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DOE Safety Metrics Indicator Program (SMIP)

Fiscal Year 1999 Annual Report of Packaging- and Transportation-related Occurrences

June 2000

Final

U.S. Department of Energy
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ABBREVIATION 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.
CAIRS	Computerized Accident/Incident Reporting System
CFR	Code of Federal Regulations
CH	Chicago Operations
CY	Calendar year
DOD	U.S. Department of Defense
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)
FAA	Federal Aviation Administration
FDF	Fluor Daniel Fernald
FE	Fossil Energy
FERM	Fernald Environmental Restoration Management Corp.
FMCSR	Federal Motor Carrier Safety Regulation
FY	Fiscal year
GOPE	Government operated/owned
GOSF	Deprecated contractor
HAZMAT	Hazardous materials
HQ	DOE Headquarters
HSR	Hazard Significance Rating
IAEA	International Atomic Energy Agency
ID	Idaho Operations
INEEL	Idaho National Engineering and Environmental Laboratory
KCP	Kansas City Plant
LANL	Los Alamos National Laboratory
LBL	Lawrence Berkeley 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.
MAR	Material-at-risk

MHSM	Mason & Hanger, Silas-Mason Co., Inc.
MK	Morrison-Knudsen Environmental Services
MK-F	MK-Ferguson
NBL	New Brunswick Laboratory
NCS	Nuclear Cargo & Service
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
ORAU	Oak Ridge Associated Universities
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
PCB	Polychlorinated Biphenyl
PGDP	Paducah Gaseous Diffusion Plant
PHMC	Project Hanford Management Contractor
PNNL	Pacific Northwest National Laboratory
POC	Pipe-overpack component
PORTS	Portsmouth Gaseous Diffusion Plant
RBOF	Receiving Basin for Offsite Fuels
RCRA	Resource Conservation and Recovery Act
R_f	Repetitive factor
RFO	Rocky Flats Office
RL	Richland Operations
RMIR	Radioactive Material Incident Reporting Database
RSF	Repetitive Significance Factor
RW	Radioactive Waste Management
SafeStat	Safety Status Measurement System
SAR	Safety Analysis Report
SC	Science
SMIP	Safety Metrics Indicator Program
SNL-A	Sandia National Laboratory–Albuquerque
SNL-L	Sandia National Laboratory–Livermore
SNM	Special nuclear material
SPR	Stakeholder and Publicity Significance Rating
SR	Savannah River Operations
SS&C	Sand Slag & Crucible
TRAGIS	Transportation Routing Analysis Geographic Information System
TRU	Transuranic

TSR	Technical Safety Requirements
UE	Uranium Enrichment
USQ	Unreviewed safety question
WHC	Westinghouse Hanford Company
WIPP	Waste Isolation Pilot Plant
WSRC	Westinghouse Savannah River Company
XRF	X-ray fluorescence
Y-12	Oak Ridge Y-12 Plant

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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 trends, impact on P&T operations and safety concerns, 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) DOE with a more accurate picture of contractors' P&T-related performance, and (3) more meaningful statistics for comparison of occurrences at a particular site, among different contractor sites, and between DOE and the private sector.

To this end, the SMIP established a severity weighting system for classification of the occurrences and has applied normalization techniques to the data for standardization and trending. The methodology was reviewed by traffic managers and subject matter experts before being published in September 1999 as the *DOE Packaging and Transportation Measurement Methodology for the Safety Metrics Indicator Program*. A short description of some of its elements is presented in this report.

In addition to the ORPS, several other systems and databases were used to obtain information and facilitate the development of safety measures: (1) DOE's Enterprise Transportation Analysis System (ETAS) was used to provide shipping data, such as carrier used, commodity type, origin, and destination; (2) DOE's Transportation Routing Analysis Geographic Information System (TRAGIS) was used to process ETAS origin/destination shipment information to provide mileage data; and (3) U.S. Department of Transportation's (DOT's) Safety Status Measurement System (SafeStat) Database was used to provide statistics such as crashes and number of power units for carriers. The Radioactive Materials Incident Reporting (RMIR) database was also reviewed for potential use.

The motor carriers used by DOE provided information on the number of miles that the carriers transported cargo during calendar year (CY) 1999. Coordinating this information with the data provided above enabled the NTPA to develop an indicator of performance based on vehicle miles. Of the carriers who transported over 50,000 miles for DOE in FY 1999, only one had a safety measure which was higher than the national average of 0.75 accidents per million miles. For all transport including DOE mileage, **DOE-utilized carriers had an average of 0.42 accidents per million miles**. **More significantly, these DOE carriers had no accidents involving shipments conducted for DOE**. This information indicates that DOE-utilized carriers have a better safety record than those of the motor carrier industry as a whole. The absence of accidents involving DOE shipments indicates that these carriers have performed well.

As part of its trend analysis function, the SMIP identified eight occurrences which had been reported by eight different sites, from October 7, 1998, through May 12, 1999, related to inadvertent offsite shipments or uncoordinated onsite transfers of material. The SMIP proactively posted a lessons learned (LL), *Inadvertent Shipping of Materials*, to the DOE LL List Server and disseminated the LL to the DOE community in order to alert sites to the need to be vigilant in this regard.

Radioactive material incidents accounted for the highest number of reported incidents, but none of the incidents resulted in significant radiological hazard. Use of the new SMIP methodology for severity rating allowed for evaluation of the significance of these events, which was determined to be low. For example, over one-third of the events involved contamination—with the majority of these occurring locally and having limited radiological consequences (minimum safety consequences with little potential for ultimately leading to endangerment of environment or personnel). However, recent European experience shows that significant public and political interest can be generated over contamination incidents like these.

Of the 2,834 occurrence reports (ORs) reported to the ORPS during FY 1999, 6.1% were packaging or transportation related. Of these 173 occurrences, 17 were classified by the sites as *unusual*, chiefly because they occurred offsite or had documentation problems with their shipping papers or waste manifests. SMIP scrutinized these occurrences to determine their import 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 (a 32 and a 40); therefore, they did not approach the SMIP alarm threshold for additional attention. However, these ORs are 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 there are two categories which have the highest frequency of occurrence, contamination and shipment preparation**. The trend for contamination incidents shows that they have been increasing, and this area may warrant additional management attention.** The data for shipment preparation incidents does not show an increasing trend, but these incidents do continue to be the most frequently reported occurrences.

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, of the 40 ORs having a root cause of personnel error, none had a direct or contributory cause of training deficiency. **Therefore, it appears that training deficiencies are not the cause of P&T incidents which occur because of management problems or personnel error**. As in previous years, the major root cause for both onsite and offsite occurrences continues to be personnel error and management problems. Most of these incidents continue to be minor, indicating that the DOE contractors are doing well overall with their compliance and training. However, if additional efforts are to be made in improving performance, these efforts should address management problems and personnel error.

In summary, the information shows that DOE shipments are being transported safely and that the frequency of occurrences continues to be low. However, if these minor incidents continue to increase, they may become precursors for more serious occurrences. Hence the NTPA will work with the DOE traffic managers to assure that they are aware of these incremental increases and are actively addressing their reduction.

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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 Operation 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 which were reported to the ORPS during the period from October 1, 1998, through September 30, 1999. 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 to the SMIP criteria, but are archived in the SMIP Subsidiary Database of occurrences, a sub-database of the main SMIP P&T Occurrence Database.

One hundred and seventy-three (173) reports were classified to the SMIP criteria, of which 119 had been finalized. Trending comparisons were made with these reports and the 695 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 were obtained from the Enterprise Transportation Analysis System (ETAS), formerly 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 which 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 rankings of DOE contractors who package and ship hazardous materials and (2) making comparisons 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 Occurrence Database. Table 1, "SMIP parameters used for ORs display," shows some of the parameters used to process the P&T occurrences involving hazardous material. To see a listing of the FY 1999 occurrences themselves and their specific values, see Table A.1, "FY 1999 SMIP classified occurrences," of the Appendix. Also for FY 1999, Table B.1 of Appendix B shows the 69 offsite occurrences and 21 others, which are designated as "on/offsite."

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 ORs display

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 HSR to indicate whether the occurrence has a history of repetitiveness. A repetitive occurrence is the repetition of a given type of event occurring at a DOE site or one that results from activities at a DOE site after the site has issued a notification report and specified corrective actions to the ORPS of a previously occurring 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 needing special attention or where the development of a specific lessons-learned report is warranted. The measure SPR is independent of HSR and RSF, and is used 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 judgements on the various elements that contribute to degradation of safety and potential or actual impacts on the environment. When combined, 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. W_{EC} ranges from an anomaly (which has a very low significance of consequence relative to safety and the environment, and 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 that is 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 judgement. 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} provides an indication of a materials 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}, is used to indicate the relative amount and graded hazard within a class. The numerical value assigned to Q_{ty} is based on the type of packaging used in the shipment that indicates the relative amount and hazard. For example, for radioactive materials, a very low quantity of material is allowed to be transported 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 arguments were used to establish the weighting factors for non-radioactive hazardous materials. As a result, Q_{ty} infers the quantity and relative hazard posed by the hazardous material, and it is based upon the packaging requirements for hazardous material, as specified in the DOT hazardous material regulations, and upon pragmatic judgement. In summary, as noted in this discussion, Q_{ty} ranges from a low value of 1 for limited quantity shipments in excepted packages to a maximum value of 5 for the largest quantities in a class and the most hazardous within a class of materials.

The other parameters of the table are chiefly for classification:

1. The parameter Pkg/Trn is used to denote whether the occurrence is related to packaging, transport, or both.

2. The parameter HM/W is used to identify 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 that it is related to an offsite shipment; and the parameter ON/ON indicates that the event occurred onsite but that it 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 on 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—as contrasted with 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, "FY 1999 SMIP classified occurrences." To get 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 1999 ORs ARCHIVED IN THE SUBSIDIARY DATABASE

The number of occurrences archived in the Subsidiary Database by FY is shown in Table 2. In FY 1999, nine occurrences which 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 that are contained in the database can be seen by examining the titles shown in Table 3 for the 36 ORs stored during FY 1999.

Table 2. Occurrences archived in Subsidiary Database per FY

FY 1994	FY 1995	FY1996	FY 1997	FY 1998	FY 1999
54	77	79	104	43	36
Total ORs in database: 394					

Table 3. FY 1999 ORs which are in the Subsidiary Database

Report Number	Title	On/Offsite	NOC[1]
ALO--WWID-WIPP-1999-0003	Traffic accident involving DOE vehicle	OFF	6A
ALO-KO-SNL-10000-1999-0001	Suspicious package in receiving	OFF	5
ALO-LA-LANL-PHYSTECH-1999-0004	Accident involving a government vehicle, resulting in the total loss of the…	OFF	6A
ALO-LA-LANL-TA55-1999-0006	The lid of an empty shipping container blew off when opened at Los…	OFF	2A
CH-AA-ANLE-ANLEPFS-1999-0003	Raised dump truck box strikes overhead conductors while driving on…	ON/ON	6A
HQ--SAYM-YMSGD-1999-0003	Elgood MAYO manride accident	OFF	6C
HQ--SPR-WH-1999-0002	Crude oil release of approximately 200 barrels, contained on site.	ON	6E
HQ--SPR-WH-1999-0003	A stop work order for safety concerns was issued to a subcontractor of…	ON/ON	6E
HQ--SPR-WI-1998-0007	250-gal brine spill outside fence at fill site area	ON/ON	6E
ID--LITC-FUELRCSTR-1999-0017	Safety document discrepancy prompted stop work	ON/OFF	3
ID--LITC-PBF-1998-0005	Improper transport of a potentially-contaminated air monitor pump	ON/ON	5
ID--LITC-TAN-1999-0010	TAN V-21 cask transport moved outside of normal transport path	ON/ON	3
NVOO--BNLV-RSLO-1999-0001	Fuel truck modification near miss	OFF	1B3
OAK--LLNL-LLNL-1999-0022	Vehicle accident at Site 300	OFF	6A
OH-FN-FDF-FEMP-1998-0029	Vehicular collision at the on site disposal facility	ON/ON	6A
OH-FN-FDF-FEMP-1999-0009	Shipping container anomaly found on site	ON/OFF	2A
ORO--BJC-K25WASTMAN-1999-0018	Drum crusher on flatbed trailer snags overhead communications cable	ON/OFF	6A
ORO--BJC-PORTENVRES-1999-0006	Eight inch UF6 cylinder larger than NCSA limits	ON/ON	2B
ORO--LMES-Y12SITE-1999-0032	Vehicle accident between privately owned vehicle and government…	ON/OFF	6A
ORO--LMES-Y12SITE-1999-0033	Transportation issue associated with qualification of drivers	OFF	6A
ORO--ORNL-X10CHEMTEC-1999-0014	Failure of swivel hoist ring during cask lift (Bldg.3019)	ON/ON	3

Table 3. (continued)

Report Number	Title	On/Offsite	NOC[1]
ORO--ORNL-X10CHEMTEC-1999-0017	Special nuclear material (SNM) material issue	ON/ON	3
ORO--ORNL-X10FUSIONE-1999-0001	Federal Motor Carrier Safety Requirements noncompliance	OFF	6
RFO--KHLL-371OPS-1999-0030	Potential Unreviewed Safety Question (USQ) discovery issue, type…	ON/ON	2B
RFO--KHLL-371OPS-1999-0036	Improper packaging Of waste drums - wrong drum liners were used	ON/ON	2C
RFO--KHLL-371OPS-1999-0045	Technical Safety Requirement (TSR) violation, waste crate moved into…	ON/ON	3
RFO--KHLL-779OPS-1999-0008	Potential discovery of an USQ regarding…	ON/ON	2
RFO--KHLL-PUFAB-1998-0086	A 55-gal drum over the 200 gram limit when the uncertainty…	ON/ON	2C
RFO--KHLL-SITEWIDE-1999-0008	Identification of additional JH-98 Outlier drums	ON/ON	2B
RL--BHI-REMACT-1998-0007	Subcontractor waste hauling container slides off haul truck	ON/OFF	3
RL--PHMC-TRANS&PKG-1999-0001	Revised procedure inconsistent with safety evaluation for packaging	ON/ON	3
RL--PHMC-WRAP-1998-0012	Several TRU waste drums accepted for processing at the WRAP facility,…	ON/ON	2B
SR--WSRC-FBLINE-1999-0026	Personnel contamination with positive nasal/saliva smears (U)	ON/ON	1A2
SR--WSRC-LTA-1999-0003	Procedure violation during SNM receipt (U)	ON/ON	5
SR--WSRC-REACL-1998-0019	Disengagement of 85 ton crane spreader beam	ON/ON	3
SR--WSRC-SLDHZD-1998-0013	Overturned OP-45 container	ON/ON	3

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

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3. SUMMARY OF SELECTED ORs

3.1 CATEGORIZATION OF ORs

DOE Order 232.1-1A categorizes ORs into three types: emergency, unusual, and off-normal. For transportation, DOE Order 232.1-1A defines these three categories as the following:

1. *Emergency* is an offsite transportation event involving the release of a reportable quantity of hazardous substance (per 49 CFR Part 171.8) that is transported in support of departmental operations.

