THE DOE NATIONAL TRANSPORTATION PROGRAM COST-ESTIMATING MODEL

R. R. Rawl and R. D. Michelhaugh
Oak Ridge National Laboratory*
P.O. Box 2008
Oak Ridge, TN 37831-6472
Tel: (865) 574-6461; Fax: (865) 574-3431
E-mail: rawlrr@ornl.gov

S. Hamp
U. S. Department of Energy
National Transportation Program
P.O. Box 5400
Albuquerque, NM 87185

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R. R. Rawl[1], R. D. Michelhaugh[1] and S. Hamp[2]

[1]Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6472, USA
Tel: 865-574-6461, E-mail: rawlrr@ornl.gov
[2] United States Department of Energy, National Transportation Program,
Albuquerque, New Mexico 87185 USA

SUMMARY

The United States Department of Energy (DOE) carries out a significant amount of transportation each year, including waste remediation activities at the sites for which it is responsible. In future years, the amount of material transported is expected to increase, and the costs of this transportation are expected to be large. To support the assessment of such costs, a cost-estimating model was developed in 1996, peer-reviewed against other available packaging and transportation cost data, and used to calculate the costs for a significant number of shipping campaigns of radioactive waste. This cost-estimating model, known as the TEn-year Plan TRAnsportation Model (TEPTRAM), served as the cost-estimating model for radioactive material shipments in developing the DOE Office of Environmental Management's *Ten Year Plan*.

The TEPTRAM model considered costs for recovery and processing of the wastes, packaging of the wastes for transport, carriage of the waste and a rough estimate of labor costs associated with preparing and undertaking the shipments. At the user's direction, the model could also include the cost for DOE's interaction with its external stakeholders (e.g., state and local governments and tribal entities) and the cost associated with tracking and communication (e.g., use of the DOE TRANSCOM system). By considering all of these sources of costs, it provided a mechanism for assessing and comparing the costs of various waste processing and shipping campaign alternatives to help guide decision-making.

Recognizing that a more user-friendly version of a cost-estimating model would be more useful to the DOE packaging and transportation community, the National Transportation Program sponsored an update of the TEPTRAM model. The new Transportation Cost Estimating Model (TRANSCOST) was developed to fulfill this need. TRANSCOST utilizes a series of input and output screens to facilitate information flow, and a number of new features were added on the basis of features identified by the DOT transportation community as being desirable.

INTRODUCTION

A large quantity of radioactive, mixed, and non-radioactive hazardous waste has accumulated at various sites within the United States as a result of the activities of DOE and its predecessor organizations. DOE has a mandate to undertake remediation (i.e., cleanup) of this waste. This

cleanup will entail some or all of the following activities: recovery, processing, packaging, storage, transport, and disposal.

During 1996 and 1997, an extensive Environmental Management Integration (EMI) effort was undertaken by DOE and its support contractors to define how to accomplish this remediation in a safe and cost-effective manner. As the development of the *Ten Year Plan*—later called the *Accelerated Cleanup Plan* (DOE, 1997)—and the EMI effort proceeded, it became apparent that one of the critical elements in remediation was going to be the packaging and transportation of waste materials. Furthermore, one significant factor identified, which needed to be addressed in the planning process and used in making decision, was the cost involved in the individual shipments of waste streams. The packaging and transportation costs needed to be evaluated relative to baseline planning cases and relative to alternatives to the baseline cases.

DEVELOPMENT OF TEPTRAM COST ESTIMATING MODEL

The initial version of TEPTRAM was developed as the first phase of the *Ten Year Plan* was approaching completion. The model, which was developed under the sponsorship of the DOE Office of Environmental Management, was based upon cost-estimating algorithms developed in 1994 for a packaging and transportation needs assessment (Pope et al., 1995; Pope and Blalock, 1996). The first version of TEPTRAM was completed and placed into use in September 1996.

The algorithms used in the model were automated using the Excel spreadsheet software, and many waste transportation cases were run using this first version of TEPTRAM. Once the model was available, it was validated using cost estimates previously made for shipments of transuranic (TRU) wastes in the TRUPACT-II container. The results of TEPTRAM compared within about 20 percent to those obtained by a separate methodology for the TRU waste shipments. In a separate and independent analysis, Argonne National Laboratory (ANL) personnel compared the costs for a hypothetical shipping campaign obtained from TEPTRAM with a methodology used by ANL for environmental risk assessments, and it was determined that the TEPTRAM and ANL results also agreed to within about 20 percent.

