LA-UR- 02-7244

Approved for public release; distribution is unlimited.

Title: Rail Cost Benefit Analysis
October 2002

Author(s): Debora M. Gage

Submitted to: LANL-CBFO, DOE-CBFO, RSI, TRU Solutions Westinghouse

Los Alamos
NATIONAL LABORATORY

Rail Cost-Benefit Analysis

Debora Gage
Institute for Regulatory Science
LANL-CBFO 2002 MBA summer intern

10/28/02

Institute for Regulatory Science
Columbia, Maryland
301-596-1700

Los Alamos
NATIONAL LABORATORY

Table of contents

Table of contents .... *i*

Executive Summary 1

1. Introduction 3

2. Model 3

2.1. Benefits *4*

2.2. Costs *4*

2.3. Model Inputs *4*

2.4. Model Outputs *5*

2.5. Underlying assumptions *5*

2.5.1. Model assumptions 5

2.5.2. Packaging parameters and assumptions 6

2.5.2.1. TRUPACT-III weight, trailer weight and shipping configurations based on weight 6

2.5.2.2. TRUPACT-III: non-divisible packaging efficiency assumptions 9

2.5.2.3. TRUPACT-III dimensions and shipping configurations 10

3. Rail Benefits and costs 11

3.1. Rail Benefit: Rail's increased weight shipments, when truck shipment management minimizes weight *11*

3.1.1. TRUPACT-III throughput 11

3.1.2. Volume/weight shipment advantage dollar conversion 13

3.2. Rail Benefit: Avoidance of Weather Delays *13*

3.2.1. Calculating weather delays 13

3.2.2. Weather delay dollar conversion 13

3.3. Rail Benefit: Overweight permit fee avoidance *14*

3.4. Rail Benefit: Trucking equipment and truck mileage costs avoidance *15*

3.5. Rail Cost: TRUPACT-III packagings *16*

3.6. Rail Cost: Tracking *16*

3.7. Rail Cost: Infrastructure development *16*

3.8. Rail Cost: Shipment costs *16*

3.9. Rail Cost: State and Nation payments *17*

3.10. Hanford rte 1 (UP/BNSF) vs. Hanford rte 2 (BNSF) *17*

3.10.1. Hanford rte 1: Rail Costs (switching costs and rail rate per car) 17

3.10.2. Hanford rte 1: Cycle Time 17

4. Sensitivity 18
4.1. Overweight permit fees under different truck shipping practices *18*
4.2. Examples: Sensitivity analysis overall rail *19*
4.3. Examples: Sensitivity analysis Hanford routes *19*

5. Results 20
5.1. Major Rail Costs *20*
5.2. Major Rail Benefits (Truck costs) *20*
5.3. Major Cost-Benefit breakeven drivers *20*
5.4. WIPP throughput changes *21*
5.5. Hanford routes *21*
5.6. Acceleration plan *22*

6. Conclusions and Recommendations 23
6.1. Conclusions *23*
6.2. Recommendations *23*
6.2.1. Data needs 23
6.2.2. Future Studies 24

7. Acknowledgments 25

8. References 26

Appendices 29
Appendix A: Individual State Rules and Fees for Overweight Shipments *29*
Figure A-1: Open TRU Waste shipping routes from Generator sites 29
Appendix B: Inventory data *48*
Appendix C: Results *50*

List of tables and figures

Document tables and figures

Table 1: Overweight permit limit rules
Table 2: Number of oversized containers
Table 3: Shipping configurations based on dimensions
Table 4: Maximum volume shippable in a TRUPACT-III TN GEMINI
Table 5: Projected DOE weekly shipping schedule by TRU-II or TRU-III
Table 6: Unused rail weight capacity
Table 7: Comparison of direct and cost function fee calculation methods
Table 8: Hanford rail route summary differences
Figure 1: Overweight permit fee estimates

Table 9: Rail Benefit (Oversize box inventory)
Table 10: Rail breakeven point based on truck costs (Oversize box inventory)
Table 11: Rail breakeven point based on percentage change in rail cost per car (Oversize box inventory)
Table 12: Rail breakeven point based on percentage change in rail cycle days (TRUPACT-III costs) (Oversize box inventory)

Appendix tables and figures

Figure A-1: Map
Table A-1: Approximate distance from generator sites to WIPP
Table A-2: Overview of overweight permit rules and fees by state
Table B-1: Size inventory data: *oversizeest.xls*
Table B-2: Weight inventory data: *INEELNONOVERP.xls* , *RFETSOVERSIZE.xls*
Table C-1: User entered assumptions for basic model case
Table C-2: Overweight permit summary
Table C-3: Effects of minimizing overweight permit fees
Table C-4: Rail: total number of shipping years
Table C-5: Basic model results (A: Costs; B: Benefits; C: Net Benefit)
Figure C-1: Cost/Benefit results based on truck costs $15/mile
Figure C-2: Cost/Benefit results based on truck costs $5/mile
Figure C-3: Rail and truck costs compared on a waste volume basis
Table C-6: Calculations of rail and truck costs on a per volume basis
Table C-7: Rail sensitivity analysis: Oversize box inventory
Table C-8: Percentages of major costs
Table C-9: Hanford route summary
Figure C-4: Hanford rail route differences, Incremental Rail Costs based on current OVERSIZE BOX inventory
Table C-10: Hanford route sensitivity analysis
Table C-11: Hanford route breakeven equation derivation
Figure C-5: Relationship between Hanford route 1 cycle days and the TRUPACT-III cost difference between route 1 and route 2
Figure C-6: Hanford breakeven variables and linear regression equations
Figure C-7: Comparison of rail time to acceleration plan time

Executive Summary

The Institute of Regulatory Sciences conducted a cost benefit analysis of DOE's potential shipment of waste by rail. Under certain assumptions, rail is cost effective. Of rail's costs (site changes, rail transport costs, tracking waste en route, additional TRUPACT-III costs, transport corridor costs) and benefits (avoidance of truck weather delays, avoidance of overweight truck permit fees, avoidance of truck operations costs) the most important driver in the analysis is the truck cost per mile affecting the truck operations costs. The truck cost per mile determines the truck shipping costs that can be avoided when shipping waste by rail; this is viewed as a rail benefit.

The model employed the following assumptions and methodologies:

- This analysis does not discount future dollars to adjust for the time value of money.
- Costs were not split between WIPP and generator sites; they were investigated for DOE as a whole.
- Only one type of packaging was considered, the TRUPACT-III.
- Empty TRUPACT-III shipments were assumed to be within state transportation limits; this avoids overweight permit fees for empty shipments.
- An overweight permit fee methodology was developed as part of this analysis. In this analysis, this methodology calculates the overweight permit fees for the entire waste inventory (appendix A). As a standalone module, it calculates single trip overweight permit fees. This standalone module has been parsed out as *overweight permit module final.xls* and *Directions for overweight permit section.doc.*
- Only CH TRU waste inventory was considered in this model (appendix B).
- Inventory shipments were considered on the number, size or weight of waste packagings; not volume. Repackaging was not considered an option in this model.
- Hanford route 2 (BNSF) was the default for shipping by rail from Hanford. Additional work investigated potential costs or benefits of Hanford route 1 (UP/BNSF) above or below this baseline.

The conclusions of this analysis are:

- The TRUPACT-III rail fleet calculated in this model is larger than that calculated in the previous RSI model. To equal the volume of a WIPP throughput of 93 TRUPACT-II per week, the previous RSI model concluded that a rail fleet of 63 TRUPACT-III was necessary. The current model concludes that a rail fleet of 72 TRUPACT-III will be necessary. The change in the TRUPACT-III fleet size results from a change in the shippable volume (all other assumptions remain the same). The shippable volume was decreased in this model (from 11.40 m^3 to 8.32 m^3) to reflect DOE's design selection for the TRUPACT-III, the TN GEMINI.
- DOE should not try to minimize truck overweight permit costs at the expense of keeping sites open longer. The shipping management should load each TRUPACT-III to volume capacity (appendix C, table C-3).
- The net rail benefit hinges on the truck cost per mile assumption. The assumption for this variable will be determined by WIPP.

Rail Net Benefit (Oversize box inventory)

	Hanford	INEEL	RFETS	SRS
Truck cost: $5 per mile	No	No	No	No
Truck cost: $15 per mile	Yes	Yes	No	Yes

- If truck costs are $15 per mile, rail is cost effective for Hanford, INEEL and SRS.
- If truck costs are $5 per mile, rail is not cost effective. Aggressive negotiations would need to decrease the rail cost per car or cycle time by more than 50% to make rail cost effective (appendix C, figure C-2).

Rail breakeven point based on truck costs (Oversize box inventory)

truck cost per mile breakeven point with present assumptions	Hanford	INEEL	RFETS	SRS
rail breakeven (truck $/mile costs)	$8.17	$8.18	$976.30	$10.62

- Rail is more cost effective the greater the distance from the waste generator site to WIPP (appendix C, figure C-3).
- Under the basic assumptions (appendix C, table C-1) rail can ship the current oversize box inventory by rail within the acceleration plan time frame (appendix C, figure C-7).
- Under the basic assumptions (appendix C, table C-1) rail cannot ship drums and SWB within the acceleration time frame by TRUPACT-III (appendix C, figure C-7).
- Increasing WIPP throughput decreases the rail benefit due to additional TRUPACT-III costs and loss of weather benefit by shorter truck shipping years.
- The results from the sensitivity analyses suggest that shipping waste by Hanford route 1 (UP/BNSF) will be more expensive than Hanford route 2 (BNSF).

Several future studies should be conducted as a result of this analysis; the most important is the application of the time value of money. This study also highlights the need to focus future efforts on correlating inventory box numbers with size and weight.

1. Introduction

This Institute of Regulatory Sciences (RSI) report and accompanying spreadsheet analysis were developed to incrementally analyze life cycle costs and benefits of shipping waste by rail. They were created to serve as a tool for various stakeholders.
The spreadsheet is an MS Excel 2002 workbook file, *RAIL cost benefit.xls*. The U.S. Department of Energy, Carlsbad Field Office (DOE/CBFO) is investigating shipping TRU waste by rail as part of the Transuranic Waste Performance Management Plan to accelerate shipments to Waste Isolation Pilot Plant (WIPP).

This incremental analysis evaluates the costs/benefits of rail shipping over truck. Costs were looked at on an overall rail choice for DOE. No attention was given to the owner of the costs (e.g. whether costs were absorbed by WIPP or by generator site). Only the TRUPACT-III packaging type was considered. This new packaging type was considered because its use will influence the baseline truck costs.

Sites included in this study are main generator sites from which rail would be feasible, i.e. there is already existing rail infrastructure. These sites are Hanford, Idaho, Rocky Flats, and Savannah River. There are two potential routes from Hanford using two different rail companies; route 1 (Union Pacific (UP) and Burlington Northern Santa Fe (BNSF)) would closely parallel the existing trucking route. Route 2 shipping by BNSF would not parallel the existing truck route. Route 2 is the baseline against which route 1 is compared. Idaho, Rocky Flats and Savannah River rail routes closely parallel the existing truck routes.

Intermodal shipping (a mix of rail and truck from one site) was not considered in this model.

Depending on when rail will be implemented, some of the truck property plant (PPE) and equipment infrastructure for TRU-III (e.g. trailers) may already be purchased (e.g. truck trailers for TRUPACT-III). If this occurs these truck infrastructure and PPE costs are sunk costs and must be removed as rail benefits of avoidance of truck costs.

The model did not investigate stepped introduction of TRUPACT-III packagings.

2. Model

The user is allowed to accept the defaults or enter their own assumptions.

The model was designed to answer the following questions:

- How many packagings (TRUPACT-III) are required for rail? How many additional packagings will have to be built above those necessary for truck?
- How will rail rate changes affect overall shipping costs?
- How will payments to states affect the cost effectiveness of rail?
- Is rail use justified on a cost basis?
    - Is rail cost effective as a shipment method from some sites but not others?
- Which of the two rail routes from Hanford is more cost effective?

- How do overweight permits affect cost/benefit analysis?

2.1. Benefits

Rail has several positive characteristics. It is relatively insensitive to weather. Rail can ship large volumes and weights of waste without the need for overweight permits; rail weight allowances are several times that of truck (214,000 pounds per rail car versus 80,000 pounds per truck shipment) (R. Smith).

From these characteristics we have identified potential advantages of shipping by rail.

- Fewer weather delays, avoidance of truck weather delay costs
- Avoidance of overweight permit fees necessary for some truck TRUPACT-III shipments.
- Avoidance of truck operations costs associated with shipping TRUPACT-III.
- Increased waste volume shipments where rail and truck shipping configurations differ. This will occur when truck shipping practices are based on weight to minimize overweight permit fees. This later shipping end date for truck will result in time and cost saving for rail.

There are also less well-defined benefits in human and environmental risk reduction. By accelerating waste shipments, the possibility of exposure at generator sites will be decreased. However, these risk benefits were not considered in the model.

2.2. Costs

Major costs were identified from RSI document Rail Draft (Prather-Stroud, RSI).

- Site changes to accept rail
    - Potential additional costs to accept rail
- Rail transport costs
- Tracking waste en route
- Additional TRUPACT-III
- Transport corridor costs

There are also less well defined costs of increased risk by transporting larger volume of waste in single shipments. However, these risk costs were not considered in the analysis.

2.3. Model Inputs

The spreadsheet allows the user to enter assumptions for the following:

- Choice whether to minimize overweight permit cost function or minimize end date difference between rail and truck
- WIPP throughput
- Truck overweight permitting and TRUPACT-III specific information
    - TRUPACT-III cost
    - TRUPACT-III weight
    - Trailer weight
    - Number of axles on truck trailer combination
    - Feet between axles on trailer

- Inventory shipping combinations
    - Number of 5x5x8 oversize boxes per TRUPACT-III
        - The default number of 5x5x8 boxes is one; user can enter 1.25 to simulate efficiencies that will take into account boxes listed in the generator site inventory range 4x4x7 to 5x5x7.
- Inventory assumptions
    - Drum waste weight (light and heavy)
    - Standard Waste Box (SWB) weight
- Percentage of truck shipping days lost to weather delays
- Rail shipment tracking costs
- State Corridor costs
- Site investment costs to accommodate rail

2.4. Model Outputs

The spreadsheet model solves for the following:

- Individual overweight permit fees (based on "shipping assumptions")
- Overweight permit fee costs functions
- Overweight permit costs for current inventory (based on inventory numbers and weight distribution, and "shipping assumptions")
- The benefit of earlier site shutdown
- The cost of weather delays
- The number of TRUPACT-III needed for rail and truck
- The cost of TRUPACT-III fleet per site necessary for rail above those necessary for truck
- Shipping time and costs under different shipping configurations
- Total rail shipping costs (based on rail quotes and inventory reported)
- Total life cycle costs

2.5. Underlying assumptions

2.5.1. Model assumptions

The following general assumptions were made:

- The time value of money and monetary risk discounting were not accounted for in this model; as a result costs and benefits will not reflect inflation nor risks.
- Depreciation of property plant and equipment were not considered in the model.
- Key assumption: TRUPACT-III acceptance rate at WIPP will be based on the TRUPACT-II acceptance rate (equated on potential packaging volume basis).
    - The time averaged rail and truck TRUPACT-III shipments are both set to maximum WIPP throughput.
- Only CH TRU waste will be considered in this model.
- Criticality, decay heat and gas generation were not considered in packaging configurations or volume.
- Assume that existing oversized box inventory will not be repackaged; this will (1) avoid repackaging costs, and (2) necessitate some overweight permit fees for boxes.
- DOE projected weekly site shipment schedule.

- Model shipments will be based on the size, number of packagings and weight of packagings, not volume. Comparable DOE and Westinghouse models have used a volume basis.
- Waste will not be a limiting factor; waste will be characterized and always ready to ship.
- Trucks and rail cars will always be available.
- TRUPACT-III will be built.
    - Assume that the TRUPACT-III design will be shippable by rail or truck.
    - Assume that packaging maintenance will be the same between truck and rail.
    - Assume that TRUPACT-III will be designated as a non-reducible packaging according to federal and state highway regulations.
    - Assume that TRUPACT-III will be loaded so that "full capacity of the cask can be used"; the full capacity may be overweight.
        - Assume that overweight permits will be granted, when necessary.
    - Assume that the TRUPACT-III will not need an overweight permit for empty transport.
    - Assume that over**size** permits will not be necessary.
    - Assume that states that need the number of axles for overweight permit fee determination following the same methodology for determining the number of axles.
- Rail is not affected by weather.

2.5.2. Packaging parameters and assumptions

Only the TRUPACT-III packaging was considered. Although the packaging design is independent of rail, it will influence the rail cost/benefit analysis outcome by influencing the truck baseline costs.

Earlier analyses have indicated potential benefits gained by shipping waste in larger packaging (Westinghouse TRU Solutions. TRUPACT-III Trade Study Summary Report. Revision 0, July 2001). The DOE currently has an RFP out for the design and manufacture of the TRUPACT-III. The TN GEMINI is a potential solution for the TRUPACT-III design (TRUPACT-III Trade Study Summary Report), the actual design is yet undetermined. The final dimensions and weight of the packaging will influence the volume and weight of waste that can be shipped. The weight restrictions and overweight permitting costs will be most limiting for truck.

2.5.2.1. TRUPACT-III weight, trailer weight and shipping configurations based on weight

In most states, truck shipments over 80000 pounds Gross Vehicle Weight (GVW) require overweight permits (see appendix A for individual state limits). The ultimate weight of the TRUPACT-III and the trailer choice will determine if overweight permits will be necessary for full and empty loads when shipping by truck. Although we are making the assumption that the return trip of an empty TRUPACT-III to a generator site will not be overweight, in reality the design and trailer choice could change this assumption.

A realistic range for the weight of an empty TRUPACT-III is 50000 to 65000 pounds (Johnson, R.). It is important to note that this is preliminary information. This is based on (1) the weight of a potential solution to the TRUPACT-III design, and (2) parameters for truck transport.

The TN GEMINI packaging (a French designed packaging certified by the International Atomic Energy Agency (IAEA)) may be a potential solution for the TRUPACT-III design. An empty TN GEMINI, as currently designed, weighs approximately 53500 pounds (K.Jackson).

Truck transport parameters result in an upper limit of 56000 pounds for the empty TRUPACT-III packaging. These parameters are (1) a relatively lightweight truck and trailer combination of 24000 pounds, and (2) states overweight permit limit of 80000 pound (R. Johnson).

A realistic model default weight for the TRUPACT-III is 53500 pounds. It is important to note that if the weight of the empty TRUPACT-III is over 56000 pounds (with an assumed truck trailer weight of 24000 pounds) that overweight permit fees will also be assessed for return empty shipments. The model limits the TRUPACT-III weight range to 50000 to 56000 pounds to avoid overweight permit fees for the return trip empty TRUPACT-III. This assumption will save significant overweight permit fees.

Using the default of 53000 pounds and 24000 pounds, 3000 pounds of waste can be shipped without paying overweight permit fees.

The TN GEMINI is engineering limited to 66000 pounds. Based on 53500 pounds per TN GEMINI TRUPACT-III, shipments are weight limited to a maximum of 12500 pounds. The overweight permit weight limit for internal waste and packaging may be less than 12500 pounds (based on TRUPACT-III and trailer weight).

Table 1: Overweight permit limit rules

	Total weight (lbs) (packaging + waste)	Internal packaging + waste weight (lbs)
State overweight limit ** based on: 53500 lbs TRU-III packaging weight 24000 lbs truck + trailer combo 80000 lb state limit	56000	3000 (may be exceeded by paying overweight permit fees)
TRU-III engineering limit	66000	12500 (may not be exceeded)

Shipping configuration and practices can be based on weight parameters. One truck shipping practices could minimize shipment weight to remain under the state highway weight limit.

Oversize boxes

One unit is the least number of oversize boxes that can be shipped per TRUPACT-III. If a shipment of one oversize box is overweight, DOE will have to pay overweight permit fees due to the assumption of no repacking.

If one box per TRUPACT-III is underweight, then DOE may be able to ship additional boxes per TRUPACT-III. Boxes in the 4x4x7 size category may also be configured two to a shipment (based on dimension constraints, section 2.1.3) and still be within weight limits. The number of large boxes (5x5x8 boxes and boxes greater than 5x5x8) per TRUPACT-III may not be increased due to dimension constraints.

