Ring, Mark

From:	Lara, Julio
Sent:	Monday, August 13, 2012 9:30 AM
To:	Casto, Chuck; Pederson, Cynthia; Shear, Gary; Reynolds, Steven; OBrien, Kenneth; Skokowski, Richard
Cc:	Cameron, Jamnes; Daley, Robert; Dickson, Billy; Duncan, Eric; Giessner, John; Hills, David; Kunowski, Michael; Peterson, Hironori; Riemer, Kenneth; Ring, Mark; Skokowski, Richard; Stone, AnnMarie
Subject:	FW: DOEL 3 (BELGIUM) - FLAW INDICATIONS IN THE REACTOR PRESSURE VESSEL
Attachments:	Doel 3 - Status_02-08-2012.docx

From: Bernardo, Robert
Sent: Monday, August 13, 2012 9:26 AM
To: Taylor, Ryan
Cc: Brand, Javier; Lara, Julio; Powers, Dale
Subject: DOEL 3 (BELGIUM) - FLAW INDICATIONS IN THE REACTOR PRESSURE VESSEL

Good morning,

We wanted to pass this along to the regional OpE POC's, since there are POTENTIALLY US plants that might be affected (mostly region 2). We'll keep you informed as we get more information.

IRS 8244P - DOEL 3 (BELGIUM) - FLAW INDICATIONS IN THE REACTOR PRESSURE VESSEL

Doel 3 is a PWR that commenced operation in 1982. In July, UT examinations to detect possible under-clad defects of the reactor vessel belt region instead found indications of fabrication flaws. This was the first time this type of testing had been performed on this portion of the vessel. The flaws appear to be laminar in nature, running parallel to the inside and outside surfaces being examined. The vessel rings containing the flaws were forged in the early 1980's at the Rotterdam Dockyards, which also forged reactor vessel rings for several plants in the U.S., including Catawba 1, McGuire 2, North Anna 1 & 2, Quad Cities 1, Sequoyah 1 & 2, Surry 1 & 2, and Watts Bar 1. Staff are in communication with the Belgian regulator to exchange information and review pending results from follow-up testing.

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B/108

Subject

Summary of the available information and preliminary evaluation by Bel V pertaining to the indications of defects found in the Doel 3 RPV in June - July 2012.

Background

Belgian reactor pressure vessels (RPV) are inspected according to ASME XI. Volumetric inservice-inspections of the beltline area are normally limited to the circumferential welds (there are no axial welds in the Belgian RPVs) and surrounding heat affected zone and base material, within the limits set by the code.

Additionally, as a result of the experience at Tricastin, inspections aiming at detecting possible underclad defects in the pressure vessel beltline region are planned for all Belgian plants. The first inspection of this kind took place at Doel 3 this summer.

These inspections are performed with a qualified UT-method for detection of underclad defects, cover a zone of about 30mm thickness from the inner RPV wall and encompass the whole height of the vessel beltline region. This means that cladded base material was inspected where no volumetric in-service inspection was performed up to now.

Results of the inspection performed to detect and characterize underclad defects (June 2012)

At Doel 3, no underclad defects were detected.

Nevertheless, lot of defect indications of an apparently different type were detected by this UT-inspection, especially in one of the three forged rings (SA-508-cl.3). These indications appear to be of a laminar type of flaw, more or less parallel to the inner/outer surface of the pressure vessel. These indications appear to be of a laminar type of flaw, more or less parallel to the inner/outer surface of the pressure vessel, located in and outside the inspected zone. Considering the fact that this inspection method is not qualified for detection at such location and for this type of indications, precise information about shape or dimension is not available at this stage. *First evaluation* shows that these sub-surface flaws are almost circular in shape with a mean diameter of about 15 mm (maximum 30 mm), with a flaw density up to 40 indications per dm^3. Obviously, it is not possible to justify those indications on a one-by-one basis by means of an analytical evaluation according to the App. A of ASME XI code requirements.