During 1997, in further developments related to detailed planning for accelerated cleanup activities, transportation subject matter experts began looking at alternatives to shipping the wastes in order to reduce system-wide, life-cycle costs. The TEPTRAM model was adapted to the needs of this study by improving the "user-friendliness" of the model and adding the ability to calculate the costs of leased packages. Application of TEPTRAM to numerous waste campaigns proved its usefulness in providing order-of-magnitude cost estimates for a variety of shipping scenarios.

DEVELOPMENT OF THE TRANSCOST MODEL

Recognizing the potential usefulness of a consistent cost-estimating capability within the DOE packaging and transportation community, the National Transportation Program sponsored the further evolution of TEPTRAM. A survey of potential users (transportation managers and program managers) identified several additional features that were believed to be useful. These features were integrated into a requirements document to guide further development.

Subsequent to the development of TEPTRAM, the National Transportation Program has also supported the development of the Transportation Routing Geographical Information System (TRAGIS) at Oak Ridge National Laboratory (ORNL). TRAGIS is an integrated rail/highway/waterway routing model with population information in a geographical information system. Since TRANSCOST requires accurate route distances and transit times, it was decided to have TRANSCOST use TRAGIS information for these purposes. This modification greatly simplified how users could specify origins and destinations (using drop-down lists from the TRAGIS database) and ensured consistency between the two models.

Since TRANSCOST is based on the earlier TEPTRAM model, it is able to calculate total costs for campaigns taking into account the following factors.

Packaging Acquisition Cost—This cost factor provides the cost of purchasing the packages needed for a given campaign. The number of packages required for the campaign is calculated based on the travel time, loading and unloading times, refurbishment downtime, capacity of package, and amount of material to be transported in a given period of time. It is assumed that each campaign requires new packages; that assumption may overestimate the costs associated with a campaign whose packagings can be reused or with situations where the packaging are already available at no or reduced cost.

Packaging Lease Cost—This cost factor is the alternative to acquiring packagings. This factor provides the cost per month to lease a packaging, and the model includes lease costs for the times involved in transit between facilities and in loading and unloading the packagings.

Packaging Maintenance Cost—This cost factor provides the estimated cost of refurbishing the package after a predetermined number of uses. This would include parts and labor for seal replacement, minor damage repair, painting, fastener replacement, etc. This value is assumed to be zero when a packaging is leased, since the maintenance cost for each packaging is assumed to be included in the lease cost.

Vehicle Lease Cost—This cost factor provides the cost of leasing the vehicle for the campaign. It is based on the number of vehicles needed for the campaign (calculated) and the lease cost per vehicle.

Carriage Cost—This cost factor provides the 'per mile' charge of the carrier and the round trip mileage. This includes fuel, driver labor, etc.

Labor Cost—This cost factor provides a rough-order-of-magnitude estimate of the labor cost for package preparation, loading, unloading, and securing packages to vehicles.

Management and Administrative Cost—This cost factor provides a rough-order-of-magnitude cost of administration and management, including contracting for carriers, hazardous material shipping document preparation, record keeping, etc.

Travel Time—The system calculates the travel time from TRAGIS routes between the sites selected and the mode selected by the user.

Campaign Time—The system calculates the duration of the campaign based on the quantity of material to be moved, packaging selected, trip time, vehicle capacity, and the like.

Number of Packages Needed—The system calculates the number of packages required to move the material in a specified time period.

Number of Vehicles Needed— The system calculates the number of vehicles required to move the material in the specified time period.

Accessorial Charges — The system also allows the inclusion of accessorial charges to be included on a per-mile basis (such as a fuel surcharge) or a trip basis (such as special equipment required).

Additional Transit Time— The system also allows the inclusion of additional transit time required for each trip.

During FY 2001, TRANSCOST was developed to provide full cost-estimating functionality, including all the facets listed above. TRANSCOST is designed to quickly and easily allow the user to specify the critical parameters defining a shipment campaign and then to calculate either the

1. shortest possible duration of the campaign, or
2. number of packagings required to complete the campaign.