Standard Waste Boxes (SWB)
The weight of SWB is weight managed to average between 1800-2000 pounds (waste + box) (G. O'Leary). These weights managed SWB's are not filled to volume capacity. Following overweight permit minimization guidelines; one or two SWB's can be shipped in a TRUPACT-III, depending on the weight of the TRUPACT-III and trailer. This is less than the dimension maximum of six SWB's per TRUPACT-III (section 2.1.3). For example, if the overweight cutoff limit is 3000 pounds then only one SWB will be able to be shipped underweight. However, if the overweight cutoff limit is 4000 pounds then two SWB's can be shipped underweight.

Drums
Drum weights are centered around two average weights: approximately 300 pounds and 750 pounds (P.Gregory). There are two basic waste mix types: lighter drums are filled with debris, paper, rags and plastic, and heavier drums are filled with cement and sludge (P. Gregory).

Inventory
Waste inventory data came from the National TRU Waste Management Plan, Corporate Board Annual Report. US Department of Energy – Carlsbad Field Office, Revision 3, July 2002. Joe Harvill provided additional information on the number of boxes and forms of waste at each site (TRUWASTE Inventories 2001 Spreadsheet *information signup adj04232002.xls* from Joe Harvill, Westinghouse-CBFO). This data can be found in appendix B.

Two types of oversize box inventory data were used in this model: size distribution, and weight distribution. Weight distribution data was only provided for two sites in the study: Idaho and RFETS, approximately 90-95% of the total number of oversize boxes are categorized by weight (J. Harvill). This highlights a difference within the inventory data; the size inventory list of oversize boxes is a more complete inventory listing than the inventory list of weight distribution. This will affect some numbers in the model when the inventory data from the two sources is used; a percentage conversion was used to equilibrate the inventory between the two data sources.

Oversize box weight distribution data for Hanford and Savannah was unknown. The weight distribution for these two sites was approximated through an assumption that a certain percentage of the oversize boxes are below 3000 pounds. This was based on the fact that 81% of Idaho and 85% of Rocky Flats oversize box inventory was below 3000 pounds. 70% of Hanford and 80% of Savannah's oversize boxes were assumed to be below 3000 pounds; Hanford's percentage was lower due to the greater number of midrange sized oversize boxes (table 2). Hanford and Savannah oversize box totals were taken from the size distribution data.

Table 2: Number of oversized containers

Number of oversized containers				
File source information: oversizeest.xls (J.Harvill)				
Site	Number of Large Containers	% of boxes 4x4x7	% of boxes between 4x4x7 and 5x5x8	% of boxes very large boxes
INEEL	11,836	87%	11%	3%
RFETS	33	91%	9%	0%
HANFORD	644	17%	83%	0%
SRS	1,075	94%	6%	0%

2.5.2.2.TRUPACT-III: non-divisible packaging efficiency assumptions

Packaging efficiency and volume management are based on (1) that the TRUPACT-III is a non-divisible packaging, and (2) that we will be able to pack the TRUPACT-III to capacity.

Reducible loads (also known as divisible loads) are defined as loads that can be reduced (have items removed from the shipment) to decrease their weight. Non-reducible loads are those that can not be reduced to decrease their weight. Different rules govern reducible and non-reducible shipments; typically states do not allow overweight permits for reducible loads (see appendix A for individual state rules). TRUPACT-II's are currently considered reducible and their number and internal packagings must be managed to stay within the overweight limit; if a second TRUPACT-II would increase the shipment weight above the overweight limit, the second TRUPACT-II must be removed (G.E. Maring, March 12, 2002 letter). To solve this, TRUPACT-II's have been underpacked and the Half-Pact was introduced. TRUPACT-III's are by design, non-divisible. This is key to shipping management.

This model assumes that the Office of Freight Management and Operations will allow DOE to fill the TRUPACT-III to capacity. This is based on the March 12, 2002 letter from Director of Office of Freight Management and Operations (G.E. Maring) to the Deputy Assistant Secretary for Integration and Disposition, Office of Environmental Management (D.G. Huizenga).

> One of the first activities of the task force was to seek an indication from FHWA that a single cask transporting nuclear waste would be considered a non-divisible load, **so that the full capacity of the cask could be used** *(emphasis added)*. The FHWA issued such a policy statement in a November 13, 1987 letter from the Associate Administrator for Motor Carriers (R.P. Landis), to the DOE Office of Civilian Radioactive Waste Management (Mr. Edwin Wilmot). The 1987 statement is the basis for the language that appears in 23 CFR 658.5 today.

This language allows DOE to fill the TRUPACT-III to capacity and obtain overweight truck shipping permits.

2.5.2.3.TRUPACT-III dimensions and shipping configurations

As a default, the model bases the TRUPACT-III dimensions and shipping configuration on the TN GEMINI. The design is a rectangular, single package with an internal cavity of 6.0 x 6.5 x 14.8 (TRUPACT-III Trade Study Summary Report).

Oversize permits are assumed not to be a factor based on the TN GEMINI external dimensions and a cursory investigation of state limits.

Various TRUPACT-III packing configurations are possible. Shipping configurations were considered within a waste box type, e.g. configurations did not consider shipping a waste box with drums.

Oversized boxes

Based on TN GEMINI dimensions, two boxes up to 5.5 x 5.5 x 7 feet can be shipped per TRUPACT-III (TRUPACT-III Trade Study Summary Report).

The inventory is listed in categories up to 4x4x7, 4x4x7 to 5x5x8, and greater than 5x5x8. Oversize boxes up to 4x4x7 were considered to be shippable two to a container.

Using a shipping configuration of one box for the category 4x4x7 to 5x5x8 may slightly overestimate the number of shipments and cost. This is due to the assumption that some of the boxes in this category are below 5x5x7, and that these boxes can be mixed and matched. Following this logic, the ability to select greater than one for shipping efficiencies was built into the model. For example, 1.25 oversize boxes may be considered a shipping configuration for the boxes in the category 4x4x7 to 5x5x8 to capture this efficiency. This is reflected in the title "shipping less than two 5x5x8". However, to simplify the model, only the shipping configuration of one 5x5x8 box was assumed.

Only one oversize box larger than 5x5x8 may be shipped per TRUPACT-III.

Table 3: Shipping configurations based on dimensions

	Size		
	Less than 4x4x8	Less than 5x5x8	Greater than 5x5x8
Number of oversize boxes per TRUPACT-III	2	1 (can also be	1

		varied for efficiencies, e.g. 1.2)	

Standard waste boxes
The size of a standard waste box (SWB) is approximately 3.5x h3x 6 ft with rounded corners (D.Moody). Based on volume configurations, six SWB can be shipped per TRUPACT-III (M. Italiano).

Drums
The existing TN GEMINI dimensions were used to determine drum shipping configurations. The configurations differ in the number of drums and the amount of time necessary to load (drum packages take less time to load than individual drums).

Packaging Configuration 1: 40 drums loaded individually
Packaging Configuration 2: 28 drums loaded in 4 packs of 7 drums
Packaging Configuration 3: 33 drums loaded in 11 packs of 3 drums

It is important to note that the heavy weight drums will be weight limited by the TRUPACT-III engineering specifications. The 66000 pound engineering weight limit for a TN GEMINI of 53500 pounds is 12500 pounds for waste and internal packaging. Only sixteen heavy drums of 750 pounds each will be able to be shipped per TRUPACT-III.

3. Rail Benefits and costs

3.1. Rail Benefit: Rail's increased weight shipments, when truck shipment management minimizes weight

3.1.1. TRUPACT-III throughput

TRUPACT-II and TRUPACT-III volumes were used to equate the packaging throughput at WIPP. The current WIPP total throughput capacity is 100 TRUPACT-II's per week. The TRUPACT-II volume was 2.47 m^3 (85% of potential shipping volume) and the TRUPACT-III maximum volume was 8.32 m^3 (from the largest shippable volume possible, 40 drums) (table 4).

****It is important to note that the TRUPACT-III volume capacity used in this model has been revised down from that used in previous models. This is due to DOE's TRUPACT-III design decision. Earlier models assumed two 5x5x8 boxes per TRUPACT-III. The TRUPACT-III design choice (TN GEMINI) can only house two 4x4x7 oversize boxes. This volume change increases the number of TRUPACT-III's necessary from earlier model results.**

Table 4: Maximum volume shippable in a TRUPACT-III TN GEMINI

	Oversize box	Oversize box	Drums
	Less than 4x4x7	Less than 5x5x8	
Number per TRUPACT-III	2	1	40
Shippable Volume per TRUPACT-III (m^3)	6.3	5.7	8.32

DOE gave the default weekly TRUPACT-II schedule. The TRUPACT-III equivalents per week per site are shown in table 5.

Table 5: Projected DOE weekly shipping schedule by TRU-II or TRU-III

WIPP Throughput	Hanford	INEEL	RFETS	SRS	LANL	Total
Shipments per Week	2	17	10	2	2	31
TRUPACT-II per Week (default)	**6**	**51**	**30**	**6**	**6**	**93**
Cubic Meters per Week	15.8	134.1	78.9	15.8	15.8	244.53
TRUPACT-III per Week Reqd. for Same Throughput	**1.9**	**16.1**	**9.5**	**1.9**	**1.9**	**29.4**

Both truck and rail TRUPACT-III shipments are based on WIPP throughput. When shipping the same volume and weight configurations by rail and truck, both shipment methods will end on the same date. Although rail CAN ship greater weight, the common TRUPACT-III packaging between rail and truck removes this benefit.

Table 6: Unused rail weight capacity

Unused rail weight capacity	
Given weight of TRU-III	53500 lbs
Given number of TRU-III per car	3
Total calculated packaging weight (without waste and internal packaging)	160500 lbs
Total given rail weight limit per car (R.Smith)	214000 lbs
Total calculated waste weight per car	53500 lbs
Total calculated waste weight per TRU-III	17833 lbs
Total given waste weight per TRU-III	12500 lbs
Percentage of unused rail capacity weight due to TRU-III engineering specifications	30%
Note: Allowable rail waste weight is greater than engineering specified waste weight limit	

Although rail CAN ship more volume in a given amount of time by adding additional cars to a shipment, it is limited by the TRUPACT-III fleet size and WIPP throughput. If WIPP throughput of TRUPACT-III's is increased then more TRUPACT-III could be fabricated to realize rail's great shipping capacity. (Note: under an increased WIPP throughput scenario truck could also realize greater shipping capacity with further capital expenditure costs.)

Rail can realize a time benefit when truck shipping practices reduce shipment weight (and resulting volume) to minimize overweight permit fees. Under this practice truck shipping configurations will switch from volume management by dimensions (section 2.1.3) to weight management (section 2.1.1).

3.1.2. Volume/weight shipment advantage dollar conversion

The sites yearly budgets were used to convert extra shipping time necessary for truck (when weight minimization practices are used) to dollars. Time savings were converted to dollars by assuming that differences between rail and truck total shipping times would result in earlier site shutdown; an earlier site shutdown would save DOE that site's budget. This is based on the assumption that when the sites have completed waste shipments to WIPP they will have completed their waste operations. Time savings in the form of site shutdown were calculated starting at the site's end date and moving backwards in time. The budgets were not based on the acceleration plan . Site budget savings were prorated. For oversize box inventory, equations were calculated up to and capped at six years. For "all inventory", equations were based on an average yearly budget. The number of years for rail advantage was capped at the number of years the site was open.

3.2. Rail Benefit: Avoidance of Weather Delays

3.2.1. Calculating weather delays

Truck shipments are suspended in bad weather such as fog, high winds, and snow. Actual weather delay data, collected from raw data in shipment logs, was used. Data was from spanned the 2001-2002 winter.

Two sites included in this analysis, INEEL and RFETS, experienced significant weather delays. Shipments were significantly delayed six months out of the year, November through April, and minimally weather delayed in the other six months, May through October. The months with the greatest number of shipments affected by weather were December through February.

Only weather delays for loaded shipments were counted; empty return shipments were assumed not to delay the next cycle. If multiple waste shipments on the same day were delayed due to bad weather on that day, one weather day was counted. Shipping windows were assumed to be in effect, so delays were rounded up to the nearest 24 hour period.

Based on 26 day month (48 shipping weeks per year), the average weather delay over the three month period for INEEL between December and February is 36%. The average weather delay over the 6 month period for INEEL, November through April, is 28%. The percentage will depend on the assumption of the number of shipping days per year.

The spreadsheet analysis converts the percentage of *days* per month affected by weather to the total number of *shipments* affected by weather. The user can enter a different percentage of days lost per year.

3.2.2. Weather delay dollar conversion

Weather delays will affect the generator site, WIPP site, and trucking operations. The weather delays will primarily affect personnel involved in shipment packing and receiving. Delays on the INEEL route will disrupt one team (7 people) at INEEL and 1 team at WIPP (5 people).

DOE pays a truck standby cost per hour of delay. This truck standby cost was calculated on a 24 hour period, following weather delay calculation methodology (delays greater than 4 hours were considered be delayed 24 hours due to shipping windows). The user can enter a different standby cost per hour.

3.3. Rail Benefit: Overweight permit fee avoidance

Waste shipments pass through several states to travel from the waste generator site to the WIPP disposal site. States independently govern waste shipments traveling in their state; each state uses their own method to calculate overweight permit fees and collects these fees independently. Multistate agreements do exist (such as COVE for the Southwestern states) that might result in lower permit processing fees. These multistate permits are typically granted for single use.

The method for assessing overweight permit fees differs between states. Some states use fixed fees for permitting while others use variable fees. These variable fees can be based on the total Gross Vehicle Weight (GVW), overweight tonnage, the distance traveled within the state, or the number of axles in a load. appendix A, table A-1 has an overview of state rules used to assess overweight permit fees. Appendix A contains extensive information state rules on overweight permit calculation. Annual and fleet permits are available for some states.

The oversize box inventory fee calculations use different site cost functions. These cost functions are derived from the actual permit fee information summarized in the table "overweight permit fees for waste at certain weights" and will change based on the user's shipping assumptions. This is possible due to the linear nature of the cost functions. The rules used in the spreadsheet to calculate the overweight permit functions are:

(1)Remove all oversize boxes less than the legal weight cutoff limit; cost=0.
(2)Pair remaining oversize boxes in any order. Determine the number of shipments based on the shipping configuration.
(3)Add up total weight of oversize boxes above the permit weight cutoff.

$$\text{Nshipments} = \frac{\text{Nboxes}}{\text{Nboxes per TRU - III}},$$

$$(\text{Nshipments} \times \text{BasePrice}) + (\text{Slope} \times \sum \text{TotalWeight})$$

As a check of the cost functions, the weight distribution inventory for one oversize box per TRUPACT-III was calculated both by the cost function and by the sum of individual boxes shown in table 7.

Table 7: Comparison of direct and cost function fee calculation methods

Overweight permit fees Comparison of cost function to direct calculation				
Oversize box inventory: one oversize box per TRUPACT-III				
	Hanford	**INEEL**	**RFETS**	**SRS**
cost function	$ 88,216	$ 1,023,360	$ 1,155	$ 141,990
direct calculation	$ 74,887	$ 882,093	$ 1,155	$ 130,702

There are some differences. It should be recognized that the overweight permit fee calculations for a given inventory are estimates. Overweight permit costs are knowingly **underestimated** for the following reasons:

- Inventory data omissions; approximately 90%-95% of the oversize box inventory is categorized by weight (J. Harvill).
- Inventory listed as "unknown weight" is not taken into account in the model.
- Inventory listed as "greater than 8000 pounds" is split over 9000, 10000 and 11000 pounds; it is possible that these boxes weigh much more than 9000 to 11000 pounds.

Idaho and Rocky Flats overweight permit fees will both be affected by the discrepancies between the two types of inventory. These inventory discrepancies were "calibrated" by assuming that the number of inventory discrepancy boxes weighed 10000 pounds each. This was an arbitrary calculation as placeholders until better data is available.

To account for errors from assumptions the costs of three cases were calculated: the closest estimate, upper cost boundary upper and lower cost boundary. The upper boundary is calculated assuming one oversize box (true for the 4x4x7, not true for larger than 4x4x8) per TRUPACT-III. This knowingly **overestimates** costs. The lower boundary is calculated by assuming two oversize boxes (not true for 4x4x7, true for larger than 4x4x7 boxes) per TRUPACT-III. This knowingly **underestimates** cost.

The boundary cases were calculated because the correlation of the size of boxes to the weight of boxes wasn't known. This information is necessary to calculate the overweight permit fees. For example, 4x4x7 boxes (shipped two to a TRUPACT-III) could be distributed over the entire weight range (1000 to 8000 pounds) or could be concentrated in the 1000 and 3000 pounds weight range. These different distributions will affect the number of shipments charged overweight permit fees.

3.4. Rail Benefit: Trucking equipment and truck mileage costs avoidance

The current truck cost quotes per mile ranges from a minimum of $5 per mile to $15 per mile depending on the assumptions (M. Italiano, K. Jackson). The avoided mileage based truck costs may be rail benefits. However, some of these costs may be contracted and unavoidable. For example, DOE may want to keep open a trucking option even if all inventory is to be shipped by rail; these option costs should be factored into the analysis and the rail benefit decreased by the option cost. Additionally, some of the costs may be unavoidably locked in by contracts. Future studies should consider which per mileage truck costs are avoidable or unavoidable based on contracts.

Shipping TRUPACT-III by truck will require special trailers. Depending on the TRUPACT-III shipping schedule, the truck trailer equipment may already be purchased before rail starts. In this case the TRUPACT-III truck trailers equipment investments can not be avoided and will be sunk costs. Future rail studies should also consider which costs are unavoidable based on timing.

3.5. Rail Cost: TRUPACT-III packagings

Since rail has longer shipment cycle times than truck, rail will require a larger TRUPACT-III fleet. The TRUPACT-III fleet is directly related to the site shipment schedule and shipment cycle time.

The TRUPACT-IIII fleet size is affected by changes in:

- Shippable TRUPACT-III volume (table 4)
- Total WIPP throughput (table 5)
- DOE projected weekly site shipment schedule (table 5)
- Cycle time

3.6. Rail Cost: Tracking

Tracking device costs will depend on several factors, e.g. if rail cars are humped, the frequency of transmissions, and the energy supply (R. Sanchez). There are two potential companies and a prototype that was used on DOE rail shipments from Mound (RSI rail draft, Prather-Stroud, W.) Testing and development costs will be necessary for products from both companies.

Testing and development costs were allocated based on a site's total TRUPACT-III fleet. Manufacturing costs were based on the number of cars necessary to ship a site's TRUPACT-III fleet. It is important to realize that if sites are omitted from the study or if the DOE projected weekly site shipment schedule changes then this allocation will change. The TRUPACT-III fleet size used to calculate the number of tracking devices included a maintenance contingency of 10%; this built in tracking device maintenance.

Tracking unit fabrication costs have been guesstimated at $5000 to $15000 and up (R.Smith).

3.7. Rail Cost: Infrastructure development

Various generator site and WIPP developments will be necessary to accommodate rail. Not all of these development costs are currently known. For example, the RFETS quote included permitting costs while other sites reported infrastructure costs (RSI rail draft, W. Prather- Stroud). The WIPP infrastructure development costs have not been estimated and as a result require a user assumption.

3.8. Rail Cost: Shipment costs

BNSF rail company provided quotes for shipping waste from the different sites on a per car basis (July 2002 BNSF).

It is not explicitly clear what these costs entail; as a result there may be additional rail costs. For example, it is unknown whether there may be additional rail emergency responder costs. Rail companies have their own emergency responder units to respond to emergencies on their private rail lines.

3.9. Rail Cost: State and Nation payments

Payments to states and nations cover passage rights, responder training to hazardous scenarios and medical facilities in the various states through which generator sites ship to WIPP.

DOE expects minimal additional payments to states and nations for rail passage. This is based on land ownership and routes. The rail companies privately own the railways and passages. The model assumes that the rail companies are responsible for emergency response and will absorb the cost of training their personnel. As a result, no additionally money would be necessary to train state or Indian nation emergency responders on the route to handle rail scenarios (R. Smith).