2. *Unusual* is an offsite transportation event involving the release of hazardous material in a quantity greater than limited quantities (or <u>any</u> release of radioactive material) or any shipment of radioactive material or hazardous waste that arrives at its destination (1) with a nonreconcilable shipping paper discrepancy or unaccounted-for package related to material quantity or (2) with radiation or contamination levels in excess of DOT allowable limits. Violations of Federal Motor Carrier Safety or Federal Aviation Administration (FAA) regulations involving a release of hazardous materials are also included as part of the definition. Onsite "unusual occurrences" are defined similarly for releases.

3. *Off-normal* is defined as an offsite event involving a release of hazardous material, other than radioactive, which does not exceed a limited quantity. Violations of marking, labeling, placarding, routing, or separating/segregating materials are included in this definition, as is any transportation event involving departmental property resulting in vehicular or aircraft damage of more than $5,000 (or total losses). The definition also includes violations of DOT Federal Motor Carrier Safety or FAA regulations, evidence of improper classification of hazardous materials, improper selection or assembly of a hazardous material package, cargo that has shifted during transport, or transportation activities performed by unqualified personnel. Onsite "off-normal" events are defined similarly.

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 Federal Motor Carrier Safety Regulations (FMCSR) 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

Seventeen of the 173 occurrences that were retrieved and reviewed from the ORPS during this fiscal year were categorized as unusual. All the other ORs were categorized as off-normal. The following 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-AO-MHSM-PANTEX-1999-0020

A Radiation Safety Technician discovered that the contractor had removed a vacuum cleaner from a controlled area in Building 12-44 to the contractor's off-site storage without the vacuum cleaner first being properly swiped and released by the Radiation Safety Department. The vacuum cleaner contained a small volume of contaminated material. The vacuum cleaner was found to be clean externally and below the allowable administrative limits internally.

ALO-LA-LANL-ACCCOMPLEX-1998-0017

A Los Alamos National Laboratory (LANL) trash truck activated the Los Alamos County landfill portal monitor because it carried an activated copper pipe (1/4 in. in diameter, approximately 16 in. long, and taped on both ends). The pipe was found in a bag with gloves and tape. Initial evaluation of the exterior of the bag indicated activation levels of about 50,000 disintegrations per minute (dpm) per 100 square centimeters (100 cm^2) beta/gamma. Later smears indicated about 1-million dpm beta/gamma removable contamination on the interior of the pipe. The bagged pipe was tagged, placed in a tagged shipping container, and returned to a controlled area.

ID--LITC-TRA-1999-0015

A positive Unreviewed Safety Question (USQ) resulted from the loss of radioactive material control. The event was caused by an isotope pellet becoming lodged on the transfer cask outside the shielded volume of a hot cell (reference OR ID-LITC-TRA-1999-0001). The event was not analyzed in the current Safety Analysis Report (SAR) and was, therefore, considered a New Information, Positive USQ.

OAK--GOSF-HCF-1998-0001

The Solid Waste Project Radiological Control Manager at Hanford was notified that during a receipt survey of the shipment at the Hanford 200 West Low Level Burial Ground, a Radiation Control Technician discovered removable contamination at a level of 30,000-35,000 dpm 100 cm^2 beta/gamma on the tarp covers and on the load. Follow-up surveys of the ground where the tarp covers had been placed and the truck revealed removable contamination at levels of 35 mrad/h. This equates to "off scale" greater than 1,000,000 dpm per 100 cm^2 on a portable Geiger-Mueller detector. After further investigation, it is suspected that the fixed contamination on the waste packages became removable during transportation.

OAK--LLNL-LLNL-1999-0002

Two LLNL employees moved a commercial hand-held x-ray fluorescence (XRF) detector between buildings at LLNL Livermore site without complying with LLNL-established policies on handling Class IV radioactive sealed sources. The XRF detector is a portable unit, with a carrying case, which is not much larger than a laptop computer. The analyzer has an integrated dual-source excitation component that consists of sealed sources of 20 mCi ^{109}Cd (Class III) and 30 mCi ^{241}Am (Class IV). The improper movement of the analyzer happened over the period November 23, 1998, through January 11, 1999, and is considered a loss of control of a Class IV sealed source.

ORO--BJC-K25GENLAN-1999-0014

Two Century 21 containers of unstabilized pond waste arrived at the disposal facility in Clive, Utah, with streaks of dried mud on the outside. The streaks appear to have originated from the container lid. Surveys performed by the disposal facility showed that the radiological contamination to be less than the minimum detectable activity of 110 dpm/100cm^2 alpha and 1,100dpm/100cm^2. A leak did occur, and scrapings of the dried mud have been taken for possible laboratory analysis.

Table 4. (continued)

ORO--BJC-K25WASTMAN-1998-0006

It was discovered that seven overpacked, empty, 55-gal drums which had contained flammable material, had been delivered to the K-1423 Container Processing Facility. After the operator removed the lids of the drums and detected an unusual odor, an investigation determined that the drums potentially contained flammable residues. The acceptance criteria for the facility prohibit containers having flammable material residues.

ORO--ORNL-X10CASD-1999-0002

On August 3, 1999, New Hampshire authorities notified the ORNL that PCB (100 ppm) analytical soil samples and their container had been found adjacent to a public roadway in Raymond, New Hampshire. The analytical samples had been properly shipped from ORNL on June 3, 1997, to Viking Instruments in Chantilly, Virginia. Since June 3, 1997, the samples had not been under the control of ORNL.

ORO--ORNL-X10ENVIOSC-1998-0003

When a "dry shipper" containing frozen leaves was being processed for shipment at a local commercial carrier place of business, a "valve popping" sound was heard and what appeared as “smoke” was observed leaking from the package. The "dry shipper" (a metal case consisting of porous material which is charged with liquid nitrogen) originated from the Environmental Sciences Division at the ORNL. The surrounding packages were frozen and two employees located close by the leak began to choke and cough. A hazardous materials expert was contacted, and six people in the area were temporarily evacuated beyond a 25 ft radius of the leaking material. The commercial carrier stabilized the package at their terminal and contacted the FAA to investigate the incident. It is believed that the event resulted from the mishandling of the package by the commercial carrier.

RFO--KHLL-371OPS-1999-0041

The Building 371 Plant Review Committee determined that a potential discovery issue existed concerning hydrogen generation in Sand Slag & Crucible (SS&C) material, which was packed in produce cans. The Discovered Condition is a potentially inadequate safety analysis because possible hydrogen generation in packaged SS&C product material was not recognized or evaluated. The product SS&C material is packed in produce cans, which are a sub-system of a complete package configuration intended to yield a Type A or Type B drum. These product produce cans are currently packaged in new generation 55-gal drums with a vent filter in the lid, 10-gal drums, and 9,975 shipping casks. The potential for hydrogen buildup in produce cans and its implications for package safety has not been evaluated.

RFO--KHLL-ANALYTOPS-1998-0016

A laboratory technician moved a can from glovebox C-6 to E-6 for further analytical processing. The can contained 21.8 g plutonium and 0.93 g of americium. This was equivalent to 124 g of material-at-risk (MAR). The building Technical Safety Requirements (TSR) requires the building to be in Nuclear Operations Mode for activities involving special nuclear material quantities greater than 100 g MAR. The laboratory technician did not identify that the can contained MAR greater than 100 g until after it had been moved, and a review of the paperwork was completed. The can movement exceeded the building mode of operations at the time, and a TSR violation was declared.

Table 4. (continued)

RFO--KHLL-WSTMGTOPS-1999-0008

A drum was discovered on the 750 Pad. The drum had pipe-component lid bolts, which had been only hand-tightened rather than properly torqued upon closure. This action challenges the integrity of the packing as credited in the accident analysis and poses a potential USQ, which could affect present or future operations of the 750 pad.

RFO--KHLL-WSTMGTOPS-1999-0011

A drum containing a Pipe-Overpack Component (POC) with the POC lid bolts not torqued was found on the 750 Pad. The discovery of an untorqued POC on the 750 Pad posed a positive USQ; the analysis found that waste storage area authorization bases were inadequate for the discovered condition and challenges the integrity of the packing as credited in the accident analysis. Moreover, later during a check of POCs that had already been disabled, another drum was identified at the 750 Pad with three of the POC lid bolts only hand-tightened.

RL--PHMC-FSS-1999-0036

Upon receipt from a general freight carrier, it was discovered that radioactive material (depleted uranium) was shipped in a noncompliant manner. The radioactive material was shipped as general freight, but the material should have been shipped according to DOT regulations. The shipment required a radioactive yellow II label with the transport index marked on it, and the packaging used was not in compliance with DOT regulations.

RL--PHMC-SNF-1999-0013

On 05/12/1999, the Chem Nuclear Shipping Cask was shipped from 100 K Area to Chem Nuclear Systems in Barnwell, S.C. Shipment surveys determined that removable contamination levels were within DOT allowable shipment limits. Upon receipt survey on 05/20/1999, after removal of the cask protective overpack, smears taken on the cask body and base plate identified areas exceeding the contamination limit of 22,000 dpm/100cm^2, beta/gamma, no alpha.

SR--WSRC-RBOF-1999-0008

On 6/9/99, the Receiving Basin for Offsite Fuels (RBOF) facility received notification from Nuclear Cargo & Service (NCS) that an empty TN 7-2 cask was received in Germany on 9/9/99 and was discovered to have beta-gamma transferable contamination in excess of International Atomic Energy Agency (IAEA) limits on the cask exterior. Seven other spots on the cask were also discovered to be above IAEA receipt limits. No personnel were contaminated during this discovery.

SR--WSRC-RBOF-1999-0009

On 6/9/99, the RBOF received notification from NCS that an empty TN 7-2 cask was received in Germany on 6/9/99 and was discovered to have beta-gamma transferable contamination in excess of IAEA limits on the cask exterior. Another TN 7-2 empty cask (#2784) in transit to Germany was held in port at Portsmouth, Virginia and was to be returned to the RBOF facility for additional radiological surveys and decontamination, if necessary. TN 7-2 cask #2784 was returned to the RBOF facility on 7/7/99, and several smears were found to be above the DOT receipt limit of 22,000 dpm/100 cm^2. The highest smear result obtained was 250,000 dpm/100 cm^2 beta-gamma transferable contamination.

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 1999 occurrences were scanned to quickly determine which of them might deserve additional scrutiny based upon their HSR. The alarm threshold is a numerical value composed by considering an OR which has (a) an event consequence for the safety or environmental significance of 4 (significant) or 5 (serious), (b) a hazard class rating of 4 (containing such materials as explosives or radioactive material), and (c) 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 ($4 \times 4 \times 4$) is considered an alert for radioactive materials; an HSR of 48 is considered high for nonradiological materials.

Though the HSR threshold was logically developed, it may be instructive to consider a more conservative level since none of the occurrences in the SMIP P&T Occurrence Database were evaluated to have alarming HSRs. For this consideration, an incident occurred in FY 1998 which received much media attention and caused DOE great concern. Because this event's HSR evaluated to only 24, it may be revealing to see how many other occurrences of the database have similar highs even though they do not approach the alarm threshold level.

With this gage, there are only 104 total occurrences from the entire SMIP P&T Occurrence Database which have HSRs greater than 24, with the highest evaluating to 40. For FY 1999, there were 8 ORs that had HSRs above 24. These ORs are identified in Table 5 below.

Table 5. FY 1999 occurrences with HSR > 24

Report number	HSR
CH-AA-ANLE-ANLE-1999-0001	32
CH-AA-ANLE-ANLEPFS-1999-0004	32
CH-AA-ANLW-HFEF-1999-0005	40
ID--LITC-TRA-1999-0015	40
RFO—KHLL-PUFAB-1999-0056	40
RFO—KHLL-WSTMGTOPS-1999-0008	32
SR—WSRC-REACK-1998-0028	40
SR—WSRC-SLDHZD-1999-0004	40

This analysis indicates that none of the occurrences of FY 1999 had HSRs that approached the value which might be considered an alarm threshold. In fact, all of the ORs identified in Table 5 involved radioactive material shipments and had event consequence measures, W_{EC}, of 2 or less, which rates the potential consequences of these shipments as *slight* (e.g., having minimum safety consequences with little potential for ultimately leading to endangerment of environment or personnel).

3.4 MANAGEMENT NOTIFICATION

Occurrences which have packaging- or transportation-related significance are downloaded weekly from the ORPS for review and classification into the SMIP Occurrence Database. During this weekly selection, any ORs identified with HSRs above 24 will be immediately reported to the NTPA for evaluation and tracking. The notification process will include those ORs which are 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.

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, please 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. Note that there is no longer a NOC 8. This category, *Occurrences Created by Others*, is now designated as NOC 7. It was decided that the existing categories were comprehensive enough, such that future additions will be unnecessary; hence the old NOC 7, *Reserved for Future Inclusion of New Parameters*, was deleted.

The occurrence database was queried to obtain a grouping of the FY 1999 ORs by NOC classification and onsite or offsite designation. Any occurrence that happens in an area which is 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, 1999. Table 8, "FY 1999 ORs classified by NOC," lists the results of the query for ORs that were reported during FY 1999. Figure 1, "NOC totals for FY 1999," presents the information conveyed in Table 8 graphically—readily showing how contamination events and shipping preparation events dominate the ORs selected this FY. Table 9 through Table 14 lists the occurrences by the quarters of the FY for comparison.

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

Table 15, "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*. Thirteen of the 161 FY 1998 reports were categorized as NOC 3; for FY 1999, 22 were classified as NOC 3. Interestingly, the FY 1999 percentage of 12.7% for the NOC 3 category is significantly higher than the percentage of occurrences in the entire database, 5.2%. Moreover, FY 1999 occurrences comprise over half of all the NOC 3 incidents in the database (23 of 45 total).

However, it is misleading to consider this 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. It will take at least

two more years of data to determine if this apparent increase could be a trend that deserves serious attention.