USING TRANSCOST

TRANSCOST can be downloaded from a web site link found on the National Transportation Program (NTP) Home Page (http://www.ntp.doe.gov). To download the software, users must register and have passwords activated. Users will receive email notices when their passwords are activated. With a username and password, the user can login and access the web page to download the software. Installation instructions are included on the download page. There is a link on the TRANSCOST page for accessing the user's manual, which has more detailed descriptions of the various cost factors and examples for new users to follow in order to get a feel for operating the software.

When running TRANSCOST, the user must first provide some basic information on the input screen. This information includes

- start date for the campaign
- end date for the campaign (unless the duration of the campaign is being calculated)
- origin (from a drop-down list of common DOE and commercial sites)
- destination (from a drop-down list of common DOE and commercial sites)
- quantity of material to be transported
- whether the packaging is 'one way,' round trip, or leased
- mode of transportation (highway, rail, or intermodal)

Figure 1 shows the input screen and depicts how this information is entered.

ORNL DWG 2001-03993

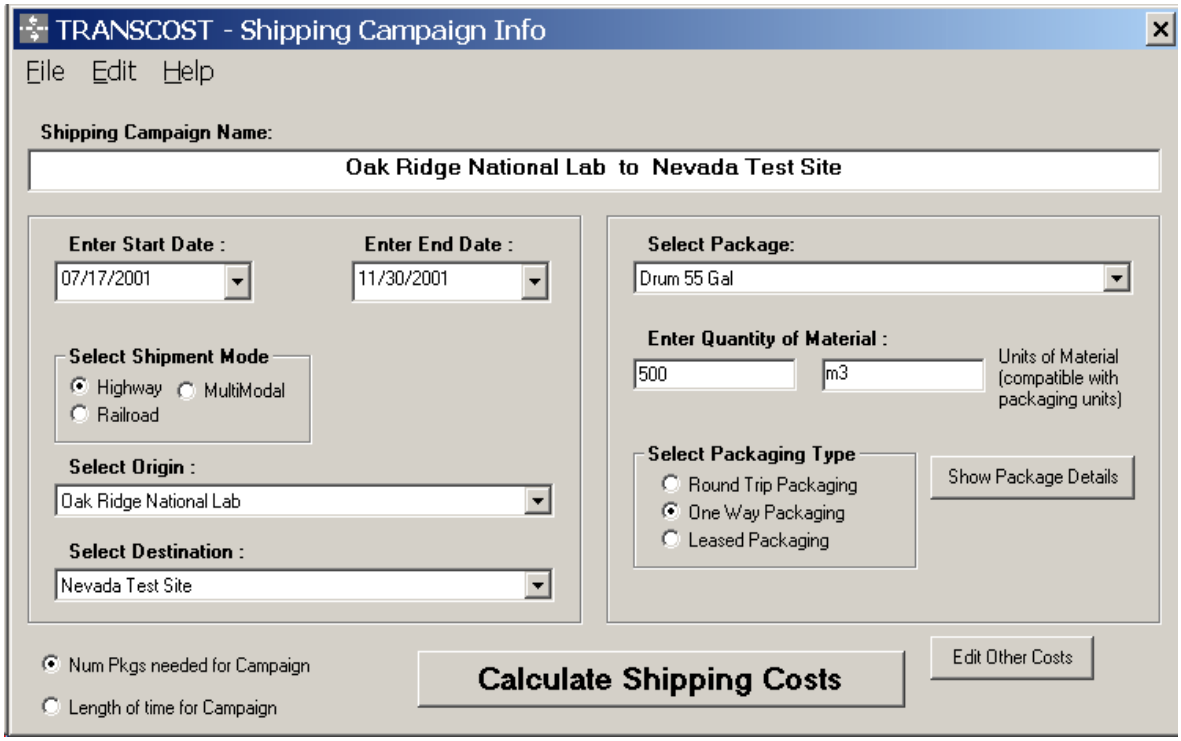

Figure 1. TRANSCOST input screen.

Information concerning the packaging is used to determine the number of packages which must be transported, loading and unloading times that must be scheduled, maintenance requirements (time and cost), and the number of vehicle trips required. The "Show Package Details" button on the input screen brings up the packaging information screen shown in Figure 2, which is used to specify the necessary parameters.