The Idaho, RFETS, Savannah and Hanford route 1 (UP/BNSF) rail routes closely parallel the existing road routes. As a result, community safety requirements have already been met. On the routes where the rail route closely parallels the current truck route, no additional emergency training would be necessary for medical personnel (R. Smith).

Hanford has two route options; route 1 (UP/BNSF) closely parallels the current truck route while route 2 is a new route. Route 2 may require training and support of new medical personnel and setup of new facilities (R. Smith).

3.10. Hanford rte 1 (UP/BNSF) vs. Hanford rte 2 (BNSF)

There are two rail options from Hanford.

Table 8: Hanford rail route summary differences

	Hanford rte 1	Hanford rte 2
Companies	UP/BNSF	BNSF
Route	Parallels current road route	New route
Distance (in miles, compared to current truck route)	Similar	Longer
Corridor training requirements	Already met	Will need to be met
Rates	Unknown	Quoted
Time	Unknown	Quoted

3.10.1. Hanford rte 1: Rail Costs (switching costs and rail rate per car)

BNSF did not provide rail rates for the route 1 (UP/BNSF). Additional switching costs may be required to transfer the cars between UP and BNSF. User assumptions are required for these shipping and switching rates on route 1.

3.10.2. Hanford rte 1: Cycle Time

We currently do not have a quoted shipment cycle time for route 1. The cycle time is crucial in that it will determine the size of the route's TRUPACT-III fleet. Although the Hanford route 1 is a shorter route (in terms of miles) than Hanford route 2, switching cars between the two companies may make the shipment cycle time longer.

4. Sensitivity

4.1. Overweight permit fees under different truck shipping practices

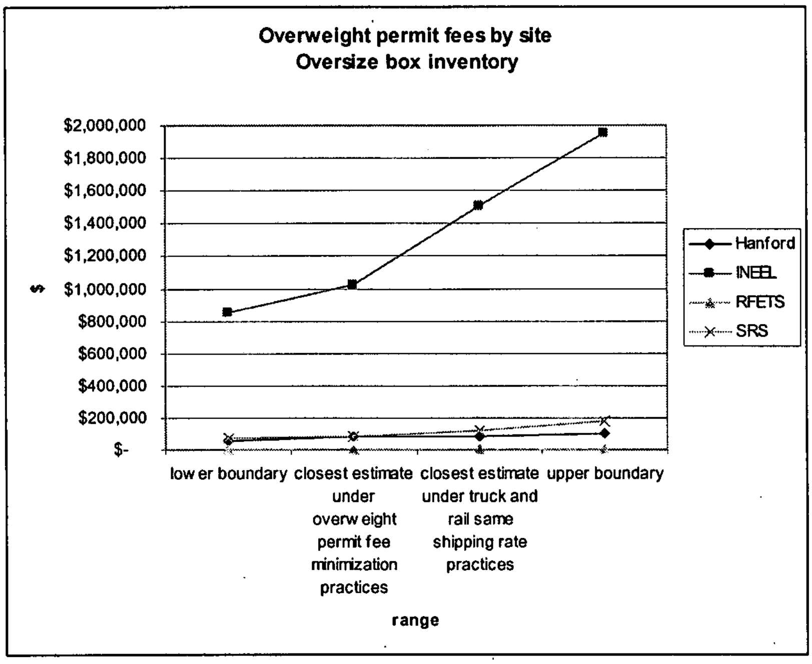
There are two basic truck shipping practices:

- Shipment practice that minimizes site closure time differences between rail and truck shipping.
- Shipment practice that minimizes overweight truck permit fees.

Overweight permit fees were calculated based on current inventory data (appendix B) and user entered trucking assumptions (appendix C, table C-1).

The permit fees will differ depending on the shipping practice. Results are shown in figure 1 and listed in appendix C, table C-2.

Figure 1: Overweight permit fee estimates



Single oversize boxes above the overweight limit cannot be reduced without repackaging. These boxes will be shipped the same under both shipping management practices.

<u>Truck maximizing volume shipping practice (volume based shipping practice):</u> This practice maximizes volume up to the TRUPACT-III engineering specified limit, approximately 12000 pounds. Under this practice, truck will have to pay overweight fees for (1) boxes that can not be reduced (one unit is smallest shippable unit and may be

overweight), and (2) shipment configurations that could be reduced to be underweight (e.g. multiple drums, multiple SWB, and 4x4x7 boxes shipped two to a TRUPACT-III). Truck and rail will use the same shipping configuration under this shipping practice. As a result (1) truck and rail will ship at the same rate, and (2) have the same shipping end date.

Truck overweight permit fee minimization practice (weight-based shipping practice): Shipping to minimize the overweight permit fees (shipping based on weight limits described in section 2.1.1) will adjust internal packaging weight (when possible) to fall below the overweight state limits.

When shipping by truck based on weight limits (overweight permit fee minimization) truck will take more years than rail to ship same the number of waste boxes and volume. This time difference has a cost. Appendix C, table C-3 summarizes the overweight permit savings and site closure differences under weight-based shipping. For example, for INEEL's oversize boxes DOE saves $480k by spending $2.4m in site budget time. It is clear from comparison that it is not time or cost efficient to minimize overweight permits.

One should realize that dollar time savings are estimates because (1) the number of shipments are the best approximation until the weight and size distribution inventory are correlated, (2) time savings are based on budgets and not on actual costs, and (3) budget savings are calculated from the site closing date (a better way would count forward truck shipping years after rail shipment time ends). However, it is questionable if the resources to better calculate the site closure cost savings would be worthwhile since with these crude estimates we are able to conclude that overweight permit fees should not be minimized at the expense of early site shut down.

As a result all examples and sensitivity analyses in the following sections will set the user entered "Minimize overweight permits" to NO.

4.2. Examples: Sensitivity analysis overall rail

Basic assumptions for the model are listed in appendix C, table C-1. Sensitivity analyses were run varying the two listed factors.

Sensitivity analyses:
Rail costs percentage change: 0%, -50%
Truck cost per mile: $5, $15

Results are listed in appendix C, tableC-4 through table C-8, and figures C-1 through C-3.

4.3. Examples: Sensitivity analysis Hanford routes

Basic assumptions for the model are listed in appendix C, table C-1. Sensitivity analyses were run changing the three listed variables.

Sensitivity:
Hanford rte 1 cycle time: 22 days, 13 days
Hanford rte 1 rate per rail car (switching cost + rail rate per car):

$35000/car, $28000/car
Hanford rte 2 yearly training costs: $125000, $300000

Results are listed in appendix C, table C-9 through C-11, and figures C-4 through C-6.

5. Results

Results (based on assumptions listed in appendix C, table C-1) are listed in appendix C, tablesC-4 through C-11 and figures C-1 through C-6. Whether rail is a cost effective depends on assumptions for user entered variables. The sensitivity analyses show that the truck cost per mile turns is the primary driver of the rail cost-benefit analysis.

For all sites, rail **is not** cost effective when the truck cost is $5 per mile. For most sites, rail **is** cost effective when the truck cost is $15 per mile.

Table 9: Rail Benefit (Oversize box inventory)

	Hanford	INEEL	RFETS	SRS
Truck cost: $5 per mile	No	No	No	No
Truck cost: $15 per mile	Yes	Yes	No	Yes

The following discussion investigates how user inputted values for the major variables affect rail's cost effectiveness.

5.1. Major Rail Costs

The two major rail costs are TRUPACT-III costs and rail shipping costs. This can be seen in the cost graph (appendix C, fig C-1A and C-2A) (supporting data in appendix C, table C-5), and the percentages from the sensitivity analyses (table C-8 cost output columns, and sum of cost output). TRUPACT-III costs and rail shipping costs together total 84% to 99% of the total costs (depending on the sensitivity analysis and the site). TRUPACT-III costs are affected by the rail cycle times; a percentage increase or decrease in the cycle time will change the number of TRUPACT-III for a required WIPP throughput.

5.2. Major Rail Benefits (Truck costs)

The major rail benefit is the avoidance of truck costs. This can be seen in the benefit graph (appendix C, fig C-1B and C-2B) (supporting data in appendix C, table C-5), and the percentages from the sensitivity analyses (table C-8 benefit output columns). This major benefit is 92% to 99% of the total benefits (depending on the sensitivity analysis value assumptions and the site).

5.3. Major Cost-Benefit breakeven drivers

Truck costs per mile is the most important user entered assumption. For Hanford, INEEL, and SRS the rail breakeven point falls within the range of assumptions ($5 per mile to $15 per mile). Rail breakeven based on truck cost per mile is listed in table 10.

Table 10: Rail breakeven point based on truck costs (Oversize box inventory)

truck cost per mile breakeven point with present assumptions	Hanford	INEEL	RFETS	SRS
rail breakeven (truck $/mile costs)	$8.17	$8.18	$976.30	$10.62

The rail breakeven point was also calculated for the other two major variables, rail costs and rail cycle days. These breakeven points were calculated at $5 per mile truck costs (rail is positive at $15 per mile).

Table 11: Rail breakeven point based on percentage change in rail cost per car (Oversize box inventory)

rail cost per car breakeven point with present assumptions	Hanford	INEEL	RFETS	SRS
rail breakeven $5 (rail cost per car)	-67%	-64%	-26037%	-111%

Table 12: Rail breakeven point based on percentage change in rail cycle days (TRUPACT-III costs) (Oversize box inventory)

rail cycle breakeven point with present assumptions	Hanford	INEEL	RFETS	SRS
rail breakeven $5 (cycle time changes)	-62%	-56%	-60%	-71%

At $5 per mile truck costs, it is unlikely that DOE would be able to negotiate the aggressive decreases (more than a 50% decrease) in rail rates or rail cycle times to make rail cost effective.

5.4. WIPP throughput changes

Changing WIPP throughput has several effects.

- Rail costs increase due to TRUPACT-III fleet size increases.
  - Although the TRUPACT-III fleet size increases for both rail and truck, rail increases faster.
- The total number of shipping years decreases. **However, since shipping years decreases for both rail and truck, this decrease is not realized as a rail benefit because it is not unique to rail.**
- Rail benefits decrease. Since truck would also benefit from this increased WIPP throughput, truck would ship for fewer years which would decrease the total truck weather costs (weather costs are on a per year basis).

DOE benefits from increasing the WIPP throughput. Although rail is limited by WIPP throughput, increasing the WIPP throughput does not make rail cost effective.

5.5. Hanford routes

The summary of the Hanford route differences can be found in appendix C, table C-9.

Under the assumptions given (found in appendix C, table C-1 and appendix C, table C-9) Hanford rte 1 is more expensive. However, the Hanford route 1 net cost will depend on the user entered values.

The Hanford breakeven point is based on user entered values for three variables:

- Route 1 rail cost per car (switching fees plus rail rates)
- Route 2 yearly transport corridor costs
- Route 1 cycle time (affects TRUPACT-III fleet size necessary to be built for the routes)
    - If the time for the Hanford route 1 (UP/BNSF) is longer than the route 2 BNSF route, then more TRU-III will be required for the same throughput. This will increase the cost of route 1. Alternatively if route 1 cycle time is less than that of route 2 BNSF, then fewer TRU-III will be necessary.

The breakeven point can be calculated using the following equation:

$$y=63.7\, x_1 - 1.9\, x_2 + 0.33\, x_3 - 1719663$$

where x_1 is the user entered value for route 1 rate per railcar
x_2 is the user entered route 2 yearly passage costs to states and nations
x_3 is the TRUPACT-III cost difference between the routes
(The TRUPACT-III can be changed by altering the cycle time for route 1 on the worksheet *user input*; the difference is calculated in worksheet *Hanford rte summary*. The relationship between route 1 cycle time and the TRUPACT-III cost difference is shown in appendix C table C-5)

The derivation of the above equation can be found in appendix C, table C-11.
**It is important to note that the above equation only holds for the assumptions found in appendix C, table C-1. If any of these assumptions are changed then the individual and combined cost equations need to be recalculated.

Whether Hanford route 1 (UP/BNSF) is more or less expensive than Hanford route 2 (BNSF) depends on the user entered values for the three main variables. Route 1's breakeven point can be determined when two of the three variables are known. Realistic assumptions in the sensitivity analysis suggest that route 1 will be more expensive than route 2. In the cases in which route 1 has a longer cycle time than route 2, route 1 is more expensive. As an example, route 1 breakeven point for the variable rail cost per car is $32726, using a route 1 cycle time of 13 days (less than route 2 cycle time of 14 days), route 2 yearly payments to state/nations of $125,000.

5.6. Acceleration plan

The time to ship waste by rail (appendix C, table C-4) is compared to the acceleration plan time frame (appendix C, figure C-7). Acceleration plan time frame supplied by J. Winkel. This comparison shows that the time necessary to ship oversize boxes is within the acceleration plan time frame. However, the time necessary to ship all inventory by rail in TRUPACT-III's is greater than the acceleration plan time frame.

The end dates in this model for shipping "all inventory" differ from those calculated by Westinghouse. This difference may be due to:

- Package options; the acceleration model uses TRUPACT-II, Half-Pact and TRUPACT-III.
- Shipping configuration; the acceleration model could assume that the extra space in TRUPACT-III shipments of one oversize box is filled with drums.
- The acceleration model could be using a smaller volume based on future start date.
- Volume versus number of boxes; this model calculates the number of shipments based on the number of boxes.
- The acceleration plan may assume repackaging.

6. Conclusions and Recommendations

6.1. Conclusions

- DOE should not try to minimize truck overweight permit costs at the expense of keeping sites open longer. The shipping management should load each TRUPACT-III to volume capacity.
- The net rail benefit hinges on the truck cost per mile assumption.
- If truck costs are $15 per mile, rail is cost effective for Hanford, INEEL and SRS.
- If truck costs are $5 per mile, rail is not cost effective. Aggressive negotiations would need to decrease the rail cost per car or cycle time by more than 50% to make rail cost effective.
- Ignoring costs, rail can ship the current oversize box inventory by rail within the acceleration plan time frame.
- Rail cannot ship drums and SWB within the acceleration time frame by TRUPACT-III.
- Increasing WIPP throughput decreases the rail benefit due to additional TRUPACT-III costs and loss of weather benefit by shorter truck shipping years.
- Rail is more cost effective the further the site has to ship.
- The TRUPACT-III rail fleet calculated in this model is larger than that calculated in the previous RSI model. To equal the volume of a WIPP throughput of 93 TRUPACT-II per week, the previous RSI model concluded that a rail fleet of 63 TRUPACT-III was necessary. The current model concludes that a rail fleet of 72 TRUPACT-III will be necessary. The change in the TRUPACT-III fleet size results from a change in the shippable volume (all other assumptions remain the same). The shippable volume was decreased in this model (from 11.40 m^3 to 8.32 m^3) to reflect DOE's design selection for the TRUPACT-III, the TN GEMINI.

<u>Hanford conclusions:</u>

- The results from the sensitivity analyses suggest that shipping waste by Hanford route 1 will be more expensive.

6.2. Recommendations

6.2.1. Data needs

6.2.1.1.Inventory needs

- More exact basic site waste inventory information should be used in this model. This includes:
  - Oversize box weight distribution for Savannah River and Hanford.
  - Number of drums for Rocky Flats.

- One of the future efforts should be tailor future inventory data collection to facilitate a more exact calculation of overweight permit fees for oversize boxes. This would require collecting information on the number of boxes in a certain weight and class size for all sites. By having this data correlated (size and weight) overweight permits could be determined with greater precision..

- Box size category: TN GEMINI can hold two 5x5x7; however, the oversize box data is listed by 5x5x8. This discontinuity will affect the number of shipments and the closing time of various sites. Knowing the number of boxes in the 4x4x7 to 5x5x8 size category that are actually less than 5x5x7 will yield a more exact result.

6.2.1.2.Other data needs

User entered values and assumptions should be investigated in the future. More exact numbers (for many of these variables arbitrary choices were made) should be sought. These variables include:

- Truck costs.
- Tracking.
- State costs for routes that parallel the truck route.
- State costs for Hanford rte 2 (that is a new route).
- Hanford rte 1: cycle time and shipping costs.
- Any other costs that rail companies would assess.

6.2.2. Future Studies

- To further support the acceleration plan, future studies could change the WIPP throughput and number of TRUPACT-III to support the acceleration plan by rail for all of the inventory.
- Additional overweight permit fee savings may be possible by permitting through interstate agencies. Multistate agreements and permitting agencies do exist (such as COVE for the Southwestern states) that might result in lower permit processing fees. These multistate permits are typically granted for single use.
- Other packaging types by rail.
- Trailer weight for TRUPACT-III. The assumption that the trailer plus empty TRUPACT-III would not be overweight may not be valid. A separate study could investigate (using this model) the overweight permit costs of shipping empty TRUPACT-III. This model can currently calculate single shipment overweight permit fees; the model can be adapted to calculate the total costs of empty overweight permit based on the number of shipments a given inventory.

- Some contributors have voiced concern of the risk of a rail accident. An accident may compromise the TRUPACT-III fleet. The risk, probability and costs should be investigated. If this is factored in then this may affect rail costs.
- There should be an investigation into the timing of unexpected delays (outside of the regular rail cycle time) and how this may impact the allowable waste shipment of 60 days. This risk can be translated in the risk of WIPP losing permit and the cost of reapplying for permits or facilitating rail shipments that are delayed to stay within the time allotment.
- The time value of money is important in any financial analysis. It was not considered in this model; it should be considered in a future model.

7. Acknowledgments

This analysis would not have been possible without the contributions and feedback made by Marc Italiano and Ralph Smith of DOE, Wren Prather-Stroud of RSI, Dave Moody, Sheila Lott and Stephanie Jennings of LANL-CO, Phil Gregory, Kim Jackson, Joe Harvill and Jeff Winkel of TRU Solutions.

8. References

Personal Communication

Gregory, P., Westinghouse, June 2002.
Italiano, M. September 2002
Jackson, K. September 2002
Johnson. R., Email communication August 7, 2002.
Moody, D., LANL, August 2002.
O'Leary,G., Rocky Flats, September, 2002
Smith, R., DOE, July 2002
Winkel, J. September 2002

Spreadsheet data

Burlington Northern Santa Fe Railway Company, April 2001, (Response to) WIPP Request for Information: Contact Handled Transuranic Waste

Westinghouse TRU Solutions, LLC, April 2001-April 2002 Shipment Delay Log; Carriers: CAST and TRI-State maintained by Angela Johnson.

TRUWASTE Inventories 2001 Spreadsheet information signup adj04232002 maintained by Joe Harvill, Westinghouse-CBFO.

Number of and volume in oversize packages
OVERSIZEEST.xls maintained by Joe Harvill, Westinghouse-CBFO.

Weight distribution of oversize packages
INEELNONOVERP.xls maintained by Joe Harvill, Westinghouse-CBFO.
RFETSOVERSIZE.xls maintained by Joe Harvill, Westinghouse-CBFO.

Rand McNally state road map and distances.

Other resources

Maring, G.E. Office of Freight Management and Operations. Letter to the Deputy Assistant Secretary for Integration and Disposition, Office of Environmental Management (D.G. Huizenga). March 12, 2002.

Prather-Stroud, Wren. Rail Draft. Institute of Regulatory Sciences. Draft June 7, 2002.

Westinghouse TRU Solutions, LLC, July 2001, TRUPACT-III Trade Study Summary Report, Revision 0

Westinghouse TRU Solutions, LLC, April 2000, TRUPACT-II Authorized Methods for Payload Control (TRAMPAC)

U.S. Department of Energy, December 1995, CH-TRU Waste Packaging Optimization Report, Revision 1

US Department of Energy– Carlsbad Field Office. National TRU Waste Management Plan, Corporate Board Annual Report. Revision 3, July 2002 (DOE/NTP-96-1204).