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	22
1A2. Personnel	18
1A3. Equipment	98
1B. Hazardous Materials	0
1B1. Environmental	21
1B2. Personnel	2
1B3. Equipment	3
Total	169
2. Packaging	
2A. Damaged	25
2B. Incorrect Selection	27
2C. Incorrect Procedures	49
Total	101
3. Storage Incident to Transport	45
Total	45
4. Improper Hazardous Material Characterization	131
Total	131
5. Shipment Preparation	93
5A. Shipping Papers	72
5B. Marking	19
5C. Labeling	38
5D. Loading and Tie-downs	20
5E. Placards	5
5F. Radiation Survey	17
Total	264

Table 7. (continued)

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	75
7B. Packaging	23
7C. Reserved	0
7D. Vehicle or Driver Safety	2
7E. Contamination	17
7F. Not otherwise specified	2
Total	125
Grand Total	858

Table 8. FY 1999 ORs classified by NOC

Code and Description	No. of ORs
1. Contamination/Release	
1A. Radioactive	
1A1. Environmental	3
1A2. Personnel	6
1A3. Equipment	27
1B. Hazardous Materials	
1B1. Environmental	2
1B2. Personnel	1
1B3. Equipment	0
Total	39
2. Packaging	0
2A. Damaged	7
2B. Incorrect Selection	4
2C. Incorrect Procedures	12
Total	23
3. Storage Incident to Transport	22
Total	22
4. Improper Hazardous Material Characterization	25
Total	25
5. Shipment Preparation	21
5A. Shipping Papers	1
5B. Marking	8
5C. Labeling	6
5D. Loading and Tie-downs	2
5E. Placards	2
5F. Radiation Survey	3
Total	43

Table 8. (continued)

Code and Description		No. of ORs
6.	Modal Safety	
	6A. Motor or Driver Safety	2
	6B. Aircraft Safety	0
	6C. Rail Safety	2
	6D. Barge Safety	0
	6E. Pipeline	0
	Total	4
7.	Occurrences Created by Others (non-DOE or DOE/Contractor)	0
	7A. Shipping Preparation	9
	7B. Packaging	5
	7C. Reserved	0
	7D. Vehicle or Driver Safety	0
	7E. Contamination	3
	7F. Not otherwise specified	0
	Total	17
	Grand Total	173

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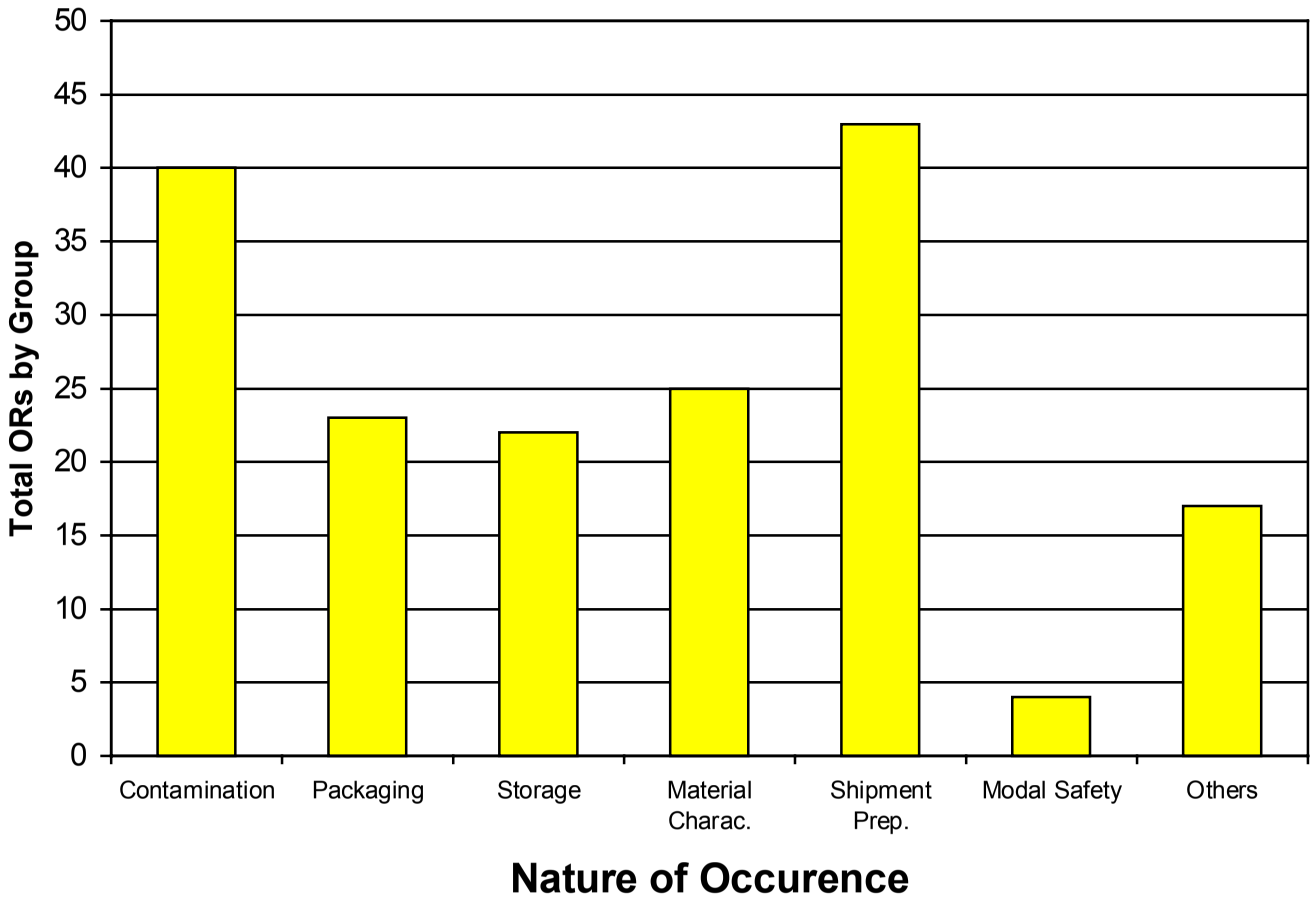

Fig. 1. NOC totals for FY 1999.

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	5	12	0	4	22
2nd Qt	10	3	8	7	11	2	5	46
3rd Qt	11	10	1	6	8	2	1	39
4th Qt	12	7	11	7	12	0	7	56
NOC sum	39	23	22	25	43	4	17	173

Table 15. Percentage of NOCs by FY

SMIP NOC	Percent totals by FY						All ORs in SMIP Database
	1994	1995	1996	1997	1998	1999	
Contamination/Release	22.1	15.9	18.9	14.8	22.4	22.5	19.7
Packaging	10.7	13.5	6.1	10.9	15.5	13.3	11.8
Loading, … Storage Incident to Transport	0	0	4.7	2.3	8.1	12.7	5.2
Improper Hazardous Material Characterization	7.4	12.7	21.6	15.6	18.0	14.5	15.3
Shipment Preparation	27.9	34.1	31.8	42.2	26.7	24.9	30.8
Modal Safety	2.5	4.0	3.4	3.1	1.2	2.3	2.7
Occurrences Created by Others	29.5	19.8	13.5	10.9	8.1	9.8	14.6
Total ORs:	122	126	148	128	161	173	

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 which occurred each FY. Table 16 presents the total shipments by FY, and each of the normalized charts are preceded by a chart listing the number of ORs by FY.

Table 16. Total shipments and number of ORs by FY

FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999	
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	173

To make the graphs more readable, the safety measures derived by dividing the number of NOCs by the number of shipments for a respective FY were multiplied by one thousand. This allows one to interpret the scale of the *y*-axis as ORs per one thousand shipments. For example, in FY 1994 there were 27 ORs categorized as contamination related, and 12,597 shipments outbound from the sites were made during the FY. The metric of 2.14 for the FY 1994 datum on the associated chart presents this figure as 2.14 ORs per one thousand shipments. To present an overall picture, Figs. 2 and 3 give a view of the total ORs per FY and their associated safety measures.

ORNL DWG 2000-04416

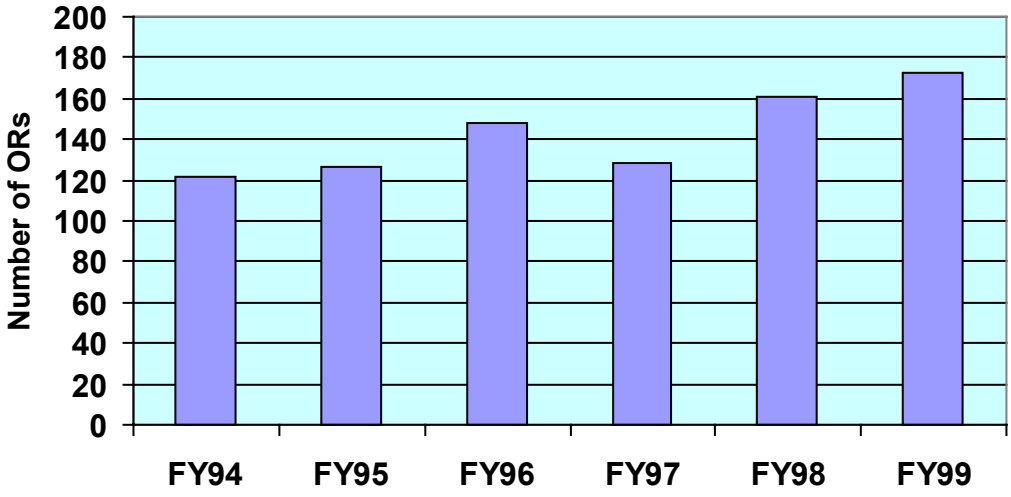

Fig. 2. Number of total ORs per FY.

Figures 3 through 17 presents the comparisons between the respective number of ORs per FY by NOC and their associated safety measure. **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 sharpness of decline or increase.**

ORNL DWG 2000-04417

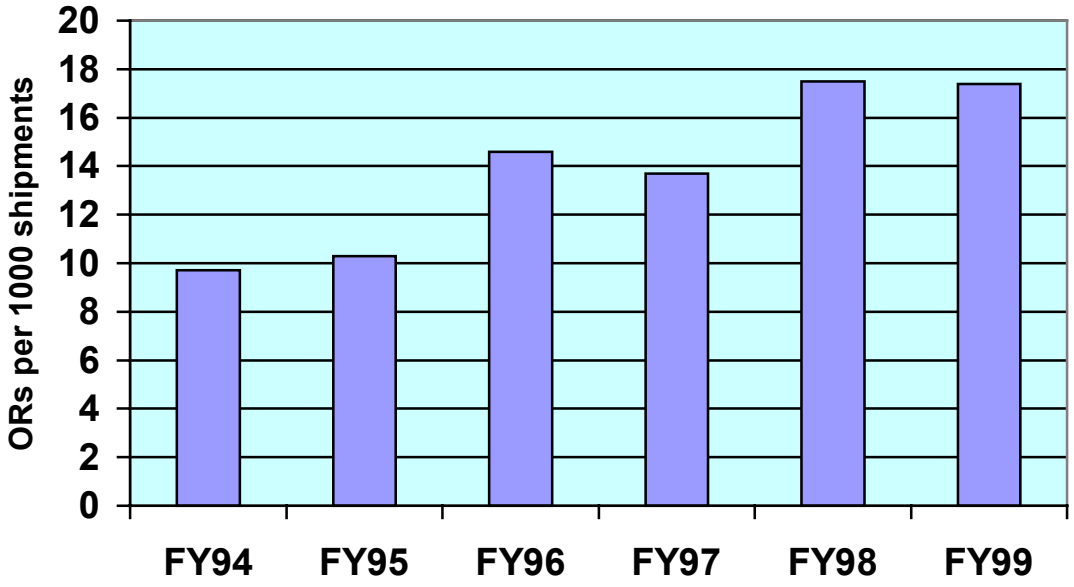

Fig. 3. Metric of total ORs per FY.

ORNL DWG 2000-04418

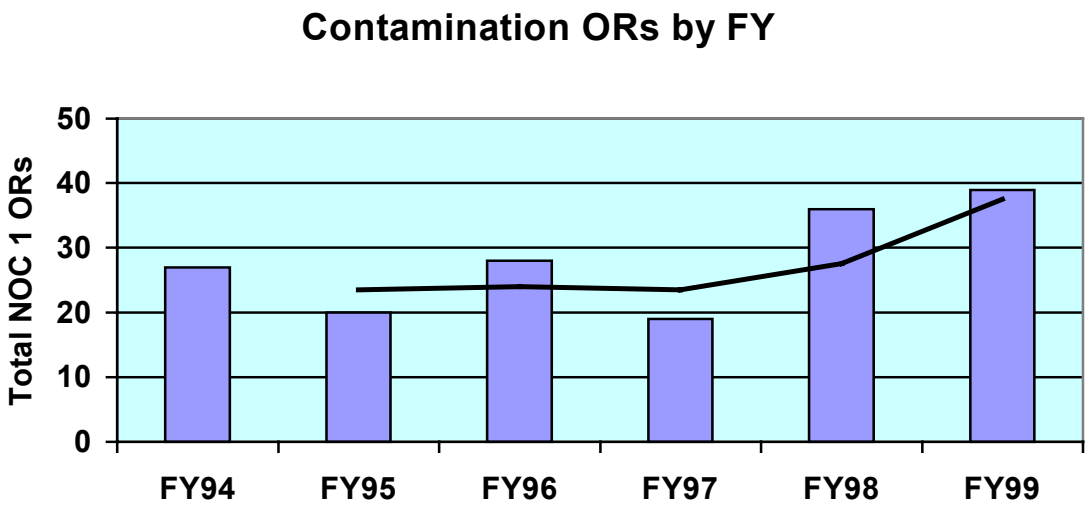

Fig. 4. Contamination ORs by FY.

Similar in flow to the above graph, the safety measure of Fig. 5 emphasizes that there is an increase of ORs based upon the number of shipments being made. However, the incidents themselves are minor.

ORNL DWG 2000-04419

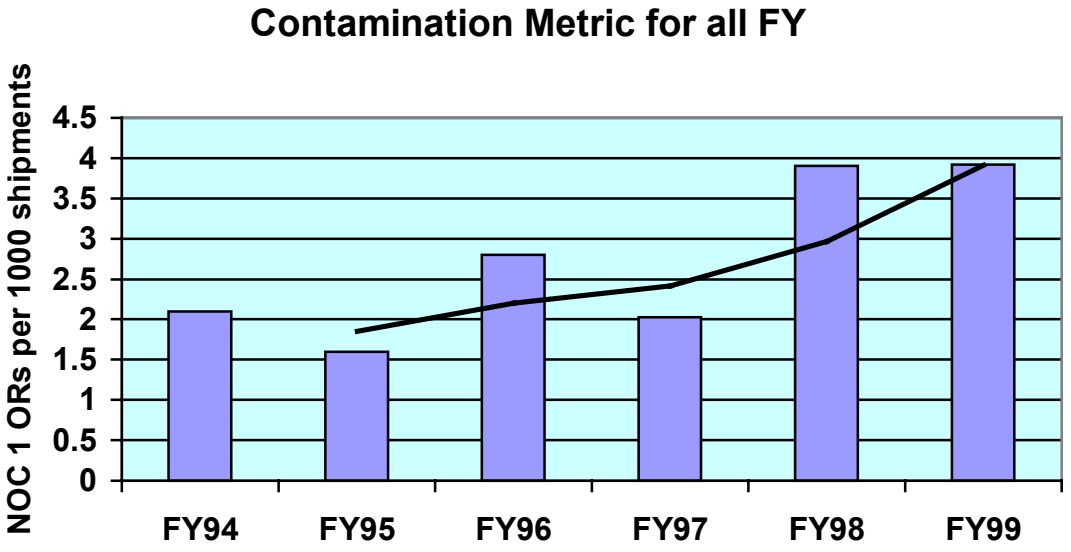

Fig. 5. Metric of contamination ORs by FY.

