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**Hardies, Robert**

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**Subject:** NRC Actions on Quasi-Laminar Flaws  
**Location:** HQ-OWFN-08B06-12p

**Start:** Tue 2/19/2013 2:00 PM  
**End:** Tue 2/19/2013 4:00 PM  
**Show Time As:** Tentative

**Recurrence:** (none)

**Meeting Status:** Not yet responded

**Organizer:** Kirk, Mark  
**Required Attendees:** Hardies, Robert; Fairbanks, Carolyn; Poehler, Jeffrey; Rosenberg, Stacey; Csontos, Aladar; Stevens, Gary; Tregoning, Robert; Davis, Robert; Nove, Carol; Focht, Eric; Min, Seung; Downey, Steven  
**Optional Attendees:** Hiser, Allen; Pham, Bo; Terao, David; Medoff, James

### **TIME FOR 3<sup>RD</sup> meeting**

### **THIS IS THE BEST I COULD DO**

#### **Tentative agenda**

- 1. Info notice**
- 2. Finalize plans for public meeting**
- 3. Review user need**
- 4. Availability of documents from Belgium**

### **UPDATE FOR 2<sup>ND</sup> meeting**

In preparation for tomorrow's meeting, I have attached here the previously sent draft user need (so it is easy to find).



2013-01-30 - draft  
QL flaw use...

Also, in view of events that have happened since our meeting of last time I have re-arranged the agenda to better reflect current status. If anyone has agenda items to add please let me know so that we can modify the agenda accordingly.

1. Summary of discussions with industry since last meeting
  - a. Report from Team 1 (Poehler / Fairbanks)
  - b. Report from Team 2 (Nove)
  - c. Report from Team 3 (Stevens / Kirk)
2. Discussion of DRAFT user need
  - a. Comments and critique
  - b. Next steps
3. Status of information notice

E/130

4. Discuss approach for March 5 public meeting
5. Other matters arising
6. Summary of actions and date for next meeting

Dear Colleagues –

This is a follow-on to the meeting we had on 14<sup>th</sup> January. I am sorry it is on a Friday ... it is the only day of this week during which a quorum of us can attend. I realize that many people use Fridays to work from home. I am hoping that with this advanced notice people can make alternate plans (like calling in).

I have attached the minutes of the 14<sup>th</sup> January meeting, as well as handouts that were provided at the meeting (see below)

Below is a draft agenda. Please let me know if you think I have missed anything. So that we may all be prepared / informed Team leads should circulate their reports in advance of the meeting.

#### **Agenda for meeting**

1. Information needed from industry
  - a. Report from Team 1 (Poehler / Fairbanks)
  - b. Report from Team 2 (Nove)
  - c. Report from Team 3 (Stevens / Kirk)
2. Activities envisaged to address the various blocks in the flowchart.
  - a. Report from Team 1 (Poehler / Fairbanks)
  - b. Report from Team 2 (Nove)
  - c. Report from Team 3 (Stevens / Kirk)
3. Review of draft user need (Hardies / Kirk)
4. Other matters arising.
5. Summary of actions and date for next meeting.



2013-01-14  
meeting minutes.doc.



mark summary of  
jan 7-8 doel m...



2013-01-14 kirk  
suggestions di...



2013-01-14 --  
Gary's Ideas on ...



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Jan 2013 mee...

**ID:** NRR/NRO User Need 2013-xxx

**Topic:** Significance of Quasi-Laminar (QL) Flaws on RPV Integrity

### **Background**

During the summer of 2012, inspections of two reactor pressure vessels (RPVs) in Belgium (Doel 3 and Tihange 2) revealed large numbers of quasi-laminar (QL) indications. Information provided by the Belgian Licensee (Electrabel) establishes the following summary information:

