K-7

----- Original Message -----
From: Mark Kirk
To: Labeau Pierre-Etienne ; benedikt.martens@sckcen.be
Cc: helmut.Schulz.krtn@t-online.de ; andre.pineau@mines-paristech.fr ; timwilliams@39bhr.fsnet.co.uk ; kim.wallin@vtt.fi ; stvims@ims.bas.bg ; ki-sig.kang@iaea.org ; Alejandro.HUERTA@oecd.org ; willy.deroovere@fanc.fgov.be
Sent: Tuesday, October 30, 2012 3:21 PM
Subject: some commemts on Tractebel documents

Dear Benedikt (& others) -

Please forgive the last blank e-mail you received from me. My clumsy thumbs pressed "send" prematurely.

Due to a late season hurricane on the east coast of the United States that has stranded me at home, i have had two uninterrupted days during which i have taken the opportunity to review some of the documents that have been provided to us by Tractebel. In specific i have made my way through all documents provided so far in the categories of:

- calculations
- safety
- strategy note

Following instructions from Professor Labeau i am sending you these comments (attached) in the hope that Tractebel may be informed of them so that the more important ones can be addressed during our meetings in late November. Also, i should note that all of these comments fall into Professor Labeau's "Category 1," i.e., those related to the general consistency of Electrabel's justification case.

Before anyone delves into the details of my comments i wish to say that overall i found the documents provided so far by Tractebel (those i have read) to be of extremely high quality and thoroughness. Even though i have identified some major technical comments I am nevertheless optimistic that they can be resolved in a satisfactory manner.

In the interest of clarity i have adopted a standardized format for my comments, which is attached. There is a separate comment file for each document i have read; it is designated by the 3 digit identification provided as part of the title within the "Electrabel Deliverables List" spreadsheet you provided previously. Also, with a view to communicating the relative importance of my various comments, and also what i hope can happen in response to my comments, i have categorized each comment as being one of the following five types:

Type ID	Definition
Editorial	Just something that was noticed. Provided for information.
Info	Additional explanation and/or information is suggested to clarify/improve the strength and/or logic of the safety case.

C/119

Tech-Minor	A technical comment having limited impact on the safety case. Address of this comment would improve the safety case, but is not viewed as necessary.
Tech-Major	A technical comment having significant impact on the safety case. Address of this comment is viewed as necessary.
Expansion	A suggested expansion of the proposed argument that is viewed as augmenting the strength of the safety case.

It is of course the "Tech-Major" comments that i particularly hope Tractebel will be able to give some thought to before our meeting at the end of November.

Finally i should note that the two attached pdf files are referenced from within some of my comments.

Please let me know if you have any questions or concerns.

Best regards,

Mark

Mark Kirk
Senior Materials Engineer
Office of Nuclear Regulatory Research
United States Nuclear Regulatory Commission

Document #: 8.1.1

Document Title: 10010363730_000_00. "Strategy for drafting the Doel 3 and Tihange 2 restart file"

Commenter: Mark Kirk, mark.kirk@nrc.gov

Date: 30th October 2012

ID	Location	Type	Comment	Resolution
8.1.1-1	Sect. 1	Info	The statement is made [redacted] (b)(4) [redacted] (b)(4) Is it possible to see this document?	
8.1.1-2	Sect. 3	Tech-Major	The statement is made [redacted] (b)(4) [redacted] (b)(4) Certainly brittle initiation is to be guarded against, and is the most worrisome outcome. [redacted] (b)(5) Can you please say how your analysis addresses the preclusion of ductile crack initiation, or argue what it is not necessary to do so?	
8.1.1-3	Sect. 7.3	Tech-Minor	The statement is made [redacted] (b)(4) [redacted] (b)(4) [redacted] (b)(4) This statement seems speculative unless it can be referenced that such segregations were actually observed in the original large scale specimens that led to the ASME K_{Ic} and K_{Ia} curves.	
8.1.1-4	N/A	N/A	Never mind. I resolved this myself.	
8.1.1-5	N/A	N/A	Never mind. I resolved this myself.	
8.1.1-6	Sect 7.5.1 & 7.5.2	Tech-Major	In 7.5.1 it is stated that the deterministic (ASME) assessment is performed [redacted] (b)(4) [redacted] (b)(4) However, in 7.5.2 the probabilistic analysis is performed only for PTS (i.e., accident) conditions. As I understand your explanation a key motivation of performing the probabilistic analysis is to deal more realistically with the very large number of indications found in Doel 3 and Tihange 2. As such, what is the justification for restricting the scope of loading cases modeled using the probabilistic analysis to only those resulting from accident loadings? Should not normal loadings be considered as well so that the effects of the very large number of indications found in Doel 3 and Tihange 2 can be assessed for those loading types?	