When the number of packages needed for the campaign is being calculated, the window for 'number of packages available' is inactive. This value is specified when the user is calculating the length of time for the campaign. Package capacity information is available for all of the packages contained in the TRANSCOST database. Loading and unloading time and labor rates are used in determining the cost and schedule requirements for these aspects of the campaign. Maintenance costs and times are also used to calculate the time and costs necessary for this function.

ORNL DWG 2001-03994

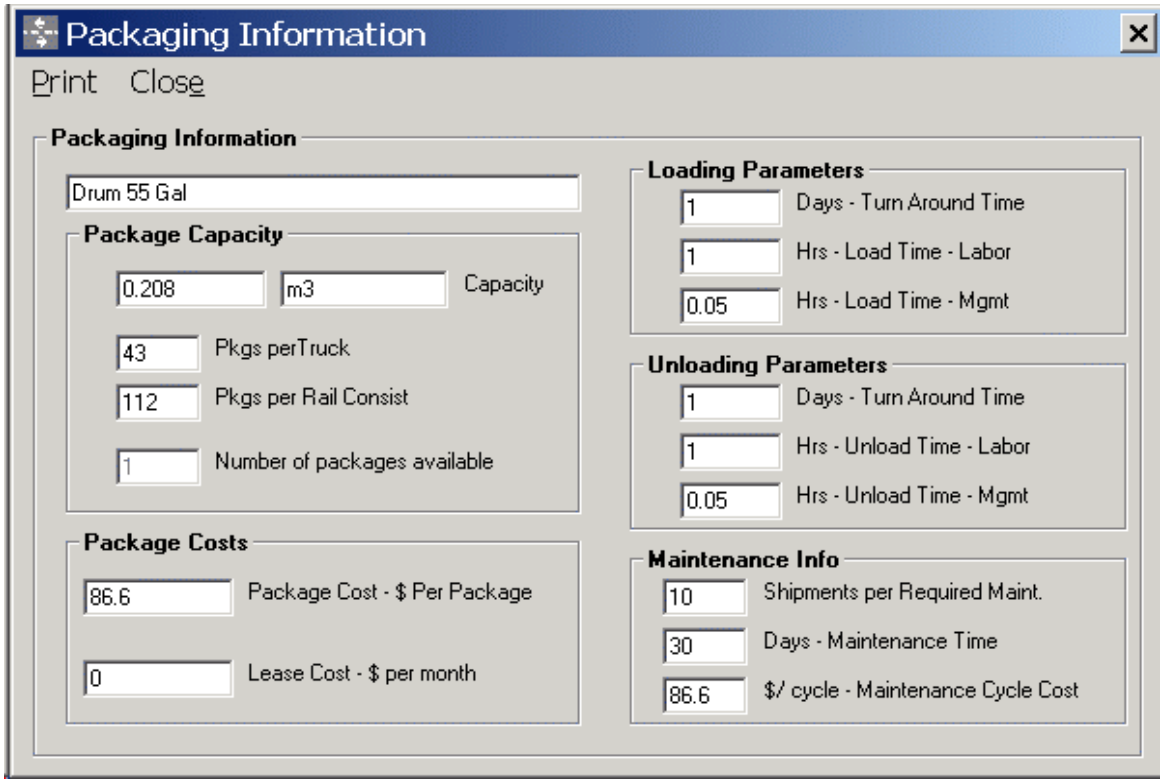

Figure 2. TRANSCOST packaging information screen.

While TRANSCOST has default values for all of the parameters required to estimate a typical shipment, many of the defaults have been very conservatively entered. Users should carefully review the default values to ensure that they are reasonable for the campaign scenario being estimated. For example, the default value for carriage costs by highway is initially set at $3.50 per mile which is very high. Consequently, all of the default values should be reviewed and modified as needed to make them accurately reflect the costs and schedules associated with the campaign being estimated.

An "Edit Other Costs" screen is accessed from the input screen to provide suitable values for

- labor and management cost rates
- highway or rail carriage costs
- vehicle costs
- accessorial charges (on a 'per shipment' and/or a 'per mile' basis)
- known transit delays (such as time required for state inspections)

Once the needed input information is provided, the user simply clicks on the "Calculate Shipping Costs" button. The calculations are performed, and the results screen (Figure 3) provides the calculated cost and other information.

