance of fuel as part of their licensing basis. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **8.2 Capabilities** | Write requirement in a m ore technology neutral format. | Rewrite requirement to the following:“*The monitoring and inspection program shall include, as applicable to the fuel type and fuel handling and storage configurations,* *onsite and in-bay* *inspections of fresh and irradiated fuel and, if necessary, hot-cell examinations*.” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **8.4 Reporting** | This requirement is already in REGDOC 3.1.1. Repeating it here has no value other than to duplicate the requirement. | Delete Section 8.4. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean EnergyMarcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **8.5 Corrective Actions** | The listed guidance is not actually guidance and should be merged into the requirement.Requirements needs to reinforce the need to use proven mechanisms and that any action will be commensurate with safety importance. Any pre-licensing engagement should seek to understand what these will be on a case-by-case basis for the fuel design being proposed. | Modify existing requirement to:“*The licensee shall ensure that the fuel monitoring and inspection program has proven mechanisms in place to take corrective or mitigating actions on findings, commensurate with importance to safety, that have potential impacts on fuel FFS or on the analysed condition.”**And delete the guidance.* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **8.6 Trending** | Fuel designers and vendors are see their information as proprietary and will control what is released to licensees. A large power plant licensee has ‘clout’ to get reasonable access to access to this information. However, smaller licensee organizions with smaller facilities have less “clout” to compel this information to be provided. Lack of access can hamstring the licensee and introduce significant uncertainties to the long term operation of the facility. It can also become a national security and/or energy security issue if not addressed up front. The existing requirement needs to confirm that the licensee has secured this access | Revise requirement to:*“The licensee shall demonstrate it has suitable access to the designer’s technical information to define levels related to expected fuel conditions and degraded states in order to identify negative trends”* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean EnergyMarcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **8.7 Inspection process** | Requirement needs to include a connection to maintaining safeguards provisions.This is important for SMR designs where fuel is not contained in a distinct fuel element, such as a molten salt reactor.Second paragraph in Guidance should be written in technology neutral language. | Revise requirement to: “*Where sampling is used, the licensee shall ensure that there is a documented inspection sample* *selection process that conforms to facility safeguards provisions and requirements”.**Change second sentence in guidance to:**“Targeted surveillance should result in selection of fuel samples/elements that represent different conditions in the reactor”.* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **8.8 Inspection** | Second sentence of requirement: "other challenges" is too vague. New reactors with new fuel designs will be going into service and some form of in service inspections are likely going to be warranted to make up for a lack of long term OPEX.First sentence of guidance “*for relevant information*” is too vague. | Rewrite second sentence to state:“*The proposed acceptable level of inspections shall take due account of degradation mechanisms and remaining uncertainties identified in the fuel qualification process*.”Rewrite first sentence of guidance to state:“*Fuel removed from the core due to it not being, or being suspected of not being, fit for service should be inspected to understand, document and address the root cause of the fitness for service issue”* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **8.9 Maintenance of Equipment** | Requirement as written is too vaue. What does “*properly*” mean? | Rewrite requirement to state:“*The licensee shall ensure that equipment used to monitor for, locate and remove fuel that is not fit for service is maintained to its fitness for service specifications*” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **8.10 Failed Fuel and fuel not fit for service** | Existing requirement is CANDU/LWR centric and should be written in a technology neutral manner. A number of advanced reactor designs, including one referenced in a licensing process in Canada utilize fuel (e.g.TRISO), a vert small portion of which may be considered to be “defective/failed before the reactor even starts up. Some SMR designs are proposing sealed cores (no access for refueling or access to fuel is only design at end of core life). Operation, in this state has been demonstrated, to a degree, in other countries to be acceptable as long as sufficient monitoring/controls are in place to determine whether acceptable operational thresholds have been exceeded (normally well below anything that would lead to potential for significant consequences) | Rewrite the first two paragraphs of the requirement to state something along of the lines of:“*Commensurate with the FFS criteria for the design of the facility, any operation of the reactor with defective or failed fuel for any extended period of time shall give first priority to minimizing the effects of fission product releases into reactor systems.**The licensee shall establish and maintain procedures to mitigate the effects of operation with failed fuel outside the FFS including timely removal of fuel that has been identified as defective or failed.”**Add new guidance along the lines of:*“*A longstanding safety practice as a result of operational experience is to avoid operation of the reactor for any extended period of time with defective or failed fuel. For water-cooled reactors, this remains a fundamental safety practice that must be met. However, a number of advanced reactor fuel designs have characteristics that result in alternative definitions of defective or failed fuel that need to be addressed within the safety case of the facility. The fuel fitness for service criteria serve as a basis to demonstrate how defective/failed fuel will need to be addressed in a timely manner to ensure that a strong Defence in Depth is maintained at all times*.” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **9 Fuel Operating Limits and Conditions** | In some SMR designs, the fuel (e.g. TRISO) can be very temperature tolerant and other reactor components (e.g. reactor vessel) may fail first. OLCs need to take this into account. | Modify existing requirement to state the following:“*In conjunction, these programs set operational limits and conditions (OLCs) to ensure that fuel and other physical barriers to releases is not damaged during normal operations or AOO conditions*.” