Stewart Brown

From: Evan Rosenbaum [e.rosenbaum@holtec.com]
Sent: Thursday, March 20, 2008 3:41 PM
To: Stewart Brown
Cc: Tammy Morin; Debu Majumdar; Indresh Rampall
Subject: Draft Position Statement - HI-STORM 100U Thermal RAIs
Attachments: General Comments on Thermal Evaluation RAIs.doc

-----Original Message-----
From: Evan Rosenbaum [mailto:e.rosenbaum@holtec.com]
Sent: Thursday, March 20, 2008 3:41 PM
To: Stewart Brown
Cc: Tammy Morin; Debu Majumdar; Indresh Rampall
Subject: Draft Position Statement - HI-STORM 100U Thermal RAIs

Mr. Brown,

Our staff has prepared a draft position statement related to the RAIs we received on our HI-STORM 100U. In particular, the draft statement addresses part of the thermal RAIs. I believe that Dr. Singh may be planning to meet with SFST management at some point tomorrow, and thought it might be good to share this draft with them in case this topic comes up. Could you please share it with the appropriate individuals?

Thank you.

Evan

****
****
Evan Rosenbaum, P.E.
Principal Engineer
Wet Storage Technical Lead
Holtec International voice: (856) 797-0900 x-627
555 Lincoln Drive West fax: (856) 797-0909
Marlton, NJ 08053 e-mail: e.rosenbaum@holtec.com

www.holtecinternational.com

The information contained herein is intended only for the person or entity to which it is addressed and may contain confidential and/or privileged material. Review, retransmission, dissemination, or other use of this information in whole or part for any other purpose by persons outside the recipient's organization is permitted only after an explicit authorization to such effect has been issued by the sender of this message. If you received this e-mail in error, please contact the sender and delete this e-mail and its attachments immediately.

ENCLOSURE 2

When issued on a project, an e-mail from Holtec International should be treated as an official communication from the company. Holtec International saves all incoming and outgoing e-mails in company's filing system for archival reference and expects the correspondent entity to do the same. Except when commercial information is involved, an e-mail is not followed by a hard copy (signature bearing) transmittal.

General Comments on Thermal Evaluation RAIs

RAIs 4-1 and 4-2 both prescribe treating the effects of a constant, unidirectional wind in the context of long-term conditions of storage. RAI 4-1 dictates applying a "bounding wind speed of 1 mile per hour in an evaluation to determine if any adverse cask-to-cask thermal interactions will take place in an array. RAI 4-2 states "A steady state sustained wind speed of 5 miles per hour (mph) appears to be a normal site condition rather than an off-normal condition." We believe that including the effect of wind, an inherently unsteady phenomenon, as a long-term steady condition is not an appropriate thermal boundary condition.

First, it is recognized that any dry storage cask system, and the spent fuel contained therein, is subject to continuous temperature cycling as a result of the continuously changing ambient environment. Factors that affect the frequency and magnitude include of this temperature cycling include:

1. Day-to-night ambient temperature variation
2. Day-to-night ambient relative humidity variation
3. Day-to-night insolation variation
4. Seasonal ambient temperature variation
5. Seasonal ambient relative humidity variation
6. Seasonal insolation variation
7. Insolation changes due to weather (cloud cover)
8. Wind velocity and direction

As the temperature of a stored intact fuel rod changes with these variations, so does its internal pressure and its resulting hoop and longitudinal stresses. Thus, the cladding of a fuel rod in a dry storage cask system is subject to a pulsating state of stress throughout its storage life. Such time-varying stress fields can be represented by a combination of a mean stress plus a cyclic (multi-harmonic) stress. The mean stress is a principal source of creep. The cyclic stress is a principal source of fatigue failure.

It is noted that current NRC guidance on the implementation of §72.92 and §72.122 already recognizes creep (a concomitant effect of mean stress) as the most important failure mechanism to be considered. Specifically, Interim Staff Guidance 11 (Appendix A in Revision 3) states:

> "Creep is the dominant mechanism for cladding deformation under normal conditions of storage."

In addition to this statement from ISG-11, further relevant guidance is provided in NUREG-1536. With respect to the effects of insolation, Section 4.0,V,3 states:

> "...the NRC staff accepts insolance presented in 10 CFR Part 71 for 10 CFR Part 72 applications. Because of the large thermal inertia of a storage cask, the values listed in 10 CFR Part 71.71 may be treated as the average insolance, calculated by averaging over a 24-hour day the reported 10 CFR 71 values for insolance over a 12-hour solar day, in a steady-state calculation."

Finally, the effects of ambient temperature variations have already been addressed through the use of an annual average value on multiple cask dockets. For example, Holtec's HI-STAR and HI-STORM dry cask storage system FSARs both state:

> "The "normal" temperature set forth in Table 2.2.2 is intended to ensure that it is greater than the annual average of ambient temperatures at any location in the continental United States."

All of these statements in ISG-11, NUREG-1536 and previously reviewed and accepted FSARs point to the use of mean values for environmental boundary conditions when performing thermal analyses for normal conditions. Because the effect of wind depends on its magnitude and its direction, both of which can vary in an unpredictable manner, the neutral state appropriate to establishing the mean cladding stress is clearly the quiescent condition.

Any wind fluctuations contribute to the cyclic component of the cladding stresses and are correctly treated under the rubric of "off-normal" conditions. This is analogous to the treatment of ambient temperatures greater than the annual average temperature, which are always analyzed as off-normal or accident conditions. The NRC has, over the years, sought to limit the mean and cyclic stress limits by specifying normal and off-normal temperature limits through issuance of NUREGs and, most recently, ISGs. The latest limits are 400°C and 570°C for the normal and off-normal conditions, respectively. There is no guarantee that, given the past, these numerical limits will not change again. However, the conceptual framework for defining normal and off-normal conditions has not changed in two decades.

Changing the regulatory definition of normal and off-normal at this time will be a far-reaching change in the licensing basis for ventilated systems, placing many in overt non-compliance. Holtec does not believe that a technical or safety rationale for such a drastic regulatory change exists.