- **The RPV Shells:** The steel for both of the Belgian RPV shells was manufactured by Krupp and forged into rings at Rotterdam Dockyard. There is a lack of evidence that adequate measures were taken to dehydrogenate the steel during those processes.
- **The Indications:** The QL flaws are thought to be hydrogen flakes that developed during the manufacturing process. Hydrogen flakes occur in heavy section steels when trapped hydrogen migrates to non-metallic segregations and inclusions, developing a sufficient pressure to crack those inclusions. In Doel 3 and Tihange 2, the observed QL indications are planar, approximately circular in shape, and appear in large numbers (thousands). They have an average diameter of approximately 10 mm, but were reported as large as 50 mm. Due to the forging process, the segregations and the corresponding QL indications, are nearly parallel to the inner surface of the RPV with an inclination relative to the inner RPV surface ranging between approximately 0° and

(b)(4),(b)(7)(D)

This User Need proposes certain evaluations to assess the continued operating integrity of RPVs in the U.S. in light of the QL indications observed in the Belgian RPVs. This document describes the NRC staff's proposed overall approach to an investigation of this issue for U.S. plants, and specific areas where NRR and NRO anticipate needing assistance from the staff from the Office of Nuclear Regulatory Research (RES).

### **Objective**

Assess the continued operating integrity of the U.S. operating RPV fleet in light of the information recently made available from the inspections of the RPV shells at the Doel Unit 3 and Tihange Unit 2 nuclear power plants in Belgium.

## Overall Approach

The NRC staff will take a two-phased approach. Only the first phase is described in detail here because, depending on the outcome of this phase, further work may be unnecessary. Figure 1 illustrates the Phase 1 approach, highlighting tasks addressing the concerns of both NRR and NRO. The Phase 1 approach is focused on developing information in three main areas:

- [A] Develop an understanding of the metallurgical origin of QL flaws of the type found in the Doel 3 and Tihange 2 RPVs such that the likelihood that nuclear RPVs in the U.S. are affected can be assessed.
- [B] Perform a generic bounding safety assessment for U.S. RPV designs to determine the structural significance of QL flaws similar to those found in the Doel 3 and Tihange 2 RPVs.
- [C] Determine if currently-required ASME Section III inspections and criteria are reliable for detecting and assessing QL flaws of the type found in the Doel 3 and Tihange 2 RPVs.

The color coding used in Figure 1 indicates the tasks in Phase 1 associated with each area of the investigation. To develop this information in an expedient fashion, NRR and NRO require the assistance of RES staff and, potentially, RES contractors, as detailed in the following.

