REAL-TIME TRACKING AND SCHEDULING FOR

WIPP WASTE TRANSPORTATION

J. M. Weaver
Westinghouse Waste Technology Services Division
Carlsbad, NM 88220

J. J. Tappen, J. D. Hurley
Westinghouse Waste Technology Services Division
Albuquerque, NM 87190

ABSTRACT

The WIPP waste transportation system requires the use of the best available scheduling and tracking systems in order to make efficient use of a limited number of shipping containers (TRUPACTs) to supply transuranic defense waste to the WIPP site. This paper describes a satellite-based tracking system for in-transit monitoring and communication and a bar-code monitoring system for use at WIPP. Data from these systems will provide real-time feedback on TRUPACT location and status into the planning and scheduling process for WIPP shipments. The WIPP transportation system is being designed to make optimal use of these features.

INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) Project will utilize a fleet of over twenty transuranic package transporters (TRUPACTs) mounted on special trailers to transport contact-handled (CH) transuranic (TRU) defense waste from at least ten Department of Energy (DOE) sites scattered across the country. It is anticipated that approximately 100 CH TRU shipments will be made per month. In addition, ten or more canisters per month of remote-handled (RH) waste may be received. Westinghouse, as a contractor to the DOE, has the responsibility to make all reasonable efforts to have this accomplished safely and efficiently. As part of these efforts it will be necessary to maintain tight control of shipments to and from the WIPP site. One objective is to minimize the number of expensive packagings needed to meet the WIPP transportation system requirements. Another objective is to be aware of and to respond to unexpected events on the road. This requires both a careful scheduling of shipments and close monitoring of a shipment's progress to ensure schedules are met safely.

This challenge is being approached in two ways. Bar coding of both the packagings (TRUPACTs) and their contents, will permit onsite tracking of shipment/shipping container status. A satellite-based tracking and communication system will provide en-route status information and will have a special feature used for emergency notification. The data from these sources will be fed to a computer system that will compare actual status with required status and provide a basis for corrective action. The use of these tracking, location, and communication systems in an integrated manner is believed to be the first of its kind. Experience gained in the development and application of this system should be useful in a variety of other applications.

SCHEDULING

The ten principal sources of material to be shipped to WIPP are shown in Fig. 1. The shipping needs for these sites vary from approximately one shipment per day to a shipment every other month. The efficient scheduling of a limited number of TRUPACTs is a complex problem involving: 1) maintaining a delivery rate at WIPP sufficient to keep the waste handlers busy during a five-day week, 2) optimizing the WIPP queue and the Rocky Flats and Idaho queues, 3) meeting the shipping requirements of the other eight shippers, 4) providing for scheduled and unscheduled maintenance, and 5) providing for unscheduled changes (weather delays or detours, other delays enroute, delays in loading or unloading). This is a challenging task that will require careful planning and initial structuring, as well as continuing cooperation among the shippers, WIPP, and the carrier.

Assuming the requisite degree of cooperation among the participants, there must be a means to collect the data important to scheduling as well as a means to integrate it. The scheduling program itself is a separate subject that will not be treated here, but the data collection system involves some special features that are the subject of this paper. These features include data collection during transport, as well as onsite tracking.

ONSITE TRACKING OF SHIPMENTS

The actual transportation between sites is only part of the transportation cycle, and not always the larger part. Therefore, it is necessary to be aware of the status of packagings onsite in order to make optimal use of a limited fleet. At a shipping site, the waiting, unloading, loading, maintenance, and dispatching times are important. The key to successful management of this portion of the transportation cycle is to find a simple, reliable method to obtain and integrate the needed data.

Manual recording and entry of data into computers are familiar to all. However, a simpler and more reliable method is easily available. The WIPP Project has adopted bar coding of waste containers as a means for ready identification and control. It is proposed to bar code the TRUPACTs also.

Fig. 1. Waste Generation Storage Sites.

Tracking a TRUPACT through the WIPP site can be accomplished by scanning the bar code at fixed site locations or by using portable readers. Fixed scanners can feed data directly into a computer. Portable scanners can download data to a computer at any time. Both can record the location and time at which the reading was taken. For example, WIPP may scan a TRUPACT as it arrives at the gate, when it is parked, when it enters the Waste Handling Building (WHB), when it leaves the WHB, and when it leaves the site. The packaging could also be scanned as it enters and leaves the TRUPACT Maintenance Facility. Another option is to provide a manual input for an expected time span that is greater than normal, e.g., time in maintenance to obtain a part or perform a repair. Thus, updating the status can bring any unexpected changes to the immediate attention of the schedulers.

The final step at all sites is the actual start of shipment. It is expected that a single carrier will be responsible for WIPP shipments. Close contact between the shippers, carriers, and WIPP operations will be essential to the effective dispatching of shipments. Obviously, if a shipment has to wait half a day for the carrier to dispatch it, the total cycle time is extended, unless there are compensating effects at the receiving site.

The capability and need to obtain detailed input from the shippers has not been determined as yet. However, as a minimum, each shipper will provide arrival times, expected shipping times, and actual shipping times that can be input manually.

The hardware that will be used for reading and recording bar-coded data has not been selected as yet. However, it is expected that laser scanners will be used since they can read a code as long as the scanner is within about a foot of the label. Software is available for several computers and will be selected as the overall tracking system is developed. Additional information on the application of bar coding to WIPP is provided in another paper presented at this meeting (The Application of Bar Coding Technology at WIPP).

