Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 21-H113.1A

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Supplementary Information

Renseignements supplémentaires

Written submission from Bruce Power

Mémoire de Bruce Power

In the Matter of

À l’égard de

Request for authorize Bruce Power Inc. to restart Bruce Nuclear Generating Station A Unit 4 and Bruce NGS B Units 5, 7, and 8 following future outages

Demande de Bruce Power Inc. afin d’obtenir l’autorisation de redémarrer la tranche 4 de la centrale nucléaire deBruce-A et les tranches 5, 7 et 8 de Bruce-B après tout arrêt futur

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Public Hearing - Hearing in writing based on written submissions

Audience Publique - Audience fondée sur des mémoires

November 2021

Novembre 2021

Canada

EAC Comments on Documents provided for Nov 12 CNSC Meeting

Nov 9, 2021

CMD_21H113_CNSC_staff_assessment_of_supplemental_information……

1. Generally agree with the overall recommendations

2. Section 4, last paragraph:*" Pressure tubes are most at risk of crack initiation and failure during heatup or cooldown of the reactor; it is irrelevant whether the heatup or cooldown cycle occurs as a result of a planned or unplanned outage*."

   This comment is valid for heat-ups, as these are planned events which are carried out under predictable conditions. Similarly, cooldowns during planned outages are carried out under predictable conditions. However, cooldowns during forced outages can be very challenging for the operators because of the sudden nature of the failure causing the outage and the possibility of unusual conditions in the reactor due to the failure. The risk of crack initiation may be higher during challenging cooldown activities.

Bruce Power Response: Bruce Power conducts a post-transient review for any shutdown (planned or unplanned). As part of this review, the cooldown curve is reviewed for potential impacts on pressure tube fitness for service. In the event that the cooldown deviates from normal, an assessment is conducted to ensure that the pressure tubes remain fit for service.

E-DOCS-#6668418-v1-CMD_21-H113_1-Submission_from_Bruce_Power_Units_4-5-7-8

3. I think that there is general agreement that it is unwise to carry out extensive, un-planned inspections during forced outages. It should not be necessary to continue to provide lengthy explanations of how carefully work is planned for a forced outage.

   Bruce Power Response: Agreed.

4. In previous submission CMD 21-H11.2A (File / dossier: 6.01.07; Date: 2021-09-02; Edocs: 6633418) Bruce Power appears to be arguing that they meet the requirements of both Option A and Option B. In this submission, Bruce Power is providing information only in support of Option B. Does Bruce Power believe that it also meets the conditions for Option A.? If so, this represents a difference of opinion from that of the CNSC. Is there an intention to resolve this difference of opinion if it still exists?

Bruce Power Response: At this time Bruce Power confirms that it has fully met the requirements of Option B only.

5. **Attachment A**, page 1, para1 states:"*All inspections completed on Unit 4 have demonstrated there were no elevated levels of hydrogen above licensing requirements in the inspected area of the tubes".* This comment is repeated several times in the Attachment. However, it is not possible to judge the relevance of this statement to the issue at hand, i.e. the observation of anomalously high Heq in the ROI, without knowing whether any of these inspections included any parts of the region of Interest. Did any do so?

Bruce Power Response: All inspections completed to date in Units 4, 5, 7 and 8 have not indicated any elevated hydrogen concentrations. Traditionally, Bruce Power has performed scrape measurements in the Rolled Joint (RJ) region (inlet or outlet) at 4 axial locations: two in compressive zone and two in the tensile region. The first location from tensile region is in the region of interest (ROI) at either 54 mm (BM+54 mm) or 62 mm (BM+62 mm) from the Burnish Mark (BM). In the compressive zone the scrapes have been performed 25 mm before the BM (BM-25 mm), and the results from this location will be the first to indicate an elevated [Heq]. It should be noted that the elevated [Heq] was first detected in Unit 3 during the A2131 outage with these standard scrape locations. Bruce Power will be pursuing inspections in the ROI in the next planned outage for each unit.

6. In Attachment A regarding unitized inspection findings, the number of flaws in the inboard 100 mm of the outlet BM (OBM) are reported for each of units 4, 5, 7 and 8.

   - What about data from Units 3 and 6?
   - Why is the axial length 100 mm when Enclosure 1 uses 75 mm for the axial inboard length to define the region of interest?

