NTPA/SMIP-02

DOE Safety Metrics Indicator Program (SMIP)

Fiscal Year 2000 Annual Report of Packaging- and Transportation-related Occurrences

July 2001

U.S. Department of Energy
National Transportation Program
Albuquerque, New Mexico

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DOE/NTPA/SMIP-02

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Fiscal Year 2000 Annual Report of Packaging- and Transportation-related Occurrences

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ABBREVIATIONS AND ACRONYMS

ALO	Albuquerque Operations
ANL-E	Argonne National Laboratory-East
ANL-W	Argonne National Laboratory-West
ATMS	Automated Transportation Management System
BNL	Brookhaven National Laboratory
BNLV	Battelle National Laboratory Nevada
BWO	Babcock and Wilcock of Ohio, Inc.
CFR	Code of Federal Regulations
CH	Chicago Operations
CY	Calendar year
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DP	Defense Programs
EH or ES&H	Office of Environment, Safety and Health
EM	Environmental Management
ER	Energy Research
ETAS	Enterprise Transportation Analysis System
ETTP	East Tennessee Technology Park (K-25 Plant)
FDF	Fluor Daniel Fernald
FE	Fossil Energy
FERM	Fernald Environmental Restoration Management Corp.
FMCSR	Federal Motor Carrier Safety Regulation
FY	Fiscal year
GOSF	Deprecated contractor
HAZMAT	Hazardous materials
HQ	DOE Headquarters
HSR	Hazard Significance Rating
ID	Idaho Operations
IFTA	International Fuel Tax Association
INEEL	Idaho National Engineering and Environmental Laboratory
LANL	Los Alamos National Laboratory
LITC	Lockheed Idaho Technologies Corp. (operator of INEEL)
LL	Lessons learned
LLNL	Lawrence Livermore National Laboratory
LLW	Low-level waste
LMES	Lockheed Martin Energy Systems, Inc.
MK	Morrison-Knudsen Environmental Services
NE	Nuclear Energy, Science and Technology
NN	Non-Proliferation and National Security
NOC	Nature of Occurrence
NTP	DOE National Transportation Program
NTPA	DOE National Transportation Program Albuquerque
NV	Nevada Operations

OAK	Oakland Operations Office
OH	Ohio Operations
OR	Occurrence report
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
ORPS	Occurrence Reporting and Processing System
P&T	Packaging and transportation
PATS	Packaging and Transportation Safety
PGDP	Paducah Gaseous Diffusion Plant
PHMC	Project Hanford Management Contractor
PNNL	Pacific Northwest National Laboratory
RBOF	Receiving Basin for Offsite Fuels
RCRA	Resource Conservation and Recovery Act
R_f	Repetitive factor
RFO	Rocky Flats Office
RL	Richland Operations
RSF	Repetitive Significance Factor
RW	Radioactive Waste Management
SAFER	Safety and Fitness Electronic Records System
SC	Science
SMIP	Safety Metrics Indicator Program
SNL-A	Sandia National Laboratory–Albuquerque
SPR	Stakeholder and Publicity Significance Rating
SR	Savannah River Operations
TCEAP	Transportation Compliance Evaluation/Assistance Program
TRAGIS	Transportation Routing Analysis Geographic Information System
TRU	Transuranic
TSR	Technical Safety Requirements
UE	Uranium Enrichment
USQ	Unreviewed safety question
WHC	Westinghouse Hanford Company
WSRC	Westinghouse Savannah River Company
Y-12	Oak Ridge Y-12 Plant

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Occurrence Reporting and Processing System (ORPS) is an interactive computer system designed to support DOE-owned or -operated facilities in reporting and processing information concerning occurrences related to facility operations. The Oak Ridge National Laboratory has been charged by the DOE National Transportation Program Albuquerque (NTPA) with the responsibility of retrieving reports and information pertaining to packaging and transportation (P&T) incidents from the centralized ORPS database. These selected reports are analyzed for safety concerns, trends, potential impact on P&T operations, and 'lessons learned' in P&T safety.

To support this analysis and trending, the Safety Metrics Indicator Program (SMIP) was established by the NTPA in fiscal year (FY) 1998. Its chief goal is to augment historical reporting of occurrence-based information by providing (1) management notification of those incidents that require attention, (2) an accurate picture of contractors' P&T-related performance, and (3) meaningful statistics on occurrences at particular sites, including comparisons among different contractor sites and between DOE and the private sector.

This annual report contains information on those P&T-related occurrences reported to the ORPS during the period from October 1, 1999, through September 30, 2000. Only those incidents that occur in preparation for transport, during transport, and during unloading of hazardous material are considered as packaging- or transportation-related occurrences.

Motor carriers that logged over 20,000 miles transporting cargo for DOE provided information on the total number of miles that they logged during calendar year (CY) 2000. Coordinating this information with the data provided by the systems and databases mentioned enabled the NTPA to develop an indicator of performance based on vehicle miles. Most carriers' safety measures showed an improvement this year, indicating that DOE carriers improved their safety performance during FY 2000. **In fact, all except one of these carriers for FY 2000 have safety measures below the U.S. Department of Transportation (DOT) nationwide-average for carriers of 0.75 accidents per million miles.** For all transport including DOE mileage, **all except one DOE-utilized carriers who reported mileage had an average of only 0.26 accidents per million miles**. **More significant, these DOE carriers had no accidents involving shipments conducted for DOE**. This information indicates that the vast majority of DOE-utilized carriers have a better safety record than the motor carrier industry as a whole. Too, comparing the FY 1999 safety measure of 0.42 shows a 38% improvement in safety. The absence of accidents involving DOE shipments indicates that these carriers have performed well when transporting DOE freight.

Ideally, P&T occurrence reports (ORs) should identifiable on the ORPS through their Activity Category or Nature of Occurrence. Because some pertinent occurrences overlap other categories such as Normal Operations or Construction, these occurrences could be overlooked if all ORs were not analyzed for SMIP-defined packaging- or transportation-related activity regardless of their categorization in ORPS.

As part of the SMIP weekly analysis of events posted to the ORPS, 11 seemingly packaging- or transportation-related events were identified in FY 2000 that involved movement of nuclear material and explosives between facilities without proper notification and authorization. Further investigation revealed that similar events had occurred during FY 1999 and four such events have occurred in FY 2001.

Through an onsite visit and discussions with management, the NTPA determined that the events in question were not actually packaging or transportation occurrences. The occurrences took place in a unique enclosure that has many facilities and literally miles of interconnected corridors. Therefore, these onsite movements of material are considered operational day-to-day activity and not transportation, per se. Hence it was necessary to remove these archived occurrences from the SMIP P&T Occurrence Database and not count these events as transportation-related. Though these occurrences did not involve transportation concerns, **this analysis does prove that the SMIP process is functioning properly and is capable of identifying abnormalities, ensuring that appropriate action is being taken to mitigate future problems.**

Of the 2,554 ORs reported to the ORPS during FY 2000, 5.7% were packaging or transportation related. Of these 146 occurrences, 13 were classified by the sites as *unusual*, chiefly because they occurred offsite. Three of these events were caused by non-DOE shippers, and five of these events were concerned with waste characterization issues. SMIP scrutinized these occurrences to determine their significance and found that all these reports had event consequences equal to or less than *slight*. Moreover, only two of the ORs classified as unusual had Hazard Significance Ratings (HSRs) above 24 (e.g., 32); therefore, they did not approach the SMIP alarm threshold for additional attention. However, these ORs were appropriately reviewed and evaluated according to the protocol mandated by DOE Order 232.1-1A. The SMIP simply complements this established system.

Review of the nature of occurrence (NOC) totals and normalized information shows that contamination and shipment preparation events continue to account for the highest frequency of occurrences. Though shipping preparation incidents remain the main source of occurrences, the number of these events has steadily declined over the last few years (from 54 ORs in 1997 to 35 ORs in FY 2000).

Correlation between the SMIP NOC codes (*what* happened) with the ORPS-assigned root-cause codes (*why*), revealed that facilities reporting incidents have assigned management problems and personnel error as the most frequent root causes, in that order. Analysis revealed that most of the incidents caused by management problems resulted from inadequate definition of policies or management's failure to provide adequate guidance. The NTPA will track sites reporting these discrepancies to ensure that their corrective actions address these deficiencies and are implemented. The majority of the incidents related to personnel error were reported to have resulted from an "inattention to detail."

SMIP's services are being recognized and utilized by other programs. For instance, SMIP data is being used in the NTPA Transportation Compliance Evaluation/Assistance Program (TCEAP) management program to focus onsite evaluations by assisting with the identification of areas at

prospective sites that need attention. SMIP is also being utilized by the Motor Carrier Safety Evaluation Program and is being integrated into their project management.

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1. INTRODUCTION

The Oak Ridge National Laboratory (ORNL) has been charged by the DOE National Transportation Program (NTP) with the responsibility of retrieving reports and information pertaining to packaging and transportation (P&T) incidents from the centralized Occurrence Reporting and Processing System (ORPS) database. These selected reports have been analyzed for trends, impact on P&T operations and safety concerns, and lessons learned (LL) in P&T operations. This task is designed not only to keep the NTP aware of what is occurring at DOE sites on a periodic basis, but also to highlight potential P&T problems that may need management attention and allow dissemination of LL to DOE Operations Offices, with the subsequent flow of information to contractors.

The Safety Metrics Indicator Program (SMIP) was established by the NTP in fiscal year (FY) 1998 as an initiative to develop a methodology for reporting occurrences with the appropriate metrics to show rates and trends. One of its chief goals has been to augment historical reporting of occurrence-based information and present more meaningful statistics for comparison of occurrences. To this end, the SMIP established a severity weighting system for the classification of the occurrences, which would allow normalization of the data and provide a basis for trending analyses. The process for application of this methodology is documented in the September 1999 report *DOE Packaging and Transportation Measurement Methodology for the Safety Metrics Indicator Program (SMIP).*

This annual report contains information on those P&T-related occurrences reported to the ORPS during the period from October 1, 1999, through September 30, 2000. Only those incidents that occur in preparation for transport, during transport, and during unloading of hazardous material are considered as packaging- or transportation-related occurrences. Other incidents with P&T significance, but not involving hazardous material (such as vehicle accidents or empty packagings), are not rated by the SMIP criteria but are archived in the SMIP Subsidiary Database of occurrences, a sub-database of the main SMIP P&T Occurrence Database.

A total of 146 reports were classified by the SMIP criteria, of which 144 have been finalized. Trending comparisons were made with these reports and the 851 other occurrence reports (ORs) accumulated in the SMIP P&T Occurrence Database since FY 1994, all of which were also evaluated according to the SMIP criteria.

Additionally, information on the number of shipments made by DOE carriers and the types of materials transported was obtained from the Enterprise Transportation Analysis System (ETAS), formerly the Shipment Mobility Accountability Collection. This information was used in conjunction with the Transportation Routing Analysis Geographic Information System (TRAGIS, a GIS-based transportation and analysis model that replaces the older HIGHWAY and INTERLINE models) to estimate point-to-point mileage, yielding a metric of vehicle-miles or package-miles. This information was subsequently used to develop indicators for (1) determining the relative safety of DOE contractors who package and ship hazardous materials and (2) comparing of DOE P&T safety with that of private industry.

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2. APPLICATION OF SMIP METHODOLOGY

2.1 SMIP-RATED ORs

SMIP methodology was used to classify and rate the occurrences according to severity. The ORs contained in the historical Packaging and Transportation Safety (PATS) Occurrence Reports Database were reviewed, reclassified to the SMIP criteria, and moved to the SMIP P&T Occurrence Database. Table 1 shows some of the parameters used to process the P&T occurrences involving hazardous material. To see a listing of the FY 2000 occurrences themselves and their specific values, see Table A.1 in the Appendix A. Also for FY 2000, Table B.1 of Appendix B shows the 68 offsite occurrences.

In Table 1, the shaded columns of the table are the most significant, representing the top-level measures used in the NTP SMIP for defining the indicators for occurrences involving hazardous material: (1) HSR, Hazard Significance Rating; (2) RSF, Repetitive Significance Factor; and (3) SPR, Stakeholder and Publicity Significance Rating.

Table 1. SMIP parameters used for display of ORs

Database classification						**Severity indicators**						
Report number	Pkg/ Trn	HM/W	ON/ OFF	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	R_f	RSF	SPR

The measure HSR is intended to indicate the actual risk posed by an occurrence. The measure RSF is then applied to the HSR to indicate whether the occurrence has a history of repetition. A repetitive occurrence is the repetition of a given type of event at a DOE site or an occurrence that results from activities at a DOE site after the site has issued a notification report and specified corrective actions to the ORPS for a previous similar event. The Repetitive Factor (R_f) is simply the number of such events, and the RSF is the product of R_f and HSR.

This combination of HSR and RSF can be used by the NTP to identify specific areas that need special attention or that warrant the development of a specific LL report. The measure SPR is independent of HSR and RSF and is used to identify the level of significance of the occurrence from a stakeholder and publicity perspective.

Of the three top-level measures identified, HSR is the most significant. It is a measure of the occurrence's hazard significance from a personnel, public safety, and environmental impact standpoint and includes a weighting factor that indicates the quantity of hazardous material involved in the occurrence. The HSR is the product of the following three factors:

$$\mathbf{HSR = W_{EC} \times W_{HC} \times Q_{ty}}$$

The HSR was subdivided into three factors to allow analysts to dissect an event and consistently make judgments on the various elements that contribute to degradation of safety and potential or actual impacts on the environment. The HSR has a numeric range of 1 to 100.

The first weighting, the Event Consequence Measure, W_{EC}, assigns a value ranging from 1 to 5 to indicate the seriousness of the event itself. The W_{EC} ranges from an "anomaly" (which has a very low significance of consequence relative to safety and the environment and a value of 1) to "very serious" (which has a major significance relative to safety and the environment and a value of 5). A W_{EC} weighting factor is assigned to each event based upon actual consequences resulting from the event.

The second factor used in developing the HSR is the Hazard Classification Measure, W_{HC}. This measure indicates the relative risk to personnel and the environment posed by the general physical contents of the hazardous material involved in the event. The value assigned to W_{HC} is based upon the hazardous material classification methodology specified in the U.S. Department of Transportation (DOT) hazardous material regulations, and upon pragmatic judgment. W_{HC} ranges from a low value of 1 for relatively innocuous hazardous materials (Class 9 materials) to a maximum value of 4 for the most hazardous of the hazardous materials (including Class 1 explosives, Class 4.1 wetted explosives, and radioactive materials).

Although the factor W_{HC} indicates a material's potential hazard, it does not provide a measure of the quantity of material involved. The quantity of material in a shipment can significantly affect the actual hazard posed. One indicator of the relative amount or quantity of material in a shipment is the type of package used. For example, with radioactive materials, where a graded approach to packaging is used, the lower-integrity packages are used for either lower quantities of material or the less hazardous of that class of materials.

Therefore, the third factor, Q_{ty}, indicates the relative amount and graded hazard within a class. The numerical value assigned to Q_{ty} is based on the type of packaging used, which indicates the relative amount and hazard. Q_{ty} ranges from a low of 1 for limited-quantity shipments in excepted packages to a maximum of 5 for the largest quantities and the most hazardous materials within a class. For example, for radioactive materials, shipment of a very low quantity of material is allowed in an excepted package (indicating a very low risk), and the Q_{ty} value for these packagings is 1. In contrast, a Type B package is used when the risk posed by the contents is high, and the Q_{ty} value assigned for a Type B package is 5. In addition, a measure is assigned for Q_{ty} to account for the presence of contamination.

Similar principles were used to establish the weighting factors for non-radioactive hazardous materials. Q_{ty} infers the quantity and relative hazard posed by the hazardous material, based on the packaging requirements for hazardous material specified in the DOT hazardous material regulations and on pragmatic judgement.

The other parameters of the table are chiefly for classification:

1. The parameter <u>Pkg/Trn</u> denotes whether the occurrence is related to packaging, transport, or both.

2. The parameter HM/W identifies whether the occurrence involves hazardous material or waste [Resource Conservation and Recovery Act (RCRA) waste, low-level waste (LLW), transuranic (TRU) waste, etc.].

3. The parameter ON/OFF denotes whether the occurrence occurred onsite or offsite. The sub-parameter OFF indicates that the occurrence had chiefly offsite applicability; the sub-parameter ON/OFF indicates that the event occurred onsite but is related to an offsite shipment; and the parameter ON/ON indicates that the event occurred onsite but is not related to an offsite shipment.

4. The parameter NOC is the nature of occurrence as identified by the NTP program, not as identified in the ORPS. The NTP NOC evaluates occurrences from the transportation specialist's perspective, whereas the ORPS-assigned NOC is more generic, including other categories. The NOC parameter is discussed in more detail in Sect. 4.

5. The parameter HC is used to identify the hazard class (or classes) of materials involved in the occurrence. This is key in proceeding to identify the HSR.

Occurrences are also evaluated by which program is actually responsible for the occurrence. Ownership is attributed to the "Technical Program" (i.e., to the programs outside of the P&T organization, such as operational programs supplying hazardous materials for transport) or to the P&T organizations if the occurrence is attributable to that area—or possibly both. A further breakdown assigns responsibility based upon the subprogram parameter to which the occurrence relates, such as management or training. Responsibility allocation (or ownership) assigns the occurrence to the program—rather than the site—that produced it.

The occurrences were evaluated as to program responsibility, and this information is included as part of the SMIP P&T Occurrence database. However, this area was left out of the table to simplify presentation and discussion.

A description of the occurrences and their associated rating is included in Appendix A as Table A.1. For more details on the SMIP methodology and its measurement parameters, see the *DOE Packaging and Transportation Measurement Methodology for the Safety Metrics Indicator Program (SMIP).*

2.2 FY 2000 ORs ARCHIVED IN THE SUBSIDIARY DATABASE

The number of occurrences archived in the Subsidiary Database by FY is shown in Table 2. In FY 2000, 21 occurrences that addressed P&T issues but either did not involve the transport of hazardous material or, if so, did not involve transport by truck, boat, plane, or rail are archived in the Subsidiary Database. In general, the type of occurrences contained in the database can be seen by examining the titles shown in Table 3 for the 21 ORs stored during FY 2000.

Table 2. Occurrences archived in Subsidiary Database per FY

FY 1994	FY 1995	FY1996	FY 1997	FY 1998	FY 1999	FY 2000
54	77	79	104	43	36	21
Total ORs in database: 414						

Table 3. FY 2000 ORs that are in the Subsidiary Database

Report Number	Title	On/Offsite	NOC[1]
ALO-AO-MHC-PANTEX-2000-0032	Ruptured waste drum near miss	ON	2A
ALO-LA-LANL-LANL-1999-0001	Official receipt of state of NM Environment Department Compliance Order	ON	5
ALO-LA-LANL-LANL-2000-0001	Official receipt of state of NM Environment Department Compliance Order	ON	4
CH-AA-ANLW-ANLW-2000-0004	Use of forklift with expired load test	ON	3
ID--BBWI-LANDLORD-2000-0022	Unauthorized modifications to calcine sample storage casks	ON	2C
ID--BBWI-RWMC-2000-0001	55-ton cask unloading incident	ON	3
ID--BBWI-SMC-2000-0002	Rupture of Kevlar lifting sling during offloading of Abrams Tank	ON	3
ID--BBWI-TAN-2000-0023	Arc strikes on OS-197 shipping cask	ON	2A
NVOO--BNLV-NTS-2000-0023	Vendor's written procedures did not comply with welding code	ON	2C
ORO--LMES-Y12SITE-2000-0030	Mercury spill from a five gallon container	ON	2A
ORO--ORNL-X10BOPLANT-1999-0008	Federal motor carrier safety requirements noncompliance	OFF	6A
RFO--KHLL-SITEWIDE-2000-0003	Positive USQD, plugged or failed drum vents "USQ"	ON	2A
RFO--KHLL-WSTMGTOPS-1999-0020	Forklift lifting mechanism fails	ON	3
RFO--KHLL-WSTMGTOPS-2000-0016	Authorization basis violation, waste drums without rigid drum liners …	ON	2B
RL--BHI-REMACT-1999-0008	Subcontractor vendor enters Radiological Buffer Area w/o dosimetry or training	ON	8D
RL--PNNL-PNNLBOPER-2000-0010	Discrepancies discovered between waste management documentation and …	ON	3
SR--WSRC-CSWE-2000-0014	Procedure non-compliance, rail shipment--melter storage box	OFF	6
SR--WSRC-CSWE-2000-0017	DOT non-compliance	ON	6
SR--WSRC-FMIS-2000-0002	Transformer oil spill at the 745-A Laydown Yard	ON	1B1
SR--WSRC-SLDHZD-1999-0012	Suspect weld quality in B-12/B-25 waste containers	OFF	8B
SR--WSRC-TSDGEN-2000-0001	WSRC procurement and packaging non-compliances	ON	2C

[1] See Table 6 for an explanation of NOC categories

.

3. SUMMARY OF SELECTED ORs

3.1 CATEGORIZATION OF ORs

DOE Order 232.1-1A, "Occurrence Reporting and Processing of Operations Information," categorizes ORs into three types: emergency, unusual, and off-normal. For transportation, DOE Manual 232.1-1A defines these three categories as the following:

Emergency

> Events or conditions that represent an actual or potential release of radiological or non-radiological hazardous materials from a DOE shipment outside a DOE site. (This definition is derived from DOE G 151.1, Categorization and Classification of Operational Emergencies, to which DOE O 241.1 defers.)

Unusual occurrences

1) Any packaging or transportation activity (including loading, unloading, or temporary storage) involving the offsite release of radioactive material, etiologic agents, a reportable quantity of hazardous substance, or marine pollutants.

2) Any shipment of radioactive material that arrives at its destination with radiation or contamination levels greater than DOT limits, or results in personnel radiation exposure higher than permitted in Federal permits, Federal regulations, or DOE standards.

3) Any shipment or onsite transfer of radioactive material or hazardous waste that arrives at its destination with an unaccounted for package or an irreconcilable shipping paper, waste manifest, or onsite transfer authorization.

4) A vehicle, vessel, rail or air incident or accident (without personal injury) that presents significant impact on the ability of a facility to conduct transportation operations and:

    (a) results in release of radioactive or hazardous materials above Federal permit, Federal regulatory, or DOE Standard limits;

    (b) involves performance degradation of safety equipment; or

    (c) is the result of failure or degradation of administrative controls required to ensure safety.

5) Violations of the Federal Motor Carrier Safety Regulations (FMCSR) or the Hazardous Materials Regulations if those violations are determined by DOT inspection and result in a fine (monetary penalty).

Off-Normal

1) Any packaging or transportation activity involving:

    (a) the offsite release of non-radioactive hazardous material, or any quantity of hazardous waste; or

    (b) the onsite release of radioactive materials, etiologic agents, hazardous substances, hazardous waste, or marine pollutants.

2) A vehicle, vessel, rail or air incident or accident (without personal injury) that affects the ability of a facility to conduct transportation operations and:

    (a) results in release of radioactive or hazardous materials below limits established by Federal permits, Federal regulations, or DOE Standard limits but must be reported to State or local agencies; or

    (b) is the result of operational procedural violations, including maintenance or administrative procedures.

3) Noncompliances (potential violations) of the DOT Hazardous Materials Regulations or the transportation and packaging requirements of the Nuclear Regulatory Commission involving:

    (a) errors made by the shipper in materials description, marking, labeling, or placarding;

    (b) an unqualified person signing shipping papers;

    (c) the highway routing selection requirements for highway route controlled shipments or the notification requirements for spent-fuel shipments not being observed;

    (d) the separation and segregation tables for hazardous materials not strictly adhered to; or

    (e) the applicable packaging requirements for the assembly, handling, or selection of a package not being in accordance with the applicable regulations.

