Chou, Rich

From: Chou, Rich
Sent: Wednesday, October 14, 2009 6:00 PM
To: Franke, Mark
Cc: Sykes, Marvin; Morrissey, Thomas; Reyes, Rogerio; Ninh, Son; Lake, Louis; Chou, Rich
Subject: Crystal River Containment Wall Cracks or Separation
Attachments: DOC_20091014160933_000.PDF

Mark:

As I reviewed the Condition Report for the Containment Wall Cracks, the Surveillance Report for Tendon Maintenance, Containment Concrete Wall Drawing, Engineering Change 63016 for Containment Opening, Reactor Building Dome Delamination Report by Gilbert Commonwealth Dated June 1976, and Safety Evaluation Report Supplement Nos. 2, 3, and 4 for Crystal River, **I have a request from NRR for a study of the Containment Wall Opening Closure related to the new rebars, concrete pour, and post tension date for the tendons in the short term base**.

The licensee will take sometime to do the root cause analysis, evaluation, and resolution for the Containment Wall Concrete Separation problem. Special Inspection Team (SIT) will take several months to gather information and make a final determination of the problem and resolution. The Containment Wall New Concrete Pour is about 45 days from now for the Steam Generator Replacement.

The Containment Wall Separation is not the Containment Aging Issue as some suggested. The Containment Wall Separation **was the original design or construction or combination of both problem** as the Reactor Building Dome Delamination originated during the construction time. Both had similar characters such as concrete was separated at the hoop tendons, both had hoop tendons in the curved dome or wall, and the pull force was toward the center of the curve due to the tendon post tension.

The discovery of the dome delamination was due to the installation of anchor bolts for the dome lighting antenna and the hollow sound identified when the hammer was used. There were no spalling or cracks on the top surface of the dome. From the outside, there was no evidence of the dome delamination. The licensee removed 105-inch diameter dome cap and repoured concrete. Similar, the containment wall delamination was not discovered by the surveillance from the surface of the concrete wall and **was discovered by the concrete demolition.**

In the Reactor Building Dome Delamination Report, the report did not identify any real cause for the dome delamination. The report only listed several potential causes or possible combinations. **In the page 3-1 of the Supplement No.2, Safety Evaluation Report , it stated that even though the applicant did not identify positively any single or overriding mechanism as the cause of the delamination**. The same page listed three potential causes provided by the applicant as :(1) concret precracks prior to the application of the post tension; (2) the coarse aggregates fragile: and (3) local stress concentration.

The licensee might not identify the real cause for the Contaiment Wall Separation again during their root cause analysis.

Here are my short term requests and long term suggestions:

1. Short Term - Evaluate the Design and Construction of the Contaiment Concrete Opening Closure for Crystal River

A. Design - Add Radial Rebars to Replace Concrete Tension Force to Resist Hoop Tendon Inward Force (Toward the Center of the Curve)

B-6

The exsiting wall design with no any radial rebars to resist the tendon force after post tension. The concrete used its tension strength to resist the tendon force. The tendons were assumed and designed a uniform pressure to the concrete and the pressure was resisted by the concrete tension strength. The 28-day compressive and tension tests were based on 6-inch diameter by 12-inch long of the cylinders. The center of the cylinder to the edge was only 3 inches. The containment wall has 42 inches thick and its center to the edge is 21 inches which 7 time more than the standard cylinder. It would take more time to cure and develop the required strength. How long will the center of the 42-inch thick concrete take to develop the strength as the design strength of 5000 PSI for compression or about 300 psi for tension? The post tension might apply too early prior to the development of full compressive strength of 5000 psi or required concrete tension strength which gradually created the separation of the concrete. Therefore, the added radial rebars could replace the concrete tension strength to resist the tendon inward force.

Besides, it is a theory to assume that the tendon inward force would apply to the concrete as the uniform pressure. In reality, it was difficult to apply the tendon inward force uniformly to the concrete due to it was difficult to place the tendons in the correct locations. The concrete near the center of the curved tendons would receive most of the inward force and only a few of the force would be received or distributed near the two ends of the tendons.
It would create uneven pressure to the concrete, not uniform pressure.

Attached is a new design for concrete closure for the containment wall opening of the Crystal River. A two layers of #11 horizontal and vertical rebars at 11" spacing each will be added between the vertical tendons and the liner plate. It lacks the radial rebars. Are the radial rebars required to prevent the concrete separation at the horizontal tendons?