ORNL DWG 2000-04420

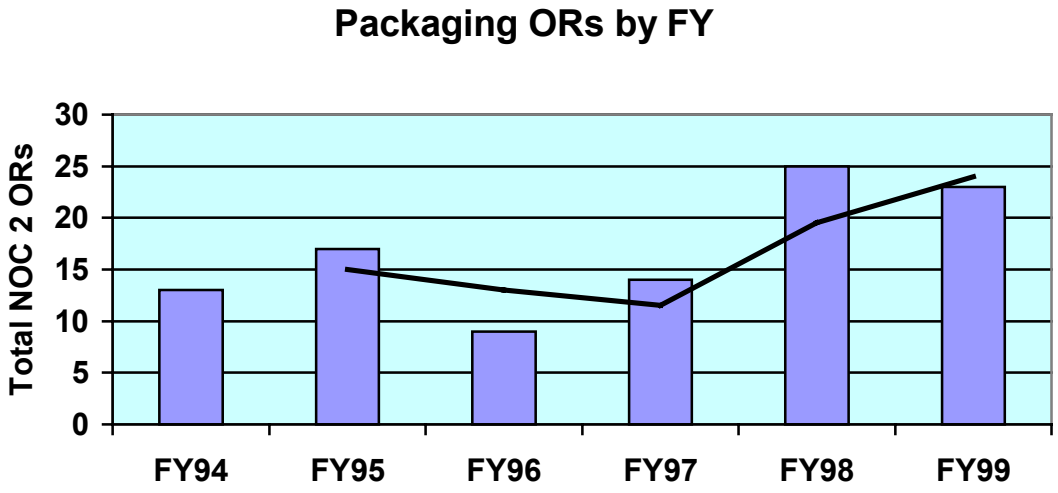

Fig. 6. Packaging ORs by FY.

ORNL DWG 2000-04421

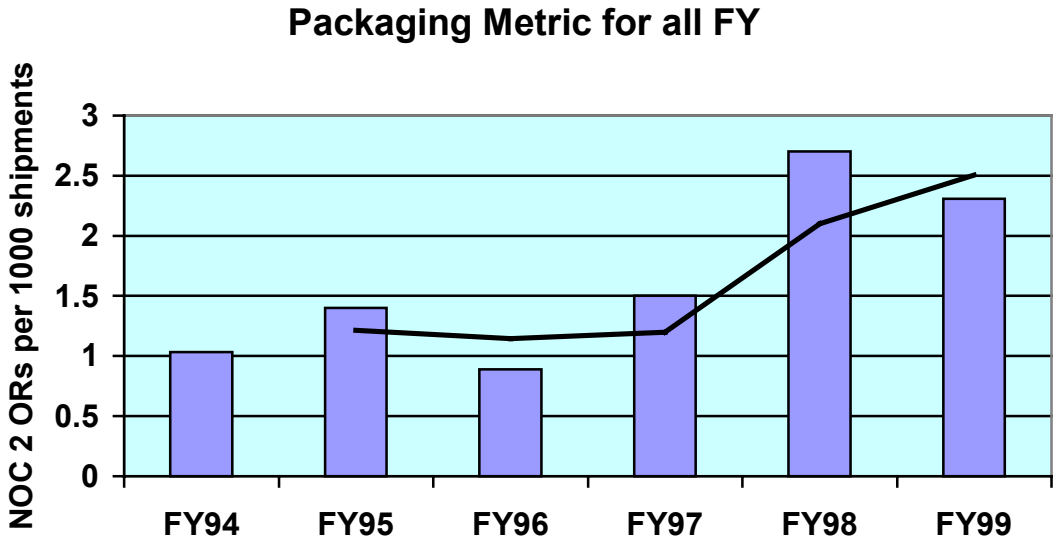

Fig. 7. Metric of packaging ORs by FY.

ORNL DWG 2000-04422

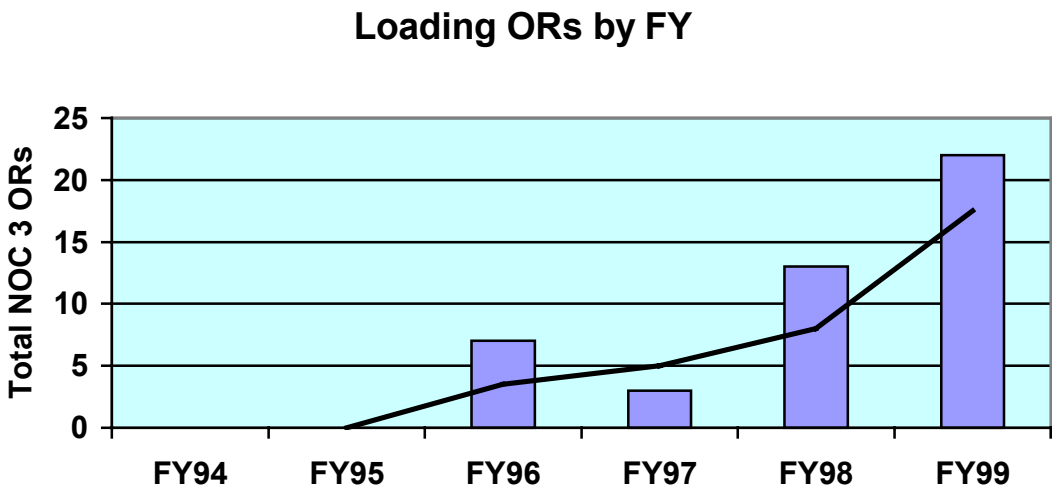

Fig. 8. Loading, unloading, and storage incident to transport ORs by FY.

ORNL DWG 2000-04423

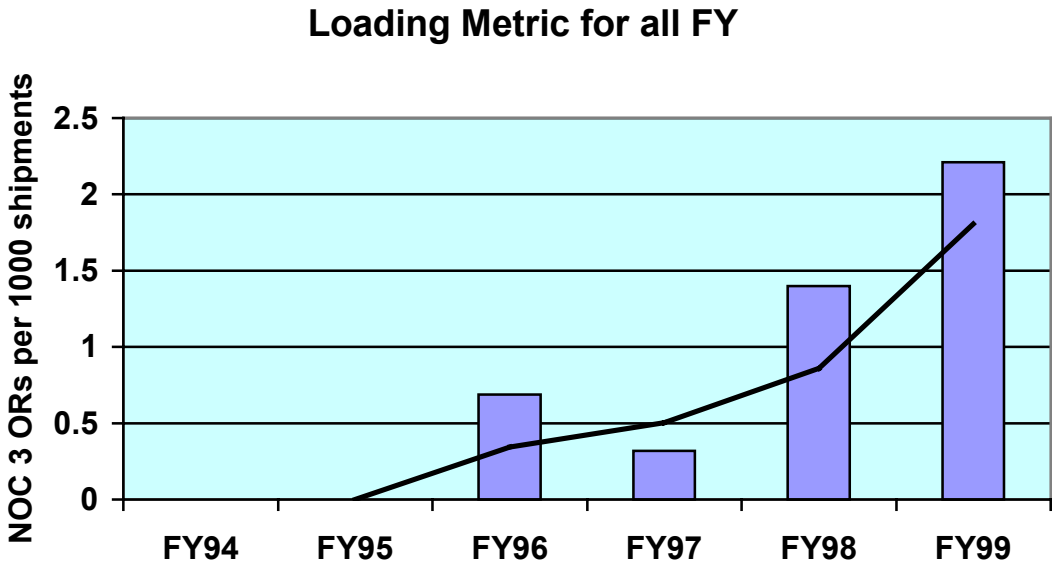

Fig. 9. Metric of loading, unloading, and storage incident to transport ORs by FY.

ORNL DWG 2000-04424

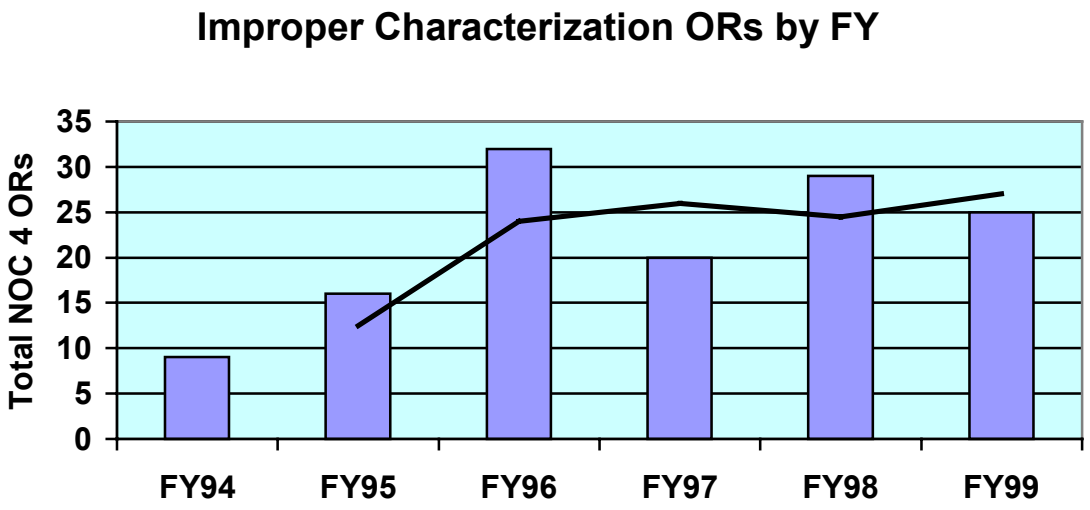

Fig. 10. Improper characterization ORs by FY.

ORNL DWG 2000-04425

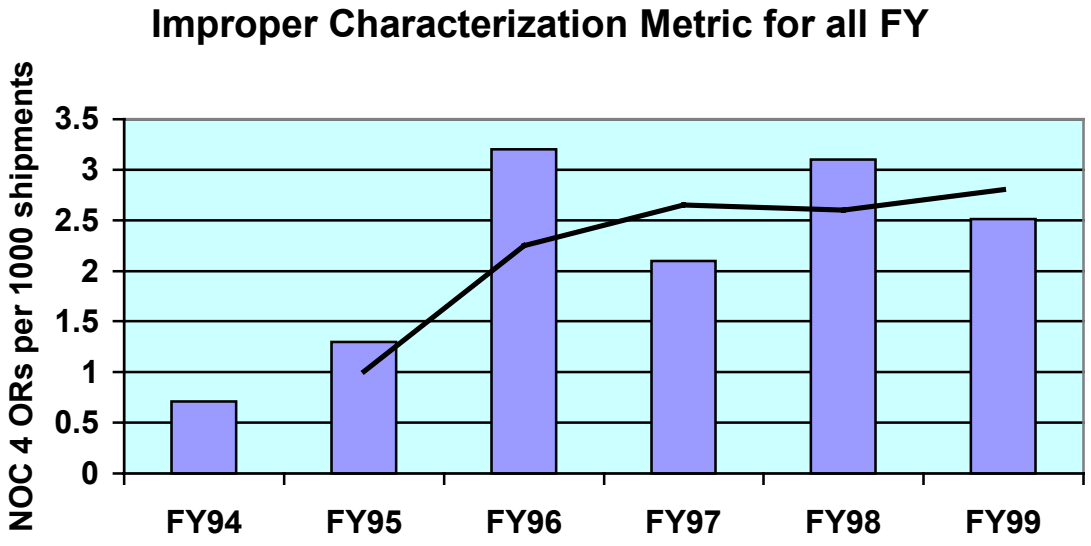

Fig. 11. Metric of improper characterization ORs by FY.

ORNL DWG 2000-04426

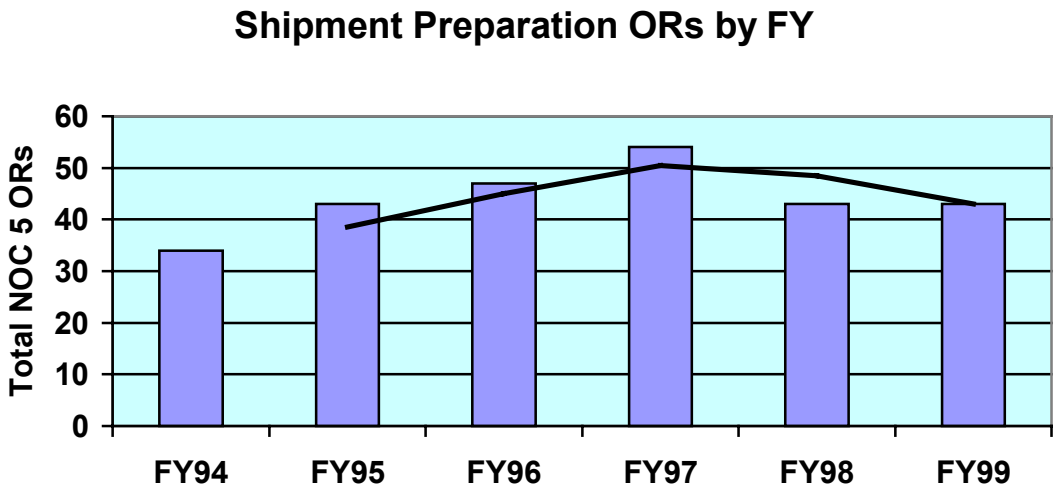

Fig. 12. Shipment preparation ORs by FY.

ORNL DWG 2000-04427

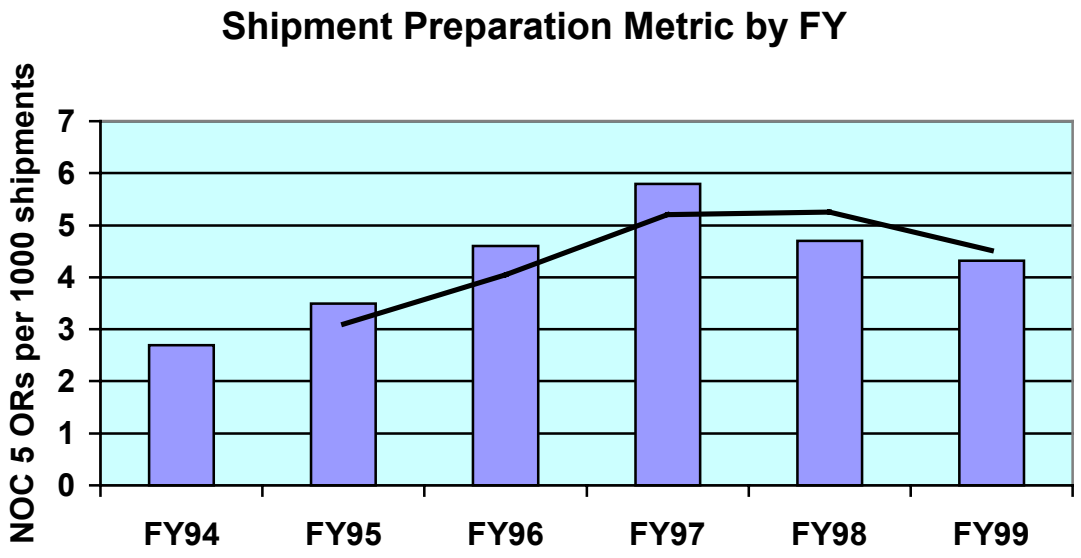

Fig. 13. Metric of shipment preparation ORs by FY.

