TRANSCOM'S NEXT MOVE: IMPROVEMENTS TO DOE'S TRANSPORTATION SATELLITE TRACKING SYSTEM

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ABSTRACT

In today's society, the use of satellites is becoming the state-of-the-art method of tracking shipments. The United States Department of Energy (US DOE) has advanced technology in this area with its transportation tracking and communications system, TRANSCOM, which has been in operation for over one year.

TRANSCOM was developed by DOE to monitor selected, unclassified shipments of radioactive materials across the country. With the latest technology in satellite communications, Long Range Navigation (Loran), and computer networks, TRANSCOM tracks shipments in near-real time, disseminates information on each shipment to authorized users of the system, and offers two-way communications between vehicle operators and TRANSCOM users anywhere in the country.

TRANSCOM's successful tracking record, during fiscal year 1989, includes shipments of spent fuel, cesium, uranium hexafluoride, and demonstration shipments for the Waste Isolation Pilot Plant (WIPP).

Plans for fiscal year 1990 include tracking additional shipments, implementing system enhancements designed to meet the users' needs, and continuing to research the technology of tracking systems so that TRANSCOM can provide its users with the newest technology available in satellite communications.

INTRODUCTION

Revitalization of the space industry, in its ability to once again deploy satellites, has caught the eye of the Federal Government and the trucking industry. Standing on the threshold of the 21st century, companies that pioneered commercial satellite tracking services are scurrying to get as many customers as they can to subscribe to the state-of-the-art method of tracking shipments. The 21st-century carrier faces two dilemmas: can it compete without knowing where its shipments are at any given time when other carriers do; and deciding it cannot, which satellite service will best serve its needs.

The US DOE, responsible for shipping radioactive wastes, faces dilemmas similar to those encountered by the trucking industry. The Atomic Energy Act, the Hazardous Materials Transportation Act, and the Nuclear Waste Policy Act require DOE to provide for safe, secure, and efficient transportation of radioactive materials. DOE faces the question, "Will DOE be allowed to ship radioactive materials without tracking its shipments?" If the trucking industry is tracking routine shipments, shouldn't DOE track its radioactive shipments? To achieve this goal, DOE developed TRANSCOM, a transportation tracking and communications system, to know where selected, unclassified radioactive shipments are while in transit and to use as a tool in working together with States, Indian governments, and other federal agencies.

BACKGROUND

While tension mounts over the transporting of radioactive materials, the fact remains that packages used to transport these materials make these shipments much safer than many other shipments which generate little or no public concern. For example, if a tanker containing gasoline is involved in a severe accident, chances are good a major fire or explosion will occur. If a trailer transporting spent nuclear fuel is involved in a severe accident, chances are considerably less there would be any threat to the public's safety or welfare due to the radioactive nature of the shipment. In fact, chances are excellent the radioactive material and the radioactivity of the material will be contained. This is made possible through the rigorous testing required by federal regulations. (1)

The TRANSCOM system keeps track of vehicle location and shipment status and provides an instant means of communication directly with the vehicle operator. DOE believes that TRANSCOM is not essential for the safe transport of radioactive materials. However, the advantages derived from its use significantly benefit transportation management and all parties involved through improved

control and coordination between affected States, Indian governments, and other federal agencies.

Available Technologies

Tracking systems offering one-way and two-way communications are beginning to appear throughout the world. One-way systems offer a tracking mechanism whereby a dispatcher can receive a vehicle position and receive messages from a vehicle operator. Communication, however, is one-sided. The dispatcher cannot talk or send messages back to the driver. Two-way systems allow for a communications exchange between the dispatcher and the vehicle operator in addition to providing vehicle position information.

One major benefit derived from two-way communications systems is the elimination of excessive telephone calls which reduces costs and frees up the dispatcher's time to communicate with customers. Transit time also decreases as a result of the onboard communications. Thus, more miles can be run, reducing costs and increasing profits. Cellular phones are also used to eliminate frequent stops, but there are "holes" or gaps in this type of coverage throughout the Western U.S. Vehicle location and status information is available at all times which aids in equipment utilization, last-minute pick-ups by a vehicle in the customer's area, and improved customer service through on-time pick-ups and deliveries and accurate estimated times of arrival. Immediate notification can be made if a problem arises with a shipment.