4) Noncompliances (potential violations) of the FMCSRs involving:

    (a) a contractor driver operating a DOE-owned motor vehicle after a positive drug test or failure of an alcohol test;

    (b) an unqualified driver operating a vehicle (medical, driver's license, or training not in compliance);

(c) the carrier (contractor management) not having required insurance;

(d) a vehicle that failed inspection not being removed from service;

(e) a specification cargo tank with expired inspection being in service with hazardous materials;

(f) a driver's log book deliberately misrepresented; or

(g) the carrier (contractor management) failing to perform random or periodic drug or substance-abuse testing.

5) Any violation of the Hazardous Material Regulations or FMCSR if that violation is determined by DOT inspection and does not result in a penalty.

Occurrences are reportable incidents as defined by DOE Order 232.1-1A. Reportable incidents for carriers of hazardous material are defined by 49 CFR Part 171.15, which regards incidents as accidents. In 49 CFR Part 390.5, the FMCSRs defines accidents as involving a (1) fatality, (2) bodily injury to a person, or (3) disabling damage to a vehicle. It is within this context that DOE ORs can be compared with shipping accidents experienced by private industry.

3.2 EMERGENCY AND UNUSUAL OCCURRENCES

Thirteen of the 146 occurrences that were retrieved and reviewed from the ORPS during FY 2000 were categorized as unusual. All the other ORs were categorized as off-normal. Table 4 includes a brief description of the ORs that were categorized as unusual. The occurrence number assigned by the ORPS to the report appears bolded above the description.

Table 4. Summary of unusual occurrences

ALO-KO-SNL-15000-2000-0001
Control was lost on 8 sealed sources contained in two carrying containers. The cases, which contained plutonium-239 calibration sources of <0.5 micro-curies each, were discovered in Rio Rancho, New Mexico outside a private residence. The authorities traced the sources to Sandia. A New Mexico Environmental Department official took possession of the sources. (The sources posed no hazards to the public or the environment.)
CH-AA-ANLE-ANLEPFS-2000-0002
ANL-E Waste Management Operations was notified by Envirocare of Utah, Inc. that a shipment was surveyed upon arrival and found to have a maximum contact dose rate of 220 mR/hr on top of the bin. The maximum allowable contact dose rate on a container shipped on an open transport vehicle, such as a flat bed, is 200mR/hr. Prior to release from ANL-E by Waste Management Operations the container had been surveyed three times and had not exceeded 70 mR/hr.

Table 4. Summary of unusual occurrences (cont'd)

CH-BH-BNL-BNL-1999-0024
Following the off-loading of a contaminated package containing lead at Bldg 650, routine surveys by personnel revealed removable contamination on the bed of the WMD rack truck reading 1000 cpm above background or 10,000 dpm. The spread of contamination is believed to be the result of a breach in the herculite covering that occurred while handling the package using a forklift within the Controlled Area of the Bldg 650 yard.
CH-BH-BNL-BNL-2000-0008
Mercury leaked from a salvage dumpster that was being loaded on to a truck by the vendor. The dumpster was the roll-off type typically used for demolition. While the operator was raising the dumpster up onto a truck, a field engineer noticed that a silver-looking fluid was dripping from the back gate of the dumpster.
ID--BBWI-TRA-2000-0008
A commercial transport company delivered a DOT shipping cask to the Test Reactor Area Hot Cells. During the performance of the receipt inspection by the facility Radiological Controls Technician, loose surface contamination was detected on a large area wipe masslin performed of the entire cask overpack and pallet surfaces. A smear performed on the underside of the cask pallet detected contamination of 2,880 dpm/100cm2.
ORO--BJC-K25WASTMAN-1999-0019
On 11/02/99, a 21st Century container of unstabilized pond sludge arrived at an out-of-state disposal facility with streaks of dried material on the outside of the container. The streaks appeared to have originated from around the container's lid. Radiological surveys performed by the disposal facility indicated radioactivity levels were compliant with DOT. This event was reported as an unusual occurrence based upon the potential for release of hazardous radioactive material.
ORO--BJC-K25WASTMAN-1999-0026
The Safety Authorization Basis for a storage facility was exceeded. Eight containers were transported from storage facilities at the Y-12 Plant and the East Tennessee Technology Park to K-1423 for nondestructive assay (NDA) before processing at the TSCA Incinerator. The material met all shipping and storage requirements based upon process knowledge supplied by the generator. While awaiting NDA results, the waste was placed into compliant storage at K-1065-E based upon process knowledge. However, after NDA results were received, the uranium enrichment levels were found to have exceeded the Safety Authorization Basis for the storage facility.
ORO--BJC-K25WASTMAN-2000-0012
On 6/16/2000, two 21st Century containers of unstabilized pond sludge arrived at an out-of-state disposal facility with streaks of dried material on the outside of the container. The streaks appeared to have originated from around the container's lid. Radiological surveys performed by the disposal facility indicated radioactivity levels were compliant with Department of Transportation (DOT) requirements. This event was reported as an unusual occurrence based upon the potential for release of hazardous radioactive material.

Table 4. Summary of unusual occurrences (cont'd)

ORO--LMES-Y12SITE-2000-0004
The Y-12 Plant Shift Superintendent's office was informed that a package labeled "Radiological Material" had been delivered to Building 9995 and had been stored in a non-radiological area. The Y-12 Source Control Custodian was not notified of the delivery. The 8-by-8-inch package contained a Yb-169 source, with listed activity of 48.8 GBq. Subsequent RadCon surveys detected no surface contamination and less than or equal to 0.1 mRem at contact.
ORO--MK-WSSRAP-2000-0002
The CERCLA reportable quantity (RQ) for lead phosphate was exceeded. During waste hauling operations between the adjacent Army site and the DOE-WSSRAP, the hauling operations into the engineered disposal facility were halted due to inclement weather. As a contingency, the lead-phosphate-contaminated soils were then placed into a staging area adjacent to the disposal facility. However, this staging area was not an engineered facility, which resulted in a CERCLA violation. The RQ for lead phosphate is 10 pounds, but calculations indicated that approximately 403 pounds of lead phosphate had been placed in the staging area.
RFO--KHLL-WSTMGTOPS-2000-0010
The Authorization Basis for Building 906 was violated when crates requiring a Limiting Condition for Operations surveillance were not surveyed prior to receipt. It was discovered that one of 17 crates received did not have the required surveillance performed upon it.
RL--PHMC-GENERAL-2000-0002
A shipment of natural uranium received had a dose rate on the surface of the package of 5 mrem/hr. The uranium (rock) was packaged in a fiberboard container and shipped as a Limited Quantity per DOT 49 CFR 173.421. DOT49 CFR 173.421 limits the dose rate at contact with the package to 0.5 mrem/hr.
RL--PHMC-SOLIDWASTE-1999-0006
During a review of bulk Low Level Waste (LLW) shipments received during FY1999, engineering personnel discovered that more than 21 cubic meters of bulk LLW that exceeded the Interim Safety Basis document administrative control limits were received and disposed in the Low-Level Burial Ground.

3.3 OCCURRENCES WITH SIGNIFICANT HSRs

All offsite events are considered significant, but only those that reach a certain level of concern should receive additional attention. The FY 2000 occurrences were scanned to quickly determine which of them might deserve additional scrutiny based upon their HSRs. The alarm threshold is a numerical value derived by considering an OR that has (1) an event consequence for the safety or environmental significance of 4 (significant) or 5 (serious), (2) a hazard class rating of 4 (containing such materials as explosives or radioactive material), and (3) materials contained in PG III or greater packagings or having radiological contamination above 1,000 times the contamination control level allowed by DOT. Hence an HSR of above 64 ($HSR = W_{EC} \times W_{HC} \times Q_{ty} = 4 \times 4 \times 4$) is considered an alert for radioactive materials; an HSR of 48 is considered high for nonradiological materials.

None of the FY 2000 occurrences have HSRs at the threshold level. Therefore, it was decided to review those occurrences that had HSRs of over 24, a level that has been shown in previous years to sometimes contain occurrences that have received media attention. For FY 2000, 18 ORs had HSRs above 24, 6 of which were 40. These ORs are identified in Table 5 below.

Table 5. FY 2000 occurrences with an HSR > 24

Report number	HSR
ALO-KO-SNL-10000-2000-0002	32
CH-AA-ANLE-ANLEAGHCF-2000-0002	40
OH-FN-FDF-FEMP-1999-0023	32
OH-FN-FDF-FEMP-2000-0019	32
ORO--BJC-K25WASTMAN-1999-0026	32
ORO--BJC-X10ENVRES-2000-0015	40
ORO--ORNL-X10HFIR-1999-0025	40
ORO--ORNL-X10PLEQUIP-1999-0009	32
RFO--KHLL-771OPS-1999-0059	32
RFO--KHLL-NONPUOPS1-1999-0004	32
RFO--KHLL-TRANSOPS-1999-0003	32
RFO--KHLL-WSTMGTOPS-2000-0013	32
RL--PHMC-324FAC-2000-0005	40
RL--PHMC-FSS-2000-0003	32
RL--PHMC-SOLIDWASTE-2000-0005	32
RP--CHG-TANKFARM-2000-0063	40
SR--WSRC-ALABF-2000-0006	32
SR--WSRC-RBOF-2000-0003	40

The FY 2000 ORs identified in Table 5 involved radioactive material shipments and had event consequence measures (W_{EC}) of 2; therefore, the potential consequences of these shipments were rated as *slight* (e.g., having minimum safety consequences with little potential for ultimately leading to endangerment of environment or personnel).

3.4 OCCURRENCES WITH POSITIVE REPETITIVE FACTORS

There was only one occurrence that had a positive RSF. A repetitive occurrence is repetition of a given type of event within a three year period after the site has issued a notification report to the ORPS of a previous similar event and identified corrective actions.

Occurrence number ORO--BJC-K25WASTMAN-20009-0012 involved two events where 21st Century waste containers arrived at Envirocare of Utah with streaks of dried mud on the outside (11/02/99 and 06/16/00). After the first events, a corrective action to "ensure a work package has been completed for the replacement of gaskets in all remaining 21st Century containers of pond waste sludge with appropriate ES&H, QA, and Management reviews" was targeted to be completed by 2/18/2000. The second event happened months after the appropriate corrective actions should have been in place to prevent its occurrence.

3.5 MANAGEMENT NOTIFICATION

Occurrences that have packaging- or transportation-related significance are downloaded weekly from the ORPS for review and classification into the SMIP P&T Occurrence Database. During this weekly selection, any ORs identified with HSRs of above 24 will be immediately reported to the NTPA for evaluation and tracking. The notification process will include those ORs classified by the sites as unusual or emergency. However, NTPA management notification will not be required for ORs having *only* SPRs above 2 unless initial determinations indicate that the ORs may be a potential source of concern to DOE.

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4. THE NATURE OF OCCURRENCE AND HAZARD CLASS

4.1 DISTRIBUTION BY NOC

The NTP assigned NOC criteria to assist with the classification of ORs. The NTP-assigned NOC basically seeks to define what occurred and to classify the incident according to specific P&T-related safety issues rather than to use the more general ORPS NOC assigned to the incident (see *ORPS User's Manual*, DOE/ID-10319). NOC coding categorizes ORs by unique P&T-related criteria to focus on patterns and useful information for NTP's use and LL. For a complete discussion of the selection criteria, see Appendix A of *DOE Packaging and Transportation Measurement Methodology for the Safety Metrics Indicator Program (SMIP).*

Table 6 presents a listing of these assigned NOC codes.

The occurrence database was queried to obtain a grouping of the FY 2000 ORs by NOC classification and onsite or offsite designation. Any occurrence that happens in an area within the boundaries of a DOE site or facility that is fenced or otherwise access-controlled is defined as an *onsite occurrence*. *Offsite occurrences* are those incidents that happen in any area within or outside a DOE site to which the public has free and unlimited access. Table 7 presents the NOC classification of all ORs currently in the database, covering packaging- or transportation-related ORs from October 1, 1993, through September 30, 2000. Table 8, "FY 2000 ORs classified by NOC," lists the results of the query for ORs that were reported during FY 2000. Figure 1, "NOC totals for FY 2000," presents the information conveyed in Table 8 graphically—readily showing how contamination events and shipping preparation events dominate the ORs selected for FY 2000. Tables 9 through 15 list the occurrences by FY for comparison.

Querying the database for detail on the ORs reveals that shipment preparation and contamination or releases are the major types of incidents that occur onsite, as in previous years. **Shipment preparation remains the major type of incident reported for offsite occurrences**.

Table 16, "Percentage of NOCs by FY," reveals that the most significant increase in ORs that were reported this FY is in NOC 3, *loading, unloading, and storage incident to transport*. This follows the trend set last FY, when occurrences of this nature comprised over half of all the NOC 3 incidents that were contained in the database.

NOC 3 events increased from 18 to 25 occurrences this year. Of itself this increase would not appear significant. However, the fact that only 6.6 % of the ORs in the SMIP P&T Occurrence Database are categorized as NOC 3 adds emphasis to this trend. Since 1998, ORs in this category have almost doubled (from 13 to 25).

Regardless—as was cautioned last FY—it is misleading to consider the increase in NOC 3 events a significant trend at this time because the NOC 3 category was modified just prior to FY 1999 when SMIP revised the category by adding loading and unloading events to what had previously collected only storage events. Moreover, the events continue to be of minor significance, having W_{EC} of 1 and 2; five of the 25 ORs involved offsite events, and only two of these involved other states. The vast majority of these ORs involve onsite transfers and have slight significance at worst ("… minimal safety consequences with little potential for ultimately

Table 6. SMIP NOC categories

1. Contamination/Release
   - 1A. Radioactive
     - 1A1. Environmental
     - 1A2. Personnel
     - 1A3. Equipment
   - 1B. Hazardous Materials
     - 1B1. Environmental
     - 1B2. Personnel
     - 1B3. Equipment

2. Packaging
   - 2A. Damaged
   - 2B. Incorrect Selection
   - 2C. Incorrect Procedures

3. Loading, Unloading, and Storage Incident to Transport

4. Improper Hazardous Material Characterization

5. Shipment Preparation
   - 5A. Shipping Papers
   - 5B. Marking
   - 5C. Labeling
   - 5D. Loading and Securing
   - 5E. Placards
   - 5F. Radiation Survey

6. Modal Safety
   - 6A. Motor or Driver Safety
   - 6B. Aircraft Safety
   - 6C. Rail Safety
   - 6D. Barge
   - 6E. Pipeline

7. Occurrence Created by Others (non-DOE or DOE/Contractor)
   - 7A. Shipping Preparation
   - 7B. Packaging
   - 7C. Reserved
   - 7D. Vehicle or Driver Safety
   - 7E. Contamination
   - 7F. Not Otherwise Specified

Table 7. OR distribution by NOC in SMIP P&T ORs Database

Code and Description	No. of ORs
1. Contamination/Release	
1A. Radioactive	5
1A1. Environmental	24
1A2. Personnel	22
1A3. Equipment	117
1B. Hazardous Materials	0
1B1. Environmental	23
1B2. Personnel	4
1B3. Equipment	5
Total	200
2. Packaging	
2A. Damaged	29
2B. Incorrect Selection	28
2C. Incorrect Procedures	56
Total	113
3. Storage Incident to Transport	66
Total	66
4. Improper Hazardous Material Characterization	149
Total	149
5. Shipment Preparation	113
5A. Shipping Papers	79
5B. Marking	22
5C. Labeling	39
5D. Loading and Tie-downs	20
5E. Placards	5
5F. Radiation Survey	19
Total	297

Table 7. (cont'd)

Code and Description	No. of ORs
6. Modal Safety	
6A. Motor or Driver Safety	16
6B. Aircraft Safety	1
6C. Rail Safety	5
6D. Barge Safety	0
6E. Pipeline	1
Total	23
7. Occurrences Created by Others (non-DOE or DOE/Contractor)	6
7A. Shipping Preparation	87
7B. Packaging	26
7C. Reserved	0
7D. Vehicle or Driver Safety	2
7E. Contamination	25
7F. Not otherwise specified	3
Total	149
Grand Total	997

Table 8. FY 2000 ORs classified by NOC

Code and Description	No. of ORs
1. Contamination/Release	
1A. Radioactive	
1A1. Environmental	2
1A2. Personnel	4
1A3. Equipment	19
1B. Hazardous Materials	
1B1. Environmental	2
1B2. Personnel	2
1B3. Equipment	2
Total	31
2. Packaging	0
2A. Damaged	4
2B. Incorrect Selection	1
2C. Incorrect Procedures	7
Total	12
3. Storage Incident to Transport	25
Total	25
4. Improper Hazardous Material Characterization	19
Total	19
5. Shipment Preparation	19
5A. Shipping Papers	7
5B. Marking	3
5C. Labeling	4
5D. Loading and Tie-downs	0
5E. Placards	0
5F. Radiation Survey	2
Total	35

Table 8. (continued)

Code and Description		No. of ORs
6.	Modal Safety	
	6A. Motor or Driver Safety	0
	6B. Aircraft Safety	0
	6C. Rail Safety	0
	6D. Barge Safety	0
	6E. Pipeline	0
	Total	0
7.	Occurrences Created by Others (non-DOE or DOE/Contractor)	0
	7A. Shipping Preparation	12
	7B. Packaging	3
	7C. Reserved	0
	7D. Vehicle or Driver Safety	0
	7E. Contamination	8
	7F. Not otherwise specified	1
	Total	24
	Grand Total	146

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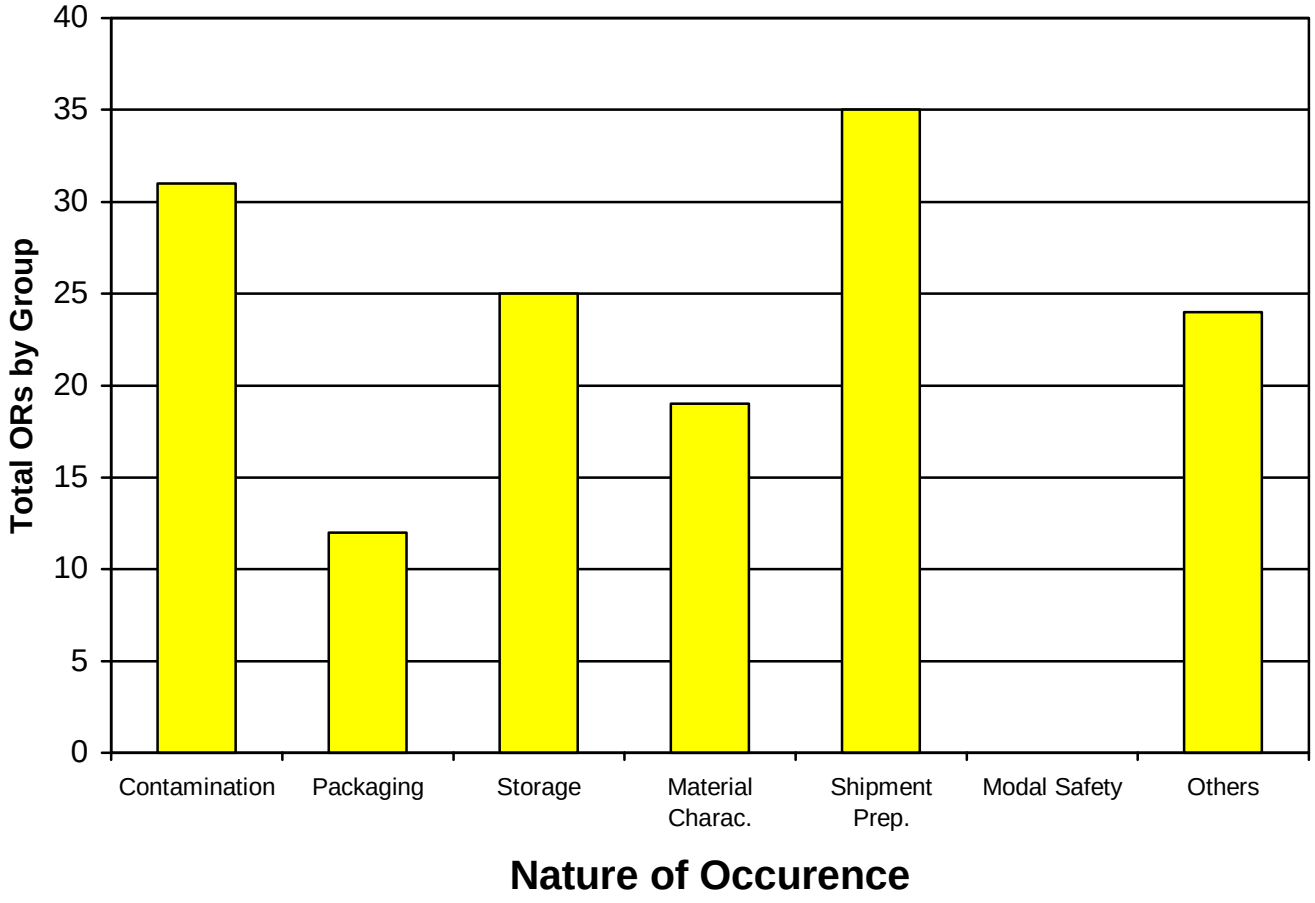

Fig. 1. NOC totals for FY 2000.

Table 9. ORs of FY 1994, as classified by NOC

	NOC category							
	1	2	3	4	5	6	7	Total
1st Qt	6	4	0	0	7	0	15	18
2nd Qt	7	5	0	2	9	0	6	29
3rd Qt	4	1	0	2	12	2	8	29
4th Qt	10	3	0	5	6	1	7	32
NOC sum	27	13	0	9	34	3	36	122

Table 10. ORs of FY 1995, as classified by NOC

	NOC category							
	1	2	3	4	5	6	7	Total
1st Qt	5	4	0	4	15	2	8	38
2nd Qt	5	3	0	3	10	0	5	26
3rd Qt	6	4	0	5	8	2	4	29
4th Qt	4	6	0	4	10	1	8	33
NOC sum	20	17	0	16	43	5	25	126

Table 11. ORs of FY 1996, as classified by NOC

	NOC category							
	1	2	3	4	5	6	7	Total
1st Qt	6	1	0	3	6	0	3	19
2nd Qt	5	2	0	10	9	0	6	32
3rd Qt	10	3	2	13	19	2	4	53
4th Qt	7	3	5	6	13	3	7	44
NOC sum	28	9	7	32	47	5	20	148

Table 12. ORs of FY 1997, as classified by NOC

	NOC category							
	1	2	3	4	5	6	7	Total
1st Qt	2	3	1	6	15	0	3	30
2nd Qt	6	5	0	9	15	3	5	43
3rd Qt	4	3	1	4	10	1	5	28
4th Qt	7	3	1	1	14	0	1	27
NOC sum	19	14	3	20	54	4	14	128

Table 13. ORs of FY 1998, as classified by NOC

	NOC category							
	1	2	3	4	5	6	7	Total
1st Qt	14	6	4	10	13	1	5	53
2nd Qt	5	7	3	9	10	1	2	37
3rd Qt	7	8	4	3	13	0	4	39
4th Qt	10	4	2	7	7	0	2	32
NOC sum	36	25	13	29	43	2	13	161

Table 14. ORs of FY 1999, as classified by NOC

	NOC category							
	1	2	3	4	5	6	7	Total
1st Qt	6	3	2	4	11	0	4	30
2nd Qt	10	3	5	7	11	2	5	43
3rd Qt	11	10	1	6	7	2	1	38
4th Qt	12	7	10	7	12	0	7	55
NOC sum	39	23	18	24	41	4	17	166

Table 15. ORs of FY 2000, as classified by NOC

	NOC category							
	1	2	3	4	5	6	7	Total
1st Qt	8	3	6	6	8	0	5	36
2nd Qt	5	4	12	2	6	0	11	40
3rd Qt	10	1	5	7	12	0	7	42
4th Qt	9	4	2	4	8	0	1	28
NOC sum	31	12	25	19	35	0	24	146

Table 16. Percentage of NOCs by FY

SMIP NOC	Percentage totals by FY							All ORs in SMIP Database
	1994	1995	1996	1997	1998	1999	2000	
Contamination/Release	22.1	15.9	18.9	14.8	22.4	23.5	21.9	20.1
Packaging	10.7	13.5	6.1	10.9	15.5	13.9	8.2	11.3
Loading, … Storage Incident to Transport	0	0	4.7	2.3	8.1	10.8	17.1	6.6
Improper Hazardous Material Characterization	7.4	12.7	21.6	15.6	18.0	14.5	13.0	14.9
Shipment Preparation	27.9	34.1	31.8	42.2	26.7	24.7	23.3	29.8
Modal Safety	2.5	4.0	3.4	3.1	1.2	2.4	0	2.3
Occurrences Created by Others	29.5	19.8	13.5	10.9	8.1	10.2	16.4	14.9
Total ORs:	122	126	148	128	161	166	146	

leading to … endangerment"). These events will continue to be monitored to determine whether or not an increase in this category deserves serious attention.