ORNL DWG 2000-04428

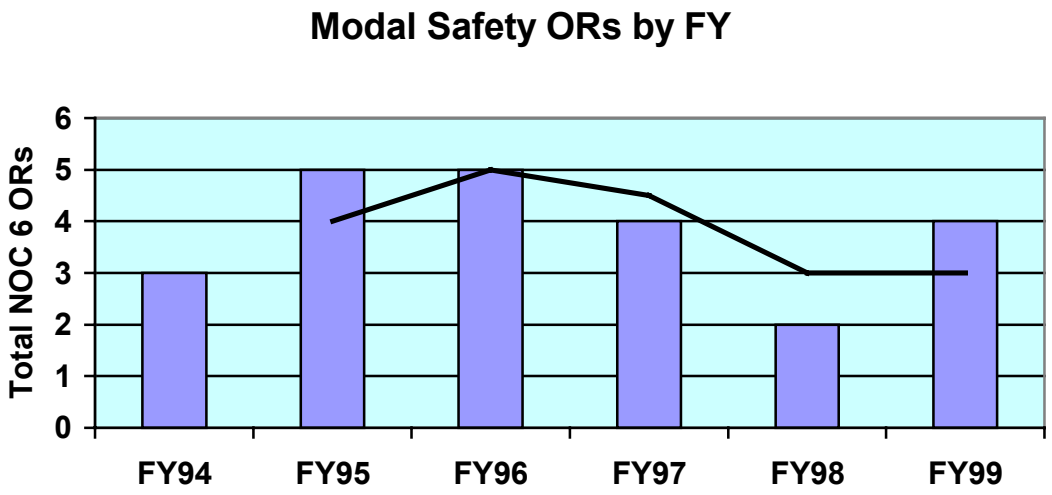

Fig. 14. Modal safety ORs by FY.

ORNL DWG 2000-04429

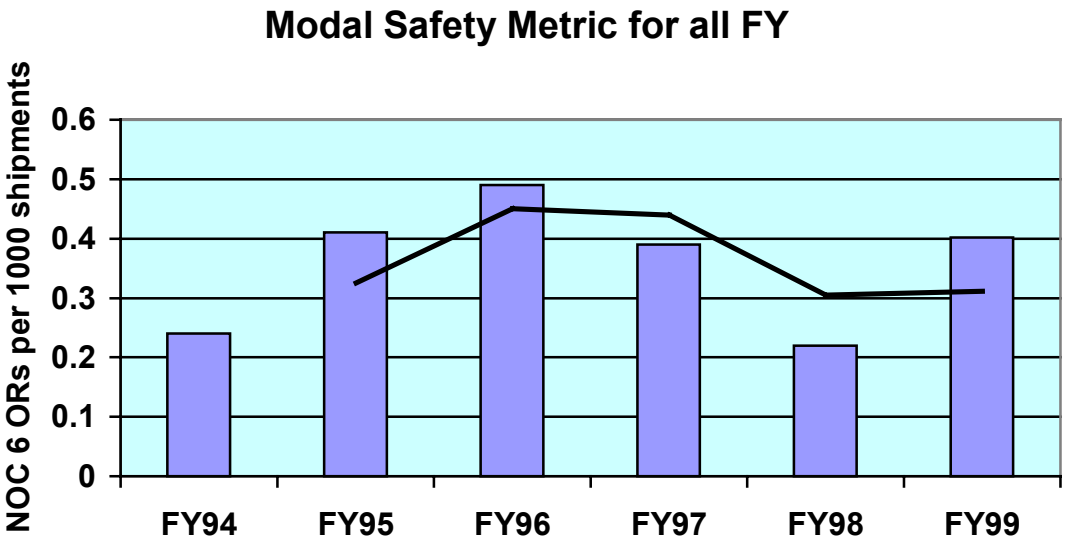

Fig. 15. Metric of modal safety ORs by FY.

ORNL DWG 2000-04430

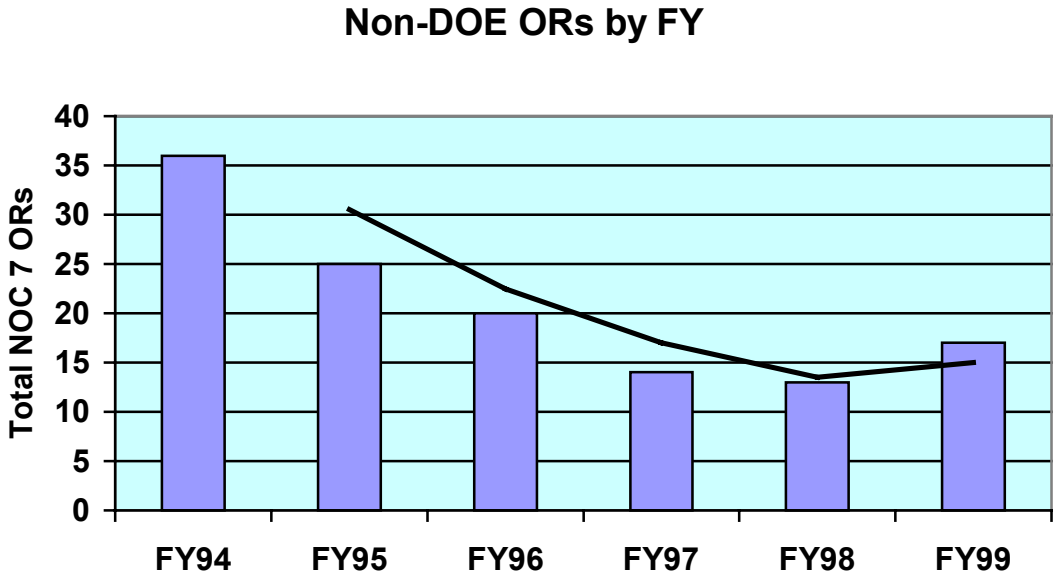

Fig.16. ORs caused by non-DOE contractors by FY.

ORNL DWG 2000-04431

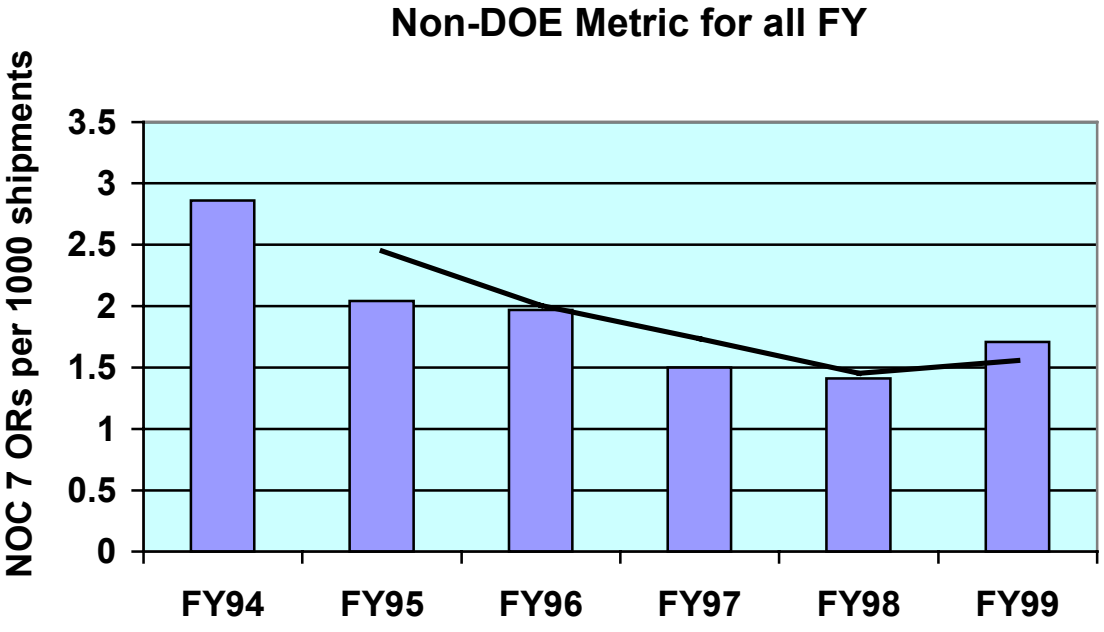

Fig. 17. Metric of ORs caused by non-DOE contractors by FY.

In most cases, the ORs per FY graph are similar 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 that were commented on in Sect. 4.1. Other than NOC 3 incidents, the normalized charts indicate that contamination and packaging incidents have increased over the years and are projected to continue to rise unless some actions are taken to retard this tendency. On the other hand, the other NOCs show a modest leveling or decrease.

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

4.3 DISTRIBUTION BY HAZARD CLASS

Checking the NOCs reported by DOT-defined hazard class can be indicative of problems developing with the handling of the material and may indicate an area where special attention needs to be applied. Table 17 below 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. It is obvious that this decrease is insignificant when one considers the low number of incidents involved.

Table 17. Distribution of ORs by DOT hazard class

Hazard class (HC)	FY 1999 ORs	%	ORs in Database	%
Class 1 (Explosive)	15	8.7	73	8.5
Class 2 (Compressed Gas)	5	2.9	37	4.3
Class 3 (Flammable Liquid)	3	1.7	29	3.4
Class 4 (Flammable Solid)	4	2.3	16	1.9
Class 5 (Oxidizer)	1	0.6	3	0.3
Class 6 (Poison)	2	1.2	10	1.2
Class 7 (Radioactive Material)	108	62.4	490	57.1
Class 8 (Corrosive Liquid)	7	4.0	39	4.6
Class 9 (Miscellaneous)	28	16.2	161	18.8
Total	173		858	

Radioactive material (HC 7) had the highest number of reported incidents. However, none of the incidents are considered alarming because they are below the SMIP HSR threshold of 64. **Use of the new SMIP methodology for severity rating allows for efficient identification of the true significance of these events.** For example, over a third of the 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). Moreover, 83 of the total 108 incidents occurred locally; 4 occurred intrastate; 19 occurred in interstate commerce; and only 2 involved international transport. None of the events had greater safety or environmental significance than *slight*. Too, the HSR of the two international events was only 1 and 16, respectively, showing at a glance that the events were minor in scope. In the past, this level of precision was not readily available.

Use of the SMIP parameters also reveals that the 15 explosives incidents, categorized as HC 1, were no cause for alarm. The majority of the incidents involved improper movements or procedural violations. Twelve of the events occurred locally; 1 occurred in intrastate commerce; and 2 occurred in interstate commerce. None of the events had significance greater than slight. In fact, 10 of the events were categorized with event consequences of *anomalies* (occurrences that could have led to endangerment or contamination). Use of the HSR as a cue focused attention on the ORs with relatively high severity ratings of 24. The two most serious of these 4 incidents (the interstate shipments) involved a Federal Express® package breaking apart and a "frangible round" being found in a chamber of a firearm in a shipment of excess firearms.

ORNL DWG 2000-03921

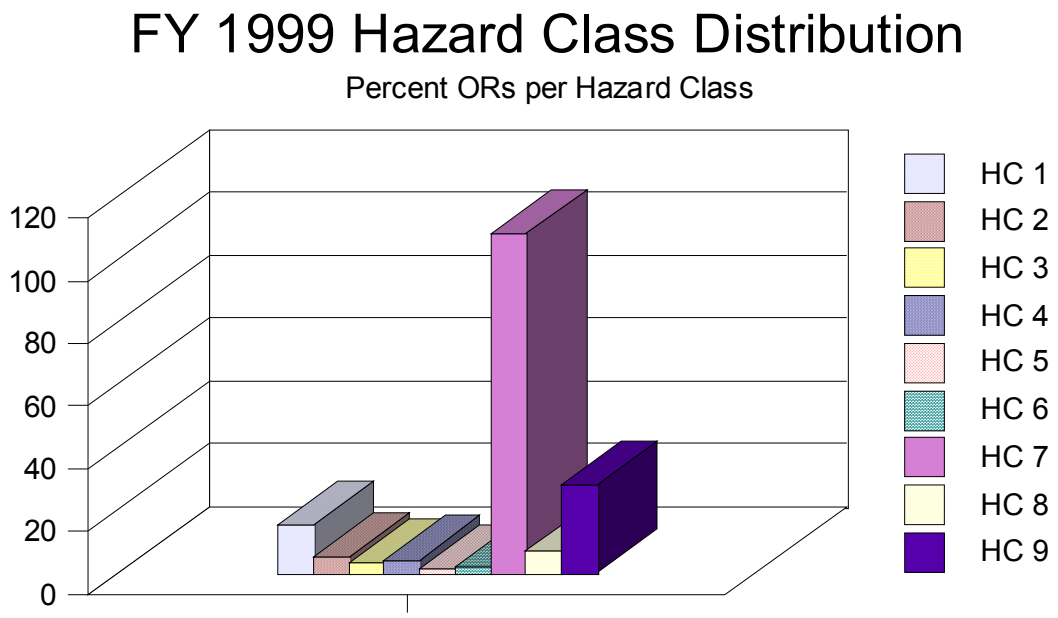

Fig. 18. FY 1999 hazard class distribution.

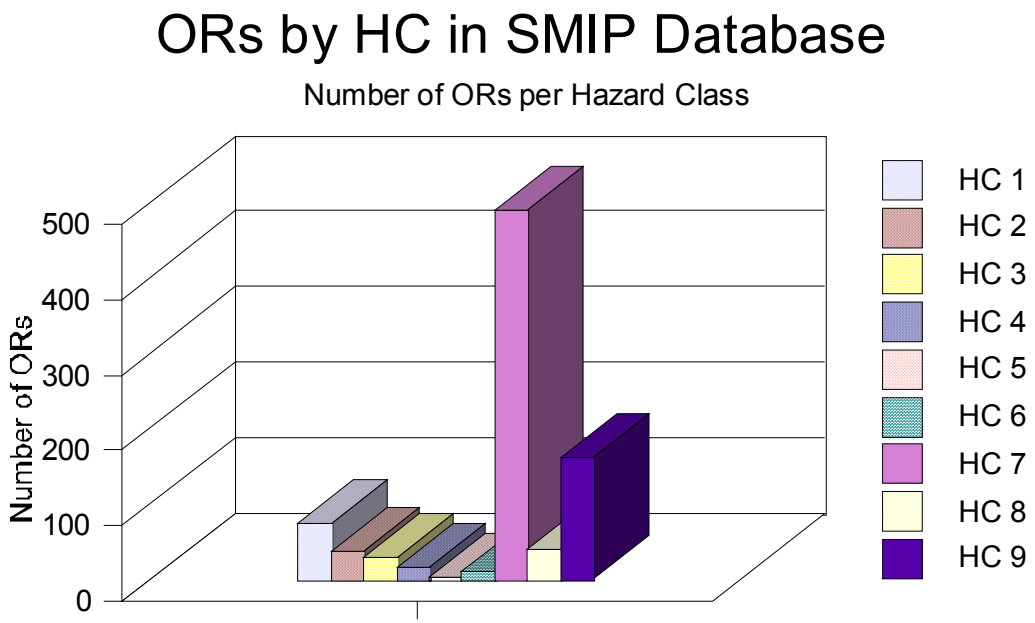

Fig 19. ORs in SMIP database by hazard class.

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5. ROOT-CAUSE ANALYSIS

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 "ORPS-assigned" root cause to distinguish it from NTP-assigned NOC coding. Table 18 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 1999 in the SMIP P&T Occurrence database is given in Table 19. Because root-cause codes are usually assigned only to final reports, the reports listed in the table are chiefly all finalized ORs. (There were 119 finals for FY 1999, but 122 reports are included in the root-cause total because three unfinalized reports are updates to the notification report and contain root-cause descriptors.) Table 20 gives a matrix of the NOC codes and the ORPS root-cause codes for ORs selected during FY 1999.

