

Response to specific questions on refuge chambers

1. Is there a significant advantage (with regard to explosion pressure) to locating portable chambers in the crosscut rather than the entry? In all cases, or under what circumstances? How much of an advantage could be expected.

Response: The pressure vs. distance maps for LLEM tests #484, 485, 498, and 500 show that the pressures approximately equalize in the three entries at a distance of several hundred feet from the face if there are no stoppings or seals in the crosscuts. The pressures would also have to be similar in the cross-cuts. Therefore, there would be no advantage with regard to explosion pressure to locating the chambers in a crosscut rather than an entry.

2. Is there a significant advantage (with regard to flying debris from the explosion) to locating portable chambers in the crosscut rather than the entry? Can you quantify this at all, for example the force of a flying post hitting a chamber...?

Response: If there was flying debris from blown-out seals and/or wood cribs traveling down an entry, the debris would tend to travel in a straight line and stay in the entry, as shown by the debris maps from 2006 LLEM Sago seal tests #505 and 506. Therefore, there would be an advantage to locating the chamber in a crosscut. However, if there was a stopping in a crosscut, there would be debris in the crosscut if the stopping was destroyed.

3. The "answers" to questions #1 and #2 may depend on whether we are talking about the first ~~primary~~ explosion or a subsequent secondary explosion? Would you agree? A developing consensus is that secondary explosions are the bigger concern. Do you agree?

Response: There are many possible scenarios, so there is no simple answer to these questions. The size of the explosion is what's important. A second explosion may or may not be larger than the first explosion. The 2nd JWR explosion was significantly larger than the 1st and traveled throughout the entire section. The answers to questions 1 and 2 regarding crosscut vs. entry would probably not change in a second explosion. The problem with predicting the impact of a second explosion is that its initiation location is less easy to predict. An initial explosion is likely to come from behind a sealed area or from a working face, but once an initial explosion destroys the mine vent system, methane buildup can occur almost anywhere making the likely location of initiation for a second explosion hard to predict.

4. From an explosions perspective, are there any obvious guidelines that you would suggest relative to chamber placement and nearby seals, gobs, etc?

Response: These items are already covered in Karl's draft. The chamber should not be in a direct line from major sources of debris such as seals, stoppings, wood cribs, etc. Based on the Sago explosion and subsequent LLEM tests, the chamber should preferably be at least 1000 ft from seals.

5. Additional Consideration (suggested by Mike Sapko): The possible movement of the refuge chamber due to the explosion pressure needs to be considered. For example, during the 2006 LLEM Sago test #502, a 1560-lb battery charger was placed at 688 ft from the face of C-drift or 365 ft from the outby face of the C-drift seal. The charger

moved ~79 ft during this explosion. The explosion pressure at the charger location was ~3½ psi. Based on the cross-sectional area of 900 in² for the end of the charger and the explosion pressure of ~3½ psi, the total force would have been ~3,100 lbs for a few milliseconds. In regard to a refuge chamber, the cross-sectional area and weight have to be considered along with the explosion pressure to see if it would move.