Type ID	Definition
Editorial	Just something that was noticed. Provided for information.
Info	Additional explanation and/or information is suggested to clarify/improve the strength and/or logic of the safety case.
Tech-Minor	A technical comment having limited impact on the safety case. Address of this comment would improve the safety case, but is not viewed as necessary.
Tech-Major	A technical comment having significant impact on the safety case. Address of this comment is viewed as necessary.
Expansion	A suggested expansion of the proposed argument that is viewed as augmenting the strength of the safety case.

Document #: 4.0.1

Document Title: Calculations : RPV Doel 3 - Methodology for the justification of the indications in Doel 3 reactor pressure vessel

Commenter: Mark Kirk, mark.kirk@nrc.gov

Date: 30th October 2012

ID	Location	Type	Comment	Resolution
4.0.1-1	Sections 4.1.2.1, 4.1.3.1, maybe others	Info	Several proprietary computer codes have been used in these analyses (e.g., SYSTUS, TRTHERM, TEEPAC, maybe others). Please provide evidence / documentation demonstrating that the solutions provided by these codes have been benchmarked to reference solutions.	
4.0.1-2	Sections 4.1.3 & 4.2	Tech-Major	This comment will apply to many documents. (b)(4) To this reviewer's knowledge, the Doel and Tihange safety cases will be unprecedented in the degree to which their outcome will (probably) depend on flaw orientation and combination rules. With this in mind it is viewed as critically important by this reviewer that the basis for and application of these rules be clearly described and understood. Having a document dedicated to that purpose, such as the 4.3.1 document, is an excellent idea. I have attached to these comments a copy of EPRI Report NP-719-SR. Appendix E of this document describes the basis for ASME's flaw orientation and combination rules. As described by the last paragraph on page E-4 of Appendix E, the ASME combination rules are non conservative (up to 20% under-prediction of $K_{APPLIED}$) for the case of equi-biaxial loading that arises during thermal transients. Demonstration that such non-	

ID	Location	Type	Comment	Resolution
			conservatism is not a characteristic of the Tractebel procedure will, of course, be important.	
4.0.1-3	Section 5.1	Tech-Minor	Same as comment 7.4.1-3	

Type ID	Definition
Editorial	Just something that was noticed. Provided for information.
Info	Additional explanation and/or information is suggested to clarify/improve the strength and/or logic of the safety case.
Tech-Minor	A technical comment having limited impact on the safety case. Address of this comment would improve the safety case, but is not viewed as necessary.
Tech-Major	A technical comment having significant impact on the safety case. Address of this comment is viewed as necessary.
Expansion	A suggested expansion of the proposed argument that is viewed as augmenting the strength of the safety case.

Document #: 4.1.1

Document Title: Calculations : RPV Doel 3 – Input data and hypotheses for the structural integrity assessment of the flaws

Commenter: Mark Kirk, mark.kirk@nrc.gov

Date: 30th October 2012

ID	Location	Type	Comment	Resolution
4.1.1-1	Sect 3.5.4 & Table 9	Expansion	I am glad to see that (b)(4) (b)(4) (b)(4) In a paper presented at the 2011 PVP conference (PVP2011-57173, which I have attached) a number of co-authors and I examined the effect of upper shelf limiting the transition fracture toughness curve based on data available for a large variety of RPV steels. The relationship we developed, $K_{Ic}^{LIMIT} = 151.771 \times exp(-0.00271 \times RT_{To})$ permits calculation of a 2.5% lower bound value of K_{Ic}^{LIMIT} based on an input value of RT_{NDT} (or RT_{To}). (b)(4) (b)(4) (b)(5) (b)(5)	
4.1.1-2	Sect 3.6	Info	Please say if the FCG relationship used represents a mean or bounding curve, and say why the selected curve (mean or bounding) was used in the analysis.	
4.1.1-3	Sect 3.6	Tech-Major	(b)(4)	
4.1.1-4	Sect 4	Info	Please provide a plot of the data that leads to the use of a maximum angle of 20°, or provide a reference to where these data can be found.	