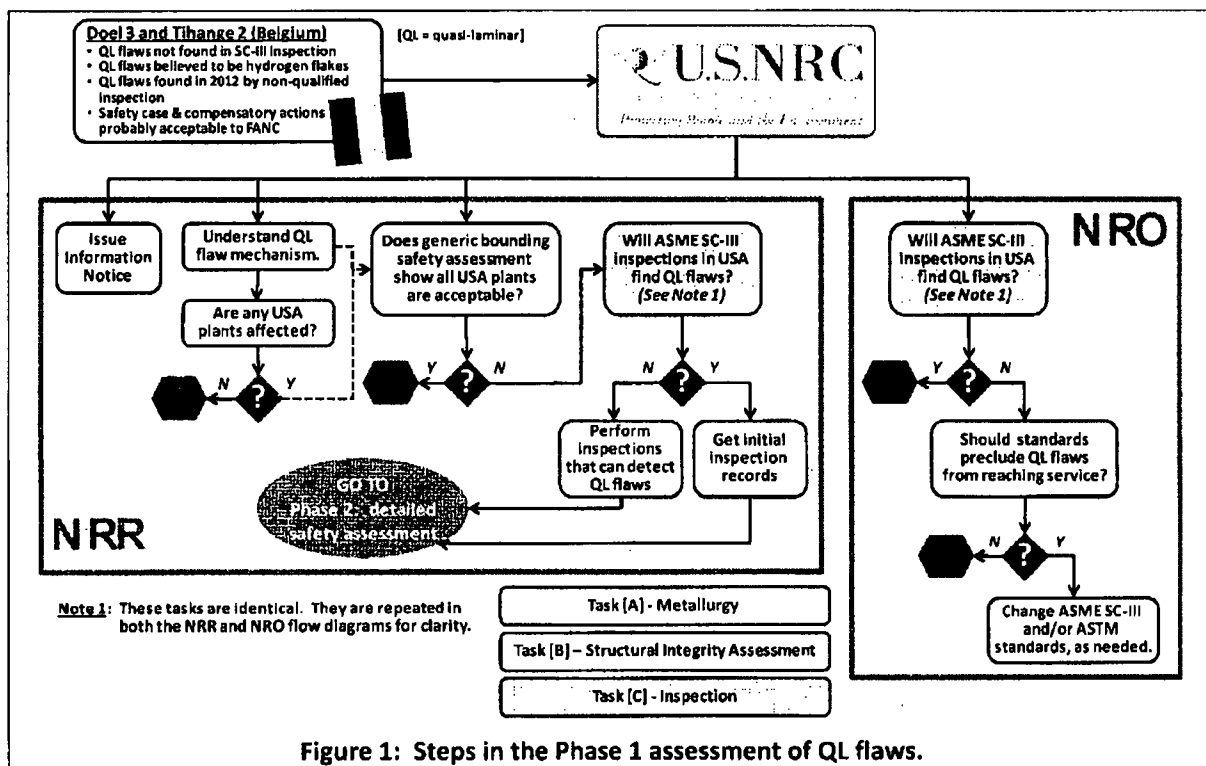


Figure 1: Steps in the Phase 1 assessment of QL flaws.

### Task [A]: Metallurgy

The licensee's documents provide extensive metallurgical information that is useful to this investigation. However those documents have not yet been reviewed in detail by metallurgical experts in the United States. The purpose of this task is to perform such a review with the aims of (a) understanding the QL flow mechanism, and (b) determining if this understanding can be used to establish criteria or metrics to assess the propensity for QL flaws to exist in U.S. plants. As indicated

in Figure 1, such an understanding could lead to the decision that QL flaws are extremely unlikely in U.S. plants (i.e., leading to a STOP condition). In any event, if this understanding is available, it will help to inform the structural integrity assessment performed in Task [B].

As indicated in Figure 1, work on this task should also include an assessment of the adequacy of current requirements specified in ASME, ASTM, and other relevant standards to ensure that a significant number of QL flaws such as those detected in the Belgian RPVs do not occur in ring forgings that are produced for future nuclear RPVs in the U.S.

(b)(4),(b)(7)(D)

Figure 2 details the currently envisioned steps for Phase 2. Phase 2 will be revised based on the outcome of Phase 1 and will, if needed, be described in a future addendum to this User Need.

### **Summary of Work Products**

Table 1 summarizes the work products requested from these three tasks. In their response, RES is requested to complete this table assuming that all work should be completed within 6-12 months from the date of this User Need. Additional details should be provided to fully describe the work products.

This effort, including both Phase 1 and (if needed) Phase 2, will establish the safety significance of QL flaws in U.S. nuclear power plants and is needed to inform potential future regulatory actions (or lack thereof). While this document describes an effort undertaken by the NRC staff, this work is not intended to preclude or discourage any related efforts that the U.S. nuclear industry may conduct on its

own. To the extent that parallel investigations are conducted, exchange between the NRC and industry is encouraged, if appropriate.

Task ID	Work Product Description	Leader	Resources		Anticipated Delivery Date
			Staff [months]	Contractor [\$K]	
[A] – Metallurgy	1	Letter/report describing QL flaw mechanism.			
	2	Letter/report ranking all operating U.S. plants for their likelihood of developing QL flaws.			
	3	Recommendation / options for modification and/or revision of consensus codes and standards to ensure that significant QL flaws are not placed into service.			
[B] – Structural Integrity	1	Letter/report providing a bounding/generic deterministic safety assessment			
	1a	Letter/report documenting the change to product [B1] based on information from Task [A]			
	2	Letter/report providing a bounding/generic probabilistic safety assessment not informed by Task [A]			
	2a	Letter/report documenting the change to product [B2] based on information from Task [A]			
[C] – Inspections	1	Letter/report assessing if historic ASME SC-III criteria and practice in the U.S. are likely to reliably detect and assess QL flaws.			
	2	Recommendation / options for modification and/or revision of ASME SC-III requirements to reliably detect and assess QL flaws.			

