

off the insulation in-house, and North American now makes this insulation. Beginning on the fourth stage, we have all North American-made insulation, and it's good. On the first three stages, we still have this supplier-made insulation. Every time we tank these stages and fire them at Mississippi, this insulation cracks when it chills down. While it's not dangerous, after we have detanked or fired, we have to go in and repair all those cracks. That runs us like 10 to 14 days, which is just lost time. Right now, down at the Cape in the low bay, we're repairing insulation damage left over from the last firing at Mississippi.

Does that sort of give you a feel for it?

Mr. WINN. How does the new thickness compare with what you were using in the past? You said 1.6 inches.

Mr. GREER. It went through the several design iterations, Mr. Winn. There were some assumptions on thermal coefficients back at the beginning which led them to believe that eighth-tenths inch would be sufficiently thick. The facility stage we built had eight-tenths-inch-thick insulation. We found out the boil-off rate of hydrogen could be too high. So, we increased the thickness to 1.6 inches. This was picked as a proper design point to control this boil-off rate of liquid hydrogen.

Mr. WINN. Thank you.

Mr. TEAGUE. Mr. Carroll, can we see some of that later?

ROBERT E. CARROLL. We have a piece of insulation being brought in.

Mr. GREER. We had the all systems test vehicle at Mississippi, and while completing our basic testing there, it did rupture under pressure. This rupture turned out to be, on close examination by putting the pieces together and looking at them, caused by a crack in a boss in the tank. This crack basically came from a sharp corner on the boss. It should have been radiused more. This caused us to look all through the tank at various other places on the stringer ends. You can't really see this too well, but there are stringers that run around here, and every place you change from one quarter panel to another these stringers terminate and there is a splice plate across them (slide 15). At the termination of these stringer ends we found small cracks, so we had to do something about that. We scalloped them out smoother and polished them down. There were some other bosses that we found that were prone to have cracks, so we radiused and smoothed those also. So, while these are very small cracks, really, the word is kind of a "scare" word. Although they were very small, we nevertheless had to do something about all of them. We thought we had a completely qualified structure; about June of this last year we suddenly found it wasn't qualified. The rework on all these problems set us back considerably on the schedule. That's another major item.

The fusion welding that we used on this stage in order to keep it lightweight is also pushing the state of the art somewhat in the welding business, and we have had various problems getting our welds up to our own specifications. We have lost quite a bit of time on this problem. I'll give you one example of the type of problem you run into.