Type ID	Definition
Editorial	Just something that was noticed. Provided for information.
Info	Additional explanation and/or information is suggested to clarify/improve the strength and/or logic of the safety case.
Tech-Minor	A technical comment having limited impact on the safety case. Address of this comment would improve the safety case, but is not viewed as necessary.
Tech-Major	A technical comment having significant impact on the safety case. Address of this comment is viewed as necessary.
Expansion	A suggested expansion of the proposed argument that is viewed as augmenting the strength of the safety case.

Document #: 4.2.1

Document Title: Calculations – RPV Doel 3- ASME-III Justification

Commenter: Mark Kirk, mark.kirk@nrc.gov

Date: 30th October 2012

ID	Location	Type	Comment	Resolution
4.2.1-1	Sect 5	Info	I understand that at the end of this section (b)(5) (b)(5) As one specific comment/question, it is stated that: (b)(4) I assume that the 1st sentence refers to information provided in Section 3.2, about the as-designed (no flaw) condition, for which: (b)(4) So I further assume that the 2nd sentence is implying that because the other as-designed values are far below the Section III requirements, i.e., (b)(4)	

ID	Location	Type	Comment	Resolution
			then the other requirements are trivially satisfied. Do I understand correctly? (b)(5) (b)(5)	
4.2.1-2	Sect 6	Tech-Major	The statement is made: (b)(4) (b)(4) (b)(5) (b)(5) (b)(5)	
4.2.1-3	Sect 6	Tech-Major	(b)(4) (b)(4) (b)(5) (b)(5)	

Type ID	Definition
Editorial	Just something that was noticed. Provided for information.
Info	Additional explanation and/or information is suggested to clarify/improve the strength and/or logic of the safety case.
Tech-Minor	A technical comment having limited impact on the safety case. Address of this comment would improve the safety case, but is not viewed as necessary.
Tech-Major	A technical comment having significant impact on the safety case. Address of this comment is viewed as necessary.
Expansion	A suggested expansion of the proposed argument that is viewed as augmenting the strength of the safety case.

Document #: 4.3.5

Document Title: Calculations : RPV Doel 3 – Tihange 2: Methodology for the determination of the acceptable flaw sizes

Commenter: Mark Kirk, mark.kirk@nrc.gov

Date: 30th October 2012

ID	Location	Type	Comment	Resolution
4.3.5-1	Sect 2.4	Info	Based on what I have read in other documents I assume that RT_{NDT} = 45.6 °C corresponds to the measured RT_{NDT} associated with the 4th surveillance capsule, while RT_{NDT} = 100 °C corresponds to this same value adjusted (based on current assumptions) to account for segregation effects. Is this correct? In any event, it would be informative to say what the motivation is for assessing this range of RT_{NDT} values.	
4.3.5-2	Sect 2.5	Info	I assume that the (b)(4) is defined as the one that leads to the smallest allowable defect size, correct?	
4.3.5-3	Sect 2.5	Tech-Major	(b)(4) What is the justification for considering different Level C/D transients in the assessment of acceptable flaw sizes than are shown by the probabilistic analysis to be important risk contributors? If these two analyses (i.e., those presented in this document and those presented in document 4.5.1) do not need to be consistent, please explain why.	
4.3.5-4	Sect 4.1 & 4.2	Tech-Major	Same as comment 4.0.1-2.	
4.3.5-5	Sect 4.3	Info	I am probably revealing my ignorance, but additional explanation of the technical basis for these equations would be greatly appreciated: (b)(4)	

ID	Location	Type	Comment	Resolution
4.3.5-6	Throughout	Info	Same as comment 4.0.1-1.	
4.3.5-7	Sect 4.5	Info	The status of this document is "FIN" (meaning final, I assume), yet the critical flaw size curves given here are said to be only an example. I assume that a future revision of this document, or some other document, will provide critical flaw size curves for the broad range of parameters outlined in this document?	

