From: Gordon Keating [redacted]
Sent: Wednesday, July 20, 2011 4:15 PM
To: English, Elizabeth W
Cc: Goen, Lawrence K; Pava, Daniel S; Kuropatwinski, James J; Lee, Richard C; Salmon, Michael W; Wallace, Terry C Jr; Hoagland, Steven R; Garcia, Kari M L; Keller, David C; Nisengard, Jennifer E
Subject: Re: Draft Final CMRR-NF SEIS for Review

Liz,
I have attached suggested edits to Section 4.3.5 -- removing 3 sentences that discuss lava flows, explosions, and surges from basaltic eruptions.
These edits are supported by revisions to the text of the 'white paper' on volcanic hazards to TA-55 (attached -- yellow highlights on new text, blue highlights on removed text). The revised document indicates that future basaltic eruptions in the Rio Grande rift near the Lab are most likely to occur in the southern end of the Cerros del Rio volcanic field, near Cochiti -- this is the location of the youngest eruptions in the field. This area is about 20 km away from TA-55, and that the proximal hazards like lava flows engulfing buildings, explosions, and surges are expected to be limited to 3-10 km from the vent.
Terry Wallace has reviewed this revised 'white paper' text. The document was also reviewed internally by Frank Perry, Giday WoldeGabriel, and David Broxton, SMEs in volcanic geology and hazards.

-Gordon

On 7/18/2011 9:06 AM, English, Elizabeth W wrote:
All:

Thanks for the expedited help you provided on the CMRR-NF Supplemental EIS in the past few weeks. Your input was provided to the subcontractor for incorporation into the draft of the Final SEIS. Please take a look at the attached SEIS to ensure that you are satisfied with how the information was incorporated, and **return any comments to me by Thursday 8am**. Comments may be provided on hard copy, electronically on the SEIS, or on the attached comment form.

The 'meat' of the SEIS is contained in Chapters 2-4 and Appendix C; however, the entire SEIS is provided for you.

Again, thank you for dropping everything to help with this effort.

Liz English
CMRR Safety and Environmental Compliance
[redacted]

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TA-55 Volcanic Hazards

The purpose of this overview is to provide analysis suitable for the CMRR Nuclear Facility (CMRR-NF) Supplemental Environmental Impact Statement, in accordance with the National Environmental Policy Act. A recent report, *Preliminary LANL Volcanic Hazards Evaluation* (Keating et al. 2010) integrated available information on the volcanic history of the region surrounding LANL, focusing on Quaternary volcanism, and described potential volcanic hazards to LANL from future eruptions in the region. Potential volcanic hazards may include lava flows, ballistic projectiles, tephra (ash and pumice) falls, pyroclastic flows and debris avalanches, lahars (mudflows) and flooding, seismic activity, ground deformation, tsunami, atmospheric effects, and acid rains and gases (DOE STD 1022). TA-55 is located in an area of the Laboratory that may experience impacts from silicic and basaltic eruption hazards. This qualitative discussion focuses on the general description of Lab-wide volcanic hazards in Keating et al. (2010) to the proposed CMRR-NF at TA-55. Volcanism in the vicinity of TA-55 is unlikely within the lifetime of the facility (ca. 50–100 years) but cannot be ruled out.

Keating et al. (2010) developed preliminary estimates of recurrence rates (eruptions per year) for two types of volcanic activity: 1) explosive silicic (e.g. rhyolite, dacite) eruptions typified by the post-caldera "Valles Rhyolite" eruptions in the Valles Caldera about 10 km west of LANL and 2) explosive and effusive basaltic eruptions like those which formed the Cerros del Rio volcanic field located in the Rio Grande rift and underlying the eastern portions of the Laboratory. The estimated recurrence rates, $1x10^{-5}$ eruptions per year for silicic eruptions and $2x10^{-5}$ eruptions per year for basaltic eruptions, were calculated by dividing the number of eruptive events by the active eruption period. These values represent the past eruption frequency within the area of known previous volcanic activity – the Valles Caldera for silicic eruptions and the Cerros del Rio volcanic field for basaltic eruptions – and they do not account for possible temporal clustering of volcanic events. The estimates of past recurrence rate are not the same as probability of future eruption that might affect a given facility.