Results of the second inspection performed to detect and characterize base material defects detected in June 2012 (July 2012)

Considering the limitations of the inspection method which revealed the presence of those defects in the base material, an inspection of the whole height of the RPV with the UT-qualified method used to control the beltline welds has subsequently been performed. This inspection covers the whole thickness and the whole height of the RPV. Results will not be available before beginning of august.

However, the *preliminary* results of this second inspection can be so far summarized as follows:

- This inspection confirms the presence of a large amount of indications in the upper and lower shell rings.
- There is a marked disparity in the flaw densities (factor 1 to 5) between the upper and the lower shell rings. Some 10000 indications were detected in the lower shell ring.
- The shape of the flaw distribution is very similar in both cases.

- The bulk of the indications are located in the base material, outside the weld regions, in a thru thickness zone extending from about 30mm from the inner surface to one half of the RPV thickness.
- These flaw indications seem to be laminar in shape and have average diameters of 25 mm.

Current investigations by the licensee

- Upper and lower vessel rings of the Doel 3 and Tihange 2 RPVs were forged by the Rotterdam Droogdok Maatschappij (also referred to as Rotterdam Dockyards or RDM), at the same time and under the same contract.
- The fabrication of both RPVs took place in the same period, following the same requirements.
- According to the Owner, RDM provided 22 vessels in Europe and the US. The list of concerned units provided by the Owner encompasses following units, not necessarily with forged rings: Atucha 1 (Argentina); Doel 3, Tihange 2 (Belgium); Brünsbuttel, Philippsburg 1 (Germany); Borssele, Dodewaard (Netherlands); Santa María de Garoña, Cofrentes (Spain) ; Ringhals 2 (Sweden); Leibstadt, Mühleberg (Switzerland); Catawba 1, Mc Guire 2, North Anna 1, North Anna 2, Quad Cities 1, Sequoyah 1, Sequoyah 2, Surry 1, Surry 2, Watts Bar 1 (USA). RDM does not exist any more.
- The Owner is currently investigating the inspection results. In parallel additional studies are being performed to analyze and, if possible, to validate and confirm the structural integrity of the vessel.
- In the absence of any other explanation at this stage, the licensee supposes the presence of fabrication defects, but does not exclude other explanations.
- Investigations are conducted to retrieve information pertaining to the fabrication and the associated controls. According to the Owner, the defects detected in 2012 should have been detected with the UT procedures used to control the base material at that time. The results of these inspections are not retrieved yet.
- A justification of the observed defects for further exploitation is required by the Belgian regulations, based on ASME XI, App. A. According to first evaluations made by the Owner, alternate requirements will be necessary. The Owner is investigating a. o. alternative rules for regrouping individual indications. A PTS study based on 10CFR50.61a is planned.
- An inspection similar to the inspection performed in July 2012 at Doel 3 will be performed at another Belgian reactor vessel (unit 2 Tihange NPP), during the upcoming outage within a few weeks.

Actions taken by the Belgian Authorities

- Communication with foreign countries: preliminary IRS; direct contacts with Safety Authorities of foreign countries having RPVs fabricated by RDM.
- Review of the available information w.r.t. the fabrication of the Doel 3 and Tihange 2 RPVs.
- Preliminary evaluation of the approaches aiming at justifying the observed defects for further exploitation.
- Further contacts with the Owner

Preliminary evaluation results by Bel V

- We retrieved very few information pertaining to the fabrication (process, follow-up...). Nevertheless, there exist some evidences of difficulties during fabrication, due to strikes, delays and technical problems.
- The lack of information related to the origin of the defects, their unusual high density in some portions of the RPV are a.o. elements which could possibly question the applicability of the justification methods proposed by the Owner. It is e.g. unclear whether the basic assumptions behind ASME XI, App. A and 10CFR50.61a are compatible with this case.