Overweight permit information

Alabama (334)834-1092

Alabama DOT rules and regulations section 32-9-29 code of Alabama (1975) revised august 1, 1981

Chapter 9 Trucks, Trailers and semitrailers

Colorado (303)757-9539

Legal Vehicle Weight Limits (CDOT FYI 2)

Permit fees for vehicles that exceed legal weight limitations (CRS 42-4-510(11))

Georgia (404)635-8529

Idaho (208) 334-8420

Idaho Overlegal Permits Tax rate charts Sep 30, 1999 (Revised Oct 6, 1999)

http://www2.state.id.us/adm/adminrules/rules/idapa39/39index.htm

Louisiana (225)343-2345

Overweight Permit Fee Schedules One through Three

Mississippi (601)359-1717, (888)737-0061

MDOT "super load" rules and regulations

Blanket permit rules and procedures

New Mexico (505)827-0376

Oregon: Overweight (503)373-0000

Reducible (503) 378-6699

Oregon Department of Transportation, Motor Carrier Transportation Division: Mileage Tax rate Tables A&B(Effective September 1,2000)

Oregon Road Use Assessment Fees- Cents per mile table (effective Jan 1, 1996)

http://www.odot.state.or.us/trucking/

South Carolina (803)253-6250

Texas (800)299-1700

Utah (801)965-4508

Fee Table for Non-divisible loads exceeding 125,000 lbs

Washington (360)704-6340

Washington State Commercial Vehicle Guide 2002-2003

Permits for Oversize/Overweight Motor Vehicles, Overweight Fee Schedule (Effective July 23, 1995) (RCW 46.44.041)

Wyoming (307)777-4376

WYDOT Overweight Loads Gross Weight Table I and II

Appendices

Appendix A: Individual State Rules and Fees for Overweight Shipments

It is important to note that the information included in this appendix should be checked with a trucking permitting agent or someone intimately familiar with the state permits. The following information is provided as a first rough estimate of overweight costs.

The main routes from the generator sites to WIPP are displayed in figure below. These routes were used to find approximate state mileages on Rand McNally maps.

Figure A-1: Open TRU Waste shipping routes from Generator sites
(adapted from National TRU Waste Management Plan)

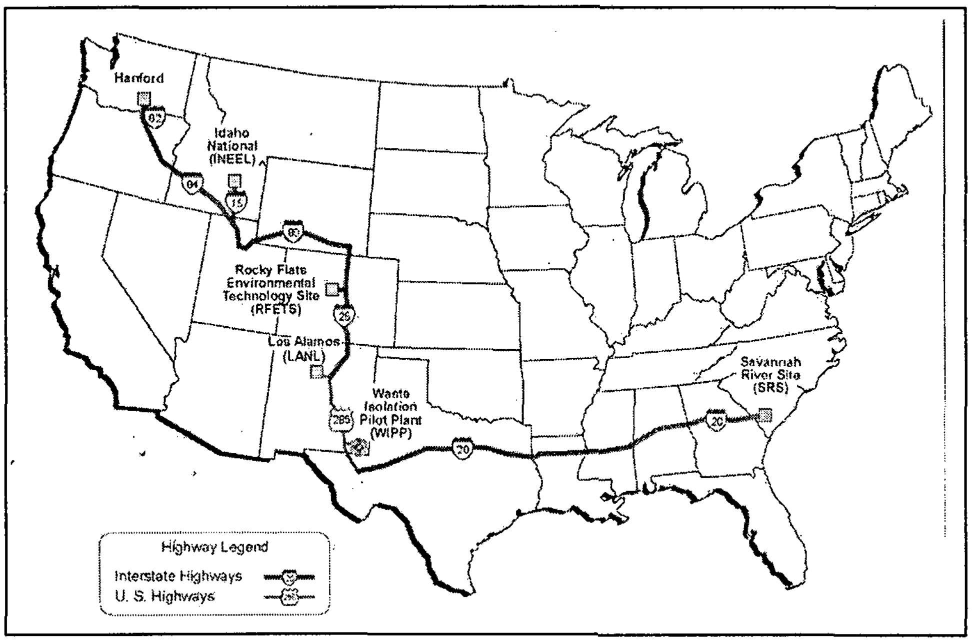


Table A-1: Approximate distance from generator sites to WIPP

	Hanford	INEEL	RFETS	SRS
	rte 2: BNSF			
Miles one way to WIPP	1808	1392	794	1540

Table A-2: Overview of overweight permit rules and fees by state

Overweight permits

		single trip permits				annual permit for non-reducible		
	weight	cost						
state	legal weight basis	fixed portion	variable portion basis	Are fees variable on mileage?	approximate miles (mi)	annual permit	weight parameters (pounds)	cost
Alabama	80000 pounds	fixed within weight class	based on weight class: <100000 pounds fee is $10; 100000-125000 pounds fee is $30; 125000-150000 pounds fee is $60; >150000 pounds fee is $100	NO	---	YES	100000-150000	$100
Colorado	80000 pounds	<200000 pounds fee is $15	fixed $15 + $5 per axle	NO	---	YES	<200000 depends on rte & *structures*	$400 (no *additional costs)*
Georgia	80000 pounds	fixed within weight class	based on weight class: <150000, $30; 150000-180000 $125, >180000 $500	NO	---	YES	<100000	$150, $500 depending on size
Idaho	80000 pounds	$18	fixed $18 + variable mileage fees based on GVW and num. axles (see chart)	YES	Hanford rte 288, INEEL rte 120	YES	<200000	fixed $43 + variable mileage
Lousiana	80000 pounds	NO FIXED PORTION	variable use fee rate changes with *mileage* and GVW(see chart)	YES	185	YES	<120000	$2500 (all inclusive)
Mississippi	80000 pounds	NO FIXED PORTION	Variable use rate is constant: $0.05/thousand #'s * miles	YES	150	NO		
New Mexico	80000 pounds	$15	NO	NO		YES	<140000	$60
Oregon	80000 pounds	$8 (may increase depending on route)	variable use fee rate for distance changes based on GVW and num. axles(see chart)	YES	208	YES	<98000	same as single
South Carolina	80000 pounds	< 130000 pounds, fee is $30	>130000: $100 + $3 for every 1000 pounds above 130000 pounds	NO	---	YES	<90000 on 5 axles	$100
Texas	*80000 pounds*	fixed within weight class	80000-120000 $80, 120000-160000 $105, *160000-200000 $130, >200000 $190*	NO	---	YES	80000-120000	$2,000
Utah	80000 pounds	<125000 pounds fee is $50	>125000, fee based on weight and mileage class	YES	124	YES, various options available	<125000	$450
Washington	based on axle spacing, tire size and # of axles	NO FIXED PORTION	variable use fee rate for distance is based *on excess weight*	YES	36	NO	---	---
Wyoming	based on axle spacing, tire size and # of axles	NO FIXED PORTION	Variable use fee rate for distance is constant: $0.04/excess ton/mile	YES	367	NO	---	---

NOTE: Information in this table should be confirmed with professional permitting agents; information is provided for planning purposes only.
Information current as of August 2002

Alabama

The Alabama DOT makes a distinction between divisible and non-divisible loads. Overweight single-trip permit fees for non-divisible loads vary depending on the weight class of the shipment; shipments from 80,001 pounds to 100,000 pounds cost $10.00; shipments from 100,001 to 125,000 pounds cost $30.00; from 125,001 pounds to 150,000 pounds overweight permits cost $60.00; shipments from 150,001 pounds and over are $100 per permit. Annual permits are available for shipments greater than 100,000 GVW but less than 150,000 GVW and cost $100 per year. Above 180,000 GVW (superload class) special approval is needed. The bridge analysis does not require extra fees. Alabama does not have a special overweight fleet permit option; however, permits are transferable between trucks.

Colorado

Colorado makes a distinction between reducible and non-reducible loads. Overweight permits are not granted for reducible loads; if a load is reducible it must be reduced to 80,000 pounds for highway transport or 85,000 pounds on secondary roads. Overweight permits for non-reducible loads are required for shipments greater than the legal limit based on axle-groupings and gross weight. There is a $15 base fee per trip and $5 per axle for weights up to 200,000 pounds. Annual permits for overweight shipments are $400/year/unit; axle fees are already included in this annual fee. Annual permits are granted for shipments up to 200,000 pounds; the range of weight for the annual permit also depends on the route. Overweight permit fees for shipments above 200,000 pounds cost $125 and need to be reviewed by the bridge engineering division for special assessment and routing. There are no special use costs for structures. Colorado has an overweight annual fleet permit; cots for this permit are $1,500 plus $25 per vehicle permitted.

Georgia

Georgia DOT does not make a distinction between reducible and non-reducible loads; permits are entirely by weight class. The legal overweight limit is 80,000 pounds. Single trip permits are as follows: below 150,000 pounds permit fees cost $30 plus administration fees; between 150,000 pounds and 180,000 pounds permits cost $125; above 180,000 pounds (super load class) permits cost $500. Annual permits are available for loads up to 100,000 pounds. For loads less then 12 feet wide the annual fee is $150; for loads up to 14 feet wide the annual fee is $500. Annual permit is also known as the blanket permit. Georgia DOT has issued a permit for a load greater than 700,000 pounds. Georgia does not have a special overweight fleet permit option.

Idaho

Anything above the legal limit (determined from Idaho DOT parameters) or 80,000 pounds (whichever is lower) must have an overweight permit. The legal weight limit is determined from the groupings of tires and axles. Idaho DOT makes a distinction between reducible and non-reducible loads in the overweight permitting process. Reducible load shipments may weigh up to 105,000 pounds with a permit. Annual reducible load permits may be obtained for $28; there are no single trip permits for reducible loads.

Non-reducible legal weight limits and superload limits are determined by the weight of the truck, the number of axles, and the axle-spacings. Overweight permits have a fixed component and variable component. The fixed base cost for a single use permit is $18; the fixed base cost for an annual permit is $43. The variable portion of the permit depends on the number of axles and the weight. Idaho DOT has a use fee table to determine this variable component. These rates can be found in the tables below. For example, a 5-axle truck/trailer/load could obtain an annual overweight permit for shipments with a GVW of 82,001 to 158,000 pounds. The variable cost rate for this 5-axle truck/trailer/load with a weight of 82,001 pounds would be $.04/mile; the variable cost rate for a 5-axle truck/trailer/load weighing 158,000 pounds would be $1.93/mile. A 5-axle truck/trailer/load above 158,000 GVW would be classified as a superload and would have to apply for a special single use permit.

Annual permits can be obtained for shipments below 200,000 pounds or the superload legal weight limit (whichever is lower). The bridge and routing departments must approve the superload single use permits; no annual permits for this super-load class are given. Idaho does not have a special overweight fleet permit option.

The mileage traveled in Idaho differs depending on the generator site from which waste is shipped. Idaho mileage for shipments from Hanford is 288 miles. Idaho mileage for shipments from INEEL is 120 miles.

Table A-3: Idaho

PATH: C:\123W\123\CHT\TAXOP.WK3
NAME: TAX RATE CHART (Overlegal Permits)
DATE: 1999 Sep 30 Thu
RVSD: 1999 Oct 06 Wed

Idaho Transportation Department
PO Box 34 (3311 W State St)
Boise ID 83731-0034 (83703)
Effective Date: 1999 July

GVW	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles	GVW
42	0.04								42
44	0.08								44
46	0.12								46
48	0.16								48
50	0.20								50
52	0.24								52
54	0.28								54
56	0.32	0.04							56
58	0.36	0.08							58
60	0.40	0.12							60
62	0.44	0.16							62
64	0.48	0.20							64
66	0.52	0.24							66
68	0.56	0.28							68
70	0.60	0.32	0.04						70
72	0.64	0.36	0.08						72
74	0.68	0.40	0.12						74
76	0.72	0.44	0.16						76
78	0.76	0.48	0.20						78
80	0.80	0.52	0.24						80
82	0.84	0.56	0.28	0.04					82
84	0.88	0.60	0.32	0.08					84
86	0.92	0.64	0.36	0.12					86
88	0.96	0.68	0.40	0.16					88
90	1.00	0.72	0.44	0.20					90
92		0.76	0.48	0.24					92
94		0.80	0.52	0.28					94
96		0.84	0.56	0.32					96
98		0.88	0.60	0.36	0.04				98
100		0.92	0.64	0.40	0.08				100
102		0.96	0.68	0.44	0.12				102
104		1.00	0.72	0.48	0.16				104
106		1.04	0.76	0.52	0.20				106
108			0.80	0.56	0.24				108
110			0.84	0.60	0.28				110
112			0.88	0.64	0.32				112
114			0.92	0.68	0.36				114
116			0.96	0.72	0.40	0.04			116
118			1.00	0.76	0.44	0.08			118
120			1.04	0.80	0.48	0.12			120
122				0.84	0.52	0.16			122
124				0.88	0.56	0.20			124
126				0.92	0.60	0.24			126
128				0.96	0.64	0.28			128
130				1.00	0.68	0.32			130
132				1.02	0.72	0.36	0.04		132
134				1.09	0.76	0.40	0.08		134
136				1.16	0.80	0.44	0.12		136
138				1.23	0.84	0.48	0.16		138
140				1.30	0.88	0.52	0.20		140
142				1.37	0.92	0.56	0.24		142
144				1.44	0.96	0.60	0.28		144
146				1.51	1.00	0.64	0.32		146
148				1.58	1.04	0.68	0.36		148
150				1.65	1.02	0.72	0.40	0.04	150
152				1.72	1.09	0.76	0.44	0.08	152
154				1.79	1.16	0.80	0.48	0.12	154
156				1.86	1.23	0.84	0.52	0.16	156
158				1.93	1.30	0.88	0.56	0.20	158
GVW	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles	GVW

PATH: C:\123W\123\CHT\TAXOP.WK3
NAME: TAX RATE CHART (Overlegal Permits)
DATE: 1999 Sep 30 Thu
RVSD: 1999 Oct 06 Wed

Idaho Transportation Department
PO Box 34 (3311 W State St)
Boise ID 83731-0034 (83703)
Effective Date: 1999 July

GVW	6 axles	7 axles	8 axles	9 axles	10 axles	11 axles	12 axles	13 axles	14 axles	15 axles	16 axles	GVW
160	1.37	0.92	0.60	0.24								160
162	1.44	0.96	0.64	0.28								162
164	1.51	1.00	0.88	0.32								164
166	1.58	1.02	0.72	0.36	0.04							166
168	1.65	1.09	0.76	0.40	0.08							168
170	1.72	1.16	0.80	0.44	0.12							170
172	1.79	1.23	0.84	0.48	0.16							172
174	1.86	1.30	0.88	0.52	0.20							174
176	1.93	1.37	0.92	0.56	0.24							176
178	2.00	1.44	0.96	0.60	0.28							178
180		1.51	1.00	0.64	0.32							180
182		1.58	1.04	0.68	0.36							182
184		1.65	1.02	0.72	0.40	0.04						184
186		1.72	1.09	0.76	0.44	0.08						186
188		1.79	1.16	0.80	0.48	0.12						188
190		1.86	1.23	0.84	0.52	0.16						190
192		1.93	1.30	0.88	0.56	0.20						192
194		2.00	1.37	0.92	0.60	0.24						194
196		2.07	1.44	0.96	0.64	0.28						196
198		2.14	1.51	1.00	0.68	0.32						198
200		2.21	1.58	1.02	0.72	0.36	0.04					200
202		2.28	1.65	1.09	0.76	0.40	0.08					202
204		2.35	1.72	1.16	0.80	0.44	0.12					204
206		2.42	1.79	1.23	0.84	0.48	0.16					206
208		2.49	1.86	1.30	0.88	0.52	0.20					208
210		2.56	1.93	1.37	0.92	0.56	0.24					210
212		2.63	2.00	1.44	0.96	0.60	0.28					212
214			2.07	1.51	1.00	0.64	0.32					214
216			2.14	1.58	1.04	0.68	0.36					216
218			2.21	1.65	1.02	0.72	0.40	0.04				218
220			2.28	1.72	1.09	0.76	0.44	0.08				220
222			2.35	1.79	1.16	0.80	0.48	0.12				222
224			2.42	1.86	1.23	0.84	0.52	0.16				224
226			2.49	1.93	1.30	0.88	0.56	0.20				226
228			2.56	2.00	1.37	0.92	0.60	0.24				228
230			2.63	2.07	1.44	0.96	0.64	0.28				230
232			2.70	2.14	1.51	1.00	0.68	0.32				232
234			2.77	2.21	1.58	1.02	0.72	0.36	0.04			234
236			2.84	2.28	1.65	1.09	0.76	0.40	0.08			236
238			2.91	2.35	1.72	1.16	0.80	0.44	0.12			238
240			2.98	2.42	1.79	1.23	0.84	0.48	0.16			240
242			3.05	2.49	1.86	1.30	0.88	0.52	0.20			242
244			3.12	2.56	1.93	1.37	0.92	0.56	0.24			244
246			3.19	2.63	2.00	1.44	0.96	0.60	0.28			246
248			3.26	2.70	2.07	1.51	1.00	0.64	0.32			248
250			3.33	2.77	2.14	1.58	1.04	0.68	0.36			250
252			3.40	2.84	2.21	1.65	1.02	0.72	0.40	0.04		252
254			3.47	2.91	2.28	1.72	1.09	0.76	0.44	0.08		254
256			3.54	2.98	2.35	1.79	1.16	0.80	0.48	0.12		256
258				3.05	2.42	1.86	1.23	0.84	0.52	0.16		258
260				3.12	2.49	1.93	1.30	0.88	0.56	0.20		260
262				3.19	2.56	2.00	1.37	0.92	0.60	0.24		262
264				3.26	2.63	2.07	1.44	0.96	0.64	0.28		264
266				3.33	2.70	2.14	1.51	1.00	0.68	0.32		266
268				3.40	2.77	2.21	1.58	1.02	0.72	0.36	0.04	268
270				3.47	2.84	2.28	1.65	1.09	0.76	0.40	0.08	270
272				3.54	2.91	2.35	1.72	1.16	0.80	0.44	0.12	272
274					2.98	2.42	1.79	1.23	0.84	0.48	0.16	274
276					3.05	2.49	1.86	1.30	0.88	0.52	0.20	276
278					3.12	2.56	1.93	1.37	0.92	0.56	0.24	278
280					3.19	2.63	2.00	1.44	0.96	0.60	0.28	280
GVW	6 axles	7 axles	8 axles	9 axles	10 axles	11 axles	12 axles	13 axles	14 axles	15 axles	16 axles	GVW

Louisiana

Louisiana makes a distinction between reducible and non-reducible loads. Reducible loads are allowed up to 80,000 pounds. Non-reducible loads may obtain overweight permits for shipments over 80,000 pounds. Single-use overweight permit fees for shipments greater than 80,000 pounds and up to 254,000 pounds are based on the gross weight class and distance traveled in state. For example, the cost of an overweight permit for a shipment weighing 120,001 - 132,000 pounds traveling 51-100 miles is $170; the cost of the permit for this shipment to travel 101-150 miles is $250. This information can be found on the table below. Shipments greater than 232,001 pounds, super load shipments, are subject to additional roadway evaluation costs, $1475, and structural use fees. Annual permits are available for shipments up to 120,000 pounds and cost $2500. This $2500 is a blanket fee and is independent of the travel distance; no additional fees are assessed in relation to the annual permit. Louisiana does not issue special overweight fleet permits.

Approximate Louisiana mileage on the Savannah route is 185 miles.

Table A-4: Louisiana

THIRD OVERWEIGHT PERMIT FEE SCHEDULE

This schedule is for combinations of vehicles with five (5) or more axles* (including the steering axle) when the gross weight exceeds 80,000 pounds.

GROSS WEIGHT (in pounds)	DISTANCE (in miles)				
	0-50	51-100	101-150	151-200	over 200
80,001-100,000	$30.00	$45.00	$65.00	$80.00	$100.00
100,001-108,000	50.00	95.00	135.00	180.00	220.00
108,001-120,000	70.00	130.00	190.00	250.00	310.00
120,001-132,000	90.00	170.00	250.00	330.00	415.00
132,001-152,000	120.00	225.00	335.00	445.00	555.00
152,001-172,000	155.00	295.00	440.00	585.00	730.00
172,001-192,000	190.00	365.00	545.00	725.00	905.00
192,001-212,000	225.00	435.00	650.00	865.00	1080.00
212,001-232,000	260.00	505.00	755.00	1005.00	1250.00
232,001-254,000	295.00	575.00	860.00	1145.00	1420.00
Over 254,000	$10.00 -- plus $0.50 per ton-mile of weight in excess of 80,000 pounds, plus a fee for structural evaluation based on the following schedule: $125.00 - for evaluation of treated timber, concrete slab, and precast concrete slab bridges $850.00 - for evaluation of truss, continuous span, and movable bridges and for all Mississippi River structures $500.00 - for all other structures				

* "Axle" here refers to single or individual axles. Tandem axle groups will be counted as two (2) axles and tridum axle groups as three (3) axles.