Table 20 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 the “what happened” and the “why it happened.” Hence more information is available on which to (1) assess the effectiveness of the root-cause assignment, (2) judge the appropriateness of corrective actions, and (3) possibly use this additional information to prevent recurrence.

The last column of Table 20 shows that facilities have assigned management problems and personnel error as the most frequent root causes. This is consistent with past years’ results. To determine how pervasive personnel error was, consider the shaded cells of Table 20. Cross-referencing the 28 ORs which are categorized as shipment preparation incidents (NOC 5) with personnel error (root cause 3) shows that personnel error was the root cause of 36% of the shipment preparation incidents. Also, intersecting the root cause of personnel error with NOC 3 (loading, unloading, and storage incident to transport) shows that 47% of the 17 ORs designated as NOC 3 were caused by personnel error. Of the 45 ORs caused by management problems (root cause 6), 18% involved contamination releases, 13% involved loading, unloading, or storage incident to transport, and the majority, 31%, involved shipment preparation.

Interestingly, Table 20 superficially indicates that 35% of the 17 incidents involving loading, unloading, or storage incident to transport (NOC-code 3, Column 4) had a root cause of management problems. However, querying these ORs in the SMIP P&T Occurrence Database

Table 18. 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 19. FY 1999 ORs of database classified according to root-cause codes

Root cause No.	ORPS root-cause code	Onsite	Offsite	Total
1	Equipment/material problem	1	3	4
2	Procedure problem	6	9	15
3	Personnel error	22	18	40
4	Design problem	2	5	7
5	Training deficiency	1	1	2
6	Management problem	20	25	45
7	External phenomenon	0	0	0
8	Radiological/HAZMAT problem	4	3	7
9	Other	2	0	2
	Total ORs	58	64	122
	% of Total	47.5	52.5	

Table 20. FY 1999 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	0	0	0	0	1	4	3.3
2	3	3	1	4	2	0	2	15	12.3
3	7	6	8	4	10	1	4	40	32.8
4	2	2	0	0	1	1	1	7	5.7
5	0	0	1	0	1	0	0	2	1.6
6	8	6	6	7	14	1	3	45	36.9
7	0	0	0	0	0	0	0	0	0
8	6	0	0	0	0	1	0	7	5.7
9	0	0	1	1	0	0	0	2	1.6
Total	26	20	17	16	28	4	11	122	

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

for detail revealed that the contributory cause and direct cause for 5 of the 6 events were related to personnel error.

Looking at shipment preparation incidents (NOC-code 5, Column 6) shows 10 of these ORs had a root cause of personnel error. For NTP quality assurance purposes in P&T operations, these 10 incidents were reviewed in detail to determine whether the personnel error may have resulted from a lack of training. None of the events had a direct or contributory cause of training deficiency. In fact, of the 40 ORs having a root cause of personnel error, none had a direct or contributory cause of training deficiency. **Therefore, it can be concluded that training deficiencies are not the cause of P&T incidents which occur because of personnel error**. For all of FY 1999 there were only two incidents which were related to a training deficiency. (See root cause 5.)

Queries were conducted of the SMIP P&T Occurrence Database for additional detail. Of the 14 shipment preparation (NOC 5) ORs which have a management problem (root cause 6), 10 had a direct cause of personnel error, and another had a contributory cause of personnel error. In total, personnel error was the root or direct cause in 75% of the 28 ORs resulting from shipment preparation problems. This further analysis serves as a caution against simply glancing at the matrix chart without doing more in-depth investigation of the statistics.

As in previous years, the major root cause for both onsite and offsite occurrences continues to be personnel error (root cause 3) and management problems (root cause 6). (However, 26 of the ORs identified as having root causes of management problems also had direct causes of personnel error; another 4 had contributory causes of personnel error.) Hence personnel error remains the main cause, at some level, of P&T occurrences.

The NTP will address the issue of personnel error or take actions when it becomes appropriate. Because most of these errors continue to be minor (as revealed by the having an event consequence measure [W_{ec}] of only *slight*), no comprehensive plan is needed as the DOE contractors are doing well with their compliance and training as a whole.

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 materials, 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-MILE 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 here—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 from using a combination of data from DOE's ETAS and DOE's 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 1999 were identified, the Safety Status Measurement System (SafeStat) was accessed to obtain statistics based on total miles driven in support of private industry. SafeStat 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 30 months*. The listed injuries and fatalities are a subset of the reportable crashes (i.e., 40 crashes that involved 3 injuries, of which 1 resulted in death).

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. 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 SafeStat database.

To determine the number of miles that the carriers operated in private industry, the carriers themselves were contacted. While it would have been ideal to get the number of miles for FY 1999, most carriers stated that this effort would require additional work. Hence we accepted the estimated miles that they drove during CY 1999 as a compromise and for consistency among the information providers.

Based upon these data sources, the following two tables were produced. Table 21 simply shows the information from SafeStat for the carriers who transported over 50,000 miles for DOE during FY 1999. The information *pertains to the last 30 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. For instance, six of the seven carriers with a Southern Freight designation and distinct DOT number report to a central office in Georgia. Hence, the Georgia DOT number was used to represent the carrier because it is headquartered there, and its DOE activity involved two Oak Ridge, Tennessee sites.

Table 21. Carrier information from SafeStat Database (within 30 months)

Carrier name	DOT No.	Power Units	Fatality	Injuries	Crashes
Southern Freight Logistics, L.L.C.	226118	286	1	2	8
Landstar Ranger ,Inc.	241572	3834	9	155	309
Rinchem Company, Inc.	298907	12	0	0	1
Hittman Transport Services	157942	41	0	1	3
Roadway Express, Inc.	71821	9450	18	272	542
Tri State Motor Transit	64158	393	0	21	35
A. J. Metler Hauling & Rigging, Inc.	41206	29	2	15	31
Hazmat Environmental Group	255684	96	0	5	7
Kindrick Trucking Company	41175	66	1	4	5
Yellow Freight Systems	65616	9585	25	285	574
Horwith Trucks, Inc.	205701	103	0	6	9
TAG Transport, Inc.	642202	24	0	1	2
Safety-Kleen TG Inc.	203954	866	0	9	12

Table 22 shows the DOT mileage obtained from the carriers directly and the measure of the carriers' crashes per one-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 SafeStat during the last 30 months by (1) 2.5 (30 months interpolated to one year) to approximate the average accidents per year, and (2) the number of miles the carrier drove during CY 1999.

To compare just how safe DOE's carriers are when driving for DOE as opposed to 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 name of the carrier in the ORPS report. Thus the 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 74 incidents that occurred offsite (and which was the fault of a DOE contractor) this FY, a comparison can be made even without knowing what specific carriers the individual sites used.

Table 22. Safety metric of DOE carriers

Carrier name	Total mileage	Average crashes/ one-million miles
Southern Freight Logistics, L.L.C.	15,000,000[1]	.2133
Landstar Ranger ,Inc.	356,517,624	.3467
Rinchem Company, Inc.	830,000	.4819
Hittman Transport Services	6,237,000	.1924
Roadway Freight	530,751,732	.4085
Tri State Motor Transit	161,300,000	.0868
A. J. Metler Hauling & Rigging, Inc.	9,916,754[2]	1.2504
Hazmat Environmental Group	9,000,000	.3110
Kindrick Trucking Company	4,233,472	.4724
Yellow Freight Systems	533,700,000	.4302
Horwith Trucks, Inc.	6,540,003	.5505
Safety-Kleen TG Inc.	86,936,516	.0552
TAG Transport	1,165,708	.6863

[1]The total mileage is a combination of Lakeway Trucking (the trucking company used by Southern Freight Logistics, Limited Liability Co.) which had 13,500,000 miles and Southern Freight Express, which accumulated 1,527,521 miles during 1999.
[2]The Safety Department (Charles Strader) stated that they downsized on March 1999 from 300 to 29 power units and have had no crashes.

Offsite shipments by the DOE contractor sites totaled 3,876,000 vehicle miles—not including government truck movements or local shipments. Table 23, "DOE carriers' shipments and mileage for DOE," gives a listing of the associated miles and number of shipments of carriers who transported over 50,000 miles for DOE. Because the carriers had no reportable accidents while transporting for DOE during FY 1999, **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.**

Table 23. DOE carriers' shipments and mileage for DOE

Carrier name	DOE Mileage	DOE Shipments	Accidents while transporting for DOE
Southern Freight Logistics, L.L.C.	612,374	334	0
Landstar Ranger ,Inc.	423,331	427	0
Rinchem Company, Inc.	305,349	430	0
Hittman Transport Services	255,107	379	0
Roadway Freight	225,384	191	0
Tri State Motor Transit	213,918	261	0
A. J. Metler Hauling & Rigging, Inc.	167,804	135	0
Hazmat Environmental Group	138,387	361	0
Kindrick Trucking Company	127,751	75	0
Yellow Freight Systems	110,279	112	0
Horwith Trucks, Inc.	93,401	237	0
Safety-Kleen TG Inc.	78,285	170	0
TAG Transport	68,154	51	0

All of the carriers used by DOE and whose transport activity for DOE was greater than 50,000 miles are authorized to carry hazardous material by interstate and have a satisfactory rating. From performing a weighted average of Table 22 data, the weighted safety indicator's average for DOE contract shippers who traveled over 50,000 miles on DOE business is 0.42, which compares favorably to the DOT national average of 0.75 accidents per million miles. **These carriers' shipments made for DOE have been conducted almost twice as safely as other carriers transporting in private industry, averaging an accident per 2,370,000 miles as compared to an accident per 1,333,000 miles.** Since these carriers had no reportable crashes while transporting cargo for DOE during CY 1999, 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.

Based on DOT's CY 1999 average of 0.75 accidents per one-million miles for all commodities, the only DOE-utilized carrier whose calculated safety measure exceeds this is A. J. Metler Hauling & Rigging, which recorded 1.25 accidents per one-million miles. However, A. J. Metler has stated that they have since downsized, have had only one accident since March 1999, and have passed a complete DOT inspection.

As evidence that not counting mileage conducted locally (usually in the same zip code) is not a significant fraction of DOE vehicle-mileage, consider that TRAGIS estimated that there were 1,006 vendor deliveries that totaled 23,526 miles and 550 shipments utilizing government trucks which totaled but 3,577 miles.

6.2 PACKAGE-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 is comprised of packages of the same hazard class which 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 8 packages, 6 of which contain flammable material and 2 of which contain oxidizers. By considering the commodity codes of the shipment, 3 packages might contain lithium metal (hazard class 4.3), 1 package might contain lithium hydride (hazard class 4.3), 2 packages might contain titanium hydride (hazard class 4.1), and 2 packages might contain sodium chlorate (an oxidizer of hazard class 5.1). In this case, the data would be interpreted by ETAS as: 4 packages of hazard class 4.3, 2 packages of hazard class 4.1, and 2 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.

Table 24 identifies the package-miles by hazard class for DOE material shipments made in FY 1999. Because package-mile distances are based on the number of packages, making meaningful comparisons between years can be cumbersome. A better way to make comparisons might be to total the miles by shipments. In this case, if a shipment is comprised of 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, "Shipment-miles by hazard class," shows a comparison between FYs 1998 and 1999 data. From this type of a comparison unusual increases or decreases are more apparent. For example, ram-contaminated exempt shipments readily stand out because of their increase from 13,544 shipments to 388,308 shipments. Reasons for this increase were sought, and it was determined that Fernald and Mound conducted cleanup campaigns (probably moving slightly contaminated dirt). In the future, trends will be derived from these data and metrics developed.

Table 24. Package-miles by hazard class

Hazard class	Package miles (FY99)
Class 1 (Explosive)	2,433,000
Class 2 (Compressed Gas)	4,134,000
Class 3 (Flammable or Combustible Liquid)	1,654,000
Class 4 (Flammable Solid)	218,000
Class 5 (Oxidizer)	356,000

Table 24. (continued)

Hazard class	Package miles (FY99)
Class 7 (Radioactive Material)	16,915,000
Class 8 (Corrosive Liquid)	2,123,300
Class 9 (Miscellaneous)	1,137,000
RAM-contaminated, Exempt	3,549,000
Hazardous Waste	1,878,000

Table 25. Shipment-miles by hazard class

Hazard class	Shipment miles (FY98)	Shipment miles (FY99)
Class 1 (Explosive)	195,845	255,230
Class 2 (Compressed Gas)	574,670	659,274
Class 3 (Flammable or Combustible Liquid)	444,468	397,425
Class 4 (Flammable Solid)	96,251	73,984
Class 5 (Oxidizer)	112,624	88,643
Class 6 (Poison)	110,094	116,412
Class 7 (Radioactive Material)	2,289,962	1,851,792
Class 8 (Corrosive Liquid)	658,902	501,842
Class 9 (Miscellaneous)	410,203	109,408
RAM-contaminated, Exempt	13,544	388,308

6.3 SITE-SPECIFIC COMPARISONS

Normalization of transport data that has been reported by individual sites should be able to 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 1999. Table 26 presents the number of shipments and ORs made by all sites for FY 1994 through FY 1999.

Table 26. Total shipments and number of ORs by FY

FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999	
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	173

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 1994 through FY 1999. 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.) In the table, "shipments" are shortened to "trips" so that more data can be displayed.

Table 27. Shipments and offsite occurrences by FY

Site	FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999	
	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	ORs	Trips	Ors
ETTP	405	2	573	0	977	4	631	1	184	1	452	2
FDF	1282	2	1032	7	405	4	518	3	113	2	604	0
LANL	464	7	146	11	135	3	278	6	486	3	579	2
LITC	627	0	563	4	303	3	441	7	339	8	517	4
LLNL	1442	2	1068	4	789	3	833	6	765	5	883	1
ORNL	507	3	815	0	818	1	665	3	681	6	575	7
SNL-AL	793	2	784	3	693	4	427	1	256	2	441	3
WSRC	664	3	884	6	947	8	842	6	833	12	802	16
Y-12	753	1	527	0	594	1	683	1	732	3	574	3

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. The safety measures have been multiplied by 1,000 for ease of communication. The last column is a weighted average of the respective sites' safety measures for the period FY 1994–1999, which was determined by summing the P&T occurrences for the 6-year period and 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	Average
ETTP (K-25)	4.93	0	4.09	1.58	5.43	4.42	3.10
FDF (FERM)	1.56	6.78	9.88	5.79	17.7	0	4.56
LANL	15.08	75.3	22.2	21.58	6.17	3.45	15.33
LITC (INEEL)	0	7.10	9.90	15.87	23.6	7.74	9.32
LLNL	1.39	3.75	3.80	7.20	6.54	1.13	3.63
ORNL	5.92	0	1.22	4.51	8.81	12.17	4.93
SNL	2.52	3.83	5.77	2.34	7.81	6.80	4.44
WSRC	4.52	6.79	8.45	7.13	14.4	20.00	10.26
Y-12	1.33	0	1.68	1.46	4.10	5.23	2.33

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 six years considered, Y-12 reported 9 occurrences and conducted 3,863 shipments. Y-12's safety measure indicates that it averaged 0.00233 occurrences per shipment (9 ÷ 3863) or, alternatively, made 429 shipments (the inverse of .00233) before it incurred an OR. As another example, LANL had 32 ORs and conducted 2,088 shipments during this period. Taking the inverse of their shipping measure average, 1 ÷ 0.0153, indicates that they averaged an occurrence every 65 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 54, the number of data points for the nine sites reporting over the 6-year period. This annual global safety measure, 8.01, 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 six fiscal years, 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 prefers to see a downward trend indicating an overall improvement in safety, as exhibited by LANL. However, note that if you were to use Table 27 and simply compare the number of ORs reported by LANL with another site which reported fewer ORs for the same period, you could generate some faulty assumptions. A problem with making site-to-site comparisons by simply dividing the number of offsite P&T occurrences by the total shipments made during the year is that this method 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.