Evaluating Table 16 reveals that *occurrences created by others* are up from 10.2% to 16.4%. However, this change is not so significant considering the actual numbers that percentages are based upon, 17 (of 166) and 24 (of 146). Similarly, the slight drop in *hazardous material characterization* occurrences from 25 to 19 is not statistically important, as there is no real significance in the decline from 14.5% to 13%.

Still, because occurrences created by others have been increasing (from 8.1% in 1998 to 16.4% in FY 2000), it was important to analyze the occurrences more closely to see if there were factors involved that could be controlled or mitigated by NTP actions.

Looking at these ORs in more detail showed that half of the 24 ORs were related to shipping preparation problems and another 8 were due to contamination. Only one of the ORs that had shipping preparation problems had a significance above *slight*. The event was caused when an improperly marked shipment of two 12-volt, 100-amp hour batteries contaminated the hands of the DOE employee who opened the damaged container that had leaked sulfuric acid from the battery vent. This occurrence was considered *minor* because it led to actual, though minimal, endangerment of a person. All of the 12 shipping preparation problems had HSRs of 24 or less. On the other hand, one of the events due to contamination had a HSR of 32. This occurrence resulted from high contamination (20,000 and 30,000 dpm beta-gamma readings) found in a shipment of 20 empty, supposedly new containers.

Of some concern to the NTPA are contamination events arising from subcontractor shipments of "cleaned" clothing that actually contains radioactive contamination. The affected sites have ensured that corrective actions are being undertaken by the subcontractors, and the NTPA will continue to be on alert for such occurrences.

4.2 TRENDING BASED UPON NOC

The distribution of occurrences by NOC was evaluated to determine whether any negative trends were present that might require action by the NTPA to mitigate. The NOC categories were normalized by the number of **outbound shipments of hazardous materials and waste for all modes of transport** that occurred each FY. Table 17 presents the total shipments by FY; its data were used to produce the overall picture shown in Figs. 2–17.

Table 17. Total shipments and number of ORs by FY

FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		FY 2000	
Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs
12,597	122	12,259	126	10,155	148	9,356	128	9,222	161	9,947	166	8,314	146

To make the graphs more readable, the safety metrics derived by dividing the total number of ORs by the number of shipments for a FY were multiplied by 1000. Thus the *y*-axis of the safety metrics charts represents ORs per 1000 shipments. Figure 2 presents the total number of ORs per FY, and Fig. 3 presents the corresponding safety metric (per 1000 shipments) per FY. Figures 4–17 compare, for each NOC category, the total number of ORs and the safety metric for each FY.

A glance at Fig. 2 shows that there were fewer occurrences in FY 2000 than in FY 1999. Further, Fig. 3 shows that FY 2000's safety measure is higher than that of FY 1999. The decrease in ORs indicates that fewer shipments were being made in FY 2000 than in FY 1999. In actuality it is probable that just as many shipments are being made but less reporting to Automated Transportation Management System (ATMS) and ETAS is occurring as more shipments are conducted by M&I contractors whose contracts do not stipulate that they must report shipping activity. **In the comparison by NOC category per FY, a moving average (of two periods) trend line has been included on the graphs to provide an indication of the NOC's direction as well as the sharpness of the decline or increase.**

In most cases, the bar charts showing ORs per FY are similar in shape to the safety measures per FY because the shipments were relatively constant, varying between 9,400 and 12,600. The trends identified are consistent with those commented on in Sect. 4.1.

For additional trending, see Appendix C for a review of trends associated with Operations Offices.

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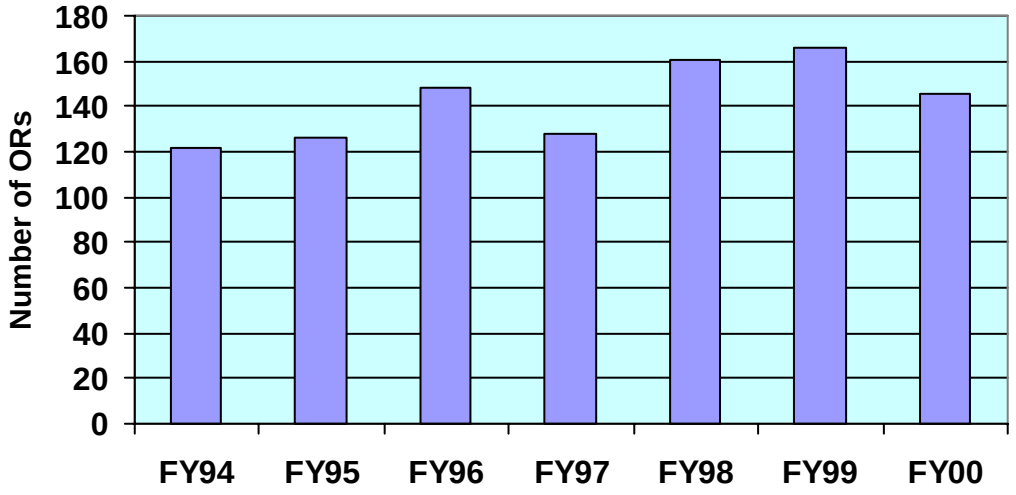

Fig. 2. Number of total ORs per FY.

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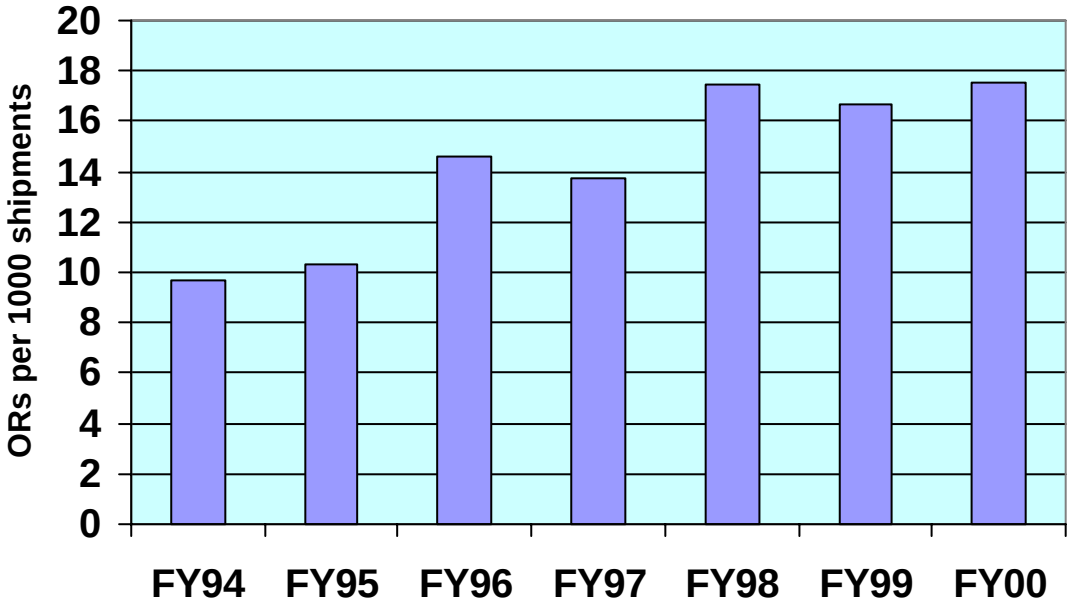

Fig. 3. Metric of total ORs per FY.

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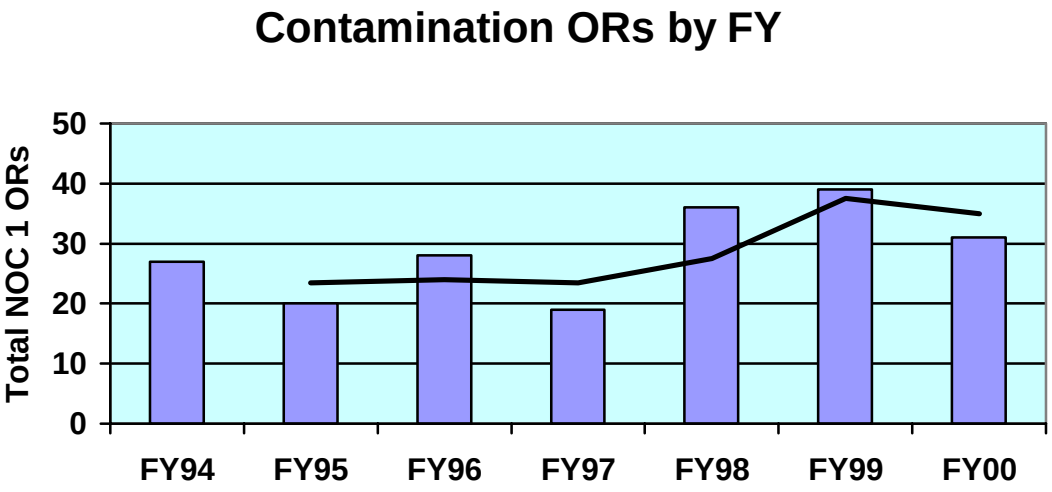

Fig. 4. Contamination ORs by FY

ORNL DWG 2001-03153

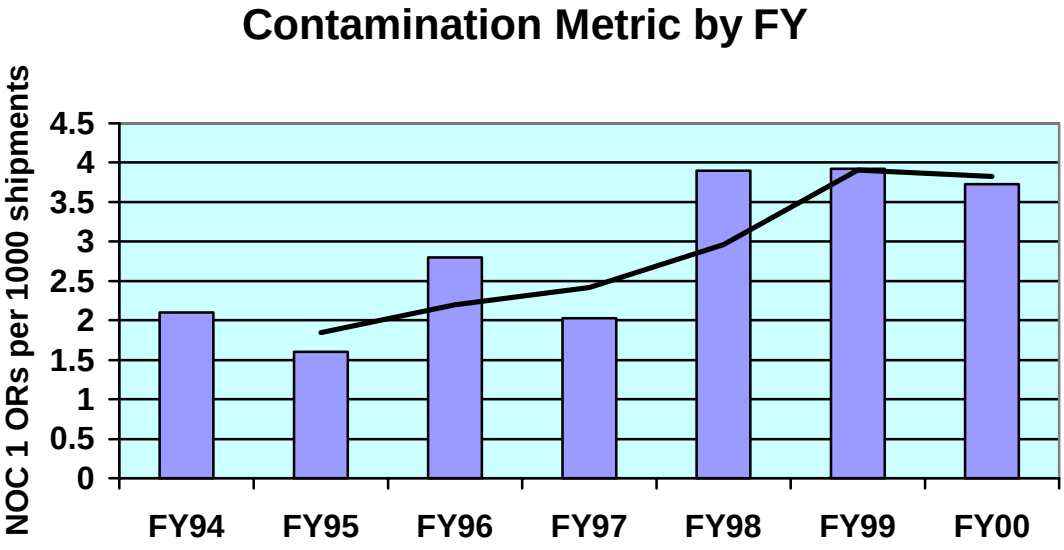

Fig. 5. Metric of contamination ORs by FY.

ORNL DWG 2001-03154

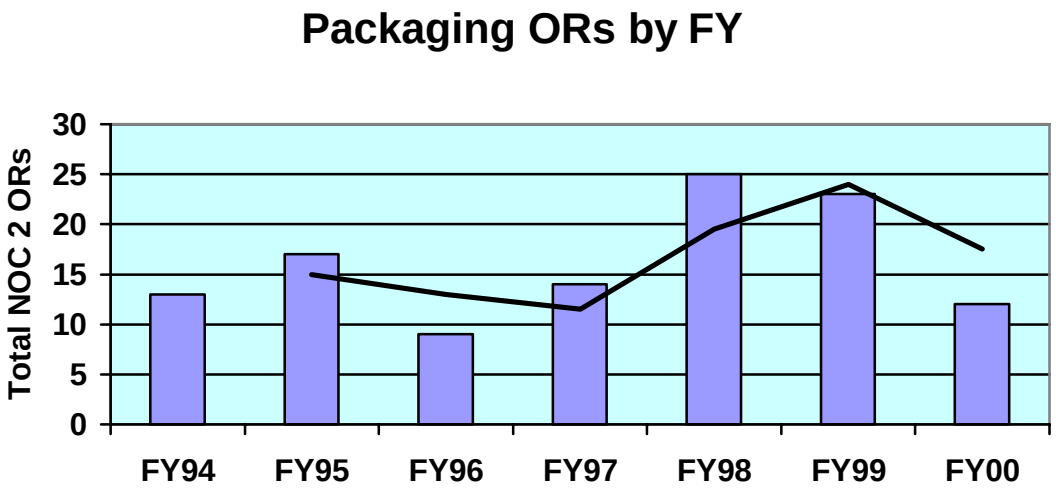

Fig. 6. Packaging ORs by FY.

ORNL DWG 2001-03155

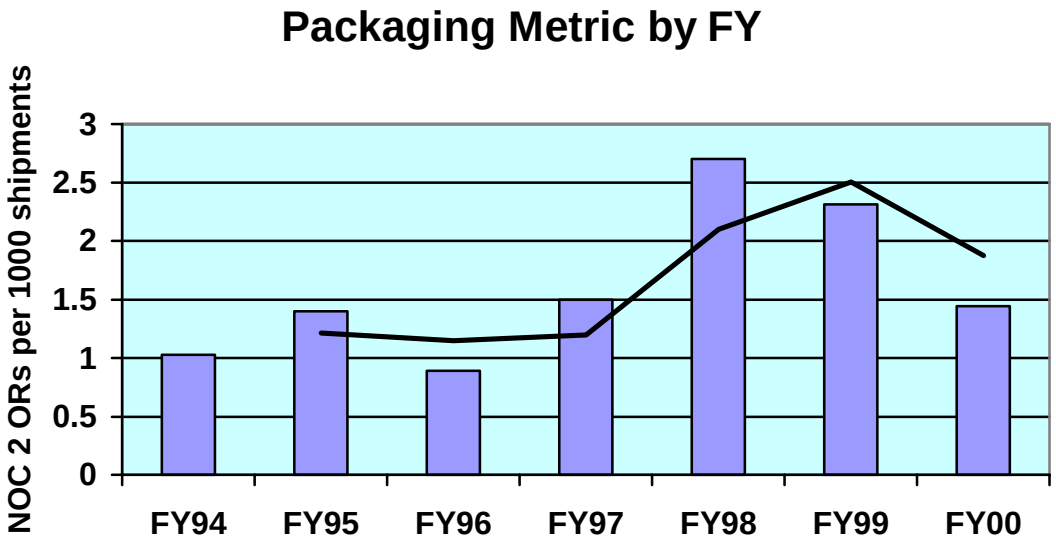

Fig. 7. Metric of packaging ORs by FY.

ORNL DWG 2001-03156

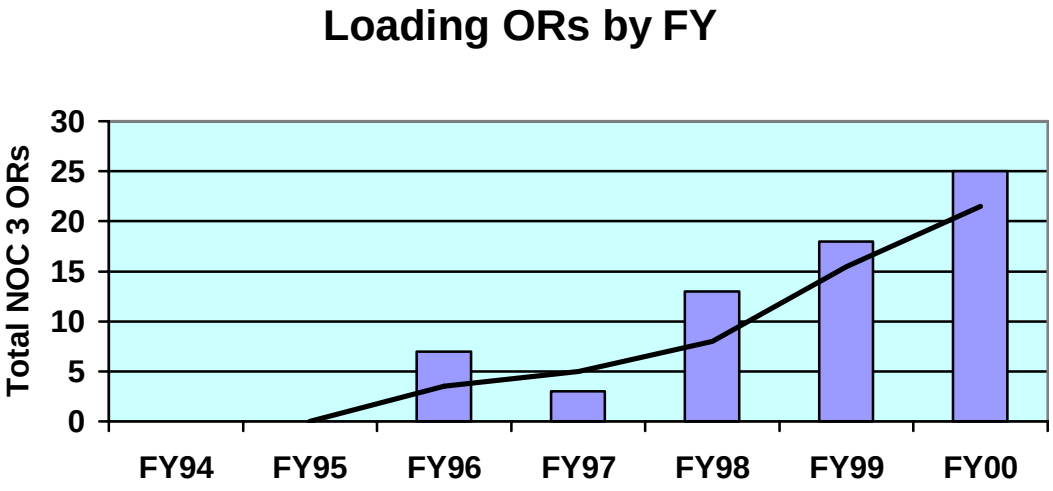

Fig. 8. Loading, unloading, and storage incident to transport ORs by FY.

ORNL DWG 2001-03157

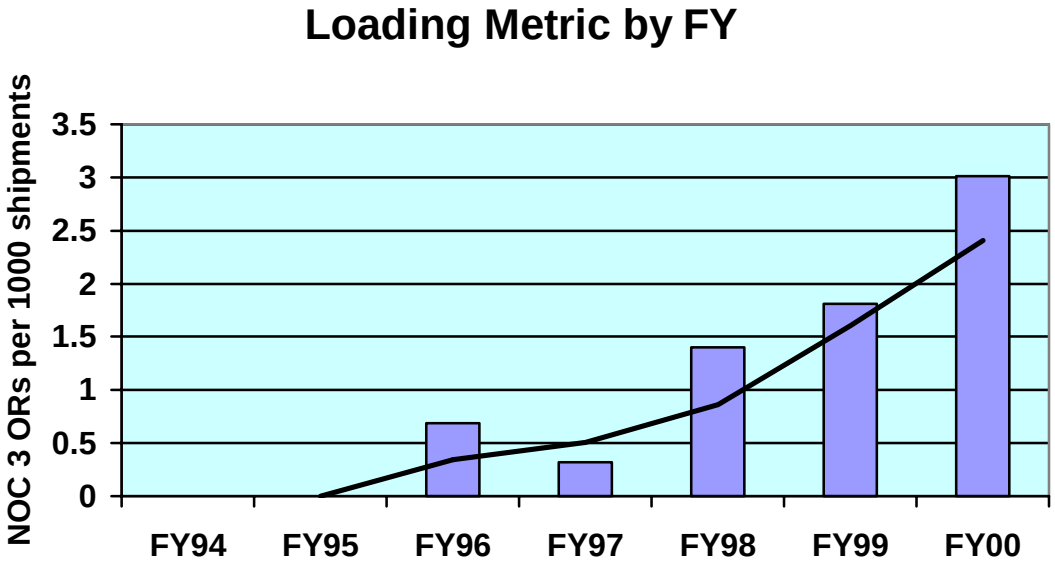

Fig. 9. Metric of loading, unloading, and storage incident to transport ORs by FY.

ORNL DWG 2001-03158

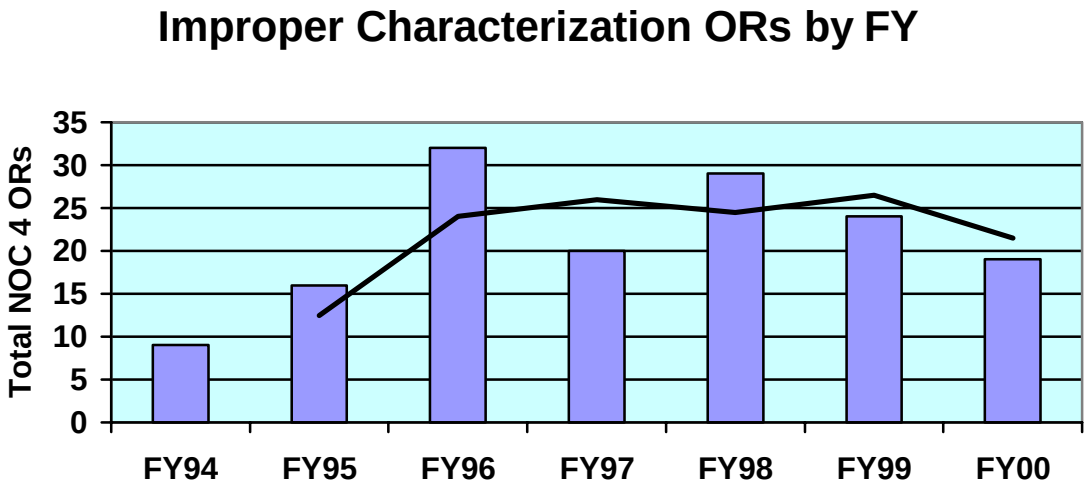

Fig. 10. Improper characterization ORs by FY.

ORNL DWG 2001-03159

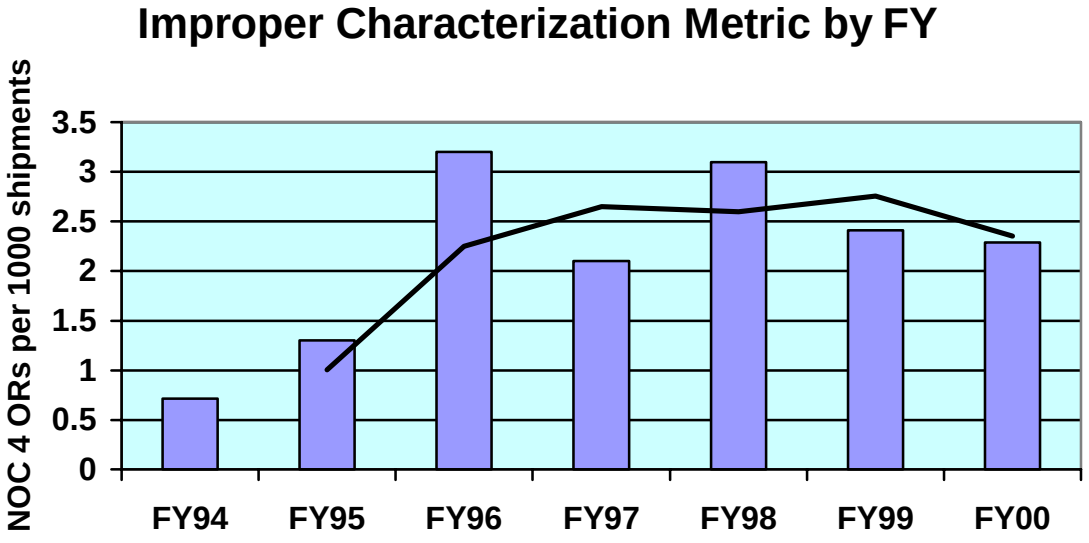

Fig. 11. Metric of improper characterization ORs by FY.

