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Questions for Technical Assessment Team

Following are questions the WIPP Site Incident Independent Review team has compiled after our reading of the TAT report released in late March. They are arranged from general inquiries regarding the overall TAT's approach to specific questions about analytical techniques and modeling and experimental results. At our meeting in July we will look forward to a detailed presentation from the TAT addressing these questions.

Methods

- With what criteria were the methods used by TAT decided upon?
- Were there additional methods considered but not used, and if so, why?
- Did the TAT consider conducting any modeling or simulation on the sibling drum?
- Page 40 refers to the TAT interfacing with LANL : "*as they conducted small scale tests to evaluate potential reactivity within the MINO2 waste."* What kind of tests were conducted by LANL and what is the MINo2 waste?
- Did the TAT consider modeling a worst case scenario of all sibling drums being in the same room at the same time?

Code

- Why was CTH-TIGER code used instead of Cheetah for modeling?
- What version of the computer code was used?
- What input of the code was used?
- How did the TAT assure the code was running properly?
- Page 28: It appears that the chemical simulation was conducted under a constant pressure of 1 atm. In reality, the pressure was variable. What would be the prediction of the CTH-TIGER code if pressure is considered variable?

Modeling

- Page 29: It appears that two models have been utilized: 1) a chemical model under constant pressure, 2) a mechanical model that has gas pressure as input. Is that the case? Shouldn't the first chemical model be under variable pressure to get more realistic and consistent results?
- Page 31: The finite element model shows that runaway occurs after 70 days, exactly similar to what was observed in reality. Considering many approximations and assumptions in the model, such accurate prediction is very unlikely.
    - Is the accurate prediction due to calibration of the model (e.g. by using heat sources of 0.12 Watt for nitrate salt and 0.17 Watt for neutralized and sorbed liquid layer) to get this very accurate result?
    - Why is the assumed heat conductivity of the contents of drum 68660 so low that in 70 days, almost no increase (only 1° C) in the drum body temperature was realized? This low increase in the temperature of the drum body is not consistent with temperature monitoring of other drums which are being monitored by LANL. Their monitoring shows increase in the body temperature.
- Page 31: It appears that an uncoupled modeling has been used: 1) a chemical model and gas generation. 2) a mechanical model with gas pressure applied inside the drum. Was the drum vent part of the model? Isn't a full coupled model more realistic?
- Page 32: Is the stress analysis of the drum an elasto-plastic or visco-plastic model? What boundary conditions were applied to the drum lid? If the vent was not part of the model, why is it claimed that: "*This slow pressurization was sufficient to overcome the drum vent*"?
- Page 34: The air flow and change in temperature in P7R7 was modeled to find out the impact of the truck fire on Drum 68660. How was the heat source (burning of the truck) modeled in this situation?

- Page 95: "*The hardening curves from the test data were implemented in the analysis for the elastic-plastic model*". How? Did the TAT try to simulate the uniaxial tensile tests? How about the softening? Did the TAT conduct a large deformation analysis?
- Page 97: Second paragraph: Is our reading accurate that the computer program used did not model the drum content? Therefore, is it correct that no gas-drum interaction was modeled? A time varying pressure boundary condition was applied that was not affected by bulging of the drum?
- Page 99-106: The yielding stress (also the stress contours) was either 29×10^3 or 40×10^3 psi. It does not seem hardening was modeled (even though it is claimed to be part of the model). Based on Figs. D10 and D11, steel can carry up to 50×10^3 psi Von-Mises stress, which is not the case in figures reported in pages 99-106.
- Page 107: It is noted that "*the deformation of the lid might provide an indication of the rate of the pressurization*." Have there been any attempts to see the actual deformed shape of the Drum 68660?
- Page 108: "*Without a better understanding of the strain in the closure ring, it was not felt it was advisable to pursue some of these issues. There is uncertainty regarding how consistent the closure ring strain is from drum to drum. An improved understanding of this is advisable prior to pursuing further mechanical modeling with respect to predicting opening pressure*." Can strain gages be installed and used to measure the actual closure ring strain?
- Page 109: It is noted that "*No analyses showed the drum rupture on its sidewall and one would not expect that to happen from this type of a pressurized event*." Was the model used capable of actually showing the rupture in the drum?

Results

- Page 19: Table 3-1 lists the samples collected. Why are samples 4 and 5 not listed or accounted for?
- Based on Fig. 4.2, almost all ingredients of Drum 68660 are lighter than water. Wouldn't this cause the material to mix up? The lighter material should gradually move upward and this especially is encouraged when the drum is shaken and moved, i.e. during its transportation.
- Page 27 (first and second paragraph): "*The chemical and physical forms of these layers and interfaces are different in chemical reactivity and thermal conductivity. The degree of mixing between the layer of neutralized and sorbed liquid and the layer of nitrate-salt admixture is not known".*

  "The physical configuration at the interface of the neutralized-and-sorbed liquid/Swheat Scoop and the nitrate-salt and mixture/Swheat Scoop layers may have formed a localized region of reactivity leading to the thermal-runway event". Based on our previous question about the materials shown in Fig. 4.2 mixing up, how certain are you about the existence of this localized region?
- Page 29: Fig. 4.3: The CTH-TIGER model shows localized high temperature after 70 days. Do you consider both heat conduction and convection in the model? Might the high temperature gradient observed in the model be due to unrealistic heat conduction/convection coefficient used?
- Page 77: 1st paragraph: The X-ray was used to observe the layer interfaces of different materials in Drum 68660. How did the TAT know the arrangement from top to bottom of these materials?
- Page 80: Equation (17) considers the reaction heat sources and heat conduction. How about the convection process?
- Page 94: Are the drum mechanical tests referred to in the literature numerical or physical tests or both?