Silicic Eruption: This discussion assumes that a future silicic eruption would be similar in size and style to the most recent rhyolitic eruptions of the East Fork Member of the Valles Rhyolite that occurred 40,000 to 60,000 years ago (Gardner et al. 2010). That period of volcanism included development of a 650 m by 1250 m explosion crater (El Cajete); extensive volcanic ash and pumice fallout greater than 30 m thick at the vent and up to 2 m thick on the Pajarito Plateau (El Cajete Pyroclastic Beds); energetic pyroclastic flows (avalanches of hot ash and volcanic gases) (Battleship Rock ignimbrite); and a rhyolite lava flow (Banco Bonito flow) (Self et al. 1988 and summarized in Keating et al. 2010). Based on the areal distribution of the deposits from these eruptions, the high terrain of the east caldera rim would be expected to limit the eastward extent of lava flows and pyroclastic flows. Hazards from ballistic projections, ground deformation, and volcanic gases would also be expected to be limited to a similar area within the topographic rim of the Valles Caldera. In the absence of local bodies of surface water, tsunamis are not expected to pose a hazard to TA-55. Atmospheric effects (lightning, volcanogenic thunderstorms) and acid rains may affect facilities at TA-55.

The main hazards from future silicic volcanic events, based on the East Fork Member deposits, would likely be fallout of volcanic ash and pumice from an eruption plume extending eastward over LANL. Ash and pumice deposits up to 2 m thick, associated with several post-caldera eruptions, have been documented on the Pajarito Plateau and LANL sites (Keating et al. 2010). In particular, El Cajete pumice

and ash beds have been found in the vicinity of TA-55: at TA-67 (2 km south of TA-55; 0.85 m thick) and across the southern edge of the Laboratory (TA-16, 49, and 39; 1-2 m thick). The primary hazard to the proposed CMRR-NF would be ash and pumice fallout that would increase roof loading. The density of ash from Mount Pinatubo (dacite) was 1.2 to 1.6 g/cm^3 (dry) and 1.5 to 2.0 g/cm^3 (wet) (Spence et al. 1996). Typical temperatures of deposition for ash and pumice fallout are expected to be relatively cool (<30°C), as inferred from experiences at the Pinatubo and Mount St. Helens eruptions (e.g., Spence et al. 1996). A related hazard would be secondary mobilization of ashfall by rain and potential flooding, forming mudflows. This possible hazard would be naturally mitigated by the mesa-top setting and relatively low slopes at TA-55 and the presence of deep canyons that would channel flows from the Jemez Mountains west of Los Alamos. Volcano-tectonic earthquakes associated with a silicic eruption of this kind could lie in the magnitude 3 to 5 range, based on historic analogue eruptions (e.g., Chaiten, 2008; Carn et al. 2009).

Basaltic Eruption: TA-55 lies on the western edge of the Cerros del Rio volcanic field, an area of basaltic eruptions that was active mainly between 2.8 and 2.3 million years ago, but extending to as recently as 1.1 million years ago. This volcanism primarily produced lava flows, cinder cones, and ash and scoria deposits, but also produced explosive eruptions when rising magma intersected near-surface ground water. The basaltic lava from these eruptions is visible in White Rock Canyon and in the highlands between Los Alamos and Santa Fe, and the lava flows are also buried under the Laboratory on the Pajarito Plateau. Ages of lava flows in the Cerros del Rio volcanic field indicate that volcanic activity was concentrated in the central part of the field during the height of eruptive activity (2.3 to 2.8 million years ago; WoldeGabriel et al. 1996), and shifted to the southern part of the field near Cochiti for the most recent eruptions (1.1 million years ago; Thompson et al. 2006). This progression of volcanic activity indicates that potential future basaltic eruptions in the Cerros del Rio volcanic field would likely occur in the southern parts of the volcanic field, about 20 km south of TA-55. Given this distance from the area of potential future volcanic activity, the primary hazards to facilities at TA-55 from basaltic eruption would likely be fallout of volcanic ash and scoria.

Ash and scoria fall may produce roof loading; basaltic ash typically is more dense than silicic ash (densities listed above). Hazards from lava flows, explosions, ballistic projectiles, ground deformation, and surges are expected to be limited to 3-10 km of the vent. The likelihood of explosive eruptions due to rising magma intersecting near-surface ground water is less today than in the past because groundwater is extremely deep (>1000 ft) beneath the facility. Earthquakes accompanying these eruptions may range up to magnitude 4 based on historic analogue eruptions (e.g. Paricutin 1943-52 eruption produced up to 4 earthquakes per month M_s 3 to 4.6; few >4.0; Luhr and Simkin 1993).

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