Notwithstanding any other provision of law to the contrary, any combination vehicle with a gross weight greater than 120,000 pounds, but not in excess of 254,000 pounds shall be authorized a maximum tandem axle weight of 45,000 pounds and a maximum steering axle weight of 13,000 pounds, provided the spread between axle groups is a minimum of 12 feet and the spread between tires in a group is a minimum of 4 feet.

Note: Loads exceeding 232,000 pounds, but not greater than 254,000 pounds, shall be allowed statewide movement on the Department of Transportation & Development selected and approved routes, the majority of which are interstate highways only. However, those portions of their route from the load's origin to the National Highway System and that portion from the National Highway System to its destination shall be subject to the structural evaluation provided for in this schedule.

Mississippi
Mississippi DOT makes a distinction between reducible and non-reducible. Reducible loads must be below the legal weight limit of 80,000 pounds; overweight permits are not available for reducible loads. Non-reducible load permits are based on the distance traveled in the state. Weight above the legal limit of 80,000 pounds is assessed at $0.05 per thousand pounds per mile. For example, an overweight permit for a non-reducible load weighing 85,000 pounds traveling 300 miles would cost $600 (5 thousand pounds * $0.05 per thousand pounds * 300 miles); a permit for this same load traveling 50 miles would cost $100. The minimum cost for a permit is $10. Shipments above 190,000 pounds are considered superload shipments; the same rate is used for calculating superload shipment fees.

Mississippi also has a blanket permit that allows greater flexibility in reporting and departure; variable use rates are still assessed. There are two levels of blanket permits, $100/year and $550/ year; the $100 level is in the process of being phased out. Mississippi does not have an annual permit nor a fleet rate.

Approximate Mississippi mileage is 150 miles.

New Mexico
Permits are available for both divisible and non-divisible loads. The legal weight limit is 80,000 pounds. Over 80,000 pounds the permit is a flat rate of $15. Shipments above 140,000 pounds are considered superload and must be approved by the highway division. Superload shipments cost $15. Annual permits are available for shipments up to 140,000 pounds and cost $60.

Oregon
The Oregon DOT makes a distinction between reducible and non-reducible. Reducible load shipments above 80,000 pounds are considered overweight; with permitting, reducible shipments are allowed up to 105,500 pounds. Annual permits are available for reducible shipments 80,000 to 105,500 pounds; annual permits are charged at the same rate as single trip permits. Reducible load shipments are managed through the registration department. Fees for reducible load shipments are in the form of a tax and are based on weight, number of axles and miles traveled in the state.

Non-reducible heavy haul shipments are managed through the overweight permitting department. Permit fees have both a fixed administrative cost and variable road use assessed fee (RAUF). The fixed administrative cost is at least $8 and increases with the complexity of the route; for example if county roads are used, county fees apply. Heavy haul non-reducible shipments below 98,000 pounds are not assessed road use fees. For non-reducible loads greater than 98,000 pounds, variable RAUF are assessed based on the gross weight, the number of axles, and the total distance traveled in the state. The number of axles includes all axles on the truck cab and trailer. The cost rates can be found on the Oregon Road Use Assessment Fee chart included below. For example, a shipment with 5 axles, weighing 115,000 pounds, traveling 200 miles would cost $200. Annual permits are available for non-reducible shipments (below 98,000 pounds); annual permits are charged at the same rate as single trip permits. Oregon does not offer special fleet rates.

Approximate Oregon mileage is 208 miles.

Table A-5: Oregon

Effective January 1, 1996

Oregon Road Use Assessment Fees - Cents per Mile

Gross Weight	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Number of Axles															
98,000 to 100,000	40	23	13	9	7	7	4	2	1	1	1	1	1	1	1	1
100,001 to 102,000	45	25	14	9	8	7	4	2	2	2	2	1	1	1	1	1
102,001 to 104,000	51	26	16	10	8	7	6	3	2	2	2	1	1	1	1	1
104,001 to 106,000	58	28	17	11	9	8	6	3	2	2	2	1	1	1	1	1
106,001 to 108,000	63	31	17	11	9	8	6	3	3	2	2	1	1	1	1	1
108,001 to 110,000	72	33	19	12	9	8	7	4	3	2	2	1	1	1	1	1
110,001 to 112,000	79	38	20	13	10	9	7	4	3	3	2	1	1	1	1	1
112,001 to 114,000	85	39	21	14	11	9	8	4	3	3	2	1	1	1	1	1
114,001 to 116,000	100	41	22	16	11	9	8	4	4	3	2	1	1	1	1	1
116,001 to 118,000	113	45	24	17	12	9	8	6	4	3	2	1	1	1	1	1
118,001 to 120,000	125	48	26	19	13	9	9	6	4	4	2	1	1	1	1	1
120,001 to 122,000		51	28	20	14	9	9	6	6	4	3	2	1	1	1	1
122,001 to 124,000		55	30	22	16	10	9	7	6	4	3	2	2	1	1	1
124,001 to 126,000		60	32	23	17	10	9	8	6	6	3	2	2	1	1	1
126,001 to 128,000		63	34	24	18	11	10	8	7	6	3	3	2	1	1	1
128,001 to 130,000		69	37	26	19	12	10	8	7	6	4	3	2	1	1	1
130,001 to 132,000		75	40	28	20	12	10	9	8	7	4	3	2	1	1	1
132,001 to 134,000		80	43	29	20	13	11	9	8	7	4	3	3	1	1	1
134,001 to 136,000		86	45	31	22	13	11	9	8	7	6	3	3	1	1	1
136,001 to 138,000		95	49	33	23	14	11	9	9	7	6	4	3	1	1	1
138,001 to 140,000		102	52	35	24	16	12	9	9	8	6	4	3	1	1	1
140,001 to 142,000		111	56	38	25	17	13	10	9	8	7	4	3	2	1	1
142,001 to 144,000			60	41	27	18	13	10	9	8	7	6	4	2	1	1
144,001 to 146,000			63	43	28	19	14	11	10	8	7	6	4	2	1	1
146,001 to 148,000			68	44	29	20	16	12	10	9	8	7	4	3	2	1
148,001 to 150,000			72	48	30	21	17	13	11	9	8	7	4	3	2	2
150,001 to 152,000			76	50	32	22	17	13	11	9	9	7	4	4	2	2
152,001 to 154,000			80	53	33	23	18	14	12	9	9	8	6	4	3	2
154,001 to 156,000			84	55	35	24	19	16	12	9	9	8	6	4	3	2
156,001 to 158,000			89	59	39	26	20	16	13	10	9	9	7	6	3	2
158,001 to 160,000			94	61	41	27	21	17	13	11	10	9	7	6	4	3
160,001 to 162,000			97	64	43	29	22	18	14	11	10	9	7	6	4	3
162,001 to 164,000			103	69	45	30	23	19	14	12	10	9	8	7	4	3
164,001 to 166,000			107	72	48	31	23	19	16	12	11	9	8	7	6	3
166,001 to 168,000			113	75	51	33	25	20	16	13	12	10	8	8	6	4
168,001 to 170,000			117	79	54	35	25	22	17	13	12	10	9	8	7	4
170,001 to 172,000			123	82	56	38	27	23	17	13	13	10	9	9	7	4
172,001 to 174,000			129	86	60	40	28	24	18	14	13	11	9	9	8	6
174,001 to 176,000			134	92	62	41	29	25	19	16	14	11	9	9	8	6
176,001 to 178,000			141	96	65	43	31	26	20	17	14	12	10	9	9	7
178,001 to 180,000			146	99	69	44	32	27	20	17	16	12	10	10	9	7
180,001 to 182,000				104	72	49	34	29	22	18	16	13	10	10	9	7
182,001 to 184,000				110	75	50	35	30	22	19	17	13	11	11	9	8
184,001 to 186,000				114	79	52	38	31	23	20	17	14	12	11	9	8
186,001 to 188,000				120	81	54	39	33	24	20	18	14	12	11	9	9
188,001 to 190,000				125	85	58	41	34	25	21	19	16	13	12	10	9
190,001 to 192,000				131	89	60	43	37	26	22	19	16	13	12	10	9
192,001 to 194,000				136	93	62	44	38	28	22	20	17	14	12	11	9
194,001 to 196,000				142	96	64	47	40	29	23	20	17	14	13	11	9
196,001 to 198,000				148	100	68	49	41	30	24	21	18	16	13	11	9
198,001 to 200,000				154	103	71	51	43	31	25	21	18	16	14	12	10

Effective January 1, 1996

Oregon Road Use Assessment Fees - Cents per Mile, Cont'd

Gross Weight	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Number of Axles															
200,001 to 202,000				159	107	74	53	44	32	26	22	19	17	14	12	10
202,001 to 204,000				166	112	77	55	45	34	27	23	19	17	16	12	10
204,001 to 206,000				172	115	80	59	48	35	28	23	20	18	16	13	11
206,001 to 208,000				178	120	83	61	49	38	29	24	21	19	16	13	11
208,001 to 210,000				184	124	87	63	51	39	30	25	21	19	17	13	11
210,001 to 212,000				191	129	92	65	53	40	31	25	22	20	18	14	12
212,001 to 214,000				199	133	95	69	55	42	32	26	23	21	18	14	12
214,001 to 216,000				206	137	100	72	58	44	34	27	23	21	18	14	13
216,001 to 218,000				212	143	104	75	60	45	35	28	24	22	19	16	13
218,001 to 220,000				219	148	108	79	61	47	38	29	25	23	19	16	14
220,001 to 222,000				227	154	113	81	63	48	39	30	25	24	20	16	14
222,001 to 224,000				236	160	116	84	65	50	41	31	26	24	21	17	14
224,001 to 226,000					166	122	89	68	52	42	32	27	25	21	17	16
226,001 to 228,000					173	127	92	71	54	44	34	27	26	22	18	16
228,001 to 230,000					179	133	96	73	56	45	35	28	26	22	18	17
230,001 to 232,000					187	138	100	75	58	48	37	29	27	23	18	17
232,001 to 234,000					195	144	103	77	60	50	38	30	27	23	19	18
234,001 to 236,000					201	149	108	79	61	52	40	30	28	24	19	18
236,001 to 238,000					210	157	113	82	63	55	42	31	29	24	20	19
238,001 to 240,000					219	165	116	85	65	58	44	32	30	25	20	19
240,001 to 242,000					227	172	119	88	67	60	45	33	31	26	21	20
242,001 to 244,000					235	179	122	91	69	62	47	34	32	27	22	20
244,001 to 246,000					243	186	125	94	71	64	48	35	33	28	23	21
246,001 to 248,000					251	193	128	97	73	66	50	36	34	29	24	21
248,001 to 250,000					259	200	131	100	75	68	51	37	35	30	25	22
250,001 to 252,000					267	207	134	103	77	70	53	38	36	31	26	22
252,001 to 254,000					275	214	137	106	79	72	54	39	37	32	27	23
254,001 to 256,000					283	221	140	109	81	74	56	40	38	33	28	23
256,001 to 258,000					291	228	144	112	83	76	57	41	39	34	29	24
258,001 to 260,000					299	235	148	115	85	78	59	42	40	35	30	24
260,001 to 262,000					307	241	152	118	87	80	60	43	41	36	31	25
262,001 to 264,000					315	248	156	121	89	82	62	44	42	37	32	25
264,001 to 266,000					323	254	160	124	91	84	63	45	43	38	33	26
266,001 to 268,000					331	261	164	127	93	86	65	46	44	39	34	26
268,001 to 270,000					339	267	168	130	95	88	66	47	45	40	35	27
270,001 to 272,000					347	274	172	133	97	90	68	48	46	41	36	28
272,001 to 274,000					355	280	176	136	99	92	69	49	47	42	37	29
274,001 to 276,000					363	287	180	139	101	94	71	50	48	43	38	30
276,001 to 278,000					371	294	184	142	103	96	73	51	49	44	39	31
278,001 to 280,000					379	300	188	145	105	98	75	52	50	45	40	32
280,001 to 282,000					387	307	192	148	108	100	77	53	51	46	41	33
282,001 to 284,000					395	314	196	151	111	102	79	54	52	47	41	34
284,001 to 286,000					403	320	200	154	114	104	81	55	53	48	42	35
286,001 to 288,000					411	327	205	157	116	106	83	56	54	49	43	36
288,001 to 290,000					419	333	210	160	119	108	85	57	55	50	43	37
290,001 to 292,000					427	339	215	163	122	110	87	58	56	51	44	38
292,001 to 294,000					435	345	220	166	125	112	88	59	57	52	45	39
294,001 to 296,000					444	352	226	169	127	114	89	60	58	53	45	40
296,001 to 298,000					453	358	232	172	130	116	90	61	59	54	46	41
298,001 to 300,000					462	364	238	175	133	118	91	62	60	55	47	42
300,001 to 302,000					471	370	244	178	136	120	93	63	61	56	48	43

South Carolina

South Carolina makes a distinction between divisible and non-divisible loads. Divisible loads may not exceed 80,000 pounds. The permit fee for a non-divisible load shipment 80,000 to 130,000 pounds is $30 (although the permit cost may change depending on what is hauled). Permit fees for non-divisible shipments above 130,000 pounds (superload class) cost $100 plus $3 for every 1000 pounds above 130,000 pounds. Additional fees may be assessed depending on structures crossed on route. The route structure assessment takes approximately 10 working days. Annual permits are available for shipments up to 90,000 pounds on 5 axles and cost $100; the annual permits are not transferable between trucks. South Carolina does not offer overweight fleet permits.

Texas

Texas has a flat base overweight permitting system and does not have a use fee (based on distance) or axle fee. They treat permitting for reducible and non-reducible loads in the same manner. Permit costs for loads up to 254,300 pounds are:

Table A-6: Texas

GVW	**Single-use permit**	**Annual permit**
80,000- 120,000 pounds	$80	$2000
120,000- 160,000 pounds	$105	Not available
160,000-200,000 pounds	$130	Not available
Above 200,000 pounds	$190	Not available

The annual permit may be transferred between trucks. Shipments above 254,300 pounds are considered superheavy loads. Permitting for superheavy loads requires additional cost and time. The initial superheavy permit fee is $155 ($30 permit fee, $125 highway maintenance fee) plus an initial $800 bridge analysis fee. This bridge analysis typically takes 6-8 weeks to process. Shipments over 500,000 pounds must also be approved by the pavement transportation division.

Additional superheavy permits on the same route cost $155 ($30 permit fee, $125 highway maintenance fee) plus a $35 fee for an additional route inspection; the initial $800 bridge analysis fee is not required.

Texas does not offer special fleet permits.

Utah

Utah DOT makes a distinction between divisible and non-divisible loads; both types of loads may obtain overweight permits. Fees for both types of shipments are assessed similarly. The legal limit is 80,000 pounds. For shipments up to 125,000 pounds, overweight permit fees are a fixed $50, regardless of the distance traveled in Utah. For shipments weighing more than 125,000 pounds, fees are assessed based on mileage. Rates are determined from the table provided below. For example, the permit cost for a shipment weighing 125,001 to 150,000 pounds, traveling 151 to 200 miles would cost $140. Semi-annual and annual permits are available depending on the weight, axle-number and axle-spacings. Semi-annual permits for divisible loads up to 112,000 pounds cost $260. A semi-annual permit for divisible loads weighing between 112,000 and 129,000 pounds cost $350; an annual permit costs $450. An annual permit for a non-divisible load up to 125,000 pounds costs $450 per year. No special fleet rates are available.

Approximate Utah mileage is 124 miles.

Table A-7: Utah

Utah

APPENDIX B

FEE TABLE FOR NON-DIVISIBLE LOADS EXCEEDING 125,000 LBS.

MILES: / POUNDS:	50	100	150	200	250	300	350	400	450	500	550	600	650
150000	$65	$70	$110	$140	$180	$210	$250	$280	$320	$350	$390	$420	$450
175000	$65	$100	$140	$190	$240	$290	$330	$380	$430	$450	$450	$450	
200000	$65	$120	$180	$240	$300	$360	$420	$450	$450				
225000	$70	$150	$220	$290	$360	$440	$450						
250000	$90	$170	$260	$340	$430	$450							
275000	$100	$200	$290	$390	$450								
300000	$110	$220	$330	$440									
325000	$120	$250	$370	$450									
350000	$140	$270	$410										
375000	$150	$300	$440										
400000	$160	$320	$450										
425000	$170	$350											
450000	$190	$370											
475000	$200	$400											
500000	$210	$420											
525000	$220	$450											
550000	$240												
575000	$250												
600000	$260												
625000	$270												
650000	$290												
675000	$300												
700000	$310												
725000	$320												
750000	$340												
775000	$350												
800000	$360												
825000	$370												
850000	$390												
875000	$400												
900000	$410												
925000	$420												
950000	$440												
975000	$450												

Washington

Washington makes a distinction between reducible and non-reducible loads. Overweight permits are not given for reducible loads. Reducible loads may request temporary single trip overweight tonnage.

Overweight permits for non-reducible loads are assessed based on the excess weight of the shipment and the distance traveled. Excess weight is determined from a shipment's legal limit; a shipment's legal limit is determined from the axle-spacings, the number of axles, and size of the tires. The legal limits can be found on the included Washington Legal Weight Limit table; these legal limits are capped at 105,500 pounds. The level of excess weight then determines the rate at which miles traveled are assessed. The rate schedule can be found on the Washington Rate Table provided below. Above 100,000 pounds weight over maximum the fee is $4.25 plus 50 cents for each 5,000 pound increment or portion thereof exceeding 100,000 pounds. For example, a shipment that is 40,000 pounds overweight is assessed at $0.79 per mile. Traveling 36 miles in Washington would give us an overweight permit cost of $28. The minimum permit charge is $14. There are no annual overweight permits and no fleet permits.

Approximate Washington mileage is 36 miles.

Table A-8: Washington

Washington Legal Weight Limit

Weight Table

Feet	2 Axle	3 Axle	4 Axle	5 Axle	6 Axle	7 Axle	8 Axle	9 Axle
4	34,000							
5	34,000							
6	34,000							
7	34,000							
8 & Less	34,000	34,000						
over 8	38,000	42,000						
9	39,000	42,500						
10	40,000	43,500						
11		44,000						
12		45,000	50,000					
13		45,500	50,500					
14		46,500	51,500					
15		47,000	52,000					
16		48,000	52,500	58,000				
17		48,500	53,500	58,500				
18		49,500	54,000	59,000				
19		50,000	54,500	60,000				
20		51,000	55,500	60,500	66,000			
21		51,500	56,000	61,000	66,500			
22		52,500	56,500	61,500	67,000			
23		53,000	57,500	62,500	68,000			
24		54,000	58,000	63,000	68,500	74,000		
25		54,500	58,500	63,500	69,000	74,500		
26		55,500	59,500	64,000	69,500	75,000		
27		56,000	60,000	65,000	70,000	75,500		
28		57,000	60,500	65,500	71,000	76,500	82,000	
29		57,500	61,500	66,000	71,500	77,000	82,500	
30		58,500	62,000	66,500	72,000	77,500	83,000	
31		59,000	62,500	67,500	72,500	78,000	83,500	
32		60,000	63,500	68,000	73,000	78,500	84,500	90,000
33			64,000	68,500	74,000	79,000	85,000	90,500
34			64,500	69,000	74,500	80,000	85,500	91,000
35			65,500	70,000	75,000	80,500	86,000	91,500
36			66,000	70,500	75,500	81,000	86,500	92,000
37			66,500	71,000	76,000	81,500	87,000	93,000
38			67,500	71,500	77,000	82,000	87,500	93,500
39			68,000	72,500	77,500	82,500	88,500	94,000
40			68,500	73,000	78,000	83,500	89,000	94,500
41			69,500	73,500	78,500	84,000	89,500	95,000
42			70,000	74,000	79,000	84,500	90,000	95,500
43			70,500	75,000	80,000	85,000	90,500	96,000
44			71,500	75,500	80,500	85,500	91,000	96,500
45			72,000	76,000	81,000	86,000	91,500	97,500
46			72,500	76,500	81,500	87,000	92,500	98,000
47			73,500	77,500	82,000	87,500	93,000	98,500
48			74,000	78,000	83,000	88,000	93,500	99,000
49			74,500	78,500	83,500	88,500	94,000	99,500
50			75,500	79,000	84,000	89,000	94,500	100,000

Table A-8 (cont): Washington

Washington Legal Weight Limit (cont.)

