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COVER The Tracking and Data Relay Satellite System (TDRSS), operated for NASA by Spacecom, was used in conjunction with 64-meter radio telescopes in Australia and Japan to perform very long baseline interferometry in space. Using this technique it has been possible to obtain angular resolution equivalent to that of a radio telescope with a diameter 1.4 times the size of the earth. See page 187. [Photograph courtesy of TRW, Inc.]

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Transportation of Hazardous Materials

Almost weekly the national media report another accident involving railroad cars carrying hazardous materials. The adjectives used are lurid, including "deadly." From the attention given the matter, one is led toward the belief that an extremely serious situation has newly developed. Federal records show that, in fact, the safety of railroad transportation of hazardous materials has improved. In the last 5 years, no fatality has occurred directly attributable to railroad transport of hazardous materials.

Responding to a climate of public concern and to congressional urging, the Office of Technology Assessment (OTA) has issued a report entitled, *Transportation of Hazardous Materials*.^{*} In this document, OTA examines the record of the various modes of transportation, including trucks, railroads, and waterborne craft and discusses measures for improving safety. Improvement can come slowly by use of improved technology. It can come quickly by reduction of human error through training and selection.

Gasoline transport is responsible for more deaths, injuries, and dollar damages than all other hazardous materials together. Yet state and local transportation restrictions and anxiety are usually aimed at shipments of hazardous wastes or radioactive material, which represent only a tiny fraction of the activity and which have caused little in the way of damage. Public concern about transportation of spent nuclear fuel seems to stem from a deep-seated fear of nuclear energy. Experts in a recent poll concerning 30 activities involving risks ranked nuclear power number 20, but the public ranked it the most hazardous. The record for public fatalities from transport of spent nuclear fuel shipments to date is zero. Behind that record is careful design and construction of shipping containers to provide for radiation protection and extreme contingencies of collision and heat. Engineers know how to design and build a safer gasoline tanker truck, but jackknifing and rollovers will continue to the foreseeable future. The improved safety record of the railroads over that of earlier decades is due to better engineering of tank cars and the couplers between them.

The OTA report devotes considerable emphasis to the need for better training of emergency response personnel. All too often they are without knowledge of how best to respond to an accident involving release of one of many possible substances. The public safety person first at a scene is likely to be one of the nation's 1 million largely untrained volunteer firefighters. He or she may be confronted with a placarded, derailed tank car emitting a cloud that burns the eyes. The volunteer firefighter "... probably has not heard that the simplest equipment for dealing with a hazardous materials accident includes tennis shoes and binoculars—tennis shoes to run away and binoculars to read the hazardous materials placard from a distance before calling for expert help." One source of expert help is the Chemical Transportation Emergency Center (CHEMTREC). It maintains an on-line database on the chemical, physical, and toxicological properties of thousands of products. At all times, staff are on duty to provide needed information.

An inappropriate response to an accident involving unfamiliar chemical products can endanger the individuals involved and the surrounding community. Of approximately 2 million people in the emergency response network, OTA estimates that a maximum of 25 percent have received adequate training to meet a hazardous materials emergency. The report recommends initiatives aimed at training trainers.

Most transportation accidents involve trucks and human error such as inattention. A study in the state of Washington showed that 70 percent of truck accidents occurred on a straight path. There is also sufficient doubt about the skills of drivers that the report advocates special driving tests and licenses for truck operators. Additional driver training and improvements in equipment can reduce accident rates. The Shell Oil Company has achieved a 58 percent reduction in rates of preventable accidents through instruction and field training, coupled with the use of automatic tachographic records. The driver knows that his driving behavior is being monitored. He also knows that the records can work to his benefit in case of an unavoidable accident.—PHILIP H. ABELSON

^{*}Office of Technology Assessment, *Transportation of Hazardous Materials* (Government Printing Office, Washington, DC, July 1986).