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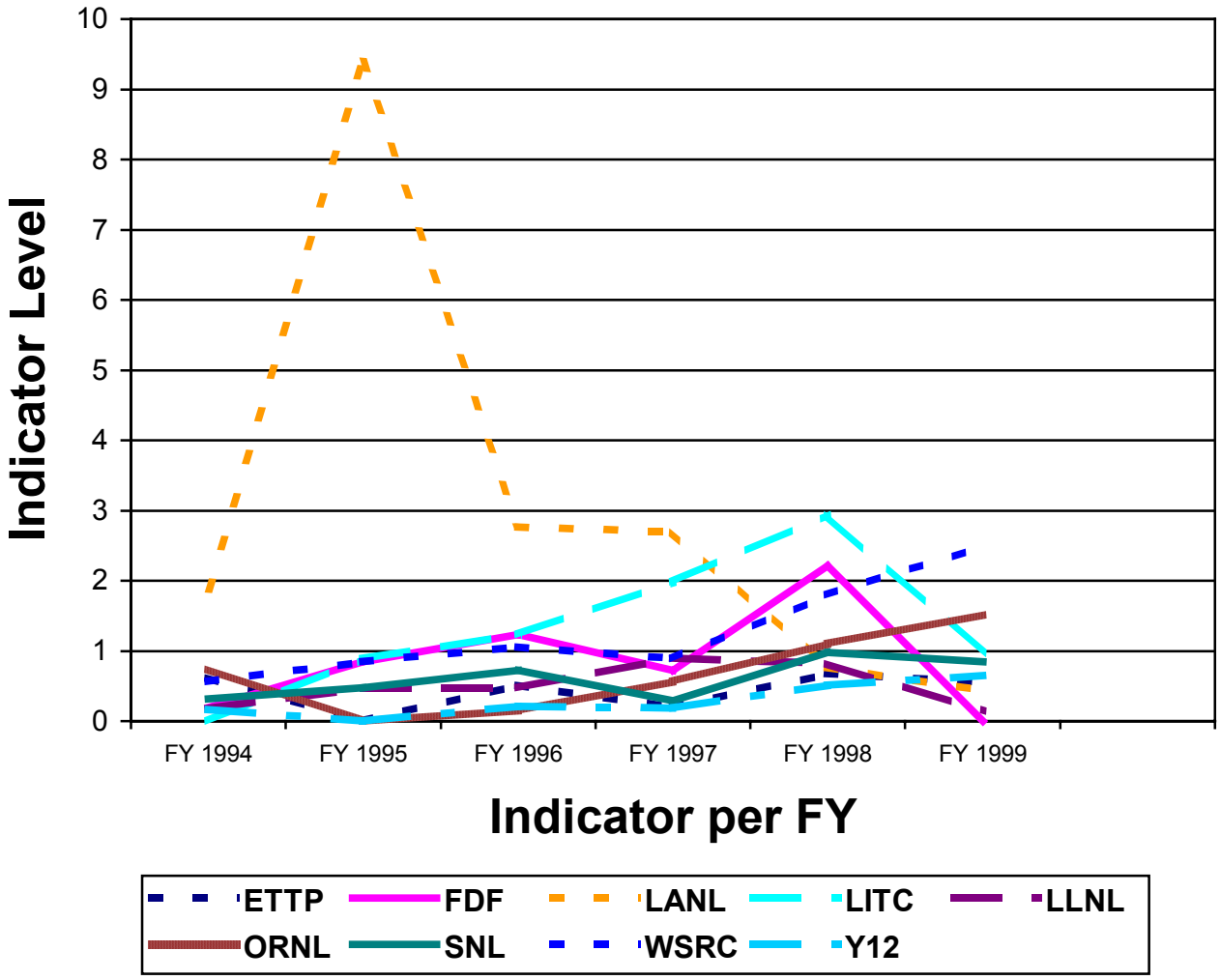

Fig. 20. Safety metric indicator based on normalized ORs per shipments.

For completeness, Table 29, "Safety metric based on shipments during FY 1999," presents all the sites which reported an offsite occurrence and the number of outbound shipments of hazardous materials or waste associated with the site. If a site reported no shipments to the Automated Transportation Management System (ATMS) or ETAS, then it has an asterisk listed under the number of shipments.

Table 29. Safety metric based on shipments during FY 1999

Site	FY 1999		Safety measure (*x* 1000)
	Shipments	Incidents	
Argonne National Lab—Illinois Site	225	1	4.44
Argonne National Lab—Idaho	177	2	11.30
Brookhaven Natl. Lab	306	2	6.54
BNFL, Inc.	*	1	NA
GOSF—Oakland Ops Office	*	1	NA
ETTP (K-25 Plant)	452	2	4.43
Fernald Env. Mngt. Project	604	1	1.66
KCP Allied Signal	20	3	150.00
Rocky Flats Plant	688	6	8.72
Los Alamos National Lab	579	2	3.45
Lawrence Berkeley Lab	95	2	21.10
Lockheed Idaho Technology	517	4	7.74
Lawrence Livermore Lab	883	1	1.13
New Brunswick Laboratory	*	1	NA
ORAU	119	1	8.40
ORNL	575	7	12.20
PANTEX	323	4	12.40
Paducah Gaseous Diffusion Plant (PGDP)	2	2	1000.00
PHMC	156	7	44.87
Pacific Northwest National Lab	426	1	2.35
Sandia National Lab, NM	441	3	6.80
Y-12 Plant (LMES)	574	3	5.23
WSRC	802	16	20.00

*did not report shipments directly to ATMS/ETAS as required by DOE Order 460.2 for DOE facilities

If one intends to use the normalization data of this section 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), the number of package-miles (Table 24), 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 the Appendix). Too, the ORs would have to be reviewed in depth to ascertain whether a real problem existed or if the statistics appear unfavorable, simply, because of a large number of minor, non-serious, occurrences being reported. Site activity and factors would also have to be considered, such as whether a waste-reduction campaign had just gotten underway or whether one incident had generated other related occurrences or even one worker's inexperience caused a number of ORs.

Also, to be considered is the material movement that is not captured by ETAS. It may be that a site has tremendous local activity (such as cylinder movement from facility to facility), which is not reflected in the mileage computations of TRAGIS.

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7. FUTURE DIRECTION

As data becomes available, more normalization approaches and comparison with private industry or other agencies will become possible. To this end, the RMIR database manager has been contacted and asked to require reporters of incidents to specify whether or not the incident concerns DOE contractors. This requirement will allow records to be verified between ORPS and RMIR, providing another trending source as well as quality assurance validation. Too, it is hoped that the Computerized Accident/Incident Reporting System (CAIRS) will be able to provide information on P&T-personnel-related hours so that valid comparisons will be possible for P&T occurrences per P&T person-hours. In the future, the SafeStat Safety Evaluation Areas for accident, driver, vehicle, and safety management may be incorporated in the SMIP Annual Report to indicate carrier safety and ranking.

Much data were presented in this report upon which useful metrics may be developed. Though some trending was performed upon Operations Offices, additional information on occurrences was provided in the Appendix without offering any metrics or comparisons. Your suggestions for normalization approaches are welcomed.

Quarterly reports on occurrences are planned to be published beginning in the third quarter of FY 2000. 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. **More trending analyses and a section addressing occurrences which involve hazardous materials transported in pipelines will be presented in the next annual report**.

The next Annual Report is planned to be published during early second quarter of FY 2001, the earliest time at which carrier CY mileage statistics are expected to be available.

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Appendix A

FY 1999 SMIP-CLASSIFIED OCCURRENCES

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Table A.1. FY 1999 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—MCTC-GJPOTAR-1999-0001	P	HM	ON/ON	1B1	3	2	1	2	4	0	0	1
ALO-AO-MHSM-PANTEX-1998-0071	P	HM	ON/ON	5C	1.4	4	1	2	8	2	16	1
ALO-AO-MHSM-PANTEX-1998-0079	P	HM	ON/ON	5B	1.4	4	2	3	24			1
ALO-AO-MHSM-PANTEX-1998-0080	P	HM	ON/ON	4	1.4	4	1	2	8			1
ALO-AO-MHSM-PANTEX-1999-0008	T	HM	ON/ON	3	1.4	4	1	2	8			1
ALO-AO-MHSM-PANTEX-1999-0012	T	HM	ON/ON	3	1.4	4	1	2	8			1
ALO-AO-MHSM-PANTEX-1999-0017	T	HM	ON/ON	3	1.4	4	1	3	12			1
ALO-AO-MHSM-PANTEX-1999-0020	P	HM	OFF	5	7	4	2	2	16	0	0	1
ALO-AO-MHSM-PANTEX-1999-0036	P	HM	ON/ON	5C	1.4	4	1	2	8	0	0	1
ALO-AO-MHSM-PANTEX-1999-0041	P	HM	ON/OFF	5E	1.1	4	2	3	24	0	0	1
ALO-AO-MHSM-PANTEX-1999-0043	P	HM	ON/OFF	2C	1.3	4	1	3	12	0	0	1
ALO-AO-MHSM-PANTEX-1999-0057	T	HM	ON/ON	3	7	4	1	5	20	0	0	1
ALO-AO-MHSM-PANTEX-1999-0065	P	HM	ON/ON	3	1	4	1	3	12	0	0	1
ALO-AO-MHSM-PANTEX-1999-0067	P	HM	ON/OFF	1A3	7	4	2	2	16	0	0	1
ALO-KC-AS-KCP-1999-0002	P	HM	OFF	5	1	4	1	2	8			1
ALO-KC-AS-KCP-1999-0012	P	HM	OFF	2A	1	4	2	0	0	0	0	2
ALO-KC-AS-KCP-1999-0013	P	HM	OFF	4	9	1	2	3	6	0	0	1
ALO-KO-SNL-10000-1998-0005	T	HM	OFF	7A	8	2	1	2	4			1
ALO-KO-SNL-10000-1999-0002	P	HM	OFF	2A	1	4	2	3	24	0	0	3
ALO-KO-SNL-15000-1999-0002	P	HM	OFF	5B	7	4	2	2	16	0	0	2
ALO-KO-SNL-2000-1999-0001	T	HM	ON/ON	5C	7	4	1	3	12	0	0	1
ALO-KO-SNL-5000-1999-0002	P	HM	ON/ON	5	7	4	1	4	16	0	0	1
ALO-KO-SNL-6000-1998-0004	T	W	ON/ON	4	7	4	1	2	8			1
ALO-KO-SNL-6000-1999-0001	T	HM	ON/ON	3	7	4	1	3	12	0	0	1
ALO-KO-SNL-NMSITE-1999-0002	P	HM	OFF	2B	7	4	1	3	12	0	0	1
ALO-LA-LANL-ACCCOMPLEX-1998-0017	P	W	OFF	1A1	7	4	2	2	16	3	72	1
ALO-LA-LANL-CMR-1998-0043	P	W	ON/ON	3	6.2	4	2	2	16			1
ALO-LA-LANL-TA55-1999-0023	P	HM	ON/ON	1A2	7	4	2	1	8	0	0	1
ALO-LA-LANL-TRITFACILS-1999-0002	P	HM	OFF	7B	7	4	1	4	16	0	0	3
ALO-LA-LANL-WASTEMGT-1999-0004	P	HM	ON/ON	1A2	7	4	2	2	16	0	0	1

Table A.1. (continued)

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{tv}	HSR	RF	RSF	SPR
ALO-LA-LANL-WASTEMGT-1999-0006	P	HM	OFF	2C	7	4	1	5	20	0	0	3
ALO-LA-LANL-WASTEMGT-1999-0008	P	HM	ON/ON	1A2	7	4	2	2	16	0	0	1
CH--NBL-NBL-1999-0001	P	HM	OFF	5	7	4	1	4	16			3
CH-AA-ANLE-ANLE-1999-0001	P	HM	OFF	7E	7	4	2	4	32	0	0	3
CH-AA-ANLE-ANLEAPS-1999-0003	P	HM	OFF	7A	7	1	1	1	1	0	0	4
CH-AA-ANLE-ANLECMB-1998-0001	P	HM	OFF	5	8	2	2	2	8			3
CH-AA-ANLE-ANLEPFS-1999-0002	P	HM	OFF	7B	5.1	2	1	2	4	0	0	1
CH-AA-ANLE-ANLEPFS-1999-0004	P	HM	ON/ON	1A3	7	4	2	4	32	0	0	1
CH-AA-ANLW-ANLW-1999-0003	P	HM	OFF	2A	8	2	2	2	8	0	0	3
CH-AA-ANLW-EBR-1999-0003	P	HM	ON/OFF	3	8	2	2	3	12	0	0	1
CH-AA-ANLW-HFEF-1998-0003	P	HM	ON/ON	2B	7	4	1	4	16			1
CH-AA-ANLW-HFEF-1999-0005	P	HM	ON/ON	4	7	4	2	5	40	0	0	1
CH-BH-BNL-BNL-1999-0005	P	HM	OFF	7A	7	1	1	1	1			3
CH-BH-BNL-BNL-1999-0011	T	HM	ON/ON	1A3	7	4	2	3	24	0	0	1
CH-BH-BNL-BNL-1999-0018	P	W	OFF	4	9	1	1	2	2	0	0	3
CH-BH-BNL-BNL-1999-0019	P	HM	OFF	5	8	2	1	2	4	0	0	3
HQ--GOPE-FETC-1999-0006	P	HM	OFF	7B	2.1	2	1	4	8	0	0	1
HQ--SPR-WH-1999-0004	T	W	ON	6A	9	1	2	2	4	0	0	1
HQ--SPR-WI-1999-0002	P	HM	OFF	7A	6.1	2	1	2	4	0	0	3
ID--LITC-CFA-1999-0015	P	HM	ON/ON	1A3	7	4	2	2	16	0	0	1
ID--LITC-CFA-1999-0016	T	HM	ON/ON	3	1	4	1	3	12	0	0	1
ID--LITC-FUELRCSTR-1999-0005	P	HM	ON/ON	5	7	4	1	5	20	0	0	1
ID--LITC-FUELRCSTR-1999-0011	P	HM	ON/ON	2A	7	4	1	5	20	0	0	1
ID--LITC-LANDLORD-1998-0033	T	HM	ON/OFF	5F	7	4	1	1	4			1
ID--LITC-TRA-1999-0005	T	W	OFF	5	9	1	1	2	2			3
ID--LITC-TRA-1999-0015	P	HM	ON/ON	2C	7	4	2	5	40	0	0	1
ID--LITC-TRA-1999-0024	P	HM	ON/ON	1A3	7	4	2	2	16	0	0	1
ID--LITC-WASTEMNGT-1999-0004	P	W	OFF	4	9	1	1	2	2			1
ID--LITC-WERF-1999-0001	T	W	ON	4	9	1	1	2	2			1
ID--LITC-WERF-1999-0003	P	HM	ON/ON	1A2	7	4	2	3	24	0	0	1
ID--LITC-WERF-1999-0005	P	W	ON/OFF	2A	9	1	2	2	4	0	0	1