ORNL DWG 2001-03160

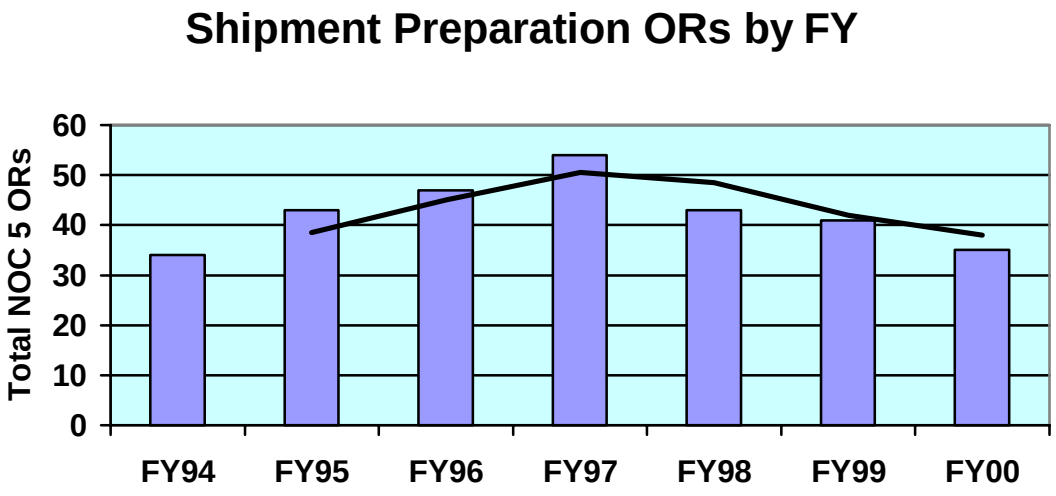

Fig. 12. Shipment preparation ORs by FY.

ORNL DWG 2001-03161

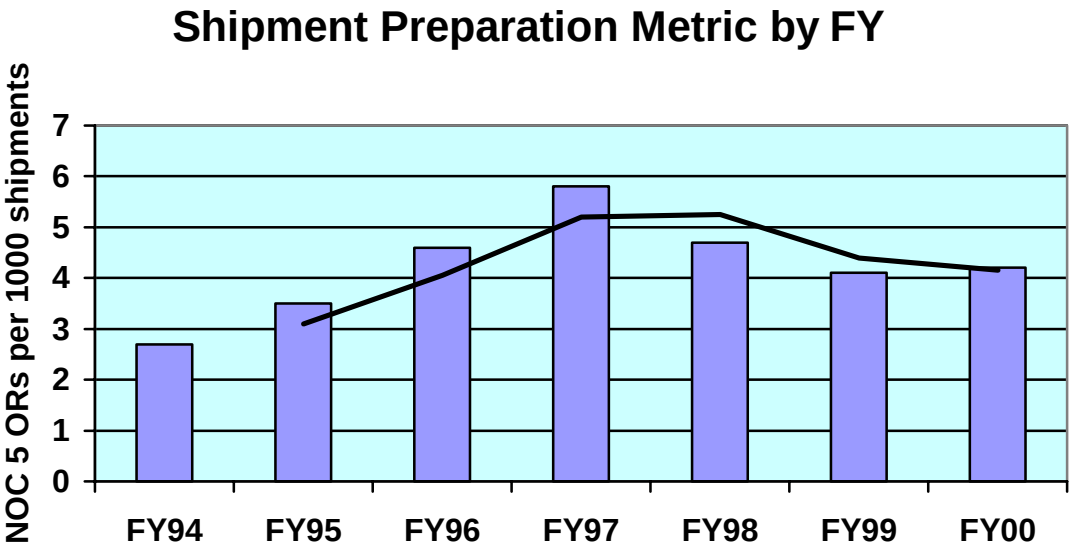

Fig. 13. Metric of shipment preparation ORs by FY.

ORNL DWG 2001-03162

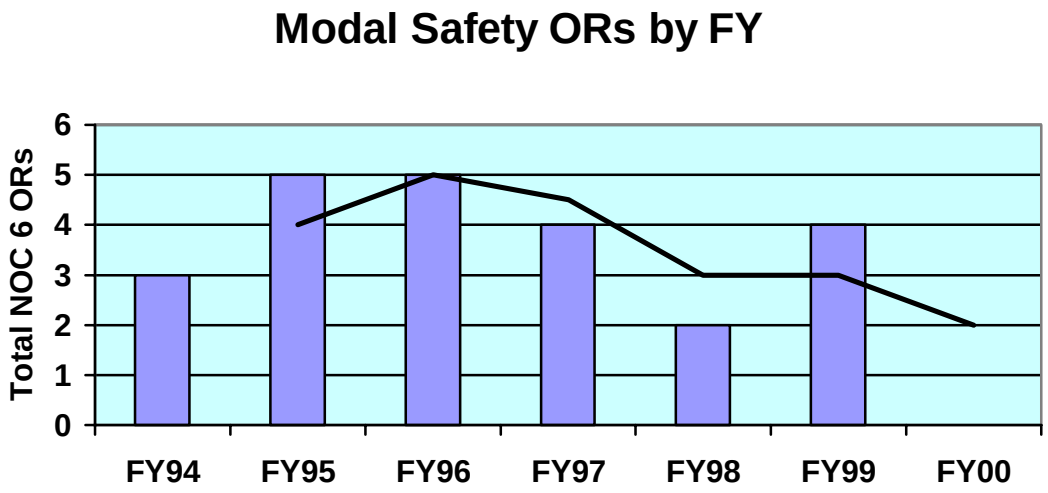

Fig. 14. Modal safety ORs by FY.

ORNL DWG 2001-03163

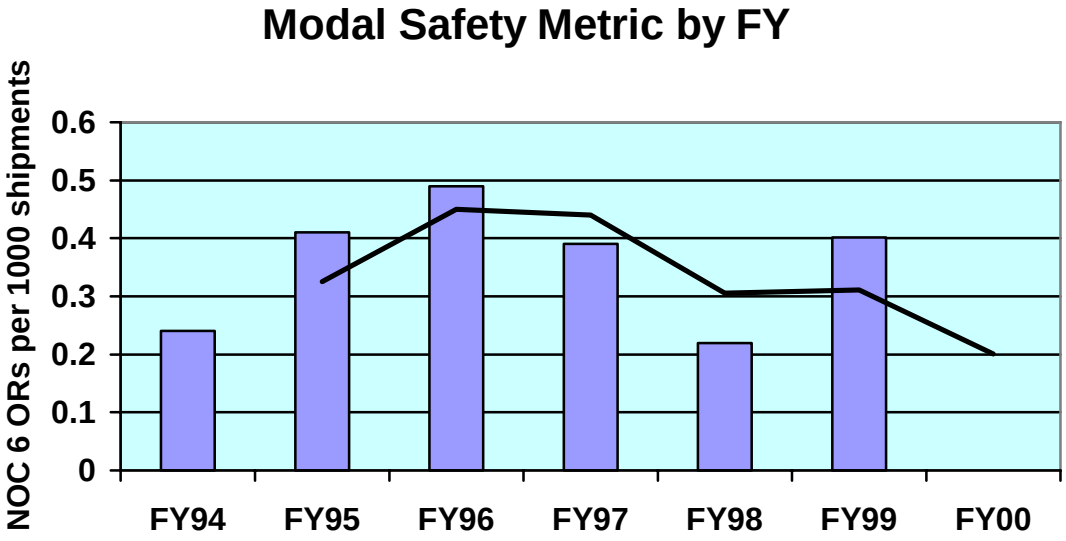

Fig. 15. Metric of modal safety ORs by FY.

ORNL DWG 2001-03164

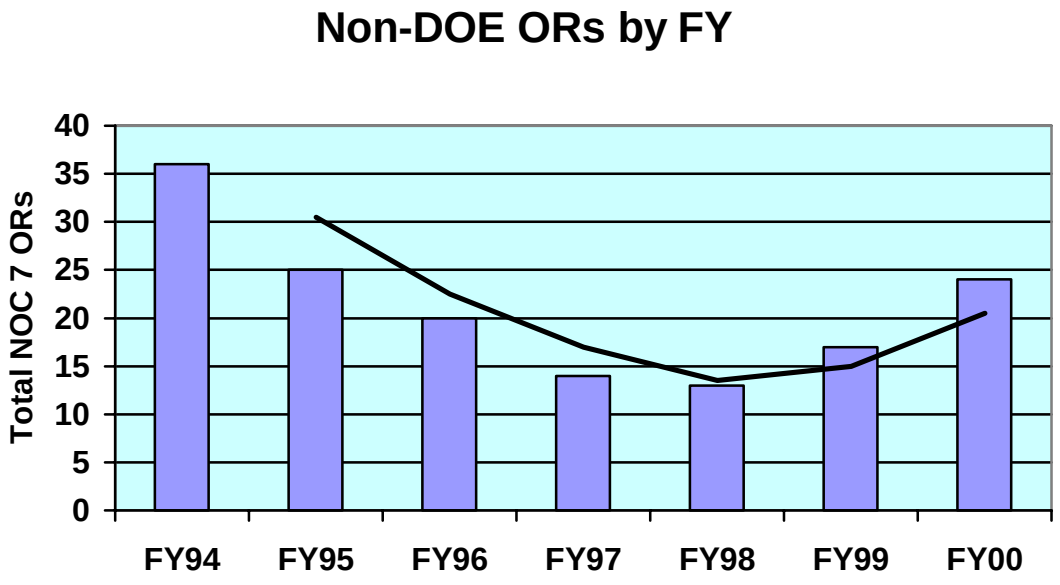

Fig.16. ORs caused by non-DOE contractors by FY.

ORNL DWG 2001-03165

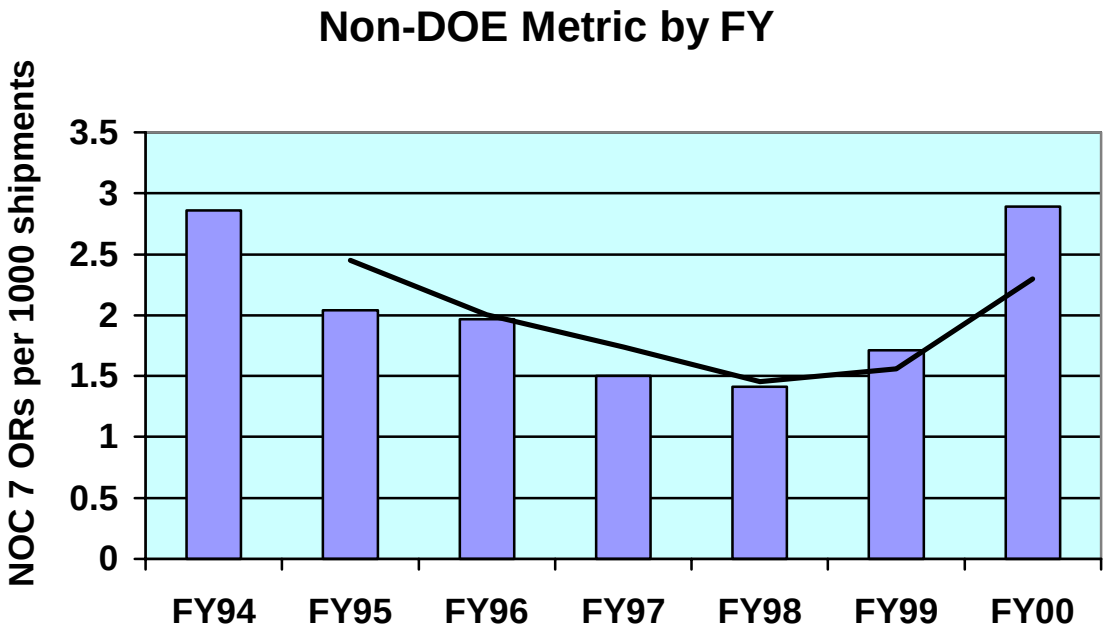

Fig. 17. Metric of ORs caused by non-DOE contractors by FY.

4.3 DISTRIBUTION BY HAZARD CLASS

Checking the NOCs reported by DOT-defined hazard class can indicate problems developing with the handling of the material and may indicate an area where special attention needs to be applied. Table 18 and Figs. 18 and 19 show the number of ORs as a function of hazard class for the FY and the entire SMIP P&T Occurrence Database. The percentage of materials involved in incidents is remarkably consistent, with only hazard class 3 (chiefly flammable liquids) showing any appreciable deviation. As stated FY 1999, it is obvious that this decrease is insignificant when one considers the low number of incidents involved.

Table 18. Distribution of ORs by DOT hazard class

Hazard class (HC)	FY 2000 ORs	%	ORs in Database	%
Class 1 (Explosive)	6	5.5	72	7.2
Class 2 (Compressed Gas)	2	1.4	39	3.9
Class 3 (Flammable Liquid)	1	0.7	30	3.0
Class 4 (Flammable Solid)	1	0.7	17	1.7
Class 5 (Oxidizer)	1	0.7	4	0.4
Class 6 (Poison)	2	1.4	12	1.2
Class 7 (Radioactive Material)	90	61.6	580	58.2
Class 8 (Corrosive Liquid)	10	6.8	49	4.9
Class 9 (Miscellaneous)	33	22.6	194	19.5
Total	146		997	

In FY 2000, radioactive material (HC 7) had the highest number of reported incidents, which is consistent with historical trends. The SMIP methodology for severity rating has established that none of the incidents involving radioactive material are considered alarming because they are below the SMIP HSR threshold of 64. One hundred and sixty of the radioactive material events involved contamination—with the vast majority of these having only *slight* consequences (resulting in minimal safety consequences with little potential for ultimately leading to suspected endangerment of people or environmental contamination). Another 160 events involved shipment preparation problems, of which the vast majority were errors in shipping papers and all but one of them were classified as of slight significance.

ORNL DWG 2001-03166

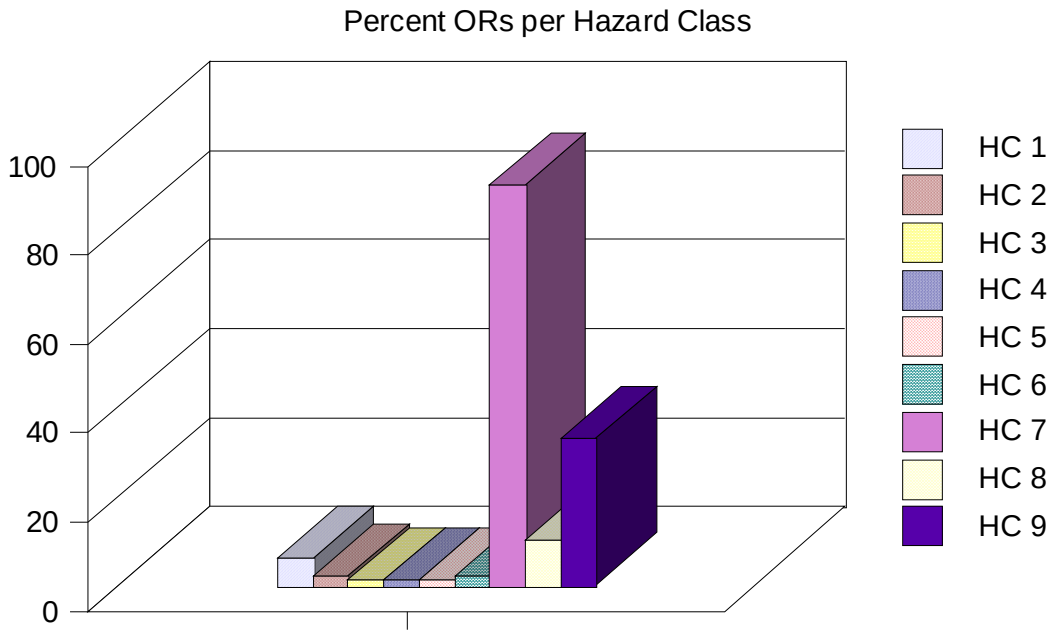

Fig. 18. FY 2000 hazard class distribution.

ORNL DWG 2001-03167

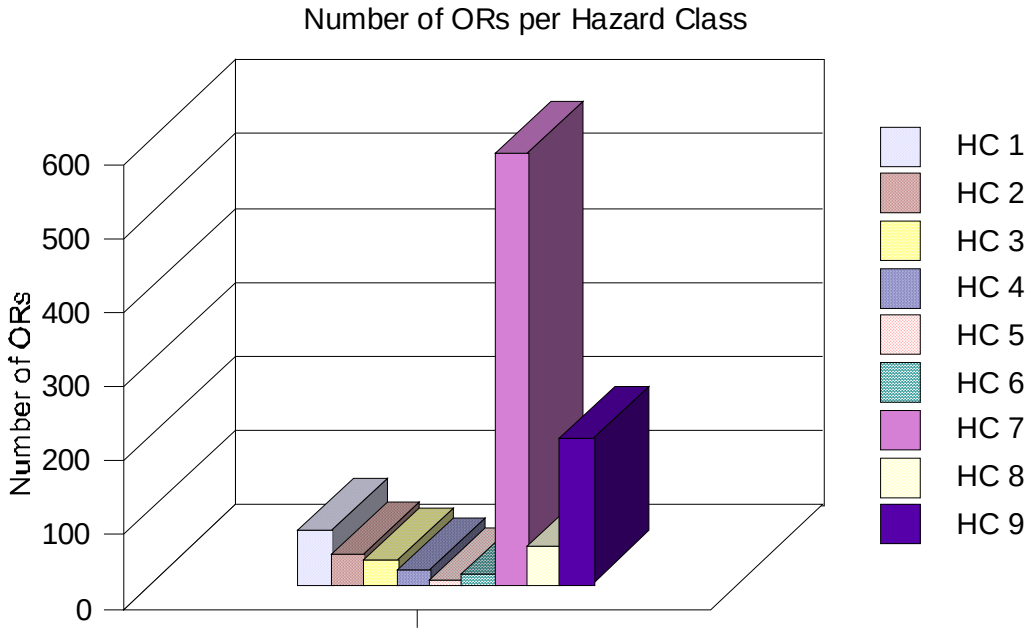

Fig 19. ORs in SMIP database by hazard class.

There was a decrease from FY 1999 of events listed in the database that involved explosives. It was determined that six of the events that were archived in FY 1999 were not actually packaging or transportation occurrences. The operations that produced the occurrences took place in a unique facility that has many buildings and miles of interconnected corridors under an enclosed structure. Therefore, the onsite movement of material is considered operational day-to-day activity, such as transferring material from one glovebox to another in the same room.

The uniqueness of this situation was brought to SMIP's attention through weekly analysis of events that are posted to the ORPS. Because the particular site had many repetitive events involving movement of explosive or radioactive material without performing proper notification, the matter attracted the attention of the NTPA. Through an onsite visit and discussions with management, the NTPA determined that the site's movements should be considered operational and not transportation. Hence it was necessary to remove archived occurrences from the database and not account these events as transportation-related. Further, it was determined that staff at the site are well aware of P&T reporting requirements and consistently report events of a transportation nature as such to the ORPS.

Though the occurrences did not involve transportation, **the work does prove that the SMIP process is functioning properly and is capable of identifying abnormalities, ensuring that appropriate action is being taken to mitigate future problems.**

5. ROOT-CAUSE ANALYSIS

A root cause is defined by DOE's Root Cause Analysis Guidance Document (DOE-NE-STD-1004-92) as

> . . . the cause that, if corrected, would prevent recurrence of this and similar occurrences. The root cause does not apply to this occurrence only, but has generic implications to a broad group of possible occurrences, and it is the most fundamental aspect of the cause that can logically be identified and corrected.

The root cause seeks to determine the 'why' of an occurrence. Root cause is assigned by the facility and reported to ORPS; in this report, this process is called the 'ORPS-assigned' root cause to distinguish it from NTP-assigned NOC coding. Table 19 presents the ORPS root-cause codes from DOE Manual 232.1-1A.

ORs were examined for the root cause as determined by the reporting facility. No changes or interpretations were made to the ORPS assigned root cause. Root-cause assignment for ORs of FY 2000 in the SMIP P&T Occurrence Database is given in Table 20. Because root-cause codes are usually assigned only to final reports, the reports listed in the table are chiefly finalized ORs. (Only 145 reports are included in the root-cause total because one of the FY 2000 occurrences is still in the notification stage.) Table 21 gives a matrix of the NOC codes and the ORPS root-cause codes for ORs selected during FY 2000.

As was the case in FY 1999, Table 20 shows that management problems were the root cause of most incidents, followed by personnel error. Table 21 shows the SMIP NOC codes cross-referenced with the ORPS-assigned root causes. This very useful table gives the analyst an indication as to the relationship between "what happened" and "why it happened." Hence more information is available that can be used to (1) assess the effectiveness of the root-cause assignment, (2) judge the appropriateness of corrective actions, and (3) possibly prevent recurrence.

Consistent with previous years, the percentage of total column of Table 21 shows that facilities have assigned management problems and personnel error as the most frequent root causes. Most of the management problems were due to inadequate administrative controls and to inadequate definition, dissemination, or enforcement of policy. Of particular concern to the NTPA are occurrences that are caused by management's failure to provide adequate written plans and guiding procedures or those due to inadequate definition of policies. Unfortunately, it is generally not known that a policy or procedure is inadequate until a challenging situation reveals its inadequacies. The NTPA is seeking to identify methods that can proactively mitigate these occurrences. The NTPA will track those sites that revealed inadequate policy and procedures to ensure that policy is developed and procedures are updated, ensuring that appropriate corrective actions are taken and implemented.

Table 19. ORPS root-cause codes (*DOE Manual 232.1-1A, Sect. 10.2*)

1. Equipment/material problem
   - 1A. Defective or failed part
   - 1B. Defective or failed material
   - 1C. Defective weld, braze, or soldered joint
   - 1D. Error by manufacturer in shipping or marking
   - 1E. Electrical or instrument noise
   - 1F. Contaminant
   - 1G. End of life failure

2. Procedure problem
   - 2A. Defective or inadequate procedure
   - 2B. Lack of procedure

3. Personnel error
   - 3A. Inattention to detail
   - 3B. Procedure not used or used incorrectly
   - 3C. Communication problem
   - 3D. Other human error

4. Design problem
   - 4A. Inadequate work environment
   - 4B. Inadequate or defective design
   - 4C. Error in equipment or material selection
   - 4D. Drawing, specification, or data errors

5. Training deficiency
   - 5A. No training provided
   - 5B. Insufficient practice or hands-on experience
   - 5C. Inadequate content
   - 5D. Insufficient refresher training
   - 5E. Inadequate presentation or materials

6. Management problem
   - 6A. Inadequate administrative control
   - 6B. Work organization/planning deficiency
   - 6C. Inadequate supervision
   - 6D. Improper resource allocation
   - 6E. Policy not adequately defined, disseminated, or enforced
   - 6F. Other management problem

7. External phenomenon
   - 7A. Weather or ambient condition
   - 7B. Power failure or transient
   - 7C. External fire or explosion
   - 7D. Theft, tampering, sabotage, or vandalism

8. Radiological/Hazardous Material Problem
   - 8A. Legacy contamination
   - 8B. Source unknown

9. Other

Table 20. FY 2000 ORs of database classified according to root-cause codes

Root cause No.	ORPS root-cause code	Onsite	Offsite	Total
1	Equipment/material problem	4	4	8
2	Procedure problem	9	7	16
3	Personnel error	32	15	47
4	Design problem	2	2	4
5	Training deficiency	1	2	3
6	Management problem	25	36	61
7	External phenomenon	0	0	0
8	Radiological/HAZMAT problem	5	1	6
9	Other	0	0	0
	Total ORs	78	67	145
	% of Total	53.8	46.2	

Table 21. FY 2000 SMIP NOC codes and ORPS root-cause codes

Root cause No.	SMIP NOC Code							Total	% of Total
	1	2	3	4	5	6	7		
1	0	3	1	0	0	0	4	8	5.5
2	3	1	4	2	4	0	2	16	11.0
3	11	2	10	5	11	0	8	47	32.4
4	1	1	1	0	1	0	0	4	2.8
5	0	0	0	1	2	0	0	3	2.1
6	11	5	9	10	17	0	9	61	42.1
7	0	0	0	0	0	0	0	0	0
8	5	0	0	0	0	0	1	6	4.1
9	0	0	0	0	0	0	0	0	0
Total	31	12	25	18	35	0	24	145	

Notes: ORPS Root-Cause Codes
1. Equipment/Material Problem
2. Procedure Problem
3. Personnel Error
4. Design Problem
5. Training Deficiency
6. Management Problem
7. External Phenomenon
8. Radiological/HAZMAT Problem
9. Other

SMIP NOC Codes
1. Contamination/Release
2. Packaging
3. Loading, Unloading, and Storage Incident to Transport
4. Improper Hazardous Material Characterization
5. Shipment Preparation
6. Modal Safety
7. Occurrences Created by Others

Queries were conducted of the SMIP P&T Occurrence Database for additional detail to help interpret the matrix of Table 21. Among the events caused by personnel error were 11 contamination ORs, 10 "loading, unloading, and storage incident to transport" ORs, and 11 shipment preparation ORs (shaded cells). The majority of these events were due to inattention to detail with procedure misuse trailing a distant second. In only one of these 32 events was a lack of training identified as a contributing or direct cause of the manifested personnel error. Because all of the ORs with a root cause of personnel error were minor (having an event consequence measure [W_{ec}] of only *slight*), no comprehensive plan is needed to address personnel error concerns although it remains the main cause, at some level (contributing, direct, or root) of P&T occurrences. The NTPA is seeking to proactively address personnel error.