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **9.3 Modes of operation** | New requirement is needed to address commissioning of new reactor designs or refurbished reactors.Existing guidance is weak with a poorly explained basis. Prevention of fuel defect conditions should be a requirement. | Add new requirement:“*Planning and execution of new build commissioning, refurbishment and post-refurbishment operations shall implement preventive measure that take due account of potential conditions that could result in fuel defects or damage.”*Delete guidance. |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **9.4 Entering new operating conditions** | A guidance statement would be useful to include some examples | Add guidance statement:“*Examples of preventive measures include:**- foreign material exclusion practices when accessing reactor structures systems and components**- PHT system operation, including pressure testing, with 'dummy' fuel to remove contaminants**- hot conditioning of the core**- chemistry control provisions”* |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Appendix A** | Appendix overall needs to be rethought. Why is it CANDU specific when it does not need to be? There is enough CNSC experience with other reactor designs such that this appendix can be written in a technology neutral manner.The DiD story should not repeat what is already in other regulatory documents, but rather to speak to the role of fuel design in DiD. | **A number pf suggestions are provided below to make Appendix A more useful to key stakeholders such as designers.** |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Appendix A** | **First paragraph** – make technology neutral and merge with second paragraph:“*Defence in Depth (DiD) is a cornerstone nuclear safety principle and objective both in Canada and around the world. Each level of defence in depthhas its specific objectoives, including the protection of barriers to releases and the means for ensuring this protection is reliable under the applicable plant states.* REGDOC-3.5.3, Regulatory Fundamentals [5] provides information on the principles of DiD.*”*Add new paragraphs below new first paragraph:*“The design of fuel, and how it is configured in a nuclear reactor system, plays a primary role in supporting multiple successive barriers to releases of radionuclides under various plant states. For example, any design of a fuel element, whether a ceramic, metallic pellet or next generation fuel such a TRi-structural ISOtropic (TRISO) particle fuel must be able to demonstrate predictable confinement performance when the fuel is maintained within its specified operating conditions. Subsequent physical barriers such as cladding or carbon layers are designed to further support the performance of the fuel element. The design of the fuel also plays a significant role in the predictability of the physics and heat generation in the core which are also integral to maintaining control and responding to operational transients.**Regardless of the robustness of the fuel, a defence in depth approach does not solely rely on the fuel but requires that other layered design and control measures be implemented to support the critical safety objectives of Control, Cool and Contain. However, design of fuel elements is increasingly receiving more design attention by fuel designers in order to increase safety performance and justify reduced need for operator and offsite intervention during events. This means that the fuel design and qualification program must be of particularly high quality in order to receive credit for claims of stronger safety performance and any uncertainties in performance of the fuel will need to be addressed through conservative design measures until these uncertainties are resolved to the extent practicable.*Keep existing text:*The CNSC has formulated requirements and provided guidance regarding fuel design, degradation mechanisms and associated limits, qualification, monitoring, inspection and operations, to ensure the application of DiD principles to all fuel-related activities so that the fuel will perform in accordance with its design safety objectives during both operational states and accident conditions. These formulated requirements and guidance can be categorized into their respective levels of defence:* *Level 1 DiD is achieved by robust engineering and construction. To ensure this, it is imperative that the fuel design and qualification processes are comprehensive and that the manufacturing is controlled. Fitness for service limits in conjunction with operating limits and conditions are defined to inform and prevent operations from deviating outside the licensing basis.* *Level 2 DiD is achieved by having appropriate fitness for service limits to support level-2 deterministic safety analysis. Level 2 is further enhanced by having a functioning monitoring and inspection program to identify deviations and abnormalities and take corrective actions to return the fuel condition to normal. Level 3 & 4 DiD is achieved by having documented and understood failure mechanisms and safety criteria in conjunction with a robust fuel design, such that if a design basis accident did occur, the fuel behaviour would be understood and the barrier protected as per the fuel design basis. For beyond design basis accidents (level 4), the understanding and protection should be to the extent practicable* |  |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Appendix A** | Level 5 DiD: Existing statement is not correct as written.  | Revise to:“*The need for, and effectiveness of any offsite response provisions under Level 5 is directly informed by the evidence that the fuel will perform predictably and effectively within the provisions for Levels 1-4*.” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Appendix B** | Section is only applicable to CANDU OPEX. Title should reflect this. | Change title to:“***Appendix B: Examples of Key Degradation Mechanisms for CANDU facility Normal Operation***”Replace opening sentence “This appendix…” with the following:“*For other reactor designs and configurations, degradation mechanisms may be similar or unique to the fuel design. The designer and the licensee will be expected to characterize the mechanisms and justify how the list of mechanisms is sufficiently complete*.” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Appendix D** | Section is only applicable to CANDU OPEX. Title should reflect this. | Change title to:“***Appendix D: Acceptance Criteria for CANDU Design Basis Accidents***”Replace opening sentence “This appendix…” with the following:“*For other reactor designs and configurations, the designer and the licensee are expected to derive the acceptance criteria and justify it as appropriate based on the level of available supporting evidence*.” |  |
|  | Marcel DevosDirector of Regulatory AffairsProdigy Clean Energy | **Glossary** | The definition of fuel design does not acknowledge that fuel also has a significant role in the Control Function in most reactor configurations. This is particularly true for advanced reactors where inherent control characteristics is a consideration in fuel design. | Please reflect the Control safety function in fuel design. |  |