From: Monarque, Stephen
Sent: Monday, December 12, 2011 4:04 PM
To: ComanchePeakCOL Resource
Subject: FW: 2011-12-12 Woodlan, RAI-240 Conference Call and eRAI Table.
Attachments: RAI 6158 Approach (DRAFT).pdf

From: Conly, John [mailto:John.Conly@energyfutureholdings.com]
Sent: Monday, December 12, 2011 4:03 PM
To: Monarque, Stephen
Cc: Evans, Todd; nicholas_kellenberger@mnes-us.com; Woodlan, Don; russell_bywater@mnes-us.com; 'tapia_joseph@mnes-us.com'
Subject: RE: 2011-12-12 Woodlan, RAI-240 Conference Call and eRAI Table.

Steve, I have attached our DRAFT approach to responding to this RAI for your use in tomorrow's (12/13) clarifying phone call at 10:00 a.m. ET.

Thanks,

John T. Conly

COLA Project Manager
(254) 897-5256

From: Woodlan, Don
Sent: Monday, December 12, 2011 11:17 AM
To: Conly, John; nicholas_kellenberger@mnes-us.com; russell_bywater@mnes-us.com; 'tapia_joseph@mnes-us.com'
Cc: Evans, Todd
Subject: 2011-12-12 Woodlan, RAI-240 Conference Call and eRAI Table.

Steve Monarque call about an hour ago. He had two comments.

The NRC staff noted that we intend to discuss our approach to responding to RAI-240 on tomorrow's conference call. If possible, they would like to see our strategy in advance so that they can be prepared to discuss. I suggest we send a cleaned up version of draft A (with Luminant comments incorporated) and marked as DRAFT. John, please work with Nick and Russ to get something to Steve.

Steve also said he intends to get us an updated eRAI Table to support this week's COLA call.

Donald R. Woodlan
Manager, Nuclear Regulatory Affairs
Luminant Power
O- 254-897-6887 C- 214-542-7761

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Subject: FW: 2011-12-12 Woodlan, RAI-240 Conference Call and eRAI Table.
Sent Date: 12/12/2011 4:03:49 PM
Received Date: 12/12/2011 4:04:32 PM
From: Monarque, Stephen

Created By: Stephen.Monarque@nrc.gov

Recipients:
"ComanchePeakCOL Resource" <ComanchePeakCOL.Resource@nrc.gov>
Tracking Status: None

Post Office: HQCLSTR02.nrc.gov

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RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company, LLC.

Docket Nos. 52-034 and 52-035

RAI NO.: 6158 (CP RAI # 240), COLA REVISION 2

SRP SECTION: 06.04 – Control Room Habitability System

QUESTIONS for CONTAINMENT AND VENTILATION BRANCH (SPCV)

DATE OF RAI ISSUE: 11/15/2011

QUESTION NO.: 06.04-14

The staff notes that CP COL 6.4(2) and STD COL 6.4(2) first appeared in Revision 2 of RCOLA Part 2 FSAR Section 6.4.7 next to Combined License Information item 6.4(2), "Automatic and manual action for the MCR HVAC system that are required in the event of postulated toxic gas release." COLA Revision 1 FSAR had only labeled item 6.4(2) as CP COL 6.4(2). The staff believes that US-APWR DCD subsection 6.4.3 contains wording that is only application specific. In particular, the RCOLA applicant cannot apply the conclusions of US-APWR DCD subsection 6.4.3 to each subsequent SCOLA applicant.

The staff requests additional information/justification as to why the applicant elected to assign the label "STD COL 6.4(2)" to the information contained in FSAR subsection 6.4.3.

ANSWER:

The left margin notation in FSAR Subsections 6.4.3 and 6.4.7 has been changed from "STD COL 6.4(2)" to "CP COL 6.4(2)".

Impact on R-COLA

See attached marked-up FSAR Rev.2 pages 6.4-1 and 6.4-4.

Impact on S-COLA

None; this response is site-specific.

Impact on DCD

None.

Draft

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company, LLC.

Docket Nos. 52-034 and 52-035

RAI NO.: 6158 (CP RAI # 240), COLA REVISION 2

SRP SECTION: 06.04 – Control Room Habitability System

QUESTIONS for CONTAINMENT AND VENTILATION BRANCH (SPCV)

DATE OF RAI ISSUE: 11/15/2011

QUESTION NO.: 06.04-15

This is follow-up RAI to RAI Letter No. 172 (4678) Question 06.04-9.

In Question 06.04-9, the staff asked a four part question that prompted the applicant to perform a sensitivity analysis to justify and show the effects of changes to the original analysis described in FSAR subsection 6.4.4.2 (i.e. the bounding case above). The applicant responded on October 6, 2010 (ADAMS Accession ML102810224) with the outcomes of changing the inputs of (1) control room intake height; (2) solar radiation and maximum ambient dry bulb temperature; and (3) stability class and wind speed. The staff verified that Revision 2 of RCOLA FSAR subsection 6.4.4.2 contained the outcomes of these sensitivity analyses. The staff performed confirmatory modeling for all the applicant's findings of FSAR Table 2.2-214 and replicated the sensitivity analysis described above.