B. Construction - Determination of the Cure Time for 42-inch Thick Concrete Prior to the Application of Post Tension

As stated above, the concrete cylinder test is only 6-inch diameter. The containment Wall is 42-inch thick. How much time is the center of 42-inch thick concrete required to get concrete cure to develop required design strength for the compression or tension? **The licensee plans to apply the post tension to the concrete after the concrete pour 7 to 11 days by the current schedule.**

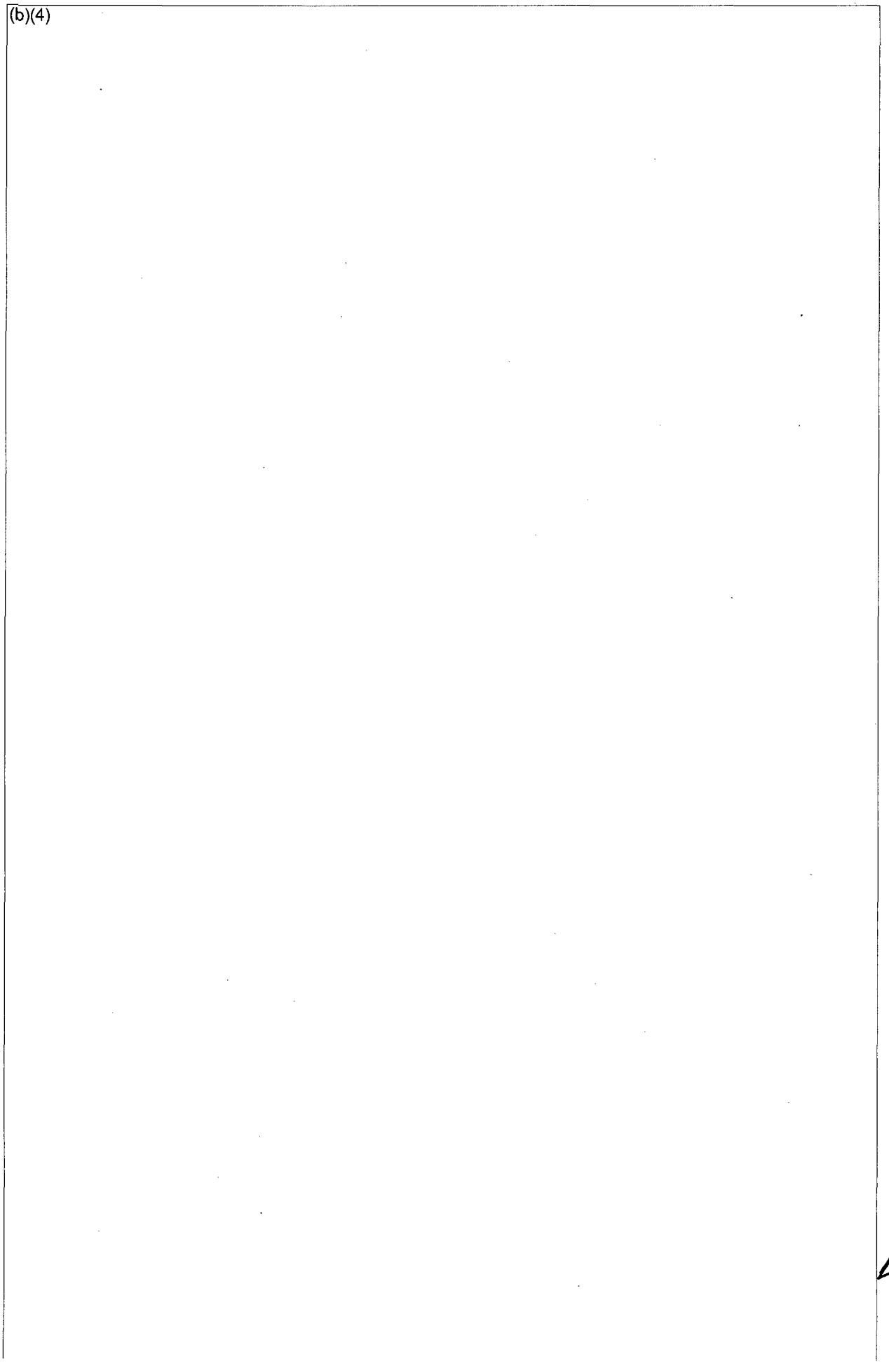
2. Long Term Solution - Generic

A. Issue a Generic Letter to Request all design and construction records from all reactor buildings constructed with tendon design.

B. Analyze and identify the potential problems from the design and construction records due to their differences in the design and construction.

C. Verify the field condition if the design or construction might present the potential problems.

(b)(4)



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