6. NORMALIZATION AND COMPARISON WITH PRIVATE INDUSTRY

Normalization is a process in which the occurrence data are standardized by a common element to show similarities and produce easily-comparable output. Use of normalization allows the SMIP to (1) help determine the relative safety rankings of DOE contractors who package and ship hazardous material and (2) make possible comparisons of DOE P&T safety with that of private industry. The SMIP is continuously developing metrics by which these comparisons can be made. The limited data available from both DOE and DOT (private sector) from which common elements have been developed for comparison are detailed in this section.

6.1 VEHICLE-MILES COMPARISONS

Vehicle-miles represent a common basis that can be used to compare DOE P&T safety with that of private industry. There are still limitations—such as the lack of onsite incidents' data from private industry—but the SMIP has developed some valid comparisons for offsite P&T shipments of hazardous materials and vehicle miles.

Mileage estimates were obtained using a combination of data from DOE's ETAS and TRAGIS. Sites are required to report information about their shipments of hazardous materials and waste to the ETAS. For each shipment, ETAS provided shipment data for each bill of lading, carrier used, commodity, number of packages in the shipment, weight, mode of transport, origin, and destination. TRAGIS used the origin-destination pair and mode of transport to calculate distance. However, shipments between locations having the same zip code (such as from one Idaho facility to another) do not have site codes identified and, consequently, will not have any associated miles. These shipments are estimated to comprise less than 5% of the total mileage shipped and therefore produce little overall error.

Based upon the ETAS and TRAGIS data, an estimate was made of the miles that carriers used by DOE totaled per DOE contractor site. After the major carriers used by DOE for FY 2000 were identified, the Safety and Fitness Electronic Records System (SAFER) was accessed to obtain accident and crash statistics based on total miles driven in support of private industry. SAFER determines the current safety status of individual motor carriers based upon their accident, driver, vehicle, and management safety evaluation areas. This online database provided the DOT number of the carrier, the number of accidents and fatalities experienced by the carrier, and the number of power units used by the carrier *during the last 24 months (May 5, 1999, forward)*.

DOT has requirements stating that a crash must be reported if it involves an injury, a fatality, or the necessity of having a vehicle towed from the scene of the crash. (Reportable crashes are the sum of the listed fatalities, injuries, and tows.) States follow these procedures and provide a crash report for each commercial motor vehicle involved in an accident (as defined by 49 CFR 390.5) that meets these requirements. Thus information on the accident is placed into the SAFER database.

To determine the number of miles that the carriers logged in private industry, the carriers themselves were contacted. Because most carriers base their mileage on yearly computations to

the International Fuel Tax Association (IFTA), carrier miles were obtained by calendar year (CY) instead of FY. If a carrier was not listed in SAFER by its ETAS database designation, a telephone book or Internet search was conducted to identify it. Some carrier telephone numbers had to be obtained from the sites that contracted the carriers.

Based upon these data sources, the following Tables 22 and 23 were produced. Table 22 simply shows the information from SAFER for the carriers who transported cargo for over 20,000 miles for DOE during FY 2000. The information *pertains to the last 24 months* of reported activity by a company. The DOT number of the carrier shown in the table sometimes designates the DOE region within which the most DOE activity occurred.

Table 22. Carrier information from SAFER Database (within 24 months)

Carrier Name	DOT No.	Power Units	Fatality	Injuries	Tow
Rinchem Company Alb, NM	298907	23	0	0	0
Roadway Freight	71821	10,095	14	170	198
Yellow Freight Systems	65616	8,362	17	187	199
TriState Motor Transit	64158	479	3	11	12
Landstar Ranger	241572	4393	13	70	100
A. J. Metler Hauling & Rigging	41206	30	0	0	0
Advanced Enviro Tech Services	609181	370	0	1	0
R and R Trucking Co., Duenweg, MO	382936	155	1	2	6
Consolidated Freightways	68876	7759	11	164	224
Triad Transport	285929	131	0	2	2
Fluid Transport, Schnieder, TX	462785	11	0	0	1
Hazmat Environmental Group	255684	96	0	1	2
Colorado All State Transportation Inc, Jefferson, CO	29793	70	1	0	0
Horwith Trucks Inc.	205701	66	0	5	2
M.P. Environmental Services	441566	149	0	2	2
TAG Transport	642202	39	0	0	0
Wood, Robbie D Inc, Warrior, AL	130504	31	0	5	4
NCT Transportation, Inc.	172389	6	0	0	0
Hittman Transport Services	157942	72	0	0	0
Autumn Industries Inc, Southington, OH	220234	91	0	4	3
Arkansas Best Freight Systems	305449	?	0	0	0
Safety-Kleen (TG) Inc.	203954	1170	0	6	3
Roberts Express Inc., Akron, OH	164025	1973	1	17	20
Martinez Trucking, Espanola, NM	741309	2	0	0	0
Roadrunner Trucking Inc., Albuquerque, NM	27297	682	1	17	22
Putnam Transfer & Storage Co, Zanesville, OH	?				
Central Freight Lines Inc., Waco, TX	117034	2071	1	25	28

Question marks in a field of Table 22 indicate that the information was unobtainable. Colorado All State Transportation is officially designated CAST Transportation; though the title change occurred in 1995, many still use the old designation. Roadrunner Trucking filed for bankruptcy during the year and had no personnel available to provide mileage. Information obtained from a

company that used Putnam Transfer & Storage suggests that the family-owned business no longer exists. NCT Transportation (Norcolo) was acquired by Aim Dedicated Logistics during the middle of CY 2000. Advanced Environmental Technical Services changed its name to Onyx Environmental Services on January 1, 1999, after merging with another company. Roberts Express changed their name in February 2000 year to Fedex Custom Critical. So the associated mileage and accidents of Roberts Express pertain to Fedex Custom Critical.

One of the reasons that Roberts Express's safety measure in Table 23 is outstanding large is because their work is performed by independent operators. Roberts Express does not actually own any of the trucks. Moreover, their fleet size has reportedly shrunk from the 1,973 listed power units to 1,450 because of a lack of activity. A depressed market would explain why the company averaged only about 1,500 miles per power unit.

DynCorp Tri-Cities Services was also listed as a major carrier, having 44,067 miles for 269 shipments conducted for DOE Richland Operations Office. However, it was determined that DynCorp transports onsite only. As a shipper, DynCorp transports about 20 miles to the site's boundary and generally turns cargo over to Tri State for further movement to final destination. The miles associated with DynCorp were not transferred to TriState's total because the ETAS information is not clear regarding this case.

Table 23 shows the DOT mileage obtained from the carriers directly and the measure of the carriers' crashes per million miles. For definition purposes, a *measure* quantifies the performance of an individual carrier whereas an *indicator* ranks performance to other carriers through comparison of measures. The "crashes/mile" measure is derived by dividing the number of crashes reported to SAFER during the last 24 months first by (1) two to approximate the average accidents per year, and (2) then by the number of miles the carrier drove during CY 2000.

To determine just how safe DOE's carriers are when driving for DOE compared with their performance when driving for private industry, the number of incidents for a specific carrier used by DOE needs to be determined. A problem arises because DOE does not list the names of carriers in the ORPS report. Thus a site must be contacted directly to try to obtain the name of a carrier involved in an incident. However, since no accidents were reported among the 68 incidents that occurred offsite (and which were the fault of a DOE contractor) this FY, a comparison can be made even without knowing what specific carriers the individual sites used.

Offsite shipments by the DOE contractor sites totaled 3,012,000 vehicle miles—not including government truck movements or local shipments. Table 24, "DOE carriers' shipments and mileage for DOE," lists the associated miles and number of shipments of carriers who logged over 20,000 miles for DOE. Because the carriers had no reportable accidents while transporting for DOE during FY 2000, **DOE's safety measure for the associated carriers is 0. This suggests that carriers for DOE have demonstrated better safety when conducting shipments for DOE than when conducting shipments for private industry.**

All of the carriers used by DOE whose transport activity for DOE was greater than 20,000 miles are authorized to carry hazardous material by interstate highway and have a satisfactory rating.

Performing a weighted average of Table 23 data for DOE contract shippers who traveled over 20,000 miles on DOE business gives a safety indicator average of 0.26, which compares favorably with the DOT national average of 0.75 accidents per million miles.

Table 23. Safety metric of DOE carriers

Carrier name	Total mileage	Average crashes/one-million miles x E 6
Rinchem Company Alb, NM	1,620,019	0
Roadway Freight	615,653,135	0.310
Yellow Freight Systems	698,928,503	0.288
TriState Motor Transit	165,619,000	.078
Landstar Ranger	391,103,038	0.234
A. J. Metler Hauling & Rigging	2,257,050	0
Advanced Enviro Tech Services	3,141,703	0.159
R and R Trucking Co., Duenweg, MO	19,567,854	0.230
Consolidated Freightways	493,655,972	0.404
Triad Transport	12,882,781	0.155
Fluid Transport, Schnieder, TX	1,057,351	0.473
Hazmat Environmental Group	9,986,000	0.150
Colorado All StateTransportation Inc	3,100,000	0.161
Horwith Trucks Inc.	5,645,928	0.620
M.P. Environmental Services	1,504,502	0.174
TAG Transport	3,800,044	0
Wood, Robbie D Inc, Warrior, AL	9,272,196	0.485
NCT Transportation, Inc.	2,403,680	0
Hittman Transport Services	6,810,000	0
Autumn Industries Inc, Southington, OH	7,300,000	0.479
Arkansas Best Freight Systems	359,000,000	0
Safety-Kleen (TG) Inc.	17,178,517	0.262
Roberts Express Inc., Akron, OH	3,042,914	6.24
Martinez Trucking, Espanola, NM	29,000	0
Roadrunner Trucking Inc., Albuquerque, NM	**Out of business**	?
Putnam Transfer & Storage Co	**Out of business**	?
Central Freight Lines Inc., Waco, TX	126,000,000	0.214

Table 24. DOE carriers' shipments and mileage for DOE

Carrier name	DOE Mileage	DOE Shipments	Accidents while transporting for DOE
Rinchem Company Alb, NM	347,490	492	0
Roadway Freight	326,649	387	0
Yellow Freight Systems	279,265	386	0
TriState Motor Transit	279,102	280	0
Landstar Ranger	228,095	301	0
A. J. Metler Hauling & Rigging	139,330	100	0
Advanced Enviro Tech Services	117,238	172	0
R and R Trucking Co., Duenweg, MO	114,371	168	0
Consolidated Freightways	81,259	192	0
Triad Transport	75,263	168	0
Fluid Transport, Schnieder, TX	70,775	44	0
Hazmat Environmental Group	50,943	127	0
Colorado All State Transportation Inc	50,824	189	0
Horwith Trucks Inc.	50,481	128	0
M.P. Environmental Services	40,941	180	0
TAG Transport	39,720	20	0
Wood, Robbie D Inc, Warrior, AL	36,769	22	0
NCT Transportation, Inc.	34,264	175	0
Hittman Transport Services	30,137	196	0
Autumn Industries Inc, Southington, OH	29,824	17	0
Arkansas Best Freight Systems	27,352	82	0
Safety-Kleen (TG) Inc.	26,224	60	0
Roberts Express Inc., Akron, OH	26,060	49	0
Martinez Trucking, Espanola, NM	**26,042**	49	0
Roadrunner Trucking Inc., Albuquerque	24,758	23	0
Putnam Transfer & Storage Co, OH	23,110	34	0
Central Freight Lines Inc., Waco, TX	22,312	94	0

These carriers' shipments made for DOE have been conducted almost three times as safely as shipments by other carriers transporting in private industry, averaging an accident per 3,866,000 miles as compared with an accident per 1,333,000 miles. Since these carriers had no reportable crashes while transporting cargo for DOE during CY 2000, it can be stated that these same carriers had increased safety performance when shipping cargo for DOE. Hence carriers used by DOE have a better safety record than that of other carriers in general, and the carriers' safety

performance appeared to be better while transporting for DOE during the past CY. All DOE-utilized carriers' safety measures were less than the DOT average of 0.75 accidents per million miles for all commodities.

6.2 SHIPMENT-MILES COMPARISONS

Package-miles can also be obtained by coordinating data from ETAS and TRAGIS. Package-miles represent the total number of miles that individual packages were transported during shipment.

When shipments are reported to ETAS, the number of packages for each commodity is reported, and then the commodity code is cross-referenced with other information to get hazard class. If a load comprises packages of the same hazard class that have a different chemical nature, then each package will have a different commodity code entered into ETAS. For example, assume a load being shipped 300 miles consists of eight packages, six of which contain flammable material and two of which contain oxidizers. The commodity codes of the shipment would show that three packages might contain lithium metal (hazard class 4.3), one package might contain lithium hydride (hazard class 4.3), two packages might contain titanium hydride (hazard class 4.1), and two packages might contain sodium chlorate (an oxidizer of hazard class 5.1). In this case, the data would be interpreted by ETAS as: four packages of hazard class 4.3, two packages of hazard class 4.1, and two packages of 5.1. Therefore, the package-miles per hazard class associated with this shipment would be 1,800 miles (4×300 and 2×300) for the flammables and 600 miles (2×300) for the oxidizers. Thus for the same 300-mile trip, there would be a wide variation in package-miles and vehicle-miles when the shipment is broken down by hazard class.

A better way to make comparisons than package-miles might be to total the miles by shipments. In this case, if a shipment comprises different hazard classes, *each hazard class* will have the distance of the transport associated with the shipment—but not each individual package of the hazard class. Table 25 shows a comparison between data for FYs 1998 through 2000. (Not listed are the 373,779 miles of non-regulated waste shipments reported.) From this type of comparison, unusual increases or decreases are more apparent. For example, flammable solids and combustible liquids show dramatic increases. Shipment of oxidizers and poisons also increased dramatically. It is unsure what factors contributed to these dramatic increases other than increased decontamination and decommissioning activity.

Table 25. Shipment-miles by hazard class

Hazard class	Shipment miles (FY 1998)	Shipment miles (FY 1999)	Shipment miles (FY 2000)
Class 1 (Explosive)	195,845	255,230	192,764
Class 2 (Compressed Gas)	574,670	659,274	545,642
Class 3 (Flammable or Combustible Liquid)	444,468	397,425	870,402
Class 4 (Flammable Solid)	96,251	73,984	410,769
Class 5 (Oxidizer)	112,624	88,643	328,026
Class 6 (Poison)	110,094	116,412	511,144
Class 7 (Radioactive Material)	2,289,962	1,851,792	1,986,134
Class 8 (Corrosive Liquid)	658,902	501,842	1,146,732
Class 9 (Miscellaneous)	410,203	109,408	578,431
RAM-contaminated, Exempt	13,544	388,308	118,386
ORM-D			4,784

6.3 SITE-SPECIFIC COMPARISONS

Normalization of transport data that have been reported by individual sites should provide a relative indication of the P&T safety of those sites. To evaluate this premise, ETAS was queried to obtain the number of outbound (prepaid and collect) hazardous material and waste shipments for **all modes of transport** from the DOE sites made from FY 1994 through FY 2000. Only 26 of the total 8,314 shipments reported during FY 2000 were made by railroad (24 by Fernald, one from Rocky Flats, and one from WVNS). Table 26 presents the number of shipments and ORs made by all sites for FY 1994 through FY 2000.

Table 26. Total shipments and number of ORs by FY

FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		FY 2000	
Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs
12,597	122	12,259	126	10,155	148	9,356	128	9,222	161	9,947	166	8,314	146

For an OR to be selected as being from a site, the information itself had to be reported by that specific site—not simply originate from the site's zip code area. Table 27 presents the number of offsite ORs that specific sites reported by year from FY 1995 through FY 2000. The sites

identified in Table 27 were chosen because they have established themselves as consistently large shippers. (Offsite incidents that were caused by others not related to the reporting site are not included in the ORs.) Readily noticeable is the drop in East Tennessee Technology Park (ETTP), Los Alamos National Laboratory (LANL), and ORNL shipments. If these sites' shipments continue to decrease—or are no longer reported because subcontractors are performing the work—then they will be replaced by other sites, such as PANTEX, which had 622 shipments this FY. In the table, column heading for "shipments" was shortened to "trips" so that more data can be displayed.

Table 27. Shipments and offsite occurrences by FY

Site	FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		FY 2000	
	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs
ETTP	573	0	977	4	631	1	184	1	452	2	15	6
FDF	1032	7	405	4	518	3	113	2	604	0	530	3
LANL	146	11	135	3	278	6	486	3	579	2	105	2
LITC	563	4	303	3	441	7	339	8	517	4	552	0
LLNL	1068	4	789	3	833	6	765	5	883	1	1342	0
ORNL	815	0	818	1	665	3	681	6	575	7	87	5
SNL-AL	784	3	693	4	427	1	256	2	441	3	1054	3
WSRC	884	6	947	8	842	6	833	12	802	16	671	8
Y-12	527	0	594	1	683	1	732	3	574	3	296	2

The metric that is used to evaluate P&T safety for the sites is created from Table 27 by dividing the number of offsite P&T occurrences reported during a specific FY by the respective number of hazardous material shipments made by the site during that year. Table 28 is a listing of this P&T safety metric by the reporting sites chosen. For ease of communication, the safety measures have been multiplied by 1,000. The last column is a weighted average of the respective sites' safety measures for the period FY 1994–2000, which was determined by summing the P&T occurrences for the 7-year period, dividing by the shipments made over that period, and multiplying by 1,000. **The weighted average signifies the average number of ORs that a site has reported per 1,000 shipments conducted.**

Table 28. Safety measures (*x* 1000) based on shipments per FY

Site	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Average
ETTP (K-25)	4.93	0	4.09	1.58	5.43	4.42	400	4.94
FDF (FERM)	1.56	6.78	9.88	5.79	17.7	0	5.67	5.93
LANL	15.08	75.3	22.2	21.58	6.17	3.45	19.05	15.62
LITC (INEEL)	0	7.10	9.90	15.87	23.6	7.74	0	9.58

Table 28. Safety measures (*x* 1000) based on shipments per FY (cont'd)

Site	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Average
LLNL	1.39	3.75	3.80	7.20	6.54	1.13	0	3.35
ORNL	5.92	0	1.22	4.51	8.81	12.17	57.47	6.04
SNL	2.52	3.83	5.77	2.34	7.81	6.80	2.85	4.38
WSRC	4.52	6.79	8.45	7.13	14.4	20.00	11.92	11.25
Y-12	1.33	0	1.68	1.46	4.10	5.23	6.76	2.94

Another way of interpreting the averages given in Table 28 is as an indication of the number of occurrences per 1,000 shipments. During the seven years considered, Y-12 reported 10 occurrences and conducted 3,406 shipments. Y-12's safety measure indicates that it averaged 0.00294 occurrences per shipment (10 ÷ 3406) or, alternatively, made 341 shipments (the inverse of 0.00294) before it incurred a reportable occurrence. As another example, LLNL had 56 ORs and conducted 4,979 shipments during this period. Taking the inverse of their shipping measure average, 1 ÷ 0.0112, indicates that they averaged an occurrence every 89 trips. While this measure provides an overall quantitative value, consideration also needs to be given to trends in the yearly figures.

Another metric can be derived by constructing a global weighted average over the nine DOE reporting sites shown in Table 28 by summing the safety measures and dividing by 63, the number of data points for the nine sites reporting over the 7-year period. This annual global safety measure, 14.83, can be used to normalize the safety measures and develop an indicator. Using the average of the safety measures as an indicator, Fig. 20 was developed to show relative safety over the seven FYs, giving an indication of a specific site's yearly performance. With the average indicator level being "1," a site's yearly performance above or below the average gives a measure of its relative safety for the FY.

Looking at the relative safety indicators of Fig. 20, one would prefer to see a downward trend indicating an overall improvement in safety, as exhibited by LANL. However, note that if you simply compare the number of ORs reported by LANL in Table 27 with a smaller number reported by another site, you could generate some faulty assumptions. Making site-to-site comparisons by simply dividing the number of offsite P&T occurrences by the total shipments made during the year superficially yields a smaller percentage for the same number of incidents if a site with a larger number of shipments is involved. Therefore, it is preferable that sites be compared with their own yearly performance or against the median safety measure of the sites.

In Fig. 20, ORNL, K-25, and LANL are above the normalized average. This chart immediately draws attention to any site that had relatively few shipments but generated several occurrences (i.e., ETTP). Investigation reveals that ETTP had 759 waste shipments conducted by a subcontractor who does not report shipment activity to ATMS or ETAS. This transportation activity would be consistent with pass performance and would give them an apparently acceptable safety measure. Moreover, X-10 and Y-12 had, respectively, 124 and 80 shipments

made by the Bechtel Jacobs Company. These shipments made by M&I contractors were not reported to ATMS or ETAS because their contracts do not stipulate that they must report shipments. For consistency with sites that do report to ETAS, these shipments were not credited to the sites—even though their quantity has been determined because other sites might also have additional shipments conducted by non-reporting subcontractors. The number of shipments or occurrences that happen at a site is not highly significant as long as the occurrences themselves are minor. The resulting safety measures are simply used to focus attention on abnormal patterns. This allows SMIP to use indicators to prevent recurrence and promote safety.