Type ID	Definition
Editorial	Just something that was noticed. Provided for information.
Info	Additional explanation and/or information is suggested to clarify/improve the strength and/or logic of the safety case.
Tech-Minor	A technical comment having limited impact on the safety case. Address of this comment would improve the safety case, but is not viewed as necessary.
Tech-Major	A technical comment having significant impact on the safety case. Address of this comment is viewed as necessary.
Expansion	A suggested expansion of the proposed argument that is viewed as augmenting the strength of the safety case.

Document #: 4.5.1

Document Title: 10CFR50.61a PTS study of the KCD3 reactor pressure vessel probabilistic apporach

Commenter: Mark Kirk, mark.kirk@nrc.gov

Date: 30th October 2012

ID	Location	Type	Comment	Resolution
4.5.1-1	Sect 5.1.2	Tech-Minor	Same comment as 7.4.1-3.	
4.5.1-2	Sect 6.1.1	Editorial	I suspect the reference to "Section 0" is in error.	
4.5.1-3	Sect 6, 7.3.2, 7.3.3	Info	As recognized by Tractebel, a key part of this analysis is demonstrating that the Beaver Valley 1 transients are appropriately assumed for Doel 3. This argument is presented in the mentioned locations. I am probably revealing that I am not a systems engineer when I say that I found the information presented in these sections to be a bit over my head. I hope it will be easier to understand the information presented in these sections, and the importance thereof, following direct discussions with Tractebel engineers.	
4.5.1-4	Sect 7.3.2.3	Info	Please document the means by which the frequencies of transient occurrence were estimated for Doel 3.	
4.5.1-5	Sect 7.2.1.1	Info	Was the best estimate chemistry for the lower shell used for both the lower and the upper shells? Why is this appropriate?	
4.5.1-6	Sect 7.2.1.2	Tech-Major	Same as comment 4.0.1-2.	
4.5.1-7	Sect 7.2.1.2	Tech-Major	(b)(4) (b)(4) It is difficult to visualize based what is written in this section what the mathematical model of the flaws in the vessel looks like, and how this compares to the NDE data. Please provide some visual, tabular, and/or graphical comparisons to demonstrate that the mathematical model is an accurate or conservative representation of the NDE data for Doel 3.	
4.5.1-8	Sect 7.2.1.2	Tech-Minor	While I agree with the following statement: (b)(4) for the low embrittlement level of the welds themselves (-2 °C) and the surrounding forgings (28 °C) the relationships between RT_{MAX-AW} and TWCF in NUREG-1874 suggest that there should be no (zero) TWCF (and therefore zero FCI) associated with the flaws in the welds. It may therefore be worth noting that all of the FCI estimated in these analyses is thought to arise due to the quasi-laminar flaws.	

ID	Location	Type	Comment	Resolution
4.5.1-9	Sect 7.2.1.4	Tech-Major	The FAVOR code does not model flaw interactions; all simulated flaws are assumed to exist in isolation from one another. While it has not been explicitly stated, I assume that flaw interaction is addressed as a pre-processing step by grouping nearby flaws together. In any event, how flaw interaction has been accounted for, or the fact that it does not need to be accounted for, needs to be described.	
4.5.1-10	Sect 7.2.1.4	Tech-Major	(b)(4) (b)(4) Please assess the impact of this limitation on the ability to model accurately (or conservatively) the flaw population found in the Doel 3 RPV.	
4.5.1-11	Sect 7.2.1.5	Tech-Major	Same comment as 8.1.1-6.	

Type ID	Definition
Editorial	Just something that was noticed. Provided for information.
Info	Additional explanation and/or information is suggested to clarify/improve the strength and/or logic of the safety case.
Tech-Minor	A technical comment having limited impact on the safety case. Address of this comment would improve the safety case, but is not viewed as necessary.
Tech-Major	A technical comment having significant impact on the safety case. Address of this comment is viewed as necessary.
Expansion	A suggested expansion of the proposed argument that is viewed as augmenting the strength of the safety case.

