BY KATHI KUBE

Improving hazmat transportation

An industry-wide collaboration forms to streamline and more-tightly focus hazmat shipping research

A BNSF Railway priority train of tank cars nears the crest of Providence Hill at Beatrice, Wash., on Nov. 12, 2003, on its way from Pasco, Wash., to Kansas City, Kan. Robert Scott

Minot, N.D., Jan. 18, 2002; Macdona, Texas, June 28, 2004; and Graniteville, S.C., Jan. 6, 2005. Each of these accidents resulted in fatalities from the unintentional release of hazardous materials.

Through the years, organizations have worked alone or together. Collaborations have included the Railroad Tank Car Safety Research and Test Project, and the Next Generation Rail Tank Car Project, seeking ways to improve the safety of hazmat transportation. But as individuals and groups pursued the same goal, they inevitably duplicated work others were doing.

This autumn, though, representatives from every industry segment involved in shipping toxic by inhalation hazardous material by rail in the U.S. and Canada formed the Advanced Tank Car Collaborative Research Program. The nine participants include the Association of American Railroads, Railway Supply Institute, Federal Railroad Administration, Transport Canada, Department of Homeland Security (including the Transportation Security Administration), American Chemistry Council, Chlorine Institute, and The Fertilizer Institute.

Although the participants in late October had yet to formalize the collaborative's guidelines, they had agreed at least in spirit to an open exchange of information — a huge step, considering the proprietary information regarding tank car designs that will be a critical part of the research. Members will share the research they've been conducting, then the group will decide collectively which projects show the most promise and should be funded. Participants will fund an anticipated annual budget ranging from $3 million to $5 million, although the amount that each contributes could vary by project. Philip Daum, senior consultant at Engineering Systems Inc., has agreed to serve as the group's project director.

LOOKING WITH NEW EYES

The group's top priority for 2010 is to define, prioritize, and select which research projects to pursue, then develop a multi-year plan to execute them.

Areas under consideration for further research include:

- Seeking and incorporating newer steels
- Modifying couplers to have fewer sharp corners
- Adding layers around the tank to absorb and distribute energy in the event of a derailment or collision
- Installing foam between the layers to help absorb energy
- Reconfiguring tank car designs

Think of a tank car as a three-dimensional jigsaw puzzle with each layer separated from the whole and laid out on a table. What would happen if you swapped one material for another and put the layers back together in the same order? What if you used the same materials, but put them together in a different way? What if you changed the material and the arrangement? In brief, this is how the collaboration is rethinking everything the industry currently believes about tank car designs.

As wide-ranging an effort as the collaboration is, it's building on past research, such as the Next Generation Rail Tank Car project, which began as a collaboration between Dow Chemical Co., Union Pacific Railroad, and Union Tank Car. Over the course of its 2.5-year existence, the group welcomed others from the government and industry to participate in discussions and research. Eventually, that cooperative spirit formed the basis for the new, wider-ranging collaboration.

Before its dissolution, the Next Generation group modeled and designed a chlorine tank car that it believes will represent a 200- to 300-percent improvement in crashworthiness for head and side impacts. Dow has issued two requests for proposals to tank car builders: one to build a new car with a thicker outer shell for crash protection, plus an inner shell to contain the lading; and another to retrofit existing tank cars with the additional steel. Officials hope to award contracts before year-end, says Henry Ward, Dow's global supply chain director, and leader of the Next Generation Tank Car project.

"Tank car design is a once every 20- to 25-year exercise," says Mark Stehly, BNSF Railway assistant vice president, technical research, development and environmental. Every year, BNSF officials examine derailment records seeking ways to improve safety systemwide, he adds.

A seldom-reported aspect of the Rail Safety Improvement Act of 2008 also requires FRA to look analytically at risk reduction. To do this, it must first conduct a risk analysis. This summer, FRA awarded ICF Consultant Services an 18-month contract to conduct the three-phase risk analysis. Researchers will evaluate the risk associated with all current aspects of hazmat transportation (not only the cars), develop a model for shipping toxic by inhalation materials to calculate the reduction in risk through regulatory and operational changes, and identify as-yet-unstudied improvements.

Also earlier this year, FRA and the Volpe Center tested several sandwich panel designs, which look like steel corrugated cardboard that could protect against puncture or absorb energy in a crash. In July FRA, with assistance from Sharma & Associates Inc., an engineering firm, took a tank car with unprotected top fittings, filled it with water, and rolled it over onto a concrete pad. As the car crashed at 24 mph, the fittings and valves broke off, releasing the water. This test provided baseline figures illustrating the forces acting on a tank car's components in a controlled rollover.

In mid-November, the two plan to conduct a similar test at 18 mph, this time with "skid" protection: that is, reinforced steel plates welded alongside and around the top fittings. Ideally, the plates will protect the fittings in case of an accident. Failures of valves and fittings account for a third of all accident-caused hazmat releases, albeit a small quantity of lading lost. Although these tests apply to fittings and valves on nonpressurized tank cars, the next step would be to run similar tests on pressurized cars.

In the meantime, Midland Manufacturing offers an improvement for current chlorine car designs. The primary seals on Midland's new Advanced Chlorine Rail Car Assembly are all below the surface of the pressure plate, and designed to contain chlorine lading if the valves are shorn off in a wreck. Specifically, "we know it will handle pressure without the valves on up to 375 pounds of pressure," says David Clugg, regional sales manager for the Eastern U.S. at Midland. Under normal shipping conditions, chlorine exerts only about 100 pounds of pressure per square inch. If the valves are shorn off an existing chlorine car, however, a release is almost inevitable.

Twenty-five cars fitted with the new assembly are operating in revenue service, the earliest having been deployed last February. The assembly costs about 60 percent more than standard fittings, but it does meet the industry requirement to withstand a 9-mph rollover without unintentional release.

THE BIG PICTURE

Even research begun in the 1970s continues to contribute to the industry's understanding of tank car safety. The RSI-AAR Railroad Tank Car Safety Research and Test Project, for instance, developed new standards in tank car designs and created a database of tank cars that had been in derailments (but not all damaged) that now totals more than 43,000.

University of Illinois at Urbana-Champaign's M. Rapik Saat conducted a statistical analysis of the database as his doctorate dissertation. Using a model he created, Saat can plug in a single alteration or combinations, and determine the safety benefit versus additional weight or cost to overall efficiency. The model can be run for specific chemicals as well as changes in the transportation process, and will enable researchers to evaluate the overall effectiveness of existing safety improvements. "But you have to look at it in full context," Saat says. "That's the ultimate goal."