ORNL DWG 2001-03168

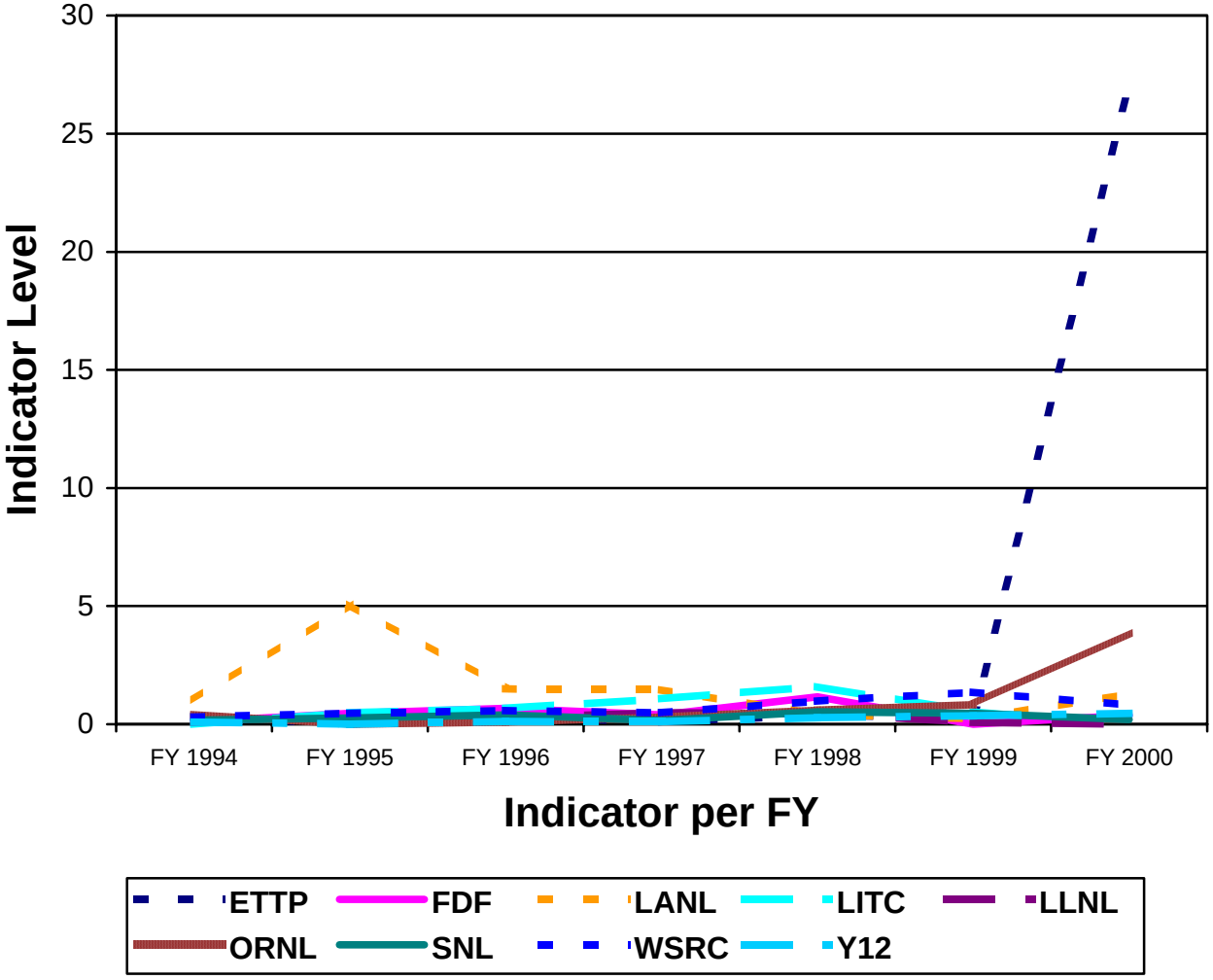

Fig. 20. Safety metric indicator based on normalized ORs per shipments.

For completeness, Table 29, "Safety metric based on shipments during FY 2000," presents all the sites that reported an offsite occurrence and the number of outbound shipments of hazardous materials or waste associated with the site. If a site is not listed as having reported shipments to the ATMS or ETAS, then it has an asterisk listed under the number of shipments.

Table 29. Safety metric based on shipments during FY 2000

Site	FY 2000		Safety measure (*x* 1000)
	Shipments	Incidents	
Argonne National Lab—Illinois Site	139	3	21.58
Bechtel Hanford, Inc.	*	2	NA
Bechtel Nevada	*	1	NA
Brookhaven Natl. Lab	311	2	6.43
CH2M Hill Hanford Group	*	1	NA
East Tennessee Technology Park (K-25)	15	6	400
Fluor Daniel Fernald	506	3	5.93
Idaho National Engineering Laboratory	552	6	10.87
Los Alamos National Lab	105	2	19.05
Lawrence Livermore Lab	1342	0	0
Mound Site	63	1	15.87
Oak Ridge Associated Universities	93	0	0
Oak Ridge National Laboratory	87	5	57.47
PANTEX	622	5	8.04
Project Hanford Management Contractor	64	8	125
Pacific Northwest National Lab	15	4	266.67
Rocky Flats Environmental Technology	184	3	16.30
Sandia National Lab, NM	1054	3	2.85
Y-12 Plant (LMES)	296	2	6.76
West Valley Site	41	0	0
Weldon Spring Site Remedial Action	*	2	NA
Savannah River Site	671	8	11.92
Yucca Mountain	*	1	NA

*Specific site-referenced shipment record not found in ATMS/ETAS

If the normalization data of this section is used for comparisons between sites, all information provided in this report should be reviewed for pertinence. This would involve looking at the number of shipments that the site had during the year (Tables 27 and 29) and the specifics of the ORs that were reported to the ORPS and selected as being P&T related by SMIP (Table A.1 of Appendix A). Too, the ORs would have to be reviewed in depth to ascertain whether a real problem exists or if the statistics appear unfavorable simply because of a large number of minor, non-serious, occurrences having been reported. Site activity and factors would also have to be considered, such as whether a waste-reduction campaign has just begun, one incident had generated other related occurrences, or one worker's inexperience has caused a number of ORs.

Also to be considered is the material movement that is not captured by ETAS. A site may have tremendous local activity (such as cylinder movement from facility to facility or work conducted by a non-reporting M&I subcontractor) that is not reflected in the mileage computations of TRAGIS.

7. FUTURE DIRECTION

The SMIP methodology continues to prove its usefulness. The metrics and safety measures have made comparisons and trending easier and more consistent. Data will continue to be sought upon which new normalization approaches and comparisons with private industry or other agencies can be developed.

A number of LL bulletins of events that are not listed in the ORPS have been circulated to the DOE LL List Server distribution. When P&T events are presented by the LL List Server, the ORPS is routinely searched to determine if DOE has a record of the events. Many of these events are not captured by ORPS because they were not caused by events that happened at DOE sites. However, their lesson is applicable to many DOE facilities. To ensure that the NTPA is abreast of these other pertinent occurrences, the SMIP now searches the Radioactive Material Incident Reports database and reviews the Office of Hazardous Materials Safety Hazardous Materials Incident data and summary statistics. Other areas will be identified that may be additional sources of information on current P&T happenings.

The Hazardous Materials Incident data provides interesting information that can be of use in constructing future reports. For example, it shows that in CY 1999 there were only 14 incidents involving radioactive material of 17,208 total incidents. In CY 2000, there were only 11 of 16,852—none of which were regarded as serious. The data also includes alternative statistics on the number of incidents per carriers. These data became available to the public only in the last few years, and they will be used more in the future for comparisons.

Publication of quarterly reports on occurrences is planned to commence with first quarter FY 2001 ORs. As SMIP data are disseminated and used, it is expected that feedback from users and the DOE complex will help shape future reports and areas of emphasis. The SMIP methodology itself may be modified to better represent P&T safety concerns and issues.

It is hoped that a more current nationwide average for accidents per million miles will be available from the DOT for use in next year's Annual Report. Because of the increase in speed limits and traffic congestion resulting from more motorists on the roads, it is believed that the average has increased.

The development of safety measures based upon crashes per million miles will be more precise next FY because the NTPA has access to DOT's online information and can identify the actual number of accidents and incidents by carrier. Thus, crashes per carrier will be based on the exact number that occurred during the year rather than an estimate.

Because of the industrial pipeline incident involving deaths that occurred during FY 2000, new regulations and requirements were promulgated for pipeline operations. The NTPA is evaluating the changes and considering accelerating program development to be consistent with the new initiatives.

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Appendix A

FY 2000 SMIP-CLASSIFIED OCCURRENCES

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Table A.1. FY 2000 SMIP classified occurrences[1]

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
ALO-AO-MHC-PANTEX-1999-0085	P	HM	ON	2A	1	4	2	3	24	0	0	1
ALO-AO-MHC-PANTEX-1999-0087	T	W	OFF	7A	9	1	2	2	4	0	0	3
ALO-AO-MHC-PANTEX-1999-0088	T	HM	OFF	5A	9	1	2	2	4	0	0	3
ALO-AO-MHC-PANTEX-2000-0007	P	HM	ON	2A	1	4	1	3	12	0	0	1
ALO-AO-MHC-PANTEX-2000-0015	T	HM	OFF	7A	1.45	4	1	3	12	0	0	3
ALO-AO-MHC-PANTEX-2000-0039	T	HM	OFF	7A	7	4	2	2	16	0	0	3
ALO-AO-MHC-PANTEX-2000-0056	T	HM	OFF	5C	1	4	2	3	24	0	0	1
ALO-AO-MHC-PANTEX-2000-0063	T	HM	ON	5	1.4	4	1	3	12	0	0	1
ALO-KO-SNL-10000-2000-0002	T	HM	OFF	4	7	4	2	4	32	0	0	3
ALO-KO-SNL-15000-2000-0001	T	HM	OFF	7F	7	4	1	1	4	0	0	3
ALO-KO-SNL-15000-2000-0004	T	HM	OFF	7A	1	4	2	3	24	0	0	3
ALO-LA-LANL-CMR-2000-0009	T	HM	OFF	4	7	4	1	2	8	0	0	1
ALO-LA-LANL-LANL-2000-0002	P	HM	OFF	7A	8	2	3	2	12	0	0	2
CH-AA-ANLE-ANLEAGHCF-2000-0002	P	HM	OFF	7B	7	4	2	5	40	0	0	3
CH-AA-ANLE-ANLEER-2000-0003	P	HM	ON	3	7	4	2	2	16	0	0	1
CH-AA-ANLE-ANLEER-2000-0004	T	HM	ON	1A3	7	4	2	2	16	0	0	1
CH-AA-ANLE-ANLEPFS-1999-0008	P	HM	OFF	3	5	4	2	2	16	0	0	2
CH-AA-ANLE-ANLEPFS-1999-0011	T	HM	ON	7E	3	2	2	2	8	0	0	1
CH-AA-ANLE-ANLEPFS-2000-0002	T	HM	OFF	5F	7	4	1	2	8	0	0	3
CH-AA-ANLE-ANLEPFS-2000-0003	T	HM	ON	1A3	7	4	2	3	24	0	0	1
CH-AA-ANLE-ANLEPFS-2000-0005	P	HM	ON	1A3	7	4	2	1	8	0	0	1
CH-AA-ANLW-FCF-1999-0007	T	HM	ON	3	9	1	1	2	2	0	0	1
CH-BH-BNL-BNL-1999-0023	P	HM	ON	1A2	7	4	2	2	16	0	0	1
CH-BH-BNL-BNL-1999-0024	P	HM	ON	1A3	7	4	2	3	24	0	0	1
CH-BH-BNL-BNL-2000-0002	P	W	OFF	1B3	8	2	1	2	4	0	0	3
CH-BH-BNL-BNL-2000-0008	T	HM	ON	1B3	8	2	1	2	4	0	0	1
CH-BH-BNL-BNL-2000-0010	P	W	ON	1B1	9	1	1	1	1	0	0	1
CH-BH-BNL-BNL-2000-0016	P	W	OFF	5	9	1	2	2	4	0	0	3
CH-BH-BNL-BNL-2000-0020	P	W	ON	1A1	7	4	2	1	8	0	0	1
HQ--SAYM-YMSGD-2000-0004	P	HM	OFF	7A	7	1	1	1	1	0	0	3

Table A.1. FY 2000 SMIP classified occurrences[1]

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
ID--BBWI-ATR-2000-0002	P	HM	ON	5F	7	4	1	1	4	0	0	1
ID--BBWI-ATR-2000-0015	P	HM	OFF	7E	7	4	2	1	8	2	0	2
ID--BBWI-CFA-2000-0002	P	HM	OFF	7E	7	4	1	3	12	0	0	3
ID--BBWI-CFA-2000-0008	T	HM	ON	5A	7	4	1	2	8	0	0	1
ID--BBWI-FUELRCSTR-1999-0001	T	HM	ON	3	7	4	1	5	20	0	0	1
ID--BBWI-LANDLORD-2000-0002	T	HM	ON	3	7	1	1	1	1	0	0	1
ID--BBWI-SMC-2000-0003	P	HM	OFF	7B	7	4	2	2	16	0	0	1
ID--BBWI-SMC-2000-0008	P	HM	ON	1A1	7	4	2	2	16	0	0	1
ID--BBWI-TAN-2000-0006	P	HM	ON	1A3	7	4	2	1	8	0	0	1
ID--BBWI-TAN-2000-0007	T	HM	ON	3	8	2	2	2	8	0	0	1
ID--BBWI-TAN-2000-0016	T	HM	OFF	5A	8	2	1	2	4	0	0	1
ID--BBWI-TRA-2000-0001	T	HM	OFF	7E	7	4	1	1	4	2	0	2
ID--BBWI-TRA-2000-0008	T	HM	OFF	7E	7	4	1	1	4	0	0	3
ID--BBWI-TRA-2000-0009	P	HM	ON	5C	7	4	1	1	4	0	0	1
NVOO--BNLV-NTS-2000-0016	T	W	OFF	5	9	1	1	2	2	0	0	2
OAK--LLNL-LLNL-1999-0051	P	HM	ON	3	8	2	2	2	8	0	0	1
OAK--LLNL-LLNL-2000-0044	P	HM	ON	1A3	7	4	1	2	8	0	0	1
OH-FN-FDF-FEMP-1999-0023	P	HM	OFF	7E	7	4	2	4	32	0	0	2
OH-FN-FDF-FEMP-2000-0017	T	HM	OFF	5	7	4	1	3	12	0	0	3
OH-FN-FDF-FEMP-2000-0019	T	HM	OFF	3	7	4	2	4	32	0	0	3
OH-MB-BWO-BWO01-2000-0007	P	HM	ON	1A3	7	4	1	1	4	0	0	1
OH-MB-BWO-BWO01-2000-0012	P	HM	ON	1A2	7	4	1	1	4	0	0	1
OH-MB-BWO-BWO03-1999-0004	P	HM	ON	5	7	4	1	4	16	0	0	1
OH-MB-BWO-BWO04-1999-0007	P	HM	ON	4	7	4	2	3	24	0	0	1
OH-MB-BWO-BWO06-1999-0005	P	HM	ON	1A3	7	4	2	2	16	0	0	1
OH-MB-BWO-BWO06-2000-0002	T	HM	OFF	5C	7	4	1	2	8	0	0	3
OH-WV-WVNS-LAG-2000-0001	T	HM	ON	5	7	4	1	2	8	0	0	1
ORO--BJC-K25WASTMAN-1999-0019	P	W	OFF	1A3	7	4	2	3	24	0	0	3
ORO--BJC-K25WASTMAN-1999-0023	P	HM	OFF	5B	7	4	1	1	4	0	0	2
ORO--BJC-K25WASTMAN-1999-0026	P	HM	OFF	3	7	4	2	4	32	0	0	1
ORO--BJC-K25WASTMAN-2000-0003	T	HM	OFF	5	7	4	2	2	16	0	0	1

Table A.1. FY 2000 SMIP classified occurrences[1]

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
ORO--BJC-K25WASTMAN-2000-0005	T	W	OFF	5A	9	1	1	2	2	0	0	2
ORO--BJC-K25WASTMAN-2000-0012	P	W	OFF	1A3	7	4	2	3	24	3	72	3
ORO--BJC-X10ENVRES-2000-0015	T	HM	ON	2C	7	4	2	5	40	0	0	1
ORO--BJC-X10WSTEMRA-2000-0001	T	HM	OFF	5	7	4	1	2	8	0	0	1
ORO--BJC-X10WSTEMRA-2000-0004	T	HM	OFF	7A	7	4	1	2	8	0	0	1
ORO--BJC-X10WSTEMRA-2000-0005	T	HM	OFF	5	2.2	3	1	4	12	0	0	1
ORO--BJC-Y12WASTE-2000-0007	T	HM	OFF	5B	7	4	1	2	8	0	0	1
ORO--LMES-Y12NUCLEAR-2000-0017	P	HM	ON	1A3	7	4	2	3	24	0	0	2
ORO--LMES-Y12NUCLEAR-2000-0028	P	HM	ON	2C	4.2	3	2	4	24	0	0	1
ORO--LMES-Y12SITE-2000-0004	T	HM	ON	3	7	4	1	2	8	0	0	1
ORO--LMES-Y12SITE-2000-0011	T	HM	OFF	3	8	2	1	3	6	0	0	3
ORO--LMES-Y12SITE-2000-0012	T	HM	ON	3	7	4	1	2	8	0	0	1
ORO--MK-WSSRAP-1999-0023	P	HM	OFF	1A3	7	4	2	3	24	0	0	2
ORO--MK-WSSRAP-2000-0002	P	W	OFF	3	9	1	2	2	4	0	0	1
ORO--MK-WSSRAP-2000-0012	T	W	ON	1B2	9	1	3	2	6	0	0	1
ORO--ORNL-X10BOPLANT-2000-0005	P	HM	OFF	4	8	2	2	2	8	0	0	3
ORO--ORNL-X10HFIR-1999-0025	P	HM	OFF	2C	7	4	2	5	40	0	0	3
ORO--ORNL-X10PLEQUIP-1999-0009	P	HM	ON	1A3	7	4	2	4	32	0	0	1
ORO--ORNL-X10PLEQUIP-2000-0012	T	W	ON	4	9	1	2	2	4	0	0	1
RFO--KHLL-371OPS-2000-0059	P	W	ON	3	9	1	1	2	2	0	0	1
RFO--KHLL-771OPS-1999-0059	P	HM	ON	1A3	7	4	2	4	32	0	0	1
RFO--KHLL-774OPS-2000-0007	T	W	ON	1B2	9	1	1	2	2	0	0	1
RFO--KHLL-FACOPS-2000-0002	T	HM	ON	3	7	4	2	2	16	0	0	1
RFO--KHLL-NONPUOPS1-1999-0004	P	HM	ON	1A3	7	4	2	4	32	0	0	1
RFO--KHLL-PUFAB-2000-0010	T	HM	ON	3	7	4	2	3	24	0	0	1
RFO--KHLL-PUFAB-2000-0022	T	HM	ON	4	7	4	2	3	24	0	0	1
RFO--KHLL-SOLIDWST-2000-0010	P	W	ON	1A2	7	4	2	3	24	0	0	1
RFO--KHLL-SOLIDWST-2000-0014	T	HM	ON	3	7	4	2	3	24	0	0	1
RFO--KHLL-SOLIDWST-2000-0022	T	HM	ON	3	7	4	2	3	24	0	0	1
RFO--KHLL-TRANSOPS-1999-0003	P	HM	ON	2C	7	4	2	4	32	0	0	1
RFO--KHLL-TRANSOPS-2000-0001	T	W	OFF	5	9	1	1	2	2	0	0	3

Table A.1. FY 2000 SMIP classified occurrences[1]

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
RFO--KHLL-TRANSOPS-2000-0002	T	HM	ON	3	7	4	1	2	8	0	0	1
RFO--KHLL-TRANSOPS-2000-0003	T	HM	OFF	7A	7	4	1	2	8	0	0	3
RFO--KHLL-WSTMGTOPS-1999-0012	T	HM	ON	3	9	1	2	2	4	0	0	1
RFO--KHLL-WSTMGTOPS-1999-0024	T	HM	OFF	4	9	1	2	2	4	0	0	3
RFO--KHLL-WSTMGTOPS-2000-0010	T	HM	ON	3	7	4	1	3	12	0	0	1
RFO--KHLL-WSTMGTOPS-2000-0011	T	W	ON	3	7	4	2	3	24	0	0	1
RFO--KHLL-WSTMGTOPS-2000-0013	P	HM	ON	2C	7	4	2	4	32	0	0	1
RL--BHI-DND-2000-0008	P	HM	ON	1A3	7	4	2	2	16	0	0	1
RL--BHI-ERDF-2000-0002	T	HM	ON	3	7	4	2	3	24	0	0	1
RL--BHI-GROUNDWTR-2000-0001	P	W	OFF	4	9	1	2	1	2	0	0	1
RL--BHI-IFSM-1999-0008	P	W	ON	4	9	1	2	2	4	0	0	1
RL--BHI-IFSM-2000-0006	P	W	ON	3	9	1	2	2	4	0	0	1
RL--BHI-IFSM-2000-0007	P	W	ON	3	9	1	2	2	4	0	0	1
RL--BHI-REMACT-2000-0001	P	HM	OFF	5	7	4	1	2	8	0	0	1
RL--PHMC-200LWP-2000-0004	T	W	OFF	5	9	1	2	2	4	0	0	1
RL--PHMC-324FAC-2000-0005	T	W	OFF	2C	7	4	2	5	40	0	0	1
RL--PHMC-ANALLAB-1999-0019	T	HM	OFF	5A	7	1	1	1	1	0	0	2
RL--PHMC-FSS-2000-0003	P	HM	ON	2A	7	4	2	4	32	0	0	1
RL--PHMC-GENERAL-2000-0002	P	HM	OFF	7A	7	4	1	2	8	0	0	3
RL--PHMC-GENSERVICE-1999-0004	T	HM	ON	5B	9	1	2	2	4	0	0	1
RL--PHMC-GENSERVICE-2000-0001	T	HM	ON	5	9	1	1	2	2	0	0	1
RL--PHMC-GENSERVICE-2000-0002	T	W	OFF	4	9	1	1	2	2	0	0	3
RL--PHMC-SOLIDWASTE-1999-0006	P	W	OFF	5	9	1	2	2	4	0	0	2
RL--PHMC-SOLIDWASTE-2000-0002	P	W	ON	4	9	1	2	2	4	0	0	1
RL--PHMC-SOLIDWASTE-2000-0005	P	HM	ON	4	7	4	2	4	32	0	0	1
RL--PHMC-WSCF-2000-0004	P	HM	OFF	7B	6.1	2	2	2	8	0	0	1
RL--PHMC-WSCF-2000-0006	P	HM	OFF	4	7	0	0	0	0	0	0	0
RL--PNNL-PNNLBOPER-1999-0033	P	HM	OFF	7A	6.1	3	2	4	24	0	0	3
RL--PNNL-PNNLBOPER-1999-0036	P	HM	OFF	4	7	4	1	1	4	0	0	3
RL--PNNL-PNNLBOPER-2000-0009	T	HM	OFF	7A	7	1	1	1	1	0	0	3
RL--PNNL-PNNLBOPER-2000-0016	P	W	ON	2B	9	1	2	1	2	0	0	1

Table A.1. FY 2000 SMIP classified occurrences[1]

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
RL--PNNL-PNNLNUCL-2000-0004	P	W	OFF	4	9	1	2	2	4	0	0	1
RL--PNNL-PNNLNUCL-2000-0008	P	W	ON	1A2	9	1	2	2	4	0	0	1
RP--CHG-TANKFARM-2000-0049	P	W	ON	1A3	9	1	2	3	6	0	0	1
RP--CHG-TANKFARM-2000-0054	P	W	ON	1A3	9	1	2	1	2	0	0	1
RP--CHG-TANKFARM-2000-0063	P	HM	OFF	2C	7	4	2	5	40	0	0	1
SR--WSRC-ALABF-1999-0019	T	HM	ON	4	7	4	1	4	16	0	0	1
SR--WSRC-ALABF-2000-0006	T	HM	ON	5	7	4	2	4	32	0	0	1
SR--WSRC-ALABF-2000-0009	T	HM	ON	5	7	4	1	4	16	0	0	1
SR--WSRC-ALABF-2000-0010	T	HM	ON	5	7	4	1	2	8	0	0	1
SR--WSRC-CIF-2000-0006	T	HM	OFF	7A	7	4	2	2	16	0	0	3
SR--WSRC-CIF-2000-0012	P	HM	OFF	7E	9	1	2	2	4	0	0	2
SR--WSRC-CSWE-2000-0007	P	HM	ON	2A	2.2	3	2	4	24	0	0	1
SR--WSRC-CSWE-2000-0012	T	HM	OFF	5A	7	1	1	5	5	0	0	3
SR--WSRC-CSWE-2000-0015	T	HM	OFF	1B1	8	2	2	2	8	0	0	1
SR--WSRC-HCAN-1999-0049	P	HM	OFF	7E	8	2	2	2	12	0	0	1
SR--WSRC-HCAN-1999-0054	T	HM	OFF	4	7	4	2	2	16	0	0	1
SR--WSRC-LTA-2000-0002	P	HM	ON	1A3	7	1	2	1	2	0	0	1
SR--WSRC-LTA-2000-0003	T	HM	ON	5	7	4	1	4	16	0	0	1
SR--WSRC-LTA-2000-0019	T	HM	ON	5	7	4	2	1	8	0	0	1
SR--WSRC-RBOF-2000-0003	P	HM	ON	4	7	4	2	5	40	0	0	1
SR--WSRC-REACL-2000-0007	T	HM	OFF	4	7	4	1	3	12	0	0	4
SR--WSRC-SEPGEN-2000-0001	T	W	ON	5A	9	1	2	2	4	0	0	1
SR--WSRC-TNX-1999-0003	T	HM	OFF	5	9	1	2	2	4	0	0	1