With interest continuing to rise in tracking shipments ranging from paper products and just-in-time deliveries of such items as automobiles and perishable goods to hazardous and radioactive materials, technology is advancing the means of tracking from the use of CB radios and cellular phones to the use of satellites and Loran equipment.

Available systems offer communications and tracking via a combination of satellite communications, Loran-C navigation, Radio Determination Satellite Service (RDSS), commercial telephone service, trunked radio systems, mobile radios with push-to-talk features, on-board data terminals, database management, and computer networks. The cost of a single tracking unit ranges from $2,000 to $5,500, with most equipment falling in the range of $4,400 to $4,800. One unit is available for only $2,000. However, exact location information is not provided; and communications are confined to a limited area. At the other end of the scale, one company offers a tracking unit for $5,500 which is solar-powered and can be used on a rail car. Monthly maintenance fees and the costs of sending messages are also competitively priced from approximately $35 to $45 per month for base service charges plus $.05 per message.

Tracking software packages are also available averaging approximately $4,500. Some packages, which include testing and integrating the software purchased with the current in-house software system, are offered at a considerably higher price.

Competition is growing steadily; however, there is still only one company with proven two-way communications capabilities. Other companies are advertising two-way communications systems that "will" be available, but these systems have not entered the market yet or have not been time tested. Several of the systems studied to date require that the equipment be permanently installed on dedicated vehicles. This may be acceptable for companies that are equipping their own fleet with tracking units. However, this is generally not feasible when different carriers are used which dictates that units be transferred from one vehicle to another.

Companies will continue to enter the market with competitive tracking systems in the race to sell the shipping community on their "Hot, New" system. Advertisements have already hit the press on many new systems that are "just around the corner."

What Makes TRANSCOM Different?

DOE developed the TRANSCOM system to track selected DOE movements of spent fuel, high-level waste, and high-visibility shipping campaigns as determined by DOE. The TRANSCOM system operates using satellite communications, Loran-C navigation, database management, computer networks, and commercial telephone service as shown in Fig. 1.

QualComm's OmniTRACS mobile communications system is utilized for two-way communications. The vehicle's location is determined using Loran-C signals. A communications unit installed on a vehicle transmits this position to a satellite which in turn transmits the information to QualComm's receiving station. The information is then transmitted to the TRANSCOM Control Center (TCC) through its direct telephone link with this receiving station, and the TCC disseminates this information to authorized users as they log onto the TRANSCOM system.

While the software packages mentioned earlier offer a tracking/communications mechanism, the TRANSCOM software was written and designed specifically for use by DOE, States, Indian governments, and other federal agencies on standard office equipment. Therefore, more specific information on bills of lading, DOT emergency response guidelines, state contacts, and shipment activity is provided by the TRANSCOM software than by other systems. The TRANSCOM system is menu driven and is relatively easy to use.

While most carriers use tracking systems to locate their vehicles at any given time, vehicle location information is kept within the organization with the exception of providing customers with estimated times of arrival. The TCC goes a

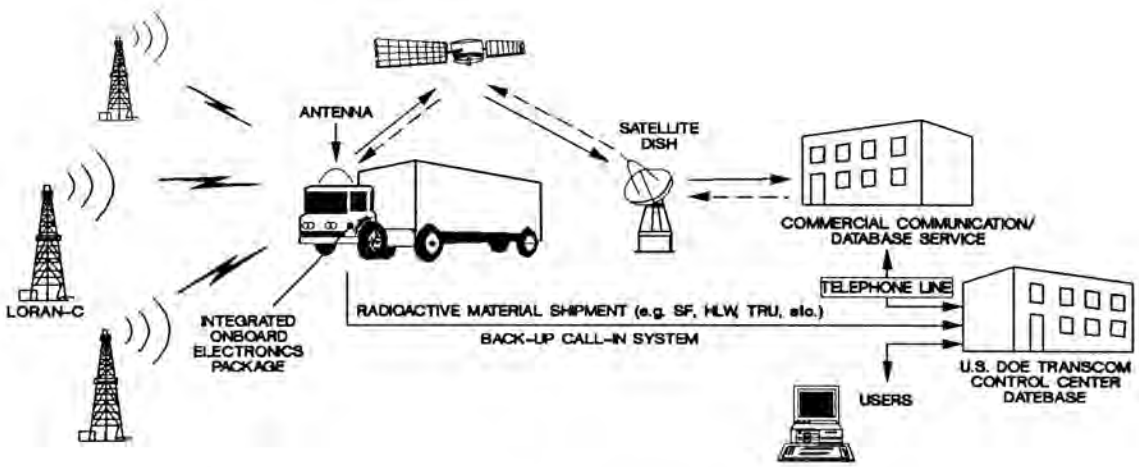

Fig. 1. TRANSCOM Tracking and Communications System.

step further and disseminates vehicle location as well as complete shipment information to its users - the States, Indian governments, other federal agencies, and DOE facilities.