Weight Table

Feet	2 Axle	3 Axle	4 Axle	5 Axle	6 Axle	7 Axle	8 Axle	9 Axle
51			76,000	80,000	84,500	89,500	95,000	100,500
52			76,500	80,500	85,000	90,500	95,500	101,000
53			77,500	81,000	86,000	91,000	96,500	102,000
54			78,000	81,500	86,500	91,500	97,000	102,500
55			78,500	82,500	87,000	92,000	97,500	103,000
56			79,500	83,000	87,500	92,500	98,000	103,500
57			80,000	83,500	88,000	93,000	98,500	104,000
58				84,000	89,000	94,000	99,000	104,500
59				85,000	89,500	94,500	99,500	105,000
60				85,500	90,000	95,000	100,500	105,500
61				86,000	90,500	95,500	101,000	105,500
62				86,500	91,000	96,000	101,500	105,500
63				87,500	92,000	96,500	102,000	105,500
64				88,000	92,500	97,500	102,500	105,500
65				88,500	93,000	98,000	103,000	105,500
66				89,000	93,500	98,500	103,500	105,500
67				90,000	94,000	99,000	104,500	105,500
68				90,500	95,000	99,500	105,000	105,500
69				91,000	95,500	100,000	105,500	105,500
70				91,500	96,000	101,000	105,500	105,500
71				92,500	96,500	101,500	105,500	105,500
72				93,000	97,000	102,000	105,500	105,500
73				93,500	98,000	102,500	105,500	105,500
74				94,000	98,500	103,000	105,500	105,500
75				95,000	99,000	103,500	105,500	105,500
76				95,500	99,500	104,500	105,500	105,500
77				96,000	100,000	105,000	105,500	105,500
78				96,500	101,000	105,500	105,500	105,500
79				97,500	101,500	105,500	105,500	105,500
80				98,000	102,000	105,500	105,500	105,500
81				98,500	102,500	105,500	105,500	105,500
82				99,000	103,000	105,500	105,500	105,500
83				100,000	104,000	105,500	105,500	105,500
84					104,500	105,500	105,500	105,500
85					105,000	105,500	105,500	105,500
86 or more					105,500	105,500	105,500	105,500

Table A-9: Washington Rate Table

Overweight Fee Schedule (RCW 46.44.041)

Effective July 23, 1995

Weight Over Maximum Legal Capacity	*Fee Per Mile on State Highways*
1 to 9,999 pounds	$ .07
10,000 to 14,999 pounds	$ .14
15,000 to 19,999 pounds	$ .21
20,000 to 24,999 pounds	$ .28
25,000 to 29,999 pounds	$ .35
30,000 to 34,999 pounds	$ .49
35,000 to 39,999 pounds	$ .63
40,000 to 44,999 pounds	$ .79
45,000 to 49,999 pounds	$ .93
50,000 to 54,999 pounds	$1.14
55,000 to 59,999 pounds	$1.35
60,000 to 64,999 pounds	$1.56
65,000 to 69,999 pounds	$1.77
70,000 to 74,999 pounds	$2.12
75,000 to 79,999 pounds	$2.47
80,000 to 84,999 pounds	$2.82
85,000 to 89,999 pounds	$3.17
90,000 to 94,999 pounds	$3.52
95,000 to 99,999 pounds	$3.87
100,000 pounds	$4.25

The fee for weights in excess of 100,000 pounds is $4.25 plus 50 cents for each 5,000 pound increment or portion thereof exceeding 100,000 pounds.

Provided

1. The minimum fee for any overweight permit shall be $14.
2. The fee for issuance of a duplicate or transfer permit shall be $14.
3. When computing overweight fees that result in an amount other than even dollars, the fee shall be carried to the next full dollar if 50 cents or over and shall be reduced to the next full dollar if 49 cents or under.

Wyoming

Wyoming DOT makes a distinction between reducible and non-reducible loads when calculating overweight permits. Reducible loads may obtain an overweight permit for weights up to 117,000 pounds; up to 117,000 pounds fees are included in the regular licensing process fees. Reducible loads exceeding 117,000 pounds require a Class W permit. Class W permits are available on an annual basis for primary and secondary highways; miles accrue on a yearly basis and permits are available in 25,000 mile/year increments at the rate of $25 per 25,000 miles/year.

Overweight permit fees for non-reducible loads are based on the distance the excess weight travels. The legal weight is based on the axle-grouping number, and the distance between axles (interbridge and overhaul bridge). This information can be found on the table below. For example, a 5-axle truck-trailer combination with 83 feet between the extremes of any group of two or more consecutive axles is legal up to 100,000 pounds. Excess weight is charged at $0.04/excess ton/mile. Excess weight is rounded up to the nearest ton. For example, a shipment 3,000 pounds overweight will be assessed as 4,000 pounds or 2 tons overweight; this load will be charged $0.08/mile traveled. Wyoming does not have annual non-reducible permits nor do they have fleet rates.

Approximate Wyoming mileage is 367 miles.

Table A-10: Wyoming

JUL-23-2002 09:37 WYDOT OVERWT LOADS 307 777 43

GROSS WEIGHT TABLE I

Distance in feet between the extremes of any group of two (2) or more consecutive axles	Maximum gross weight in pounds carried on any group of two (2) or more consecutive axles							
	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 or more axles
4	36,000							
5	36,000							
6	36,000							
7	36,000							
8	38,000	42,000						
9	39,000	42,500						
10	40,000	43,500						
11		44,000						
12		45,000	50,000					
13		45,500	50,500					
14		46,500	51,500					
15		47,000	52,000					
16		48,000	52,500	58,000				
17		48,500	53,500	58,500				
18		49,500	54,000	59,000				
19		50,000	54,500	60,000				
20		51,000	55,500	60,500	66,000			
21		51,500	56,000	61,000	66,500			
22		52,500	56,500	61,500	67,000			
23		53,000	57,500	62,500	68,000			
24		54,000	58,000	63,000	68,500	74,000		
25		54,500	58,500	63,500	69,000	74,500		
26		55,500	59,500	64,000	69,500	75,000		
27		56,000	60,000	65,000	70,000	76,000		
28		57,000	60,500	65,500	71,000	76,500	82,000	
29		57,500	61,500	66,000	71,500	77,000	82,500	
30		58,500	62,000	66,500	72,000	77,500	83,000	
31		59,000	62,500	67,500	72,500	78,000	83,500	
32		60,000	63,500	68,000	73,000	78,500	84,500	90,000
33			64,000	68,500	74,000	79,000	85,000	90,500
34			64,500	69,000	74,500	80,000	85,500	91,000
35			65,500	70,000	75,000	80,500	86,000	91,500
36	Two (2) consecutive		66,000	70,500	75,500	81,000	86,500	92,000
37	sets of tandem axles		66,500	71,000	76,000	81,500	87,000	93,000
38	may carry 36,000		67,500	72,000	77,000	82,000	87,500	93,500
39	pounds each if the		68,000	72,500	77,500	82,500	88,500	94,000
40	distance is 38 feet		68,500	73,000	78,000	83,500	89,000	94,500
41	or more between		69,500	73,500	78,500	84,000	89,500	95,000
42	the consecutive sets		70,000	74,000	79,000	84,500	90,000	95,500
43	of tandem axles		70,500	75,000	80,000	85,000	90,500	96,000
44			71,500	75,500	80,500	85,500	91,000	96,500
45			72,000	76,000	81,000	86,000	91,500	97,500
46			72,500	76,500	81,500	87,000	92,500	98,000
47			73,500	77,500	82,000	87,500	93,000	98,500
48			74,000	78,000	83,000	88,000	93,500	99,000
49			74,500	78,500	83,500	88,500	94,000	99,500
50			75,500	79,000	84,000	89,000	94,500	100,000

Wyoming(cont.)

GROSS WEIGHT TABLE I

Distance in feet between the extremes of any group of two (2) or more consecutive axles	Maximum gross weight in pounds carried on any group of two (2) or more consecutive axles							
	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 or more axles
51			76,000	80,000	84,500	89,500	95,000	100,500
52			76,500	80,500	85,000	90,500	95,500	101,000
53			77,500	81,000	86,000	91,000	96,500	102,000
54			78,000	81,500	86,500	91,500	97,000	102,500
55			78,500	82,500	87,000	92,000	97,500	103,000
56			79,500	83,000	87,500	92,500	98,000	103,500
57			80,000	83,500	88,000	93,000	98,500	104,000
58				84,000	89,000	94,000	99,000	104,500
59				85,000	89,500	94,500	99,500	105,000
60				85,500	90,000	95,000	100,500	105,500
61				86,000	90,500	95,500	101,000	106,000
62				87,000	91,000	96,000	101,500	107,000
63				87,500	92,000	97,000	102,000	107,500
64				88,000	92,500	97,500	102,500	108,000
65				88,500	93,000	98,000	103,000	108,500
66				89,000	93,500	98,500	104,000	109,000
67				90,000	94,000	99,000	104,500	110,000
68				90,500	95,000	99,500	105,000	110,500
69				91,000	95,500	100,000	105,500	111,000
70				92,000	96,000	101,000	106,000	111,500
71				92,500	96,500	101,500	106,500	112,000
72				93,000	97,000	102,000	107,000	112,500
73				93,500	98,000	102,500	107,500	113,000
74				94,500	98,500	103,000	108,500	113,500
75				95,000	99,000	104,000	109,000	114,000
76				95,500	99,500	104,500	109,500	115,000
77				96,000	100,000	105,000	110,000	115,500
78				97,000	101,000	105,500	110,500	116,000
79				97,500	101,500	106,000	111,000	116,500
80				98,000	102,000	106,500	111,500	117,000
81				98,500	102,500	107,000	112,000	
82				99,000	103,000	108,000	113,000	
83				100,000	104,000	108,500	113,500	
84					104,500	109,000	114,000	
85					105,000	109,500	114,500	
86					105,500	110,000	115,000	
87					106,000	111,000	115,500	
88					107,000	111,500	116,000	
89					107,500	112,000	117,000	
90					108,000	112,500		
91					108,500	113,000		
92					109,000	113,500		
93					110,000	114,000		
94					110,500	115,000		
95	or more				111,000	115,500		

Appendix B: Inventory data

Table B-1: Size inventory data: *oversizeest.xls*

Site	Number of Large Containers	Total Volume	Estimated Number of Large Containers in Envelope[3]	Estimated Volume of Large Containers in Envelope	Estimated Number of Large Containers Outside Envelope[4]	Estimated Volume of Large Containers Outside Envelope	Estimated Number of Very Large Containers or Containers With Uncertain Dimensions[5]	Estimated Volume of Very Large Containers or Containers With Uncertain Dimensions
		(m^3)		(m^3)		(m^3)		(m^3)
ANL-E	17	46	7	12	10	34		
INEEL[1]	11,836	21,058	10,266	19,742	1,257	1,316	313	Not Reported
LANL	1,458	3,688	1,048	1,099	410	2,588		
LLNL	31	155			31	155		
MOUND	68	214	42	105	26	109		
NTS[2]	61	274	3	6	58	268		
ORNL	59	201			59	201		
RFETS	33	137	30	91	3	46		
HANFORD	644	6,643	107	247	537	6,397		
SRS	1,075	3,594	1,011	861	64	2,733		
Totals	15,282	36,011	12,514	22,163	2,455	13,847	313	0.00
Notes:								
1	Data on container numbers reported by INEEL on March 7, 2001. Volume information from previous INEEL report. 303 containers without dimensions. About 40 to 50% thought to be LLW.							
2	Numbers include two, 3 to 4 foot stainless steel spheres							
3	Envelope size 4 X 4 X 7							
4	Between 4 X 4 X 7 and 5 X 5 X 8							
5	Greater than 5 X 5 X 8 or size uncertain							

Information was available for Idaho and Rocky Flats. Hanford and Savannah River site data was unavailable. Information provided by Joe Harvill.

Table B-2: INEEL Weight inventory data: *INEELNONOVERP.xls*

INEELNONOVERP.xls

Details on INEEL Oversize Containers

Total Number of Oversized Boxes		10448*
Weight Range (lb)	<1000	118
	<2000	5305
	<3000	3504
	<4000	976
	<5000	351
	<6000	125
	<7000	32
	<8000	11
	>8000	25
	Unknown	1

% oversized boxes under 3000 pounds **85%**

* Based on available container numbers excluding reported 83-85 gallon containers

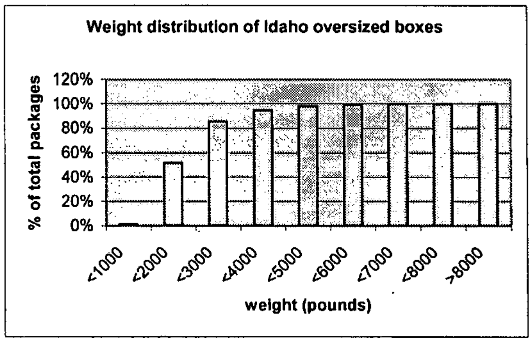


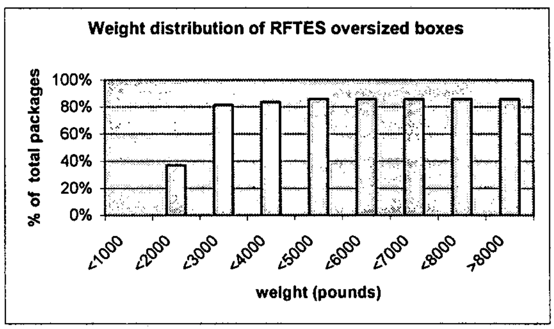
Table B-3: RFETS Weight inventory data: *RFETSOVERSIZE.xls*

RFETSOVERSIZE.xls

Details on RFETS Oversize Containers

Total Number of Oversized Boxes		43
Weight Range (lb)	<1000	0
	<2000	16
	<3000	19
	<4000	1
	<5000	1
	<6000	0
	<7000	0
	<8000	0
	>8000	0
	Unknown	6

% oversized boxes under 3000 pounds **81%**



Appendix C: Results

Table C-1: User entered assumptions for basic model case, *Rail cost benefit.xls*

	DEFAULT	USER DEFINED	
Shipments received at WIPP per week			
key assumption			
TRU-III will be based on the same volume throughput as the TRU-II			
breakdown of ratio of shipments from each site			
WIPP weekly throughput (number of TRUPACT-II)	99	99	
Truck: overweight permitting and TRUPACT-III specific information			
Cost of a TRUPACT-III	$ 1,100,000	$ 1,100,000	
Based on assumption that return trip will be below 80,000:			
weight of trailer/tractor (pounds)	24,000	24,000	
TRU-III weight (lbs) (range 50,000 to 56,000 lbs)	53500	53,500	
Note: 56000 lbs is upper limit; greater than 56000 (with default trailer weight of 24000 lbs) empty return trip would also require overweight permit fees			
Engineering specifications for loaded TRUPACT-III weight	66000	66,000	
number of axles (range 5-9 axles)	5	5	
Feet between axles (range 3-85 feet)		52	intial arbitrary choice
Single overweight permit fee calculations			
Single loaded waste box weight (lbs)	12500	3,000	
Gross Vehicle Weight (GVW) (lbs) (FOR MODEL TO WORK, THIS SHOULD BE ZERO)**			RESET TO ZERO
** Note: User can override model to calculate single trip overweight permit fee based on GVW. This can be done by entering a GVW other than zero on the "user input" worksheet. BE SURE TO RESET USER INPUT GVW TO ZERO WHEN DONE.			
TRU-III Inventory Shipping combinations			
Oversize boxes (two combinaitons are for comparison)			
Oversize boxes to a TRUPACT-III (default for comparison; do not change)	2		
Alternate oversize boxes to a TRUPACT-III	1	1.0	
Site Inventory to be shipped			
General weight assumptions:			
Drums			
light drum waste (pounds per drum)	300	300	
heavy drum waste (pounds per drum)	750	750	
Standard Waste Box (SWB)	2000	2,000	
Assumptions for sites we don't have all information			
Distribution of oversize boxes by weight			
Hanford: % of oversize boxes that are below 3000 pounds	70%	70%	
Savannah River: % of oversize boxes that are below 3000 pounds	80%	80%	
Basic Information			
Rocky Flats			
number of drums		1,000	intial arbitrary choice
number of boxes		1,000	intial arbitrary choice
Rail TRU-III shipping configurations and loading			
number of TRU-III per car	3	3	
num. of cars per train shipment	3	3	
time to unload or load 3 rail cars (9 TRUPACT-III) (days)		1.5	
time to unload or load 1 TRU-III (days)		0.2	
Time			
Shipping days per month	25.85	26	
Shipping weeks per year	48	48	
Shipping days per year	336	336	
Truck operations costs			
truck cost per mile	$ 15	$ 15	

User entered values and assumptions (continued)

Weather days lost for trucking				
percentage of shipping days lost per year				
Idaho (%)		13%	13%	
Rocky Flats (%)		4%	4%	
Translating weather delays to dollars				
transportation cost: $ per hour truck waiting time	$	70	$ 70	
# personnel at INEEL site		7	7	
# of WIPP personnel affected due to a 1 day of a INEEL weather delay		5	5	
# personnel at RFETS site			5	intial arbitrary choice
# of WIPP personnel affected due to a 1 day of a RFETS weather delay			5	intial arbitrary choice

Tracking rail shipments	please type in caps		
Which provider? (QUALCOMM or ORBCOMM)	QUALCOMM	QUALCOMM	
QUALCOMM			
cost to develop and test		$	100,000
cost to build ($ per unit)		$	5,000
ORBCOMM			
cost to develop and tst		$	50,000
cost to build ($ per unit)		$	5,000

State Corridor			
Extra money paid to states and tribes for passage, training, etc. per year			
Hanford: rte 1 (route 1 closely parallels the road)	$	-	-
Idaho	$	-	-
Rocky Flats	$	-	-
Savannah	$	-	-

Site Investments to accommodate rail		
Additional costs for site changes		
WIPP	$	100,000
Hanford	$	-
Idaho	$	-
Rocky Flats	$	-
Savannah	$	-

Charges and time for the alternate Hanford route*			
route 1 (UP/BNSF) vs. route 2 (BNSF)			
Hanford rte 1: UP/BNSF			
switching fees between rail companies on route1 (switching fee per car)			
route 1 rail rate per car	$	35,000	
cycle time (days) (round trip shipping)		22	
Hanford: rte 2 BNSF			
Basic Responder STEP Training: new route (one time charge:$)	$	100,000	arbitrary
Passage rights to states and nations and Future hazardous training refreshers (starting yr 2 of shipping on this rte) ($/yr)	$	125,000	arbitrary

Rail rate senstivity		
sensitivity	% change in rail costs per car (enter decrease as a negative %)	0%
sensitivity	% change in rail cycle times (enter decrease as a negative %)	0%

Note: Entering a 0% change will let model calculate with rates and cycle times that rail provided
Note: The percentage changes will also cycle time and rates for both Hanford routes