ORNL DWG 2001-03995

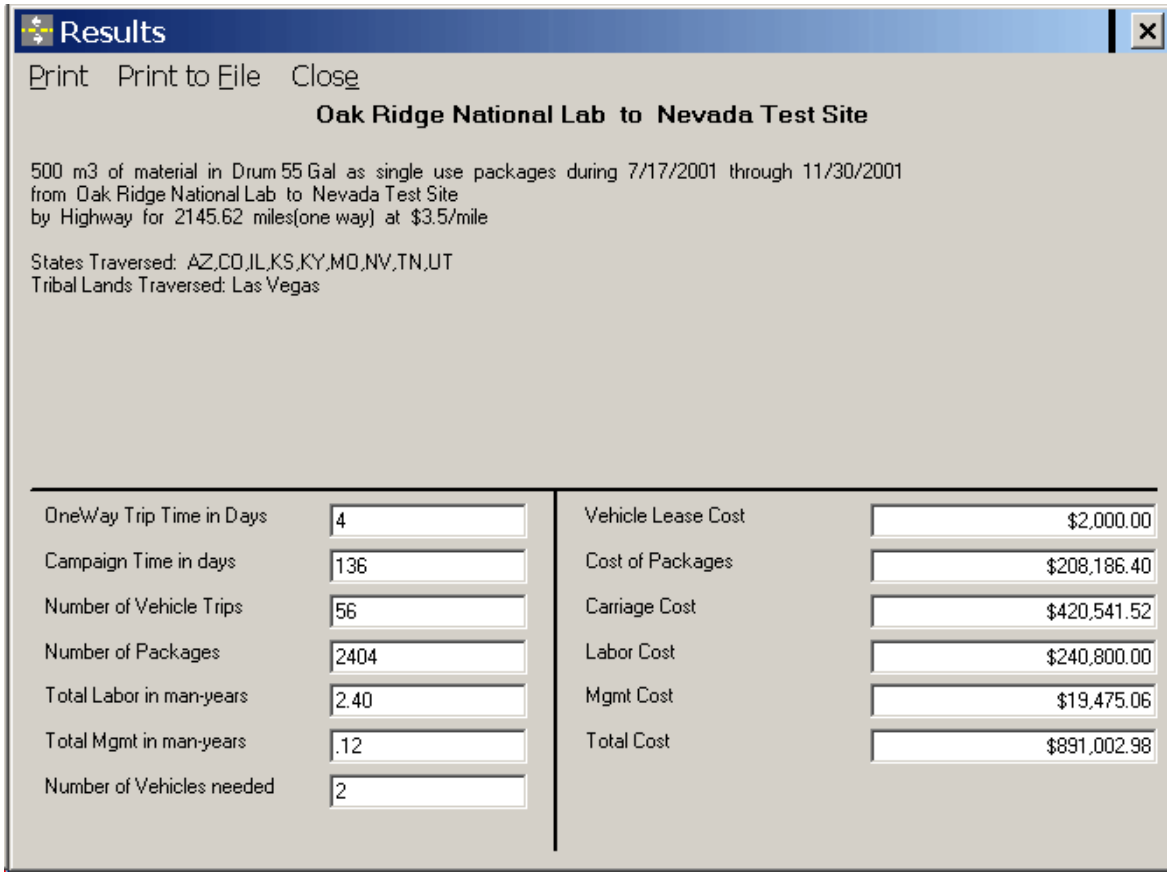

Figure 3. TRANSCOST results screen.

Users can evaluate and compare packaging and transportation options by running alternate scenarios. For example, bulk shipments can be compared to non-bulk, and different package types (with different capacities or costs) can be evaluated. Using accurate carriage costs, modal options can be evaluated as well. TRANSCOST is designed to support quick and easy evaluation of the alternatives that transportation and program managers may have in successfully completing campaigns.

TRANSCOST FUTURE DEVELOPMENT

Future enhancements planned for TRANSCOST in FY 2002 include

- providing a direct internet link to the TRAGIS routing model server in order to be able to generate routes for new shipping scenarios
- enlarging the library of packages available
- adding additional cost factors as users identify such needs

CONCLUSION

Transportation and program managers are encouraged to visit the National Transportation Program home page (http://www.ntp.doe.gov/) and download TRANSCOST for their use. Assistance with the installation and use of TRANSCOST is available from the TRANSCOST help desk by telephone at (865) 574-6819, fax at (865) 574-3431 and email at michelhaugh@ornl.gov. Comments and suggestions are welcomed.

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