Vehicle location is displayed on the computer screen in relation to a set of maps at the national, state, and county levels. A glance at a vehicle icon on a map will indicate the vehicle's identification number, if it is a truck or a rail shipment, if the shipment is full or empty, if there are any unacknowledged messages associated with that shipment, and the exact location of the vehicle.

Another unique feature of the TRANSCOM software is the provision of advance shipment information which is usually entered into the database seven days in advance of the actual shipment. This allows States, Indian governments, and other federal agencies to access certain advance shipment information as well as complete shipment information which is contained in a bill of lading.

Emergency response information from DOT's Emergency Response Guidebook is also provided via the TRANSCOM software. This information lists appropriate actions to take in the event of an emergency situation associated with the particular material transported in a shipment and also lists emergency contacts for each individual shipment. This information may be very useful to local first responders.

A special feature of the software is a message function which allows selected users to communicate with the vehicle operator, each other, and the TCC. This is a distinctive feature because it allows parties involved with a shipment to communicate with each other directly through the network.

A report option providing a summary of the shipments in transit is also available to users as well as a detailed description of each shipment.

The TCC has access to several maintenance utilities and a map editor. The maintenance utilities make it possible to update various dictionaries and information contained in the database. The map editor allows TCC operators to update and correct maps as necessary.

The TCC Connection

When an active shipment is on the road, a TCC operator is on duty 24 hours per day, 365 days per year if needed. Each operator has been thoroughly trained in system operations. This includes managing the hardware and software, and following standard operating procedures. An automatic position reading is received on each vehicle, usually every fifteen minutes. The software can be programmed, however, to provide automatic readings as often as every five minutes.

Current shipment information is disseminated to users as they log onto the system. Therefore, users may log onto the system for a brief period at various intervals to obtain status updates. The TCC operator, however, tracks a shipment continuously and is prepared to follow appropriate procedures if a nonroutine event or emergency situation arises. These procedures include notifying DOE's Emer-

gency Operations Centers who have the lead responsibility for alerting DOE in such situations.

What Have We Tracked?

Using the Phase IV version of the TRANSCOM software (the latest version), the TCC successfully tracked 60 truck shipments during fiscal year 1989 and the first quarter of fiscal year 1990. These shipments include spent fuel, cesium, uranium hexafluoride, WIPP demonstration shipments, and empty returns.

Since the TCC began tracking operations in September, 1988, there has been less activity than anticipated for users to observe. This is due in part to the delay in the opening of WIPP. Tracking the WIPP shipments was a projected primary task of the TCC. With the delayed WIPP opening, DOE has looked elsewhere for shipments to be tracked by the TCC. This has created some controversy among shippers, receivers, States, and other government agencies. While some groups support the tracking of their shipments, others oppose the tracking because they do not want to set a precedent of having all of their shipments tracked. Several organizations fear that additional equipment and personnel will be required on a dedicated basis. Some organizations do not feel that this system is necessary along with their own dispatch operation, and others do not want to spend time learning a new system. While the TRANSCOM system and its operational use is not the issue or problem at hand, the system is frequently directly affected by matters out of its control.

Who Have We Trained?

DOE provides training to DOE shippers and receivers as well as to States and other federal agencies. Each TRANSCOM state representative is the Governor's Designee for the advance notice of nuclear shipments. Indian governments whose territory is traversed by tracked shipments may also receive TRANSCOM training in order to track movements in their jurisdiction.

A total of 57 people have been trained on the Phase IV version of the TRANSCOM software. This group includes the Governors' Designees (or their representatives) from the states of New Mexico, Wyoming, Colorado, Idaho, and Utah, and a representative from the Shoshone-Bannock Tribe in Idaho. These five States and the Shoshone-Bannock Tribe represent the first WIPP shipment corridor and were trained first in preparation to track the WIPP shipments. Personnel from WIPP, the Idaho National Engineering Laboratory (INEL), the Rocky Flats Plant (RFP), the Oak Ridge National Laboratory (ORNL), and the Oak Ridge Emergency Operations Center have also been trained.