[1]**Abbreviations:**

HC = hazard class, DOT
HM = hazardous material
HSR = hazard significance rating
NOC = Nature of occurrence
Off/On:
  OFF = Offsite
  ON/OFF = Onsite, related to offsite shipment
  ON/ON = Onsite, not related to offsite shipment
Pkg = packaging related
Q_{ty} = quantity
RF = repetitive factor
RSF = repetitive significance factor
SPR = stakeholder and publicity rating
Trn = transportation related
W = Waste
W_{EC} = event consequence measure
W_{HC} = quantity classification measure

Appendix B

FY 2000 OFFSITE OCCURRENCES

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Table B.1. FY 2000 offsite occurrences[1]

Report Number	Pkg/Trn	HM/W	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
ALO-AO-MHC-PANTEX-1999-0087	T	W	7A	9	1	2	2	4	0	0	3
ALO-AO-MHC-PANTEX-1999-0088	T	HM	5A	9	1	2	2	4	0	0	3
ALO-AO-MHC-PANTEX-2000-0015	T	HM	7A	1.45	4	1	3	12	0	0	3
ALO-AO-MHC-PANTEX-2000-0039	T	HM	7A	7	4	2	2	16	0	0	3
ALO-AO-MHC-PANTEX-2000-0056	T	HM	5C	1	4	2	3	24	0	0	1
ALO-KO-SNL-10000-2000-0002	T	HM	4	7	4	2	4	32	0	0	3
ALO-KO-SNL-15000-2000-0001	T	HM	7F	7	4	1	1	4	0	0	3
ALO-KO-SNL-15000-2000-0004	T	HM	7A	1	4	2	3	24	0	0	3
ALO-LA-LANL-CMR-2000-0009	T	HM	4	7	4	1	2	8	0	0	1
ALO-LA-LANL-LANL-2000-0002	P	HM	7A	8	2	3	2	12	0	0	2
CH-AA-ANLE-ANLEAGHCF-2000-0002	P	HM	7B	7	4	2	5	40	0	0	3
CH-AA-ANLE-ANLEPFS-1999-0008	P	HM	3	5	4	2	2	16	0	0	2
CH-AA-ANLE-ANLEPFS-2000-0002	T	HM	5F	7	4	1	2	8	0	0	3
CH-BH-BNL-BNL-2000-0002	P	W	1B3	8	2	1	2	4	0	0	3
CH-BH-BNL-BNL-2000-0016	P	W	5	9	1	2	2	4	0	0	3
HQ--SAYM-YMSGD-2000-0004	P	HM	7A	7	1	1	1	1	0	0	3
ID--BBWI-ATR-2000-0015	P	HM	7E	7	4	2	1	8	2	0	2
ID--BBWI-CFA-2000-0002	P	HM	7E	7	4	1	3	12	0	0	3
ID--BBWI-SMC-2000-0003	P	HM	7B	7	4	2	2	16	0	0	1
ID--BBWI-TAN-2000-0016	T	HM	5A	8	2	1	2	4	0	0	1
ID--BBWI-TRA-2000-0001	T	HM	7E	7	4	1	1	4	2	0	2
ID--BBWI-TRA-2000-0008	T	HM	7E	7	4	1	1	4	0	0	3
NVOO--BNLV-NTS-2000-0016	T	W	5	9	1	1	2	2	0	0	2
OH-FN-FDF-FEMP-1999-0023	P	HM	7E	7	4	2	4	32	0	0	2
OH-FN-FDF-FEMP-2000-0017	T	HM	5	7	4	1	3	12	0	0	3
OH-FN-FDF-FEMP-2000-0019	T	HM	3	7	4	2	4	32	0	0	3
OH-MB-BWO-BWO06-2000-0002	T	HM	5C	7	4	1	2	8	0	0	3
ORO--BJC-K25WASTMAN-1999-0019	P	W	1A3	7	4	2	3	24	0	0	3
ORO--BJC-K25WASTMAN-1999-0023	P	HM	5B	7	4	1	1	4	0	0	2
ORO--BJC-K25WASTMAN-1999-0026	P	HM	3	7	4	2	4	32	0	0	1

Table B.1. FY 2000 offsite occurrences[1]

Report Number	Pkg/Trn	HM/W	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
ORO--BJC-K25WASTMAN-2000-0003	T	HM	5	7	4	2	2	16	0	0	1
ORO--BJC-K25WASTMAN-2000-0005	T	W	5A	9	1	1	2	2	0	0	2
ORO--BJC-K25WASTMAN-2000-0012	P	W	1A3	7	4	2	3	24	3	72	3
ORO--BJC-X10WSTEMRA-2000-0001	T	HM	5	7	4	1	2	8	0	0	1
ORO--BJC-X10WSTEMRA-2000-0004	T	HM	7A	7	4	1	2	8	0	0	1
ORO--BJC-X10WSTEMRA-2000-0005	T	HM	5	2.2	3	1	4	12	0	0	1
ORO--BJC-Y12WASTE-2000-0007	T	HM	5B	7	4	1	2	8	0	0	1
ORO--LMES-Y12SITE-2000-0011	T	HM	3	8	2	1	3	6	0	0	3
ORO--MK-WSSRAP-1999-0023	P	HM	1A3	7	4	2	3	24	0	0	2
ORO--MK-WSSRAP-2000-0002	P	W	3	9	1	2	2	4	0	0	1
ORO--ORNL-X10BOPLANT-2000-0005	P	HM	4	8	2	2	2	8	0	0	3
ORO--ORNL-X10HFIR-1999-0025	P	HM	2C	7	4	2	5	40	0	0	3
RFO--KHLL-TRANSOPS-2000-0001	T	W	5	9	1	1	2	2	0	0	3
RFO--KHLL-TRANSOPS-2000-0003	T	HM	7A	7	4	1	2	8	0	0	3
RFO--KHLL-WSTMGTOPS-1999-0024	T	HM	4	9	1	2	2	4	0	0	3
RL--BHI-GROUNDWTR-2000-0001	P	W	4	9	1	2	1	2	0	0	1
RL--BHI-REMACT-2000-0001	P	HM	5	7	4	1	2	8	0	0	1
RL--PHMC-200LWP-2000-0004	T	W	5	9	1	2	2	4	0	0	1
RL--PHMC-324FAC-2000-0005	T	W	2C	7	4	2	5	40	0	0	1
RL--PHMC-ANALLAB-1999-0019	T	HM	5A	7	1	1	1	1	0	0	2
RL--PHMC-GENERAL-2000-0002	P	HM	7A	7	4	1	2	8	0	0	3
RL--PHMC-GENSERVICE-2000-0002	T	W	4	9	1	1	2	2	0	0	3
RL--PHMC-SOLIDWASTE-1999-0006	P	W	5	9	1	2	2	4	0	0	2
RL--PHMC-WSCF-2000-0004	P	HM	7B	6.1	2	2	2	8	0	0	1
RL--PHMC-WSCF-2000-0006	P	HM	4	7	0	0	0	0	0	0	0
RL--PNNL-PNNLBOPER-1999-0033	P	HM	7A	6.1	3	2	4	24	0	0	3
RL--PNNL-PNNLBOPER-1999-0036	P	HM	4	7	4	1	1	4	0	0	3
RL--PNNL-PNNLBOPER-2000-0009	T	HM	7A	7	1	1	1	1	0	0	3
RL--PNNL-PNNLNUCL-2000-0004	P	W	4	9	1	2	2	4	0	0	1
RP--CHG-TANKFARM-2000-0063	P	HM	2C	7	4	2	5	40	0	0	1
SR--WSRC-CIF-2000-0006	T	HM	7A	7	4	2	2	16	0	0	3

Table B.1. FY 2000 offsite occurrences[1]

Report Number	Pkg/Trn	HM/W	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
SR--WSRC-CIF-2000-0012	P	HM	7E	9	1	2	2	4	0	0	2
SR--WSRC-CSWE-2000-0012	T	HM	5A	7	1	1	5	5	0	0	3
SR--WSRC-CSWE-2000-0015	T	HM	1B1	8	2	2	2	8	0	0	1
SR--WSRC-HCAN-1999-0049	P	HM	7E	8	2	2	2	12	0	0	1
SR--WSRC-HCAN-1999-0054	T	HM	4	7	4	2	2	16	0	0	1
SR--WSRC-REACL-2000-0007	T	HM	4	7	4	1	3	12	0	0	4
SR--WSRC-TNX-1999-0003	T	HM	5	9	1	2	2	4	0	0	1

[1]**Abbreviations:**

HC = hazard class, DOT
HM = hazardous material
HSR = hazard significance rating
NOC = Nature of occurrence
Off/On:
  OFF = Offsite
  ON/OFF = Onsite, related to offsite shipment
  ON/ON = Onsite, not related to offsite shipment
Pkg = packaging related
Q_{ty} = quantity
RF = repetitive factor
RSF = repetitive significance factor
SPR = stakeholder and publicity rating
Trn = transportation related
W = Waste
W_{EC} = event consequence measure
W_{HC} = quantity classification measure

Appendix C

DISTRIBUTION OF ORS BY ORGANIZATION

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DISTRIBUTION OF ORS BY ORGANIZATION

At multiprogram-funded sites, ORPS does not consistently identify the Program Office (PO) directly responsible for the occurrence. Hence a reporting facility may assign some occurrences to POs that are operationally responsible but may not be responsible for and/or directly involved in shipping activity. Therefore, in Table C.1, the SMIP simply presents the number of ORs as reported by the sites without normalization. Also, shipments are not reported by PO; therefore, it would be inadvisable for SMIP to normalize these ORs at the PO level.

The Environmental Management (EM) program reported about 72% of the ORs generated during this FY, although ten of the occurrences were caused by others (non-DOE sites or non-DOE contractors). Defense programs (DP) accounted for about 14 % of the ORs. Reporting a combined 126 ORs, these two programs together reported about 86% of the P&T-related ORs filed this FY, a percentage consistent with past FY reporting profiles.

Non-DOE contractor 'others' account for 15% of the occurrences reported this quarter. Violations attributed to 'others' have been separated from the ORs that are clearly the full responsibility of the reporting group so that such occurrences are not charged to the reporting PO, the Operations Office, or the contractor. ORPS makes no distinction between reporter and violator.

Table C.1. FY 2000 OR distribution by DOE Program Office

		No. of ORs	
Code	Description	Owner	Others
DP	Defense Programs	15	6
EH	Environmental Safety and Health	0	0
EM	Environmental Management	95	10
ER	Energy Research	0	0
FE	Fossil Energy	0	0
NE	Nuclear Energy	3	3
NN	Nonproliferation and National Security	0	0
SC	Science	9	4
RW	Radioactive Waste Management	0	1
	Totals	122	24

Table C.2 lists the number of FY 2000 ORs reported by DOE Operations Office.

Table C.2. FY 2000 OR distribution by DOE Operations Office

Code	Description	No. of ORs	
		Owner	Others
ALO	Albuquerque Operations	7	6
CH	Chicago Operations	14	2
HQ	DOE Headquarters	0	1
ID	Idaho Operations	9	5
NV	Nevada Operations	1	0
OAK	Oakland Operations	2	0
OH	Ohio Field Office	9	1
ORO	Oak Ridge Operations	22	1
RFO	Rocky Flats Operations	18	1
RL	Richland Operations	22	4
RP	River Protection Operations	3	0
SR	Savannah River Operations	15	3
	Totals	122	24
	Grand Total		146

To perform trending analysis, the outbound shipments of hazardous material and waste for all modes of transport made by the Operations Offices during FY 1994 through 2000 were used to normalize occurrences reported by the sites to the different Operations Offices. Table C.3 shows these shipments by FY and is the basis upon which the safety measures are calculated. The table is based upon shipment records reported to the ETAS, *where a shipment is considered to be whatever record is reported by a site to ETAS for a single shipping paper or manifest*. Hence a shipment could comprise 10 railcars of hazardous waste or one small sample.

Using the data of Table C.2 for ORs that are the responsibility of the Operations Offices and the shipment data of Table C.3, a metric of ORs per shipment was constructed for FY 2000 (Fig. C.1). Because the safety measures were multiplied by 1,000 so that the information could be more speedily grasped, the *y*-axis represents occurrences per 1,000 shipments. At a glance, Fig. C.1 indicates that the Operations Offices averaged less than 20 occurrences per 1,000 shipments. In fact, the occurrence-per-shipment metrics are a little better than indicated. Oak Ridge Operations and Rocky Flats Operations—the Operations Offices with the highest safety

measures—actually don't have as many occurrences per shipment as the chart indicates because many of the sites under their jurisdiction use M&I contractors who don't report shipments to ETAS to conduct many of their shipments.

Further, using Table C.3 and the numbers and types of occurrences reported by the Operations Offices per FY, Figs. C.1–C.8 were developed. They indicate the metrics for the seven NOC categories for each of the Operations Office. All of the Operations Offices are displayed on the graph so that a rough comparison can be made of the ORs per respective shipments reported to the Operations Offices by FY. Also, a trend line showing a moving average of two periods based on the average of the ORs reported during a FY has been provided on Figs. C.2–C.8 to indicate the overall trend of the ORs.

Table C.3. Outbound shipments of hazardous materials by Operations Offices

Code	Description	Fiscal Year						
		1994	1995	1996	1997	1998	1999	2000
ALO	Albuquerque Ops	3316	2493	2137	1417	1538	1587	2191
CH	Chicago Operations	1265	1118	778	553	749	765	766
HQ	DOE Headquarters	16	63	15	26	2	7	24
ID	Idaho Operations	718	604	312	441	339	510	552
NV	Nevada Operations	262	154	107	122	192	202	104
OAK	Oakland Operations	1880	1421	965	997	993	1120	1375
OH	Ohio Field Office	26	1523	1048	1034	685	922	651
ORO	Oak Ridge Ops	3242	2994	2512	2028	1746	1725	492
RFO	Rocky Flats Ops	0*	0*	349	678	815	688	301
RL	Richland Operations	762	524	538	516	783	657	374
SR	Savannah River Ops	664	884	947	842	833	799	671
	Total	12151	11778	9,708	8,654	8,675	8,982	9,501

*The sites now under RFO jurisdiction previously reported to ALO.

ORNL DWG 2001-03169

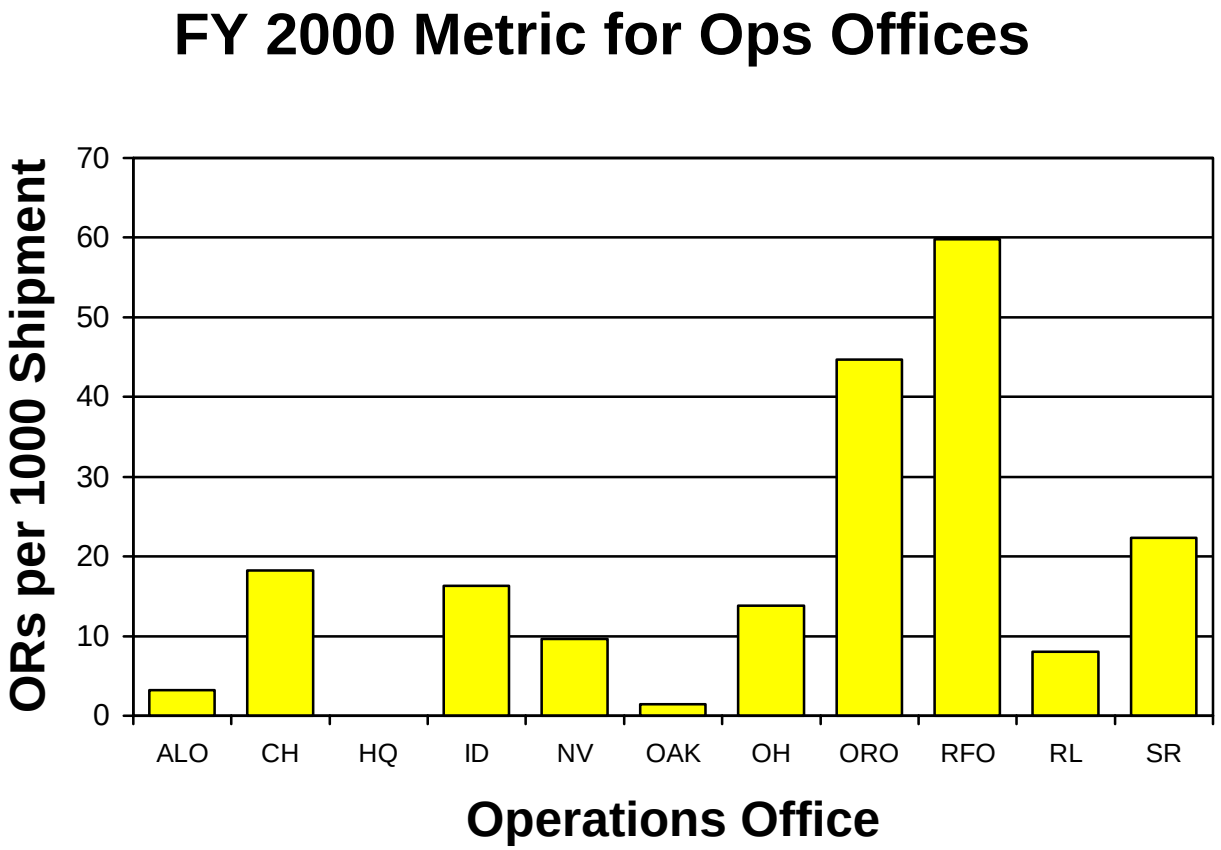

Fig C.1. FY 2000 safety measures for DOE Operations Offices.

ORNL DWG 2001-03170

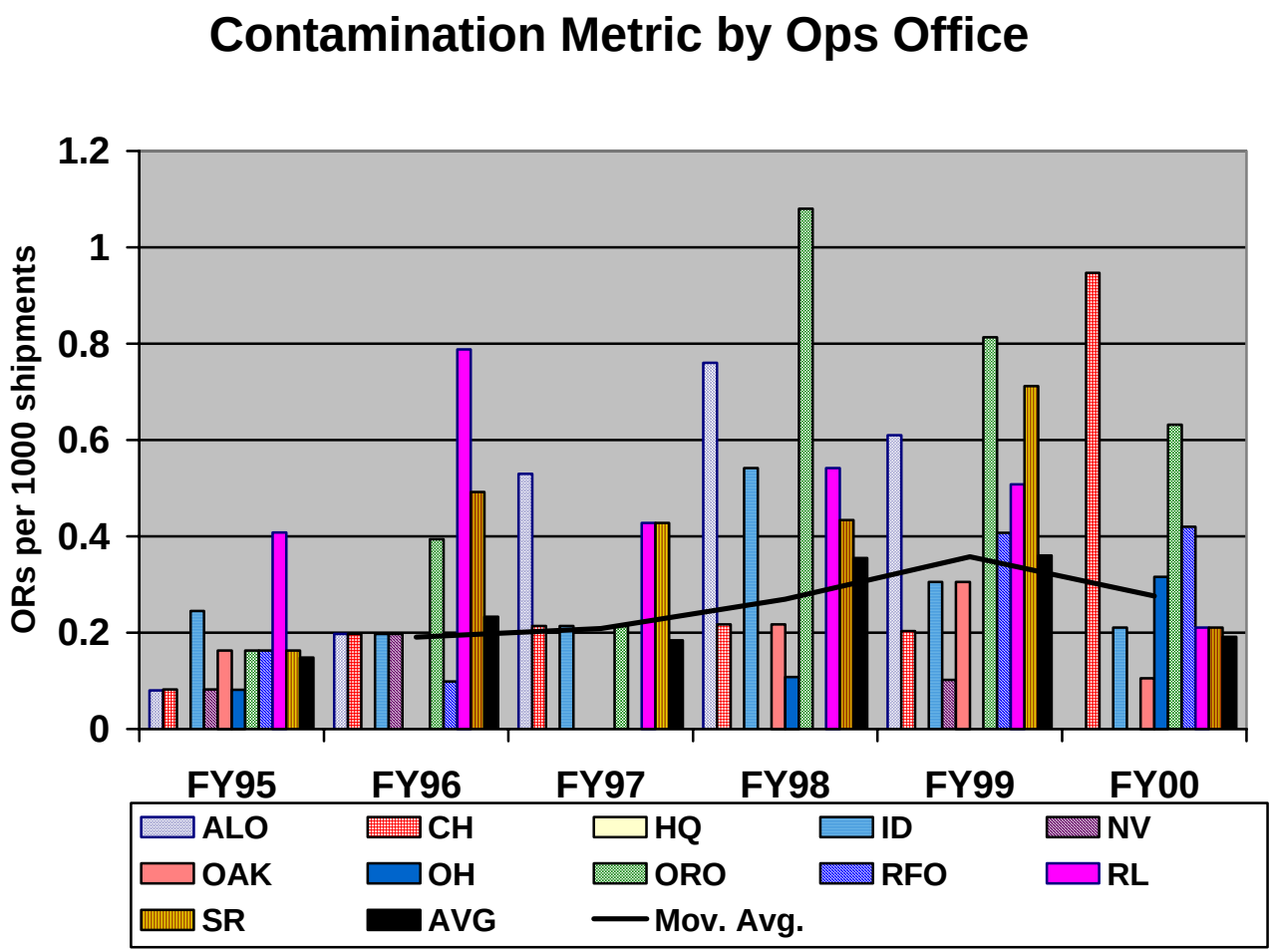

Fig. C.2. Safety metric for contamination ORs by Operations Office.