   Bruce Power Response: The data for Unit 3 and Unit 6 were provided in the Enclosures of CMD 21-H113.1. The results for Units 3 and 6 are consistent with the results for Units 4, 5, 7 and 8. The data for Unit 3 was also previously provided in support of the Unit 3 return to service in Enclosure 1 of CMD 21-H110.1B. Unit 6 is currently undergoing its Major Component Replacement (MCR) outage where all pressure tubes will be removed and replaced and for this reason was not subject to the order.

100 mm from the outlet burnish mark was originally used as a convenient and conservative range for examining flaw incidence in the vicinity of the region of interest. The 75 mm axial range for the region of interest was defined by CNSC after this information was generated. Note that the selection of 75 mm or 100 mm does not impact the numbers reported in the tables (i.e., there are no reportable flaws between 75 mm and 100 mm).

We realize that we are missing some detail in the methodology, but we are unable to find the description in prior updates of supplemental information from BP. As noted at the November 5 hearing, it would be much easier for the readers and particularly the decision-makers to understand the arguments if the text of the CMD presents the information necessary to understand the argument without needing to dig through previous submissions on the subject.

7. **Enclosure 1**: In section 4.0, para 2, the statement is made: "*It was judged that the product of these two probabilities would be virtually unaffected by increasing the axial extent of the database*." A judgement decision would be more acceptable if there were some sensitivity cases run to confirm that the two terms do indeed cancel each other out.

   Bruce Power Response: Sensitivities relating to this assumption about the axial extent considered were not deemed necessary given confidence that the assumption was reasonable. The dataset considering an axial extent up to the end of the first bundle has a large number of flaws, and that region is closest to the region of interest and as such is considered to be most relevant.

8. Section 5.1 on page 20 of 37 begins with the statement: "*This probability is assumed to follow a Poisson distribution*". Is there any physical evidence to confirm that this assumption is valid? What would be the consequence if it wasn't? Validating assumptions is an important part of any engineering assessment.

   Bruce Power Response: For sets of randomly occurring, discrete observations the Poisson distribution is most commonly used, and was deemed to be appropriate for this application. The mean incidence rate (λ) was based on actual detection of flaws obtained in-reactor. While other distributions could be considered for this exercise, they would not be any more valid than the Poisson distribution.

9. In Section 5.2 and 5.4, results are given to 5 significant figures. For example in Section5.2 "…*that a flaw is present is estimated to be 0.011606*". What is the basis for the surprisingly large number of significant figures reported in these sections of the report?

   Bruce Power Response: It is a calculated value, which is only considered meaningful up to 3 significant figures (as reported in the tables).

10. **Enclosure 2**: In the last sentence of the Results Section (on p.35 of 37), the following statement is made:" *the estimated number of flaws in the uninspected population was …~1.9-2.0. The updated, more refined analysis … indicate a more realistic value of 0.6 dispositionable flaws* …". What is the basis for stating that 0.6 is more realistic than 2. It is more favourable (which is why the conservatism was removed), but how was it concluded that the lower figure is more realistic?

Bruce Power Response: It is more realistic because the flaws of concern for pressure tube integrity are dispositionable flaws. The observation of a proportion of all flaws being dispositionable (i.e., roughly 1/3 based observations outside the region of interest) is not apparent in the region of interest, where there have been zero dispositionable flaws in the inspected tubes. This is consistent with the understanding that debris flaws tend to be both more numerous and more severe around fuel bundle bearing pads where debris can get trapped against the pressure tube surface. Since fuel bundle bearing pads have not resided in the region of interest to trap debris and form flaws in this manner, the observation of less severe fretting flaws in that region is consistent with expectations.

11. In addition, the argument is that there were 6 real flaws and it was assumed that 1/3 would be dispositionable, i.e. there would be 2 dispositionables. In fact, there were 0 dispositionable flaws. Saying that this shows the assumption is conservative seems a bit weak. If we calculate how often in a population you would get you get 0 dispositionable items if you had a 1/3 dispositionable population …. we think it is just (2/3)^6 which means that 9% of the time, that is the result you would expect. It seems inappropriate to discard the 1.9 expected flaws when it is expected that 9% of the time that is indeed the number you expect.

Bruce Power Response: The expected number of flaws was presented using different approaches in Tables 2, 3 & 4 of Enclosure #2; none of the approaches were discarded. However, per the response to comment #10 above, it is believed that the approach based on dispositionable flaws is more representative and better aligned with the physical understanding of the formation of debris fretting flaws.