TRANSCOM Status

DOE has entered a new phase whereby the benefits and value of the TRANSCOM system will be proven as DOE works together with the States, Indian governments, and other federal agencies allowing them access to prenotification, routing, tracking, and emergency response information. These users will also be instrumental in assisting DOE in identifying and resolving any logistical problems with the system's operation. By continuing to test the system, more shipments can be tracked, the TCC can test and analyze its operational procedures, and improvements can be made to enhance the system.

The training of additional users will be postponed during this testing phase. Currently, the system can accommodate 24 phone lines simultaneously. The TCC uses four of these lines, leaving 20 available lines for users. Consequently, these constraints limit the number of users the system will allow at one time. This has not been a problem, however, because it is not necessary for users to remain logged onto the system continuously. A user may want to log onto the system, check the status of a shipment, then log off. TCC operators track all shipments on a 24-hour basis; therefore, it is not necessary that users track a shipment continuously throughout its duration.

In the programming area, the Phase IV software has been tested and validated, and the software code is undergoing documentation. Precoded messages have also been incorporated into the software for use by the vehicle operator. This will reduce time and effort on the driver's part when he/she needs to send a message. As a safety measure, vehicle operators are instructed not to use the message function while the vehicle is in motion. However, if a team of drivers is onboard, the inactive driver may operate the system while in transit.

Planned Actions for Fiscal Year 1990

Plans for 1990 include continuing to operate the TCC and tracking additional shipments. Several shipping campaigns have been identified as prospects for tracking by the TCC. One of these campaigns will average three shipments of spent fuel per week and will run at least 18-24 months. This campaign was originally scheduled to begin in November, 1989, but has been postponed until early 1990.

The TCC is also scheduled to track the shipment of a steam generator from Florida to California. While this shipment is not hazardous, it is of high value and is unusual in that it is about 85 feet long, 8 feet wide, 8 feet high, and weighs approximately 146 tons. TRANSCOM will enable

those individuals responsible for the shipment to track its movement and maintain contact with the drivers at all times.

The TCC still plans to track the WIPP shipments once WIPP is in operation. These are expected to average up to five shipments per week during the first five years of operation.

Further software modifications will include various screen enhancements and quicker response times when receiving a download and when changing from one option to another. A feature is expected to be added which will enable determination by users at log-in time as to whether shipments are scheduled to travel through their area of jurisdiction. An enhancement will be added to display the trail of a shipment on the screen to show the direction of a vehicle. This will include position updates for the past hour.

Research to be conducted will include methods by which the States can disseminate emergency and other shipment information to first responders. Long-range plans are also being prepared to provide direction for TRANSCOM and its relationship to Electronic Data Interchange (EDI).

TRANSCOM personnel will observe tracking trends in the shipping industry and new advances in the field of tracking. TRANSCOM managers are waiting to see what new innovations will transpire to modernize the tracking industry before expanding its equipment base.

Personnel will also continue to investigate the possibilities of using the TRANSCOM system with carriers already equipped with their own tracking units. Although it is technically feasible for both the carrier and the TCC to receive the same information by the satellite service company sending the information to both parties, the requirements to do so make this method impossible at present.

CONCLUSION

Overall, TRANSCOM is gaining recognition by most organizations as being a valuable tool in providing its users with advance notification of shipments as well as up-to-date, comprehensive shipment and emergency response information. DOE facilities are also finding the system useful for maintaining contact with the motor carrier and for scheduling personnel and equipment.

As TRANSCOM benefits from technological advances, so will the organizations using the system. Organizations such as the Office of Civilian Radioactive Waste Management (OCRWM) may have a need for TRANSCOM in the future. The OCRWM shipments are scheduled to begin early in the next century, and TRANSCOM could be a definite asset to those involved in the management of this program.

TRANSCOM is one option to enhance environmental and waste management through the cooperative efforts of DOE, States, Indian governments, and other federal agencies. In the growing endeavor to work as a team, progress is bound to result which will benefit all concerned. Consequently, everybody wins!

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