Document #: 4.6.1

Document Title: Calculation: RPV Doel 3 : Fatigue crack growth analysis

Commenter: Mark Kirk, mark.kirk@nrc.gov

Date: 30th October 2012

ID	Location	Type	Comment	Resolution
4.6.1-1	Sect. 2	Tech-Major	Same as comment 4.0.1-2.	
4.6.1-2	Sect. 3.3	Info	The number of cycles assumed in 40 years seems to be greatly conservative (e.g., 200 full heatups and cooldowns per year → 5 per year). If this is indeed an intentional conservatism it is probably worth mentioning.	
4.6.1-3	Sect 3.4 & 4	Tech-Major	(b)(4) These points are, in my opinion, well demonstrated by these analyses. (b)(5) (b)(5)	
4.6.1-4	Various	Info	Same comment as 4.0.1-1.	
4.6.1-5	Sect. 5.2.3	Info	I can accept that Tractebel has performed the FCG calculations correctly, but I feel that this section should be re-written to better describe what their procedure does, or does not, do. In specific I think that the re-write should describe better the following points: 1. What procedures are used to account for the effect of loading sequence on the calculation? If the effect of loading sequence is ignored, why is it appropriate to do so? 2. It is said that stress ratio (R-factor) is computed, but it is not clear that the value of R influences the FCG computation following the Paris law. What is the effect of R factor, if any, on the calculation? If R factor is ignored why is it appropriate to do so? 3. The following statement is made: (b)(4) This passage speaks only of *"pressure evolution."* Does this imply that the affects of thermal loading on K is not considered in the FCG analysis? If so why is this appropriate? 4. The following statements are made:	

ID	Location	Type	Comment	Resolution
			(b)(4) It is probably due to my unfamiliarity with ASME FCG protocols, but I have had great difficulty understanding what these sentences are trying to tell me regarding how the ΔK values and the number of cycles are computed from the information in the table given in Section 3.3 for input into the FCG calculation. The addition of a few details for the unfamiliar would be most welcome.	

Type ID	Definition
Editorial	Just something that was noticed. Provided for information.
Info	Additional explanation and/or information is suggested to clarify/improve the strength and/or logic of the safety case.
Tech-Minor	A technical comment having limited impact on the safety case. Address of this comment would improve the safety case, but is not viewed as necessary.
Tech-Major	A technical comment having significant impact on the safety case. Address of this comment is viewed as necessary.
Expansion	A suggested expansion of the proposed argument that is viewed as augmenting the strength of the safety case.

Document #: 7.4.1

Document Title: Safety Referential: Doel, - Reactor Vessel Integrity of Doel 3

Commenter: Mark Kirk, mark.kirk@nrc.gov

Date: 30th October 2012

ID	Location	Type	Comment	Resolution
7.4.1-1	Sect 3.1.1	Info	Can we get a copy of Royal Decree of 30 November 3011, articles 20 and 24 on aging management?	
7.4.1-2	N/A	N/A	Never mind. I resolved this question myself.	
7.4.1-3	Sect 5.3.2	Tech-Minor	It should be noted that 10 CFR 50.61a does not require that the licensee perform a probabilistic assessment as is being done for Doel. All that 10 CFR 50.61a requires (should a licensee decide to use it) is that the values of the reference temperature calculated as outlined in 10 CFR 50.61a should be less than certain critical values. In this manner the requirements of 10 CFR 50.61a are similar in format to those of 10 CFR 50.61. Of course there is nothing in 10 CFR 50.61a that prohibits a licensee from performing a probabilistic analysis.	

Type ID	Definition
Editorial	Just something that was noticed. Provided for information.
Info	Additional explanation and/or information is suggested to clarify/improve the strength and/or logic of the safety case.
Tech-Minor	A technical comment having limited impact on the safety case. Address of this comment would improve the safety case, but is not viewed as necessary.
Tech-Major	A technical comment having significant impact on the safety case. Address of this comment is viewed as necessary.
Expansion	A suggested expansion of the proposed argument that is viewed as augmenting the strength of the safety case.