In addition, the staff performed HABIT modeling for extended runs beyond the applicant's HABIT models which were programmatically limited by timing out (e.g. 12.5 minutes for chlorine). The results of the staff's HABIT modeling of the chlorine accident yielded a MCR concentration still below the IDHL limits but not substantially below. In particular, for the extended run modeling of the chlorine event the staff used an elevated MCR intake of 14.3 meters and a 5% exceedance temperature [i.e. 36.11˚C (97˚F)]. This model resulted in a maximum peak MCR concentration equal to 8.8 ppm which occurred at 28.25 minutes into the event. This lack of significant margin prompted further investigation by the staff. The staff notes that the ALOHA manual defines a heavy gas as "A gas that has a molecular weight greater than that of air (the average molecular weight of air is about 29 kilograms per kilomole) will form a heavy gas cloud if enough gas is released." Chlorine with a molecular weight of 70.9 grams/mole fits the definition of a heavy gas. Based on this, the staff modeled in ALOHA the chlorine event as a heavy gas based on a 5% exceedance temperature and other parameters similar to the HABIT modeling. The staff notes that there is one limitation of the ALOHA model in that MCR intake elevations cannot be factored into the model. The ALOHA heavy gas model for the chlorine event yielded a peak internal building concentration of 46.5 ppm occurring at approximately 25 minutes into the event. Internal building concentration for this chlorine model exceeded the IDHL limit of 10 ppm at approximately 18 minutes into the event.

In light of the comparative results of the HABIT versus ALOHA modeling for chlorine, the staff produced a ALOHA heavy gas model for a 93% by weight sulfuric acid solution. The molecular weight of a sulfuric acid solution equals 98.1 grams/mole with an IDHL of 15 mg/m3.

The ALOHA heavy gas model for sulfuric acid assumed a continuous release over 60 minutes and used a 5% exceedance temperature and a stability class consistent with Regulatory Guide 1.78 guidance. The results of the ALOHA heavy gas analysis for sulfuric acid yielded an indoor concentration of 8,090 mg/m3 at 60 minutes with an onward (beyond the graph) slope of 10-15º rising. It appears that the IDLH within the building at ground level (i.e. not representative of an elevated MCR) could be exceeded at about 5 minutes after the event (i.e. sulfuric tank rupture). As a point of comparison, the staff ran a HABIT model adhering to the temperature and stability class guidance of RG 1.78. A non-elevated MCR intake and a “Liquid Tank Burst” were also assumed. The staff’s Habit run, timed out at 18.9 min with both the external and internal concentrations still slowing rising. At 18.9 min the CRE concentration was up to 5.082E-2 mg/m3. The IDHL is 15 mg/m3.

The staff also notes that both the applicant’s and the staff’s HABIT modeling illustrate the sensitivity of the EXTRAN results to the parameter of MCR intake height. The staff believes that the MCR HVAC intake height used in the habitability analyses needs to be captured as a plant attribute in FSAR 6.4.4.2 “Toxic Gas Protection”. The staff requests that the applicant revise FSAR 6.4.4.2 accordingly.

In summation, the staff posits that since chlorine and sulfuric acid clearly fit the definition of a heavy gas that ALOHA modeling is the more appropriate program (i.e. as opposed to HABIT) to use for determining MCR habitability. More specifically, the use of the HABIT Gaussian model may be producing non-conservative results for these two heavy gases. The staff requests that the applicant re-evaluate their findings of FSAR 6.4.4.2 and address the fact that chlorine and sulfuric acid are heavy gases and provide a comprehensive justification for why the results are appropriate and conservative.

ANSWER:

Chlorine IDLH Margin

There is a margin of 13.6% between the staff’s calculated maximum MCR concentration of 8.8 ppm and the IDLH of 10 ppm, which can be justified as a significant margin. More importantly, the IDLH limits are inherently conservative and their use provides significant margin. For example, the NIOSH “Documentation for Immediately Dangerous To Life or Health Concentrations (IDLHs)” for chlorine indicates an Original IDLH of 30 ppm based on “exposure to 30 ppm will cause intense coughing fits, and exposure to 40 to 60 ppm for 30 to 60 minutes or more may cause serious damage”. However, RG 1.78, Rev. 1, states:

> The IDLH value or limit, based on a 30-minute exposure level, is defined as one that is likely to cause death or immediate or delayed permanent adverse health effects if no protection is afforded within 30 minutes. For each chemical considered, the IDLH limit can be tolerated for 2 minutes without physical incapacitation (for example, severe coughing, eye burn, or severe skin irritation) of an average human. Thus, a 2-minute exposure to the IDLH limits provides an adequate margin of safety in protecting control room operators, and these limits are recommended.

Accordingly, the NIOSH Original IDLH limit of 30 ppm appears to be more consistent with the RG intent and can be used to illustrate significant margins.

Perhaps most importantly, RG 1.78 states:

> It is expected that a control room operator will take protective measures within 2 minutes (adequate time to don a respirator and protective clothing) after the detection and, therefore, will not be subjected to prolonged exposure at the IDLH concentration levels. If toxicity limits of released chemicals are not available and no detection instruments are available in the control room for the hazardous chemicals under consideration, the human detection threshold, such as the odor threshold, may be used.