Table C-2: Overweight permit summary

Oversize boxes	Hanford		INEEL		RFETS		SRS	
	Overweight permit fees ($)							
Lower boundary	two oversize boxes (regardless of size)							
Total overweight permit fees($)	$	55,497	$	596,822	$	578	$	79,595
Estimated corrections for inventory discrepancies ($)	$	-	$	253,032	$	(275)	$	-
Corrected total ($)	**$**	**55,497**	**$**	**849,854**	**$**	**303**	**$**	**79,595**
Closest estimate minimizing overweight permit fees	two 4x4x8, one 4x4x8 one, one 5x5x8 and one very large box *							
Total overweight permit fees($)	$	82,779	$	653,401	$	630	$	83,309
Estimated corrections for inventory discrepancies ($)	$	-	$	370,874	$	(550)	$	-
Corrected total ($)	**$**	**82,779**	**$**	**1,024,274**	**$**	**80**	**$**	**83,309**
Closest estimate NOT minimizing overweight permit fees	two 4x4x8, one 5x5x8 or one very large box *							
Total overweight permit fees($)	$	85,812	$	1,133,686	$	1,030	$	120,885
Estimated corrections for inventory discrepancies ($)	$	-	$	189,268	$	-	$	-
Corrected total ($)	**$**	**85,812**	**$**	**1,504,559**	**$**	**755**	**$**	**120,885**
Upper Boundary	one oversize box (regardless of size) above weight limit; two boxes below the weight limit							
Total overweight permit fees($)	$	106,467	$	1,577,096	$	1,595	$	181,944
Estimated corrections for inventory discrepancies ($)	$	-	$	370,874	$	(550)	$	-
Corrected total ($)	**$**	**106,467**	**$**	**1,947,969**	**$**	**1,045**	**$**	**181,944**
* Note: fees were calculated with the assumption that total box size percentages were applied within each weight range								
All inventory								
	Overweight permit fees ($)							
Closest estimate minimizing overweight permit fees	two 4x4x8, one 4x4x8, one 5x5x8 and one very large box *							
Oversize boxes	$	82,779	$	1,024,274	$	80	$	83,309
SWB	$	-	$	-	$	-	$	-
Drums	$	-	$	-	$	-	$	-
Total	**$**	**82,779**	**$**	**1,024,274**	**$**	**80**	**$**	**83,309**
Closest estimate NOT minimizing overweight permit fees	two 4x4x8, one 5x5x8 or one very large box *							
Oversize boxes	$	85,812	$	1,504,559	$	755	$	120,885
SWB	$	733,667	$	481,067	$	9,167	$	100,146
Drums	$	332,959	$	1,389,080	$	2,406	$	493,943
Total	**$**	**1,152,438**	**$**	**3,374,706**	**$**	**12,328**	**$**	**714,974**
* Note: fees were calculated with the assumption that total box size percentages were applied within each weight range								

Table C-3: Effects of minimizing overweight permit fees

Oversize boxes

	Hanford	INEEL	RFETS	SRS
	Overweight permit fees ($)			
Overweight permit savings ($)	$ 3,032	$ 480,285	$ 675	$ 37,576
	Time differences: Truck - rail (years)			
Truck shipping years lost by minimizing overweight permit fees	-0.14	-3.37	-0.01	-1.48
	Site closure dollar differences ($) for longer truck shipping time			
Site budget costs for difference in shipping years (not based on acceleration plan budgets) ($)	$ (2,397,335)	$ (2,397,335)	$ (201,978,139)	$ (6,157)

All inventory

	Hanford	INEEL	RFETS	SRS
	Overweight permit fees ($)			
Overweight permit savings ($)	$ 1,069,658	$ 2,350,432	$ 12,248	$ 631,664
	Time differences: Truck - rail (years)			
Truck shipping years lost by minimizing overweight permit fees	-208.3	-60.5	-2.5	-132.5
	Site closure dollar differences ($) for longer truck shipping time			
Site budget costs for difference in shipping years (not based on acceleration plan budgets) ($)	$ (5,947,694,000)	$ (1,879,645,000)	$ (3,973,127)	$ (8,851,502,000)

Table C-4: Rail: total number of shipping years

Rail Time	Hanford rte 1: UP/BNSF	Hanford rte 2: BNSF	Idaho	RFETS	SRS
Oversize box inventory					
All Oversize boxes (less than two 5x5x8 to a TRU-III)	6.49	6.5	8.7	0.0	6.3
All inventory (drums + SWB + all oversized)					
can ship less than two 5x5x8 oversize boxes in a TRU-III					
drum config 1 (40 light drums and weight limited heavy weight drums)	44.3	44.3	17.9	0.5	26.9
drum config 2 (28 light drums and weight limited heavy weight drums)	45.7	45.7	18.7	0.5	29.0
drum config 3 (33 light drums and weight limited heavy weight drums)	45.0	45.0	18.3	0.5	27.9

Table C-5: Basic model results (A: Costs; B: Benefits; C: Net Benefit) (see table C-1 for assumptions; note basic model assumes truck costs of $15 per mile)

A. Costs

Costs

$ (in thousands)

	WIPP	Hanford: rte 2 rte 2: BNSF	Idaho	Rocky Flats	Savannah
Transport corridor*					
Transport corridor costs: oversized		$ 786	$ -	$ -	$ -
Transport corridor costs: all inventory		$ 5,511	$ -	$ -	$ -
Tracking shipments **	$ -	$ 14	$ 139	$ 61	$ 18
Infrastructure changes	$ 100	$ 190	$ 500	$ 600	$ 350
Cost of additional TRUPACT-III's	$ -	$ 2,825	$ 33,395	$ 13,574	$ 4,701
Rail Transport costs ***					
Rail transport costs: oversize boxes oversize boxes (less than 2 5x5x8 per TRU-III)	$ -	$ 5,059	$ 46,698	$ 53	$ 4,429
Rail Transport costs: all inventory all inventory (oversize boxes (5x5x8 less than 2 to a container), 6 SWB per TRU-III, 40 drums per TRU-III)	$ -	$ 34,534	$ 96,350	$ 677	$ 19,037
Total cost (oversize shipments)	**$ 100**	**$ 8,874**	**$ 80,731**	**$ 14,289**	**$ 9,498**
Total cost (all inventory)	**$ 100**	**$ 43,075**	**$ 130,383**	**$ 14,912**	**$ 24,107**

* Assumptions for transport corridor for Hanford rte 2 will differ from other sites due to route

** Tracking shipments has both an allocated and variable portion; if a site is taken out of study then development costs will be reallocated over remaining sites

*** Rail transport costs include Hanford rte 1 switching cost

B: Benefits

$ (in thousands)

	WIPP	Hanford	Idaho	Rocky Flats	Savannah
Overweight permit fees will differ depending on shipping practices (minimizing overweight permit fees)					
Avoidance of overweight permit fees					
oversize boxes (1 box per TRU-III) (upper bound of overweight permit fees)		$ 86	$ 1,505	$ 1	$ 121
boxes (based on 6 SWB)		$ 734	$ 481	$ 9	$ 100
drums (based on 40 light weight drums and weight limited heavy drums)		$ 333	$ 1,389	$ 2	$ 494
all inventory		$ 1,152	$ 3,375	$ 12	$ 715
Weather delay: time savings in dollars					
oversize boxes (less than two 5x5x8 oversize boxes per TRU-II)			$ 2,345	$ 3	
all inventory (based on less than 2 oversize boxes per TRU-III,6 SWB and 40 light drums and weight limited heavy drums)			$ 4,837	$ 38	
Avoidance of Truck operation costs					
oversize boxes (less than two 5x5x8 per TRU-III)		$ 16,081	$ 140,523	$ 546	$ 13,222
all inventory (less than two 5x5x8 oversize boxes, based on 6 SWB and 40 light drums and weight limited heavy drums)		$ 109,393	$ 84,736	$ 165,048	$ 5,343
if overweight permit fees are NOT minimized then there will be no early site shut down benefit					
Early site shut down (minimizing overweight permit fees)					
oversize boxes (less than two 5x5x8 oversize boxes per TRU-II)		$ -	$ -	$ -	$ -
all inventory (based on 6 SWB and 40 light drums and weight limited heavy drums)		$ -	$ -	$ -	$ -
Total benefit (oversize inventory less than two 5x5x8 oversize boxes per TRU-III) NOTE: overweight box based on 1 box per TRU-III	**$ -**	**$ 16,167**	**$ 144,372**	**$ 550**	**$ 13,343**
Total Benefit: all inventory (less than two 5x5x8 oversize boxes, based on 6 SWB and 40 light drums and weight limited heavy drums)		**$ 110,546**	**$ 92,948**	**$ 165,098**	**$ 6,058**

C. Net Rail Benefit

Benefit-Cost

(positive value means there is a benefit to rail)

	WIPP	Hanford: rte 2 rte 2: BNSF	$ (in thousands) Idaho	Rocky Flats	Savannah
oversize boxes only (less than two 5x5x8 oversize boxes per TRU-III)		$ 7,292	$ 63,640	$ (13,739)	$ 3,844
all inventory		$ 67,471	$ (37,435)	$ 150,186	$ (18,049)

Figure C-1: Cost/Benefit results based on truck costs $15/mile
(A,B,C are results for oversize box inventory; D,E,F are results for all inventory)

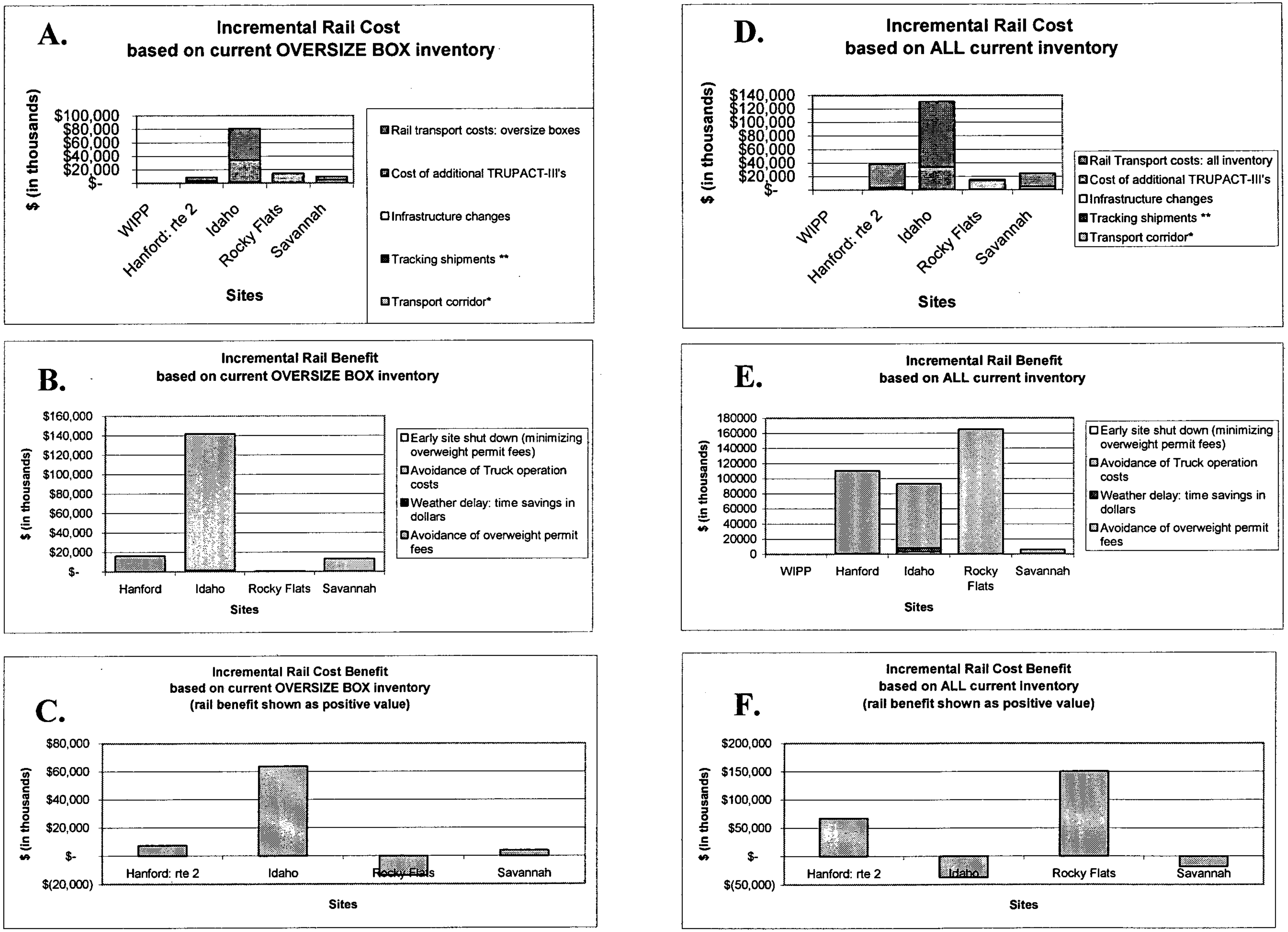


Figure C-2: Cost/Benefit results based on truck costs $5/mile
(A,B,C are results for oversize box inventory; D,E,F are results for all inventory)

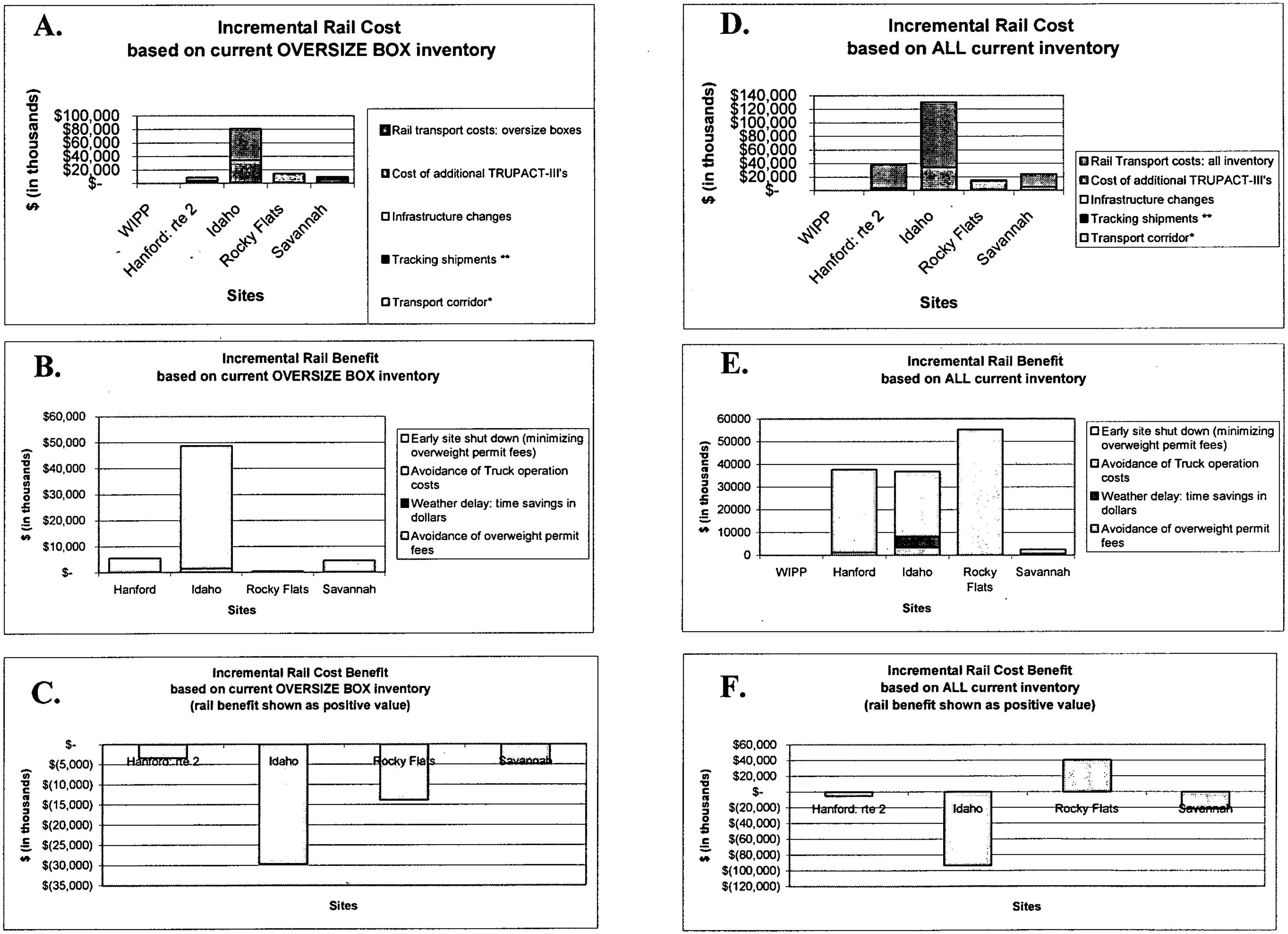


Figure C-3: Rail and truck costs compared on a waste volume basis

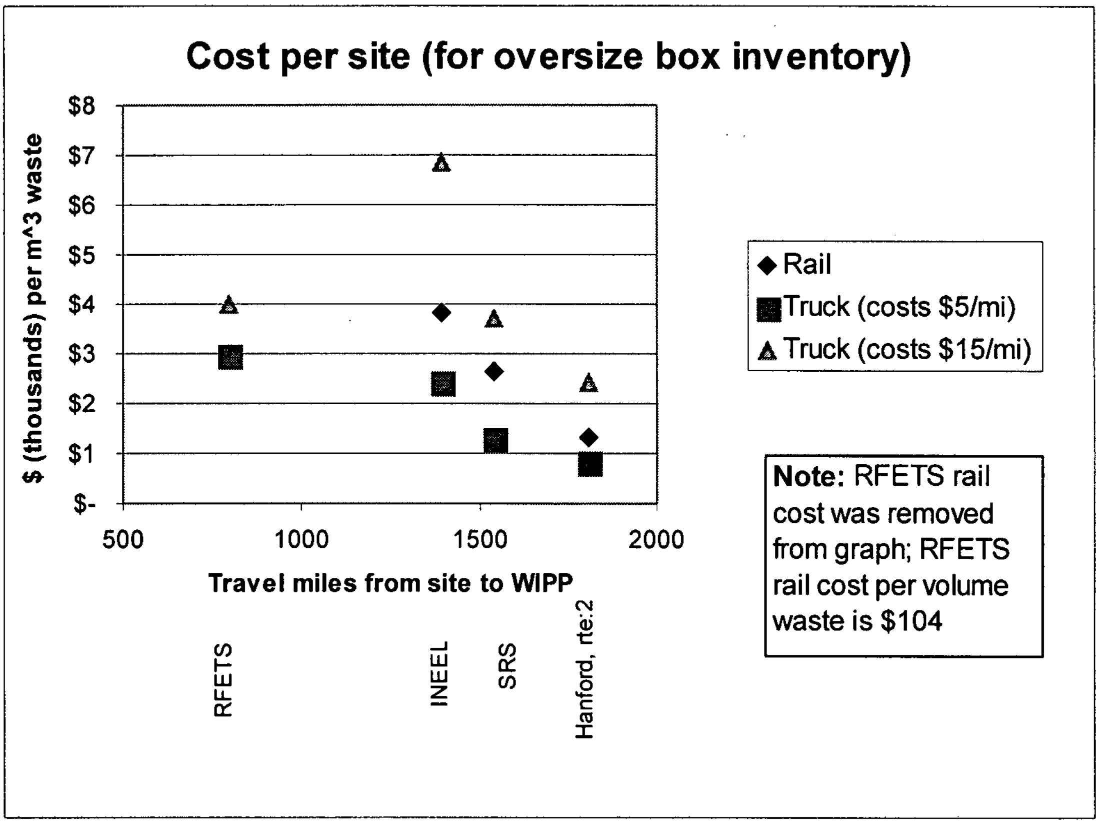


Table C-6: Calculations of rail and truck costs on a per volume basis

Rail	Hanford rte 2: BNSF	INEEL	RFETS	SRS
total miles to WIPP	1808	1392	794	1540
rail cost (thousand $)	$ 8,874	$ 80,731	$ 14,289	$ 9,498
oversize box inventory volume m^3	6,643	21,058	137	3,594
Total rail shipping cost thousand $ per m^3 (for oversize box inventory, 5x5x8 shipped less than 2 to a TRU-III)	$ 1.34	$ 3.83	$ 104.30	$ 2.64
Total rail shipping cost thousand $ per m^3 (for oversize box inventory, 5x5x8 shipped less than 2 to a TRU-III)	$ 1.34	$ 3.83		$ 2.64

Truck (costs $5/mi)	Hanford	INEEL	RFETS	SRS
truck costs (thousand $)	$ 5,490	$ 51,066	$ 407	$ 4,572
oversize box inventory volume m^3	6,643	21,058	137	3,594
Total truck shipping costs thousand $ per m^3 (for oversize box inventory, 5x5x8 shipped less than 2 to a TRU-III)	$ 0.83	$ 2.43	$ 2.97	$ 1.27
Truck (costs $15/mi)				
truck costs (thousand $)	$ 16,167	$ 144,372	$ 550	$ 13,343
oversize box inventory volume m^3	$ 6,643	$ 21,058	$ 137	$ 3,594
Total truck shipping costs thousand $ per m^3 (for oversize box inventory, 5x5x8 shipped less than 2 to a TRU-III)	$ 2.43	$ 6.86	$ 4.01	$ 3.71
*Not in truck costs:	truck TRU-III considered to be sunk costs			
Considered as truck costs:	special TRU-III trailers (depending on timing may be sunk cost)			