ORNL DWG 2001-03171

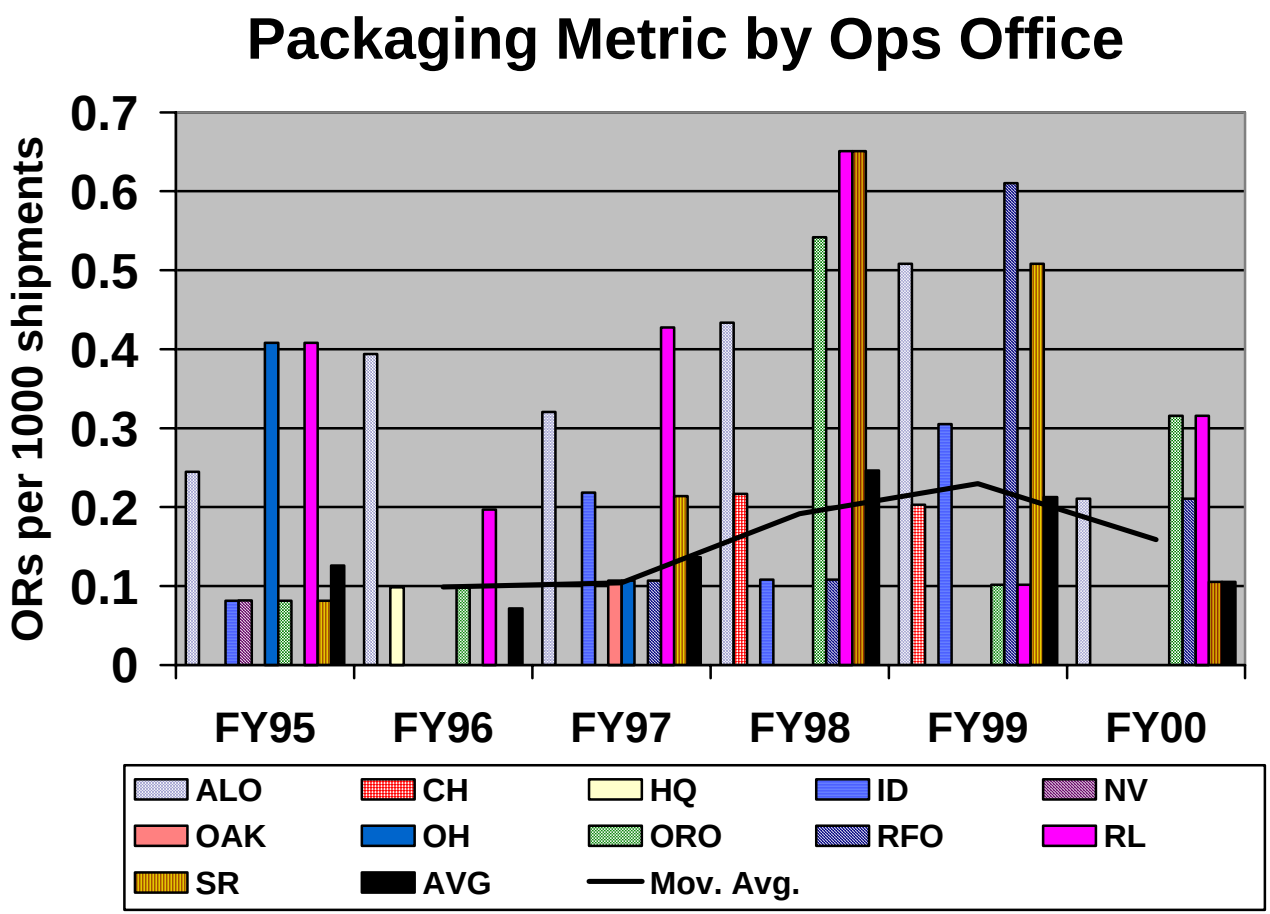

Fig. C.3. Safety metric for packaging ORs by Operations Office.

ORNL DWG 2001-03280

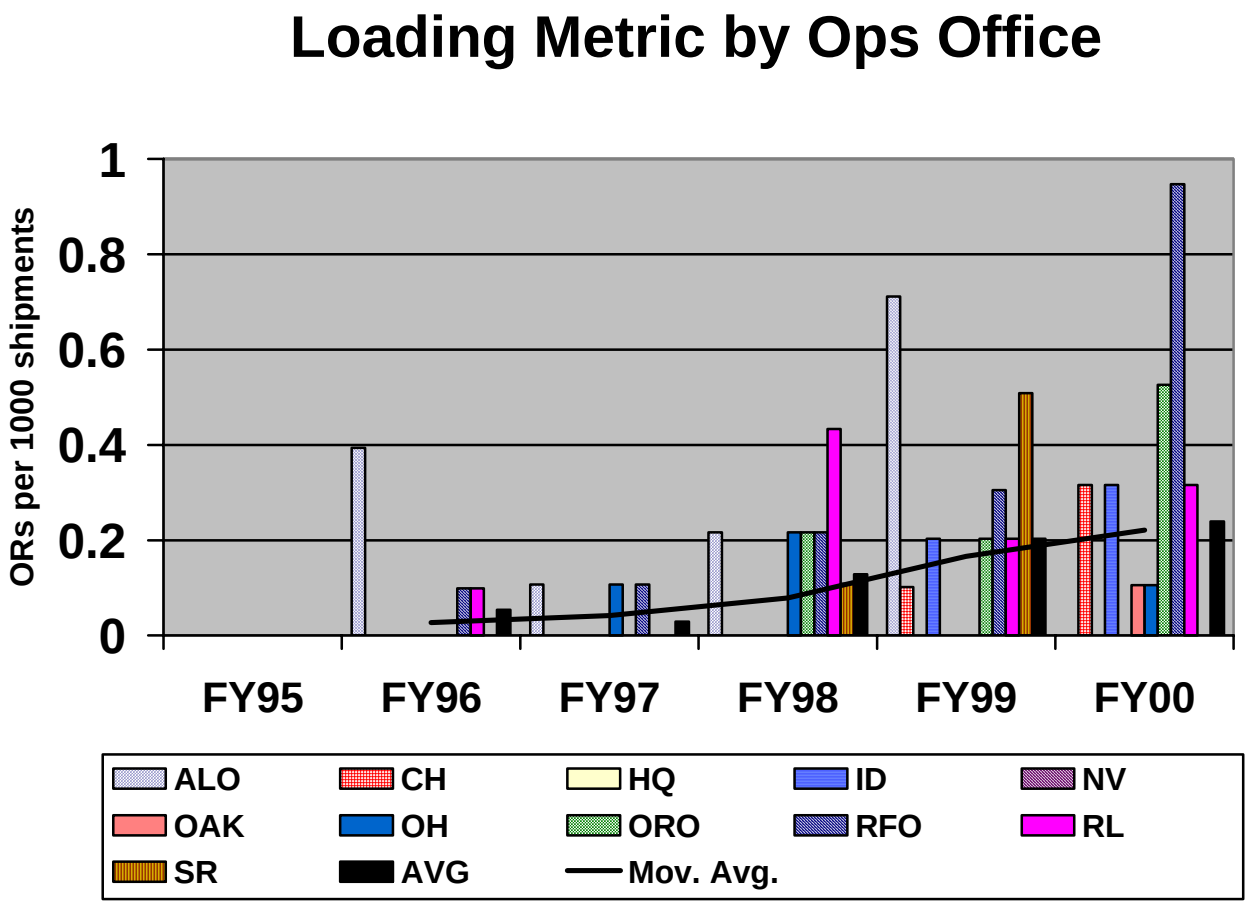

Fig. C.4. Safety metric for loading, unloading, or storage incident to transport ORs by Operations Office.

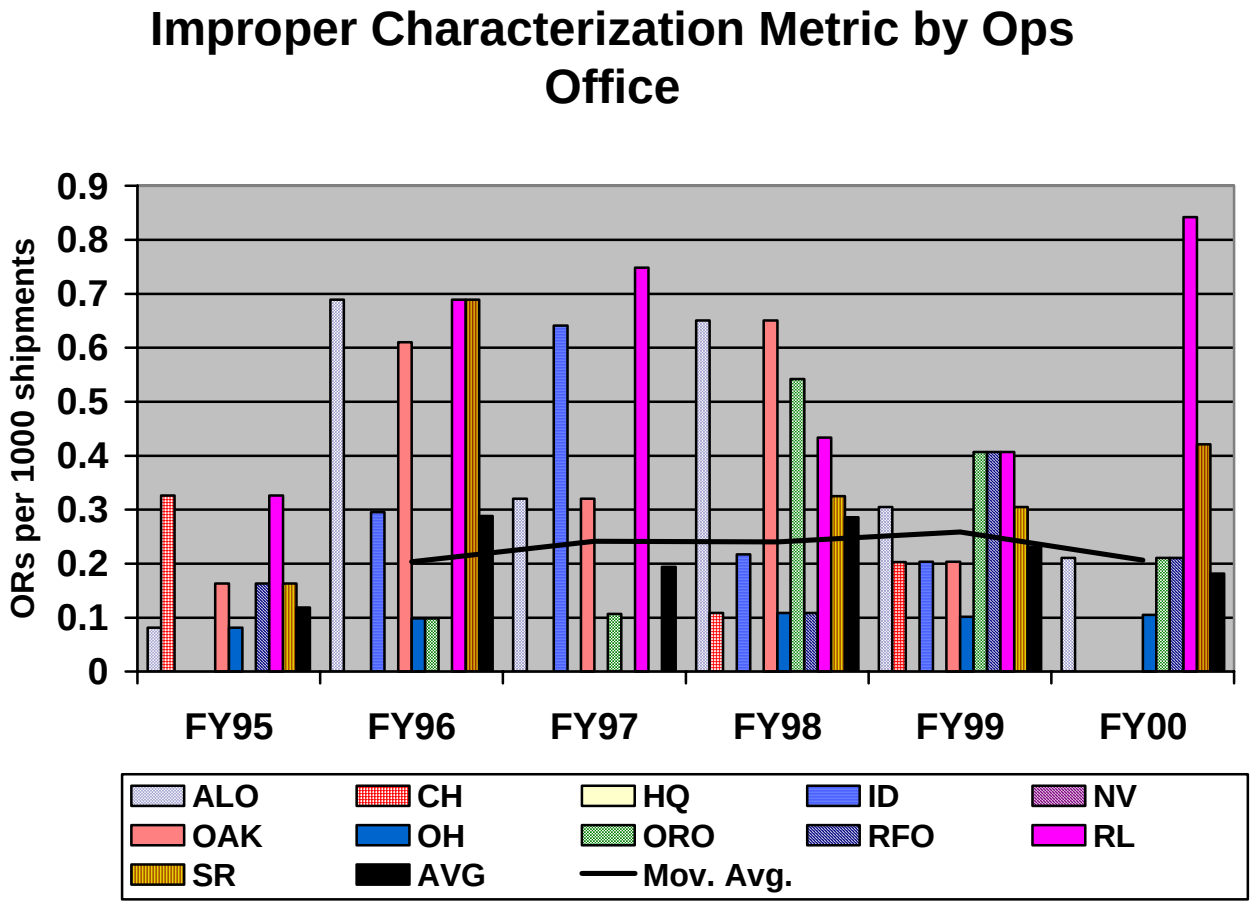

Fig. C.5. Safety metric for improper HAZMAT characterization ORs by Operations Office.

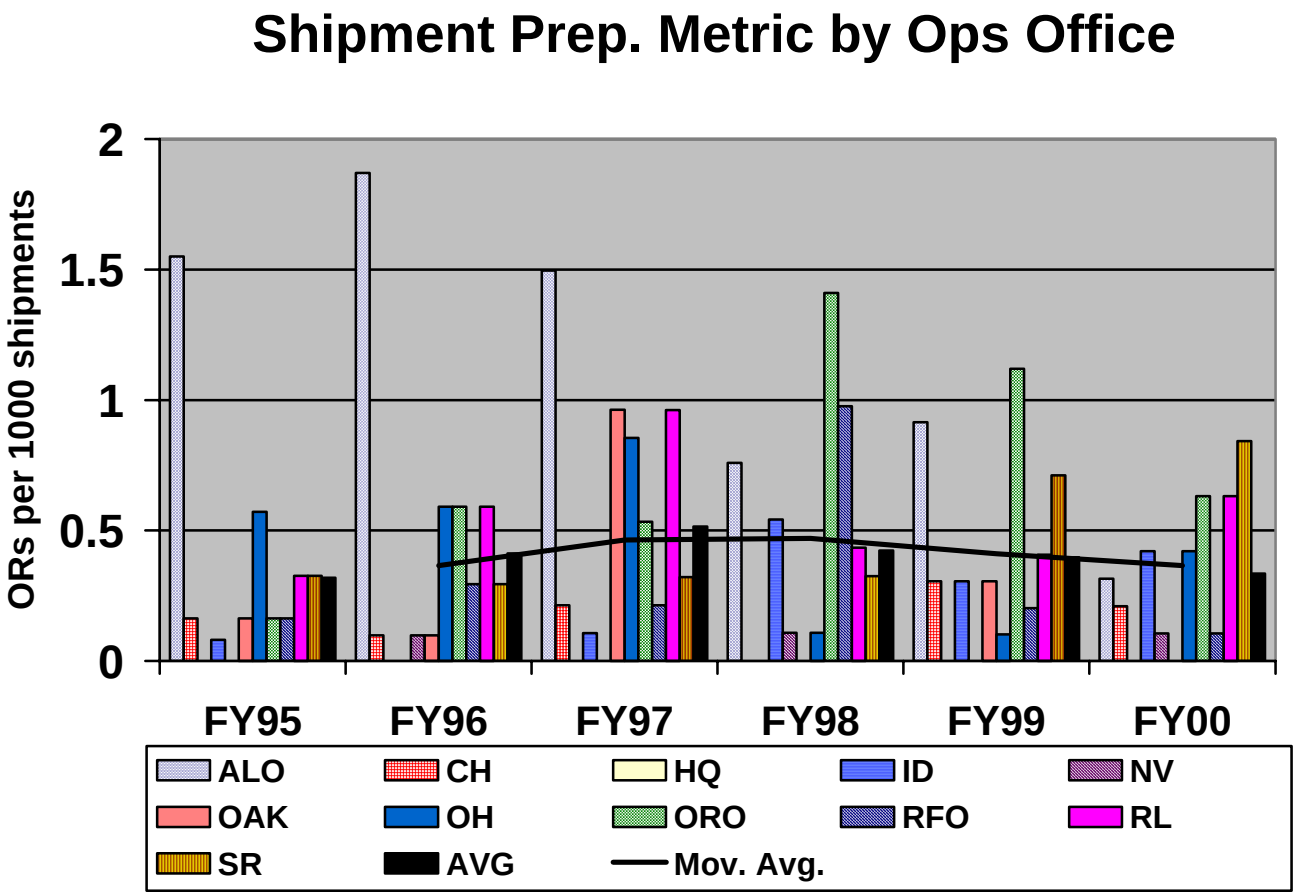

Fig. C.6. Safety metric for shipment preparation ORs by Operations Office.

ORNL DWG 2001-03283

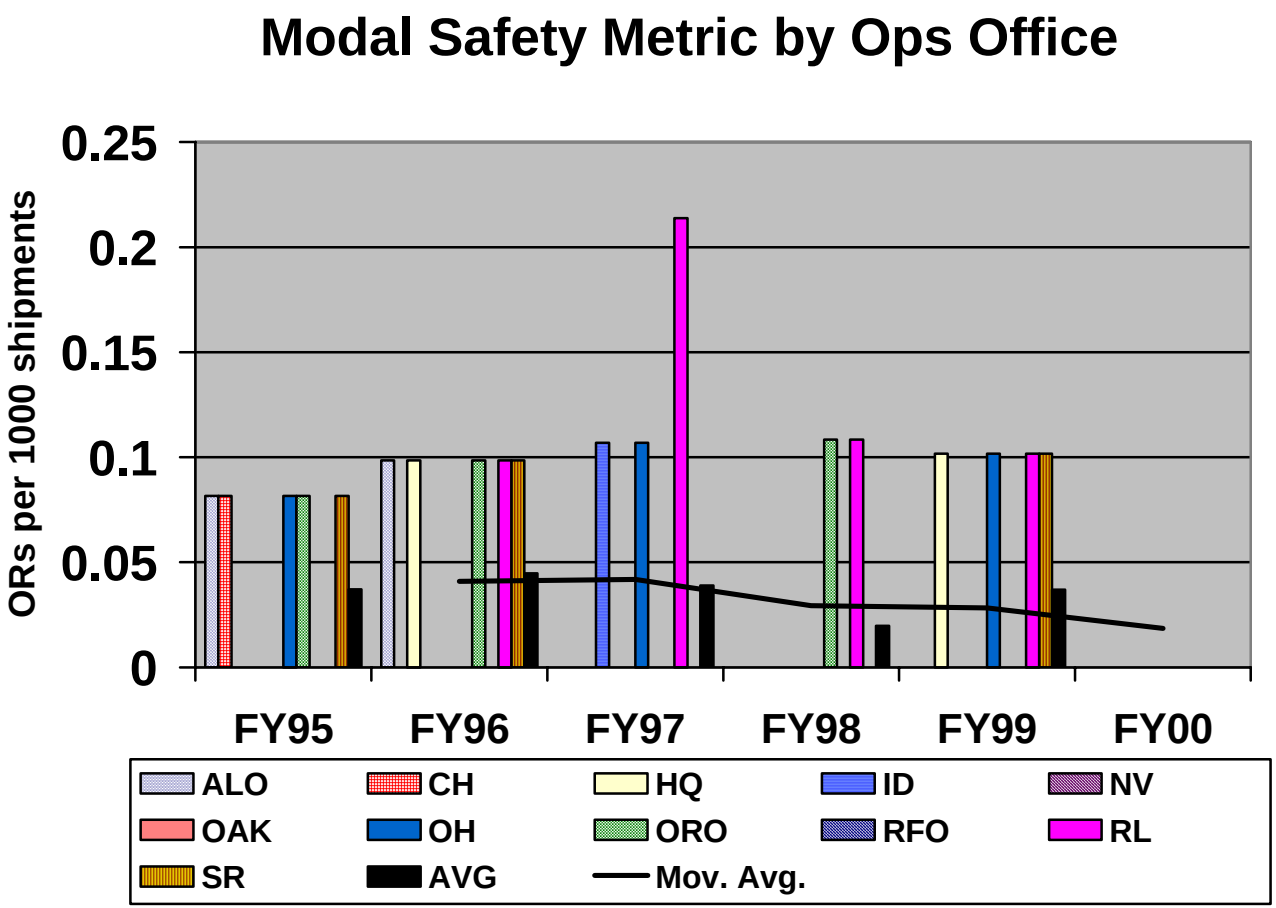

Fig. C.7. Safety metric for modal safety ORs by Operations Office.

ORNL DWG 2001-03284

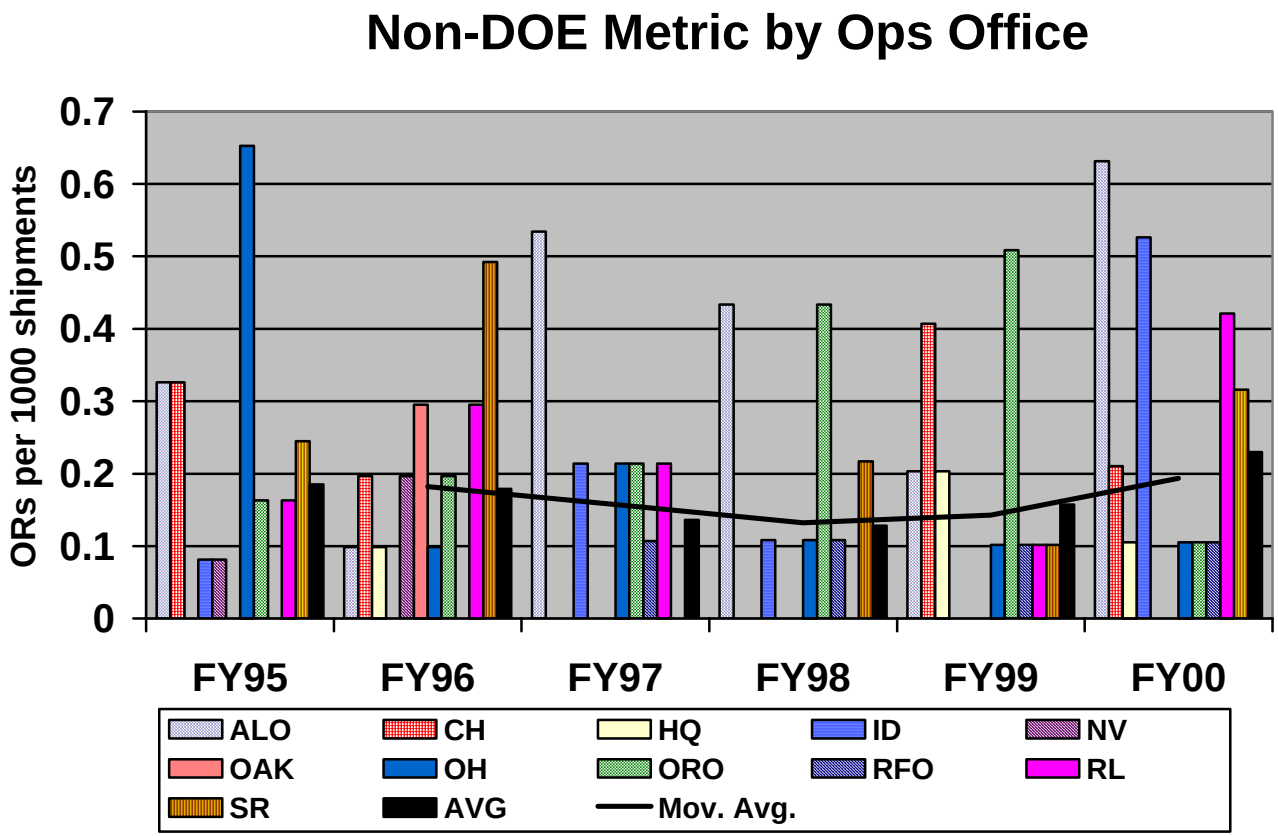

Fig. C.8. Safety metric for non-DOE ORs by Operations Office.

The normalized data of Figs. C2 through C8 reveal that only ORs for loading, unloading, or storage incident to transport events and ORs created by non-DOE contractors are increasing. All other occurrence types are either decreasing or leveling off. Because the scale of the *y*-axis of all the graphs is for ORs per 1000, using the trend line reveals that the Operation Offices individually have fewer than one OR reported to them per 1000 shipments conducted (other than shipping preparation occurrences).

For completeness, Table C.4 shows the occurrence report distribution by PO for all reports contained in the SMIP P&T Occurrence Database. Table C.5 presents a listing of the number of ORs that DOE contractors reported to the ORPS during FY 2000. Though designation changes by the contractor organizations must be considered, past reporting percentages by the sites are consistent.

Table C.4. OR distribution by DOE Program Office in archive database

Code	Description	No. of ORs	
		Owner	Others
DP	Defense Programs	202	50
EH	Environmental Safety and Health	0	1
EM	Environmental Management	517	64
ER	Energy Research	45	12
FE	Fossil Energy	4	3
NE	Nuclear Energy	33	3
NN	Nonproliferation and National Security	1	1
RW	Radioactive Waste Management	0	1
SC	Science	39	14
UE	Uranium Enrichment	7	0
	Totals	848	149
	Grand Total		997

Table C.5. FY 2000 distribution by contractor organizations

Code	Description	No. of ORs	
		Owner	Others
ANLE	Argonne, Illinois East	6	2
ANLW	Argonne, Illinois West	1	0
BBWI	Bechtel BWXT Idaho, L.L.C.	9	5
BHI	Bechtel Hanford, Inc.	7	0
BJC	Bechtel Jacobs Company	10	1
BNL	Brookhaven National Laboratory	7	0
BNLV	Battelle National Laboratory Nevada	1	0
BWO	Babcock and Wilcock of Ohio, Inc.	6	0
CHG	CH2M Hill Hanford Group, Inc.	3	0
FEMP FD	Fernald Environmental Management Project	2	1
KHLL	Kaiser-Hill Company, L.L.C.	18	1
LANL	Los Alamos National Laboratory	1	1
LLNL	Lawrence Livermore National Laboratory	2	0
MK	Morrison-Knudsen Environmental Services	3	0
ORNL	Oak Ridge National Laboratory	4	0
PANTEX	Pantex Plant	5	3
PGDP	Paducah Gaseous Diffusion Plant	0	0
PHMC	Project Hanford Management Contractor	11	2
PNNL	Pacific Northwest National Laboratory	4	2
SAYM	Science Applications Int. Co. (YMP)	0	1
SNL	Sandia National Laboratory	1	2
WSRC	Westinghouse Savannah River Company	15	3
WVNS	West Valley Nuclear Services, Inc.	1	0
Y12	Oak Ridge Y-12 Site	5	0
	Totals	122	24
	Grand Total		146