TRUPACT TRACKING AND COMMUNICATION SYSTEM

As part of an overall waste management program to ensure the efficient use of TRUPACT and the waste handling facilities at WIPP, and to improve the tracking of and communication with the transport vehicle, the use of a satellite-based system was evaluated, on a preliminary basis, as an alternative to the periodic, driver-initiated call-in system. This evaluation indicated that a satellite-based tracking and communication system (TRACOMs) provided a cost-effective alternative which increased scheduling efficiency, decreased transport time, and improved confidence in vehicle location. The following sections summarize the steps taken by Westinghouse to design and procure an effective transportation tracking and communication system.

Purpose

The goals of any tracking and communication system are to provide reliable two-way communication and accurate vehicle location information. The benefits of using such a system are improved safety, upgraded security, and increased efficiency in transport vehicle scheduling.

Under current practices, information on the location of trucks transporting TRU wastes is dependent upon data provided by the drivers through their dispatcher to the Department of Energy (DOE). Verification of the location of the shipment is dependent upon visual confirmation. In the case of rail transport, shipment location is dependent on communication with the engineer and/or track monitoring using video cameras. In both cases, communications are, for the most part, by unsecured transmissions, i.e., telephone, radio-phone, or C.B. radio.

An initial comparision of these systems indicates that use of a commercial satellite-based system is cost-effective. The use of such a commercial system can eliminate the need for information to be relayed to DOE through a third person and provides for secure communications. The satellite-based system can query the transport vehicle, determine its location and make a location comparison against a prescribed route, and automatically record that information.

Conceptual System Design

The elements of a satellite-based tracking and communication system have been identified and a conceptual design constructed. The system would consist, at a minimum, of two satellites in geosynchronous orbit above the U.S., individual transceivers (transmitter and receiver) on the transport vehicle and at the monitoring station, an earth station, and a central computer facility. The use of two satellites is necessary to ensure accurate location determination through triangulation. The signals from the satellites would be received by the earth station and transmitted to the computer facility for processing.

Communication with the vehicle for non-location related information would require the use of only one of the satellites.

System Requirements

As part of the evaluation process, Westinghouse has developed several preliminary criteria for evaluating available or pending tracking and communication systems. These criteria require that the system provide:

- o Real-time, digital, two-way communication between the transport vehicle and DOE;
- o Uplink/downlink radio frequencies and all transmission equipment which must be licensable by the federal government;
- o All transmissions to be secure and capable of meeting the National Security Agency Data Encryption Standard;
- o End user input and query capabilities, user authentication, and vehicle identification;
- o Accurate, reliable position location information with resolution to +/-200 meters;
- o Automatic storage of all response queries and duress signals in a computerized data base system; and
- o System components that have a minimum life expectancy of 10 years.

These system requirements form the bases upon which commercially available systems can be evaluated.

Preliminary Program Plan

A preliminary program plan for the procurement, installation, and operation of such a satellite-based system has been developed. It is anticipated that the system could be implemented and operational within thirty-six months, by August 1988.

The plan has been divided into three stages: the first stage, the development stage, consists of establishing system requirements, selecting a vendor or developer, procuring the system, and establishing the initial operating capabilities of the system. This stage is scheduled for completion by November 1986.

The second stage of the program is the demonstration stage. During this stage, the system will be utilized with the TRUPACT Prototype Fleet during the time contact-handled waste is being shipped from the Rocky Flats Plant to the Idaho National Engineering Laboratory. Concurrent with use of the system, the system performance will be evaluated and modifications made to the system design. It is anticipated that this stage will be completed by January 1988.

The final stage of the program is the procurement, installation, and operation of the tracking and communication system on the operational TRUPACT Fleet. This stage is scheduled for completion by August 1988.

Methodology

In order to determine the availability of commercial systems, the program plan called for Westinghouse to place an announcement in the Commerce Business Daily requesting vendors and developers of such systems to submit written expressions of interest in providing a turn-key tracking and communication system. Respondents to this notice would be provided with a written Request for Information (RFI) which outlined the preliminary requirements for the system and requested the respondents to provide a verbal presentation on their company and available or developing system.

The information provided by these companies would then be used to assist in establishing the final system requirements including system capabilities, equipment requirements, and timelines. These requirements would be used as the guidelines in the Request for Proposal (RFP).

Status

An announcement was published in the Commerce Business Daily on November 22, 1985, requesting vendors to provide written requests for the RFI. In response to this notice, Westinghouse received 19 written requests within the 14 calendar day response period. An additional seven verbal and written responses were received after the close of the response period.

Verbal presentations by interested vendors were made to the evaluation team during the period of January 21-31, 1986. These presentations were used to assist in finalizing the performance and capability requirements of the system. The requirements are contained in the RFP, which is undergoing final internal review prior to release.

SUMMARY

Westinghouse is in the process of implementing a program to establish an effective transportation scheduling, tracking, and communication system for WIPP. The system will use a satellite-based system for offsite tracking that will improve safety, upgrade security, and increase the efficiency of TRUPACT scheduling. WIPP onsite tracking will use a bar code system.

In developing this program, a plan was established to determine the availability of commercial satellite-based systems to meet the system requirements. The program plan is a multiple-stage program in which each stage has definitive requirements and target dates.

Work supported by the U.S. Department of Energy Assistant Secretary for Defense Programs, under DOE Contract No. DE-AC04-86AL31950.