Table C-7: Rail sensitivity analysis: Oversize box inventory

negative number means that rail is more expensive

	cost	cost	benefit	Total Rail Cost (thousands $)				Total Rail Benefit (thousands $)				Total Rail benefit-cost (thousands $)			
shipping config. For 5x5x8 boxes per TRU-III	rail cycle (days)	Rail cost per car rates	Truck costs per mile	Hanford	INEEL	RFETS	SRS	Hanford	INEEL	RFETS	SRS	Hanford	INEEL	RFETS	SRS
1	0%	0%	$ 5.00	$ 8,874	$ 80,731	$ 14,289	$ 9,498	$ 5,490	$ 51,066	$ 407	$ 4,572	($3,384)	($29,665)	($13,882)	($4,926)
1	0%	-50%	$ 5.00	$ 6,345	$ 57,383	$ 14,262	$ 7,284	$ 5,490	$ 51,066	$ 407	$ 4,572	($855)	($6,317)	($13,855)	($2,712)
1	0%	0%	$ 15.00	$ 8,874	$ 80,731	$ 14,289	$ 9,498	$ 16,167	$ 144,372	$ 550	$ 13,343	$7,292	$63,640	($13,739)	$3,844
1	0%	-50%	$ 15.00	$ 6,345	$ 57,383	$ 14,262	$ 7,284	$ 16,167	$ 144,372	$ 550	$ 13,343	$9,822	$86,989	($13,712)	$6,059
	-20%	0%	$ 5.00	$ 7,791	$ 70,209	$ 9,647	$ 8,106	$ 5,490	$ 51,066	$ 407	$ 4,572	($2,301)	($19,143)	($9,240)	($3,533)
	-20%	0%	$ 15.00	$ 7,791	$ 70,209	$ 9,647	$ 8,106	$ 16,167	$ 144,372	$ 550	$ 13,343	$8,376	$74,163	($9,097)	$5,237

Table C-8: Percentages of major costs

Percentage of total

	cost input	benefit input	benfit output				cost output				cost output				*sum of cost output*			
shipping configuration	Rail rates	Truck costs per mile	Truck operations cost as percentage of total rail benefit				Rail transport cost as percentage of total cost				Cost of additional TRUPACT-III as percentage of total cost							
			Hanford	INEEL	RFETS	SRS	Hanford	INEEL	RFETS	SRS	Hanford	INEEL	RFETS	SRS	*Hanford*	*INEEL*	*RFETS*	*SRS*
1	0%	$ 5.00	98%	92%	99%	97%	57%	58%	0.37%	47%	32%	41%	95%	49%	*89%*	*99%*	*95%*	*96%*
1	-50%	$ 5.00	98%	92%	99%	97%	40%	41%	0.19%	30%	45%	58%	95%	65%	*84%*	*99%*	*95%*	*95%*
1	0%	$ 15.00	99%	97%	99%	99%	57%	58%	0.37%	47%	32%	41%	95%	49%	*89%*	*99%*	*95%*	*96%*
1	-50%	$ 15.00	99%	97%	99%	99%	40%	41%	0.19%	30%	45%	58%	95%	65%	*84%*	*99%*	*95%*	*95%*

Table C-9: Hanford route summary

Hanford route differences*

Differences between routes	Hanford			
Costs	**rte 1: UP/BNSF**		**rte 2: BNSF** baseline	
Average cycle time (days)		22		14
Transportation costs ($)				
switch costs per car	$	-		NA
rail transport cost per car	$	35,000	$	25,700
total rail transport cost (oversize inventory less than two 5x5x8 oversize boxes per TRU-III)	$	6,889,167	$	5,058,617
Transport Corridor ($)				
Total Training costs on same route (based on less than two 5x5x8 oversize boxes per TRU-III)		0		
Total Training costs on new route (based on less than two 5x5x8 oversize boxes per TRU-III)			$	785,983
TRUPACT-III fleet				
Total Number of TRUPACT-III fleet required for rail		7.7		4.9
TRU-III rail fleet required above the necessary truck fleet		5.4		2.6
Cost to build the fleet ($)	$	5,915,246	$	2,825,192
total cost	**$**	**12,804,412**	**$**	**8,669,791**
Cost of the route (rte 2 is baseline)	**$**	**4,134,621**	**$**	**-**

(if positive then rte 1 is more expensive; if negative then rte 2 is more expensive)

* Only differences were taken into account

Figure C-4: Hanford rail route differences, Incremental Rail Costs based on current OVERSIZE BOX inventory

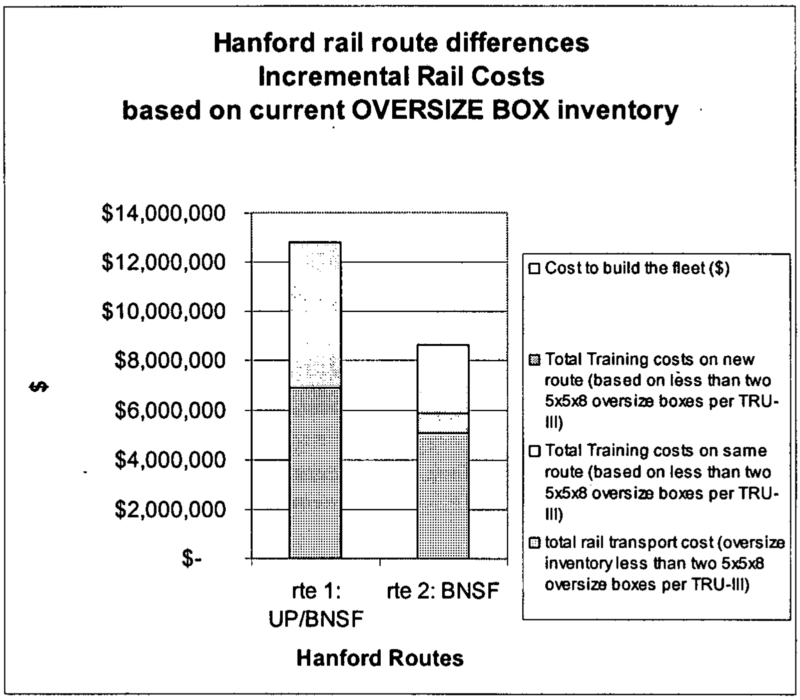


Table C-10: Hanford route sensitivity analysis

Hanford route sensitivity*

Input				Output		
Hanford rte 1: UP/BNSF		Hanford rte 1: UP/BNSF	Hanford rte 2: BNSF			
cycle time rte 1	cycle time difference from rte 2	rate per rail car (switching cost + rail rate)	Passage to states and nations and Hazardous waste training costs ($ per year)**	Difference in number of TRU-III required (above those nec. For truck)	cost difference of TRU-III	cost difference between the two routes (rte 2 as baseline) (if positive then rte 1 has more costs; if negative then rte 2 has more costs)
22	8	$35,000	$ 125,000	2.81	$ 3,090,054	$ 4,134,621
13	-1	$35,000	$ 125,000	(0.35)	$ (386,257)	$ 658,311
22	8	$28,000	$ 125,000	2.81	$ 3,090,054	$ 2,756,788
13	-1	$28,000	$ 125,000	(0.35)	$ (386,257)	$ (719,523)
22	8	$35,000	$ 300,000	2.81	$ 3,090,054	$ 3,174,245
13	-1	$35,000	$ 300,000	(0.35)	$ (386,257)	$ (302,065)
22	8	$28,000	$ 300,000	2.81	$ 3,090,054	$ 1,796,412
13	-1	$28,000	$ 300,000	(0.35)	$ (386,257)	$ (1,679,898)

* Route sensitivty examples are all based on same underlying assumptions for Hanford rte 2 (e.g. cost of trucking and cost of rail changes)

** Passage costs include one time $100,000 fee

Table C-11: Hanford route breakeven equation derivation

Cost functions:

Rate per rail car (x_1)

equation of best fitting line: $y=191x_1-5x10^6$

Yearly passage costs to states & nations (x_2)

equation of best fitting line: $y=-5.65x_2-58989$

TRU-III Cost difference btwn routes (x_3)

equation of best fitting line: $y=x_3-100,000$

Solution equation:

$y=63.7\ x_1\ -1.9\ x_2\ +0.33\ x_3\ -\ 1,719,663$

Figure C-5: Relationship between Hanford route 1 cycle days and the TRUPACT-III cost difference between route 1 and route 2

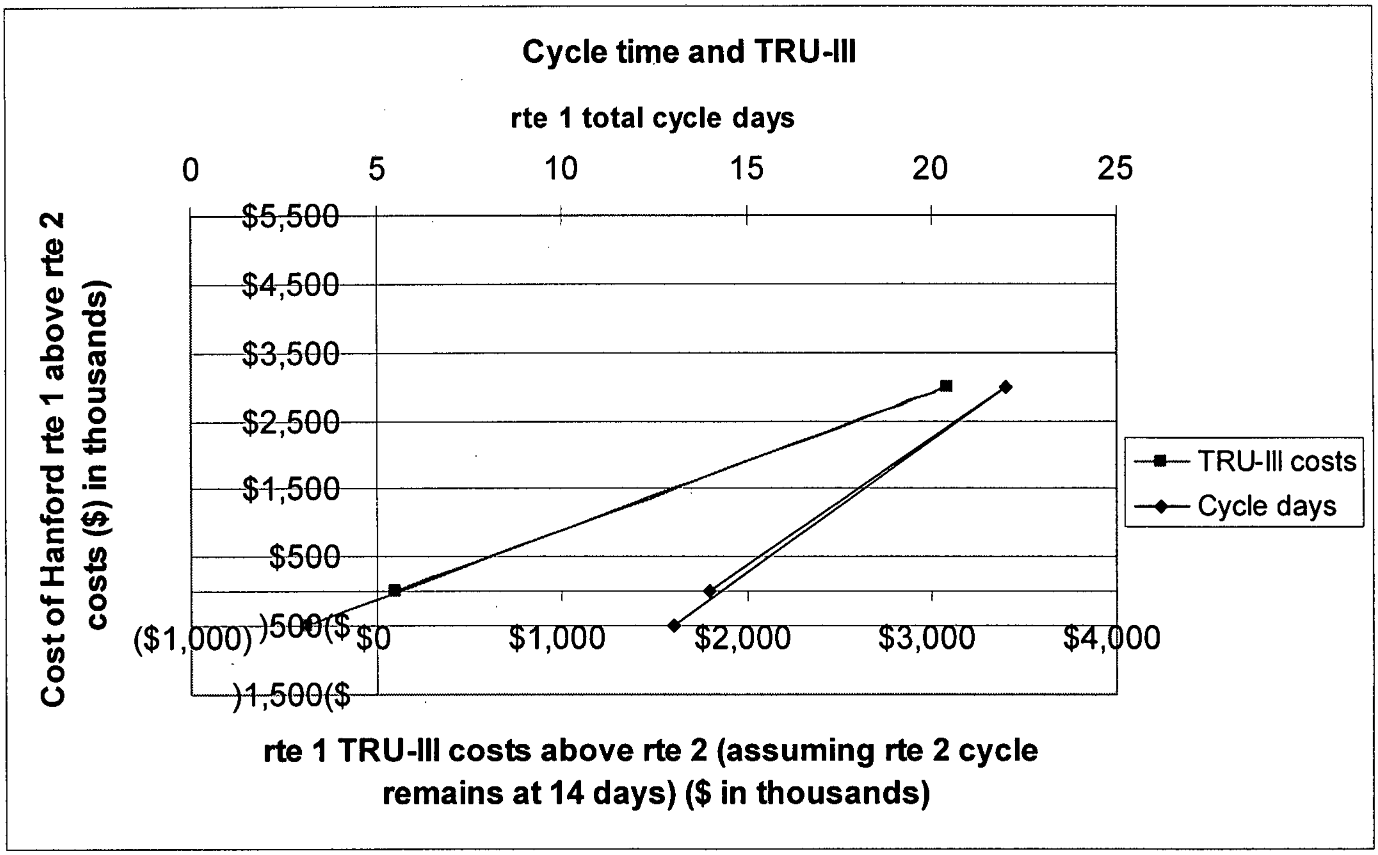


Figure C-6: Hanford breakeven variables and linear regression equations

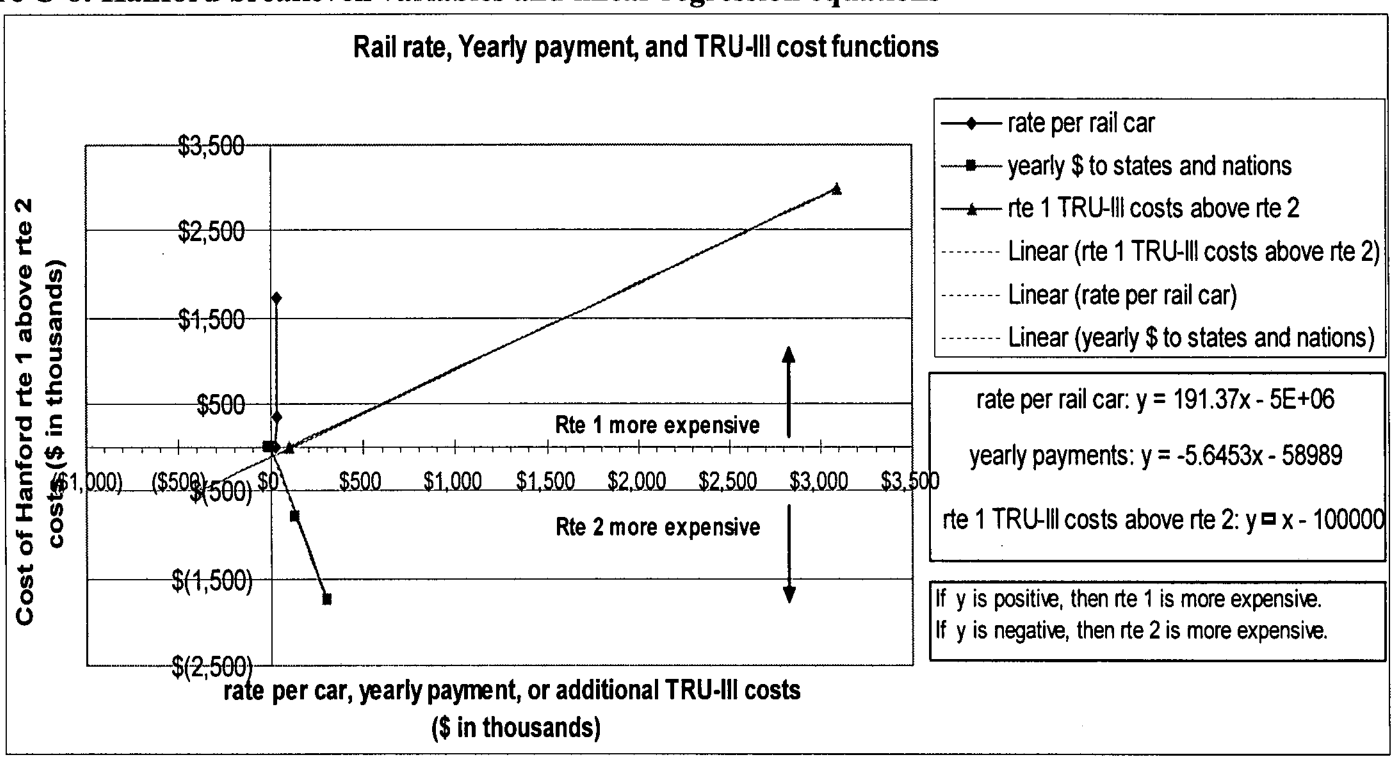
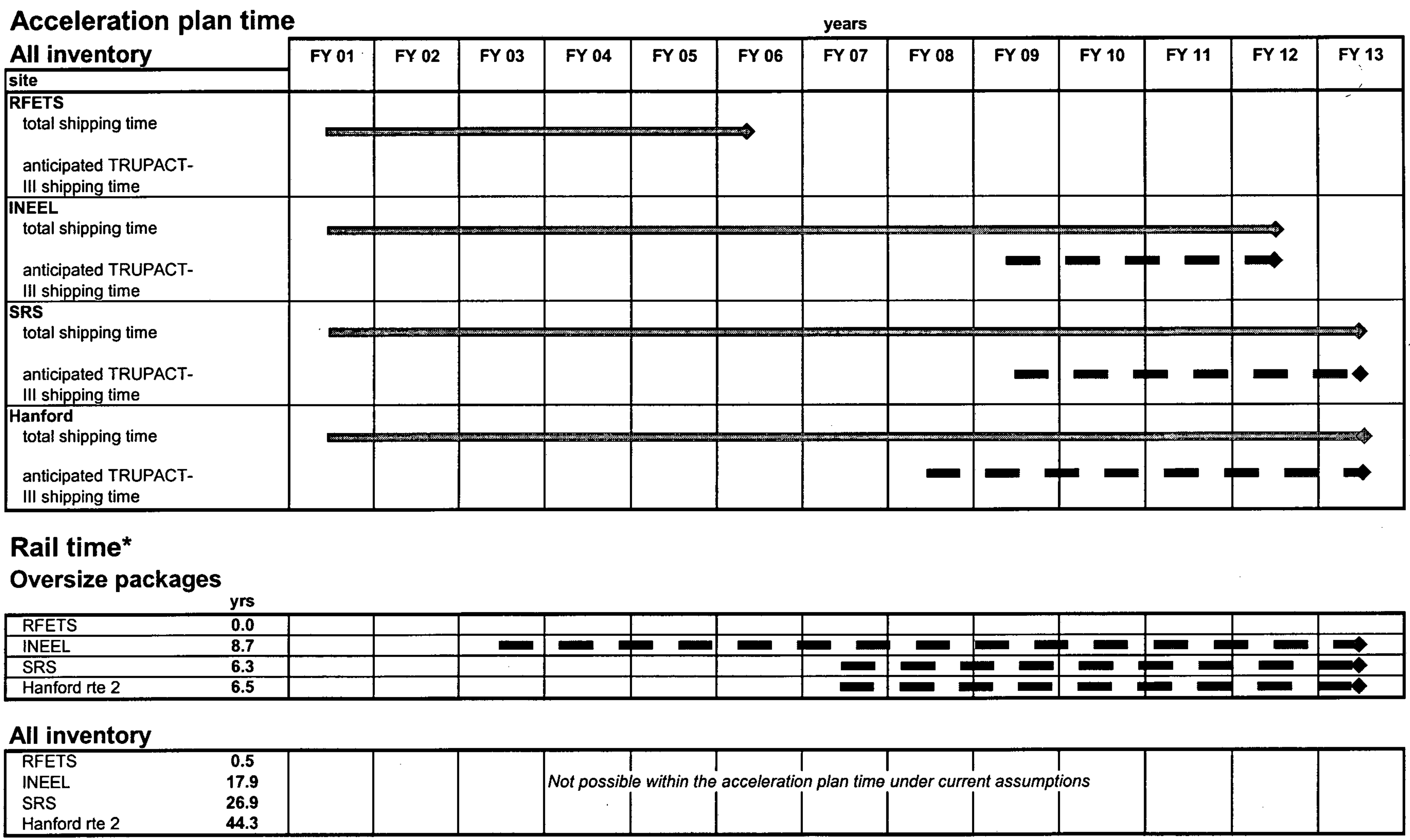


Figure C-7: Comparison of rail time to acceleration plan time
(Acceleration plan time frame supplied by J. Winkel)



*Overweight minimization practice was not considered as an option

Legend
Site operation time
TRUPACT-III shipping time

Note: The end dates could be different due to:

(1) Package options; acceleration model uses both TRUPACT-II, Half-Pact and TRUPACT-III
(2) Shipping configuration; acceleration model could be filling up extra in TRUPACT-III oversize box shipments with drums
(3) Acceleration model could be using a smaller volume based on future start date
(4) Volume versus number of boxes; acceleration plan may have a different assumption for repackaging.