Accordingly, the critical parameter is not the peak MCR concentration, but whether the time between the odor detection threshold (0.08 ppm for chlorine per NUREG /CR-6624) and the IDLH limit exceeds 2 minutes.

No discussion of a minimum margin to IDLH limits is included in RG 1.78. None is considered necessary due to the inherent conservatism in using the IDLH limit, as discussed in RG 1.78, as well as the significant conservatisms utilized in the modeling of the event, including:

- Postulation of a full chlorine release from a maximum capacity truck accident at the highway location of closest approach to the control room intake
- Postulation of meteorological characteristics representative of the worst five percent (RG 1.78) or of even lower probability conditions (e.g., worst lower percentage temperatures, utilization of zero cloud cover conditions, etc.)
- Control room intake conditions representative of worst-case intake flow combined with worst-case postulated infiltration, with no operator action.
- No control room operator notification of the initiation of the event prior to event determination by the odor detection threshold.
- No credit for the significant dispersion effects of building wakes in the vicinity of the control room intake.

Heavy Gas Dispersion

The RAI states “the staff modeled in ALOHA the chlorine event” and “that ALOHA modeling is the more appropriate program (i.e. as opposed to HABIT) to use for determining MCR habitability” for heavy gases. Also, the “staff notes that there is one limitation of the ALOHA model in that MCR intake elevations cannot be factored into the model”, and that the “HABIT modeling illustrate(s) the sensitivity of the EXTRAN results to the parameter of MCR intake height”.

However, RG 1.78, Rev. 1, states “The NRC uses a computer code, HABIT, for control room habitability evaluation.”

Therefore, the HABIT program as endorsed by the NRC for control room habitability evaluation was utilized for Comanche Peak Units 3 and 4. Re-evaluation using the EPA program ALOHA, with its limitation in an important area (especially for the relatively high 14.3 meter control room intake elevation applicable here) as noted by the NRC, is deemed unnecessary as discussed further below.

NUREG/CR-6624 states about the HABIT EXTRAN model:

> ... a Gaussian puff dispersion model… approach was selected because puff models permit more realistic treatment of temporal variations in release terms and concentrations… consistent with the Gaussian plume models used by the NRC for other licensing applications and the puff models used for emergency response applications.

Per NUREG/CR-6210, in EXTRAN's three-dimensional puff diffusion model "it is assumed that diffusion proceeds independently in the longitudinal, lateral and vertical directions", and with respect to the use of the control room intake height,

> …concentration estimates are sensitive to the difference between the release height and the intake height. Maximum concentration estimates can be obtained by setting both the release height and intake height to zero.

ALOHA was developed for a purpose other than control room habitability evaluations. Per the user manual, ALOHA was developed to support first responders at the scene of an accident. Therefore, ALOHA is concerned mainly with ground level concentrations for outdoor emergency personnel. ALOHA was not intended to determine concentrations above ground level for personnel who may be indoors and protected by an elevated ventilation intake. Hence, the limitation of the ALOHA model noted by the staff in that MCR intake elevations cannot be factored into the model is critically important, especially considering the ALOHA treatment of a heavy gas. From the February 2007 ALOHA User's Manual:

> When a gas that is heavier than air is released, it initially behaves very differently from a neutrally buoyant gas. The heavy gas will first "slump," or sink, because it is heavier than the surrounding air.

These types of ALOHA limitations are further described in the US DOE's June 2004 "ALOHA Computer Code Application Guidance for Documented Safety Analysis" Final Report, as illustrated by the following:

> Dense (Heavy) Gas Atmospheric Transport and Dispersion undergoes "gravitational slumping", characterized by "significantly greater lateral (crosswind) spreading and reduced vertical spreading as compared to the spreading that occurs with a neutrally buoyant release."
>
> A Dense Gas Cloud initially "hugs the ground under the influence of its high density and spreads laterally similar to that of a liquid spill." "Dense-gas cloud dispersion is thus characterized by significantly greater lateral (crosswind) spreading and reduced vertical spreading as compared to the spreading that occurs with a neutrally buoyant release."

Therefore, modeling an elevated air intake to protect control room operators from a ground level heavy gas release is critically important, and the use of HABIT is appropriate and consistent with NRC guidance.

In order to recognize the importance of an elevated intake to provide protection for the operators, FSAR Subsection 6.4.4.2 has been revised to add the MCR HVAC intake height (14.3 meters) that was used in the habitability analyses.

<u>Sulfuric Acid Modeling</u>

The vapor pressure of a sulfuric acid solution at normal temperatures is approximately 0.001 torr. In accordance with 2009 correspondence between URS and the NRC, such negligible vapor pressure solutions (well below 10 torr) can be screened out from consideration for control room habitability evaluation. Boil off and flashing rates for low vapor pressure liquid chemicals are not considered to result in significant atmospheric gaseous releases.

Impact on R-COLA

See attached marked-up FSAR Revision 2 page 6.4-2.

Impact on S-COLA

None; this response is site-specific.

Impact on DCD

None.