Table A.1. (continued)

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{tv}	HSR	RF	RSF	SPR
ID--LITC-WROC-1999-0003	P	W	ON/ON	3	9	1	1	2	2	0	0	1
NVOO--BNLV-NTS-1999-0017	T	HM	ON/ON	1B1	3	2	1	2	4	0	0	1
OAK-GOSF-HCF-1998-0001	P	W	OFF	1A3	7	4	2	2	16			1
OAK--LBL-EHS-1999-0001	P	HM	OFF	1A3	7	4	2	1	8	0	0	1
OAK--LBL-EHS-1999-0003	P	W	OFF	4	9	1	1	2	2	0	0	3
OAK-LLNL-LLNL-1998-0058	T	HM	ON/ON	5	7	4	1	1	4			1
OAK-LLNL-LLNL-1998-0063	T	W	OFF	4	4.3	2	2	3	12			2
OAK--LLNL-LLNL-1999-0002	P	HM	ON/ON	5	7	1	1	1	1	0	0	1
OAK--LLNL-LLNL-1999-0003	P	HM	ON/ON	5B	7	1	1	1	1	0	0	1
OAK--LLNL-LLNL-1999-0045	P	W	ON/ON	1B2	9	1	2	2	4	0	0	1
OH-FN-FDF-FEMP-1998-0031	T	HM	ON/ON	5D	7	4	1	1	4			1
OH-FN-FDF-FEMP-1999-0004	P	HM	OFF	7E	7	4	2	1	8			3
OH-FN-FDF-FEMP-1999-0006	P	HM	ON/OFF	6C	7	1	1	1	1	0	0	1
OH-MB-BWO-BWO06-1999-0002	P	HM	ON/ON	4	7	1	1	2	2	0	0	1
ORO--BJC-K25GENLAN-1998-0018	P	HM	ON/ON	5	7	4	1	1	4			1
ORO--BJC-K25GENLAN-1999-0014	P	HM	OFF	7E	7	1	2	2	4	0	0	3
ORO--BJC-K25WASTMAN-1998-0006	P	HM	ON/ON	3	2.1	3	2	2	12			1
ORO--BJC-K25WASTMAN-1998-0007	P	W	ON/ON	5	7	4	1	1	4			1
ORO--BJC-K25WASTMAN-1999-0001	P	W	OFF	5	9	1	1	2	2			1
ORO--BJC-K25WASTMAN-1999-0008	P	W	OFF	4	9	1	1	2	2	0	0	1
ORO--BJC-PGDPENVRES-1998-0017	T	W	ON/OFF	5	3	2	1	2	4			1
ORO--BJC-PGDPENVRES-1999-0001	P	W	OFF	7A	9	1	1	2	2	0	0	3
ORO--BJC-PGDPENVRES-1999-0010	P	W	OFF	5B	9	1	1	2	2	0	0	3
ORO--BJC-PORTENVRES-1999-0010	P	W	OFF	7A	9	1	1	2	2	0	0	3
ORO--BJC-Y12WASTE-1999-0001	P	W	OFF	7A	9	1	1	2	2			3
ORO--BJC-Y12WASTE-1999-0003	P	W	OFF	4	9	1	2	2	4	0	0	2
ORO--BNFL-K33-1998-0017	P	HM	ON/ON	1A3	7	4	1	1	4			1
ORO--BNFL-K33-1999-0007	P	W	OFF	5E	7	1	1	2	2	0	0	3
ORO--LMES-Y12DPMGMT-1999-0001	P	HM	OFF	1A3	7	4	1	2	8			3
ORO--LMES-Y12NUCLEAR-1999-0018	P	HM	OFF	1A3	7	4	1	1	4			3
ORO--LMES-Y12NUCLEAR-1999-0057	P	HM	ON/ON	3	7	4	1	1	4	0	0	1

Table A.1. (continued)

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{tv}	HSR	RF	RSF	SPR
ORO--LMES-Y12SITE-1999-0013	P	HM	ON/ON	5B	7	1	1	2	2	0	0	1
ORO--MK-WSSRAP-1999-0021	P	HM	ON/ON	1A3	7	4	2	2	16	0	0	1
ORO--ORAU-ORISE-1999-0003	P	HM	OFF	4	7	1	1	1	1	0	0	3
ORO--ORNL-X10BOPLANT-1999-0003	P	HM	OFF	1A3	7	4	2	2	16	0	0	1
ORO--ORNL-X10BOPLANT-1999-0007	P	HM	OFF	5C	7	4	1	1	4	0	0	2
ORO--ORNL-X10CASD-1999-0002	T	W	OFF	5D	9	1	2	1	2	0	0	3
ORO--ORNL-X10CHEMTEC-1998-0008	T	HM	OFF	4	4.1	2	1	1	2			1
ORO--ORNL-X10ENVIOSC-1998-0003	P	HM	OFF	2A	2.2	3	1	1	3			1
ORO--ORNL-X10HFIR-1999-0008	T	HM	OFF	5	7	4	1	1	4	0	0	1
ORO--ORNL-X10IANDC-1998-0002	T	HM	OFF	7A	7	4	2	2	16			2
ORO--ORNL-X10METCER-1999-0005	P	HM	OFF	5C	4.3	3	1	1	3	0	0	2
ORO--ORNL-X10METCER-1999-0008	P	HM	ON/ON	1A2	7	4	2	1	8	0	0	1
ORO--ORNL-X10RADPROT-1999-0001	P	HM	ON/ON	1A3	7	4	1	1	4	0	0	1
ORO--ORNL-X10REDC-1998-0013	P	HM	ON/ON	1A3	7	4	1	1	4			1
RFO--KHLL-371OPS-1999-0001	P	HM	ON/ON	4	7	4	1	5	20			1
RFO--KHLL-371OPS-1999-0041	P	HM	ON/ON	2B	7	4	1	4	16	0	0	1
RFO--KHLL-771OPS-1999-0031	P	HM	ON/ON	1A3	7	4	2	1	8	0	0	1
RFO--KHLL-771OPS-1999-0042	P	HM	ON/ON	1A3	7	4	1	1	4	0	0	1
RFO--KHLL-779OPS-1998-0041	P	HM	ON/ON	1A3	7	4	1	2	8			1
RFO--KHLL-ANALYTOPS-1998-0016	P	HM	ON/ON	4	7	4	2	2	16			1
RFO--KHLL-FACOPS-1999-0004	P	HM	OFF	5B	9	1	2	2	4	0	0	1
RFO--KHLL-OFFSITE-1999-0001	T	HM	OFF	1A2	7	1	1	1	1			1
RFO--KHLL-PROTFORCE-1999-0001	P	HM	OFF	7A	1.4	4	2	3	24			3
RFO--KHLL-PUFAB-1999-0006	P	HM	ON/ON	3	7	4	1	5	20			1
RFO--KHLL-PUFAB-1999-0027	P	HM	ON/ON	2C	7	4	1	5	20	0	0	1
RFO--KHLL-PUFAB-1999-0044	T	HM	ON/ON	3	7	4	1	5	20	0	0	1
RFO--KHLL-PUFAB-1999-0054	T	HM	ON/ON	4	7	4	1	5	20	0	0	1
RFO--KHLL-PUFAB-1999-0056	P	HM	ON/OFF	2A	7	4	2	5	40	0	0	1
RFO--KHLL-SOLIDWST-1999-0037	T	HM	ON/ON	3	7	1	1	1	1	0	0	1
RFO--KHLL-TRANSOPS-1998-0004	T	HM	OFF	5	7	4	2	2	16			1
RFO--KHLL-TRANSOPS-1999-0002	P	HM	ON/OFF	2C	7	4	1	4	16	0	0	1

Table A.1. (continued)

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
RFO--KHLL-WSTMGTOPS-1999-0003	P	W	ON/ON	4	9	1	2	2	4	0	0	1
RFO--KHLL-WSTMGTOPS-1999-0008	P	HM	ON/OFF	2C	7	4	2	4	32	0	0	1
RFO--KHLL-WSTMGTOPS-1999-0011	P	HM	ON/ON	2C	7	4	1	4	16	0	0	1
RL--BHI-REMACT-1999-0002	T	HM	ON/ON	3	9	1	2	2	4			1
RL--PHMC-FSS-1999-0001	P	HM	ON/OFF	1A3	7	4	2	2	16			1
RL--PHMC-FSS-1999-0014	P	HM	ON/OFF	1A3	7	4	2	1	8	0	0	1
RL--PHMC-FSS-1999-0036	P	HM	OFF	5	7	4	1	4	16	0	0	3
RL--PHMC-GENERAL-1999-0004	P	HM	ON/ON	6C	7	4	1	5	20	0	0	1
RL--PHMC-GENSERVICE-1999-0001	P	HM	ON/ON	4	9	1	1	2	2			1
RL--PHMC-GENSERVICE-1999-0003	P	HM	OFF	4	7	4	1	2	8	0	0	3
RL--PHMC-SNF-1998-0016	P	HM	ON/OFF	7B	7	4	1	5	20			2
RL--PHMC-SNF-1999-0013	P	HM	OFF	1A3	7	4	2	1	8	0	0	3
RL--PHMC-SOLIDWASTE-1998-0010	T	W	ON/ON	1A1	7	4	2	1	8			1
RL--PHMC-SOLIDWASTE-1999-0005	T	HM	ON/ON	1A1	7	4	2	3	24	0	0	1
RL--PHMC-TPLANT-1999-0009	T	HM	OFF	4	9	1	1	2	2	0	0	3
RL--PHMC-TPLANT-1999-0010	T	HM	ON/ON	5	7	1	1	1	1	0	0	1
RL--PHMC-TRANS&PKG-1999-0002	T	HM	OFF	4	7	4	1	2	8			3
RL--PHMC-WSCF-1999-0005	P	W	ON/ON	2C	9	1	1	2	2	0	0	1
RL--PNNL-PNNLBOPEM-1999-0001	T	HM	ON/ON	5F	7	4	1	2	8	0	0	1
RL--PNNL-PNNLBOPER-1999-0028	T	HM	ON/OFF	5	7	1	1	1	1	0	0	1
RL--PNNL-PNNLNUCL-1999-0012	P	W	ON/ON	3	9	1	1	2	2	0	0	1
SR--WSRC-ALABF-1999-0009	T	HM	OFF	4	7	4	1	4	16			3
SR--WSRC-ALABF-1999-0011	P	HM	OFF	1A3	7	4	2	2	16	0	0	1
SR--WSRC-ALABF-1999-0013	T	W	ON/ON	4	9	1	1	2	2	0	0	1
SR--WSRC-CIF-1999-0004	P	HM	ON/OFF	1A3	7	4	2	2	16			1
SR--WSRC-CIF-1999-0015	T	W	ON/ON	5B	9	1	1	2	2	0	0	1
SR--WSRC-CSWE-1999-0003	P	HM	OFF	2B	7	4	2	2	16			3
SR--WSRC-CSWE-1999-0011	T	HM	ON/ON	6A	7	4	1	4	16	0	0	1
SR--WSRC-CSWE-1999-0012	P	HM	OFF	5B	8	3	1	3	9	0	0	1
SR--WSRC-ETF-1999-0002	P	HM	ON/ON	1A3	7	4	2	2	16	0	0	1
SR--WSRC-ETF-1999-0004	P	HM	ON/ON	2C	2.2	3	2	4	24	0	0	1

Table A.1. (continued)

Report Number	Pkg/Trn	HM/W	Off/On	NOC	HC	W_{HC}	W_{EC}	Q_{ty}	HSR	RF	RSF	SPR
SR--WSRC-FMIS-1998-0003	P	HM	OFF	5C	8	2	1	2	4			1
SR--WSRC-HBLINE-1999-0020	P	HM	ON/ON	3	7	4	1	4	16	0	0	1
SR--WSRC-HCAN-1998-0032	T	HM	ON/OFF	5A	7	4	1	1	4			1
SR--WSRC-HCAN-1999-0017	T	HM	ON/OFF	5	7	4	1	2	8	0	0	1
SR--WSRC-HCAN-1999-0040	T	HM	ON/OFF	1A3	7	4	2	1	8	0	0	1
SR--WSRC-HPIH-1998-0003	P	HM	OFF	7B	4.2	3	2	2	12			2
SR--WSRC-LTA-1999-0002	P	HM	ON/ON	3	7	4	1	4	16			1
SR--WSRC-LTA-1999-0006	T	HM	ON/OFF	1A3	7	4	2	1	8			1
SR--WSRC-LTA-1999-0018	P	HM	OFF	5	2.2	3	1	4	12	0	0	1
SR--WSRC-RBOF-1999-0008	P	HM	OFF	1A3	7	4	2	2	16	0	0	4
SR--WSRC-RBOF-1999-0009	P	HM	OFF	5F	7	4	2	3	24	0	0	3
SR--WSRC-REACK-1998-0028	P	HM	ON/ON	2C	7	4	2	5	40			1
SR--WSRC-REACK-1999-0004	P	HM	ON/ON	3	7	4	1	5	20			1
SR--WSRC-REACK-1999-0009	P	HM	OFF	2C	7	4	1	5	20	0	0	1
SR--WSRC-RMAT-1999-0003	P	W	ON/ON	4	9	1	1	2	2	0	0	1
SR--WSRC-SLDHZD-1999-0004	P	HM	ON/OFF	3	7	4	2	5	40	0	0	1
SR--WSRC-TRIT-1999-0016	P	HM	ON/ON	3	7	4	1	5	20	0	0	1
SR--WSRC-TRIT-1999-0019	P	HM	OFF	2C	7	4	1	5	20	0	0	3
SR--WSRC-W299H-1999-0002	P	HM	ON/ON	1A3	7	4	2	1	8	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
QTY = quantity
RF = repetitive factor
RSF = repetitive significance factor
SPR = stakeholder and publicity rating
Trn = transportation related
W = Waste
WEC = event consequence measure
WHC = quantity classification measure

Appendix B

FY 1999 OFFSITE OCCURRENCES

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Table B.1. FY 1999 offsite occurrences[1]

Report Number	Pkg/Trn	HM/W	NOC	HC	W_{HC}	W_{EC}	Q_{tv}	HSR	RF	RSF	SPR
ALO-AO-MHSM-PANTEX-1999-0020	P	HM	5	7	4	2	2	16	0	0	1
ALO-AO-MHSM-PANTEX-1999-0041	P	HM	5E	1.1	4	2	3	24	0	0	1
ALO-AO-MHSM-PANTEX-1999-0043	P	HM	2C	1.3	4	1	3	12	0	0	1
ALO-AO-MHSM-PANTEX-1999-0067	P	HM	1A3	7	4	2	2	16	0	0	1
ALO-KC-AS-KCP-1999-0002	P	HM	5	1	4	1	2	8			1
ALO-KC-AS-KCP-1999-0012	P	HM	2A	1	4	2	0	0	0	0	2
ALO-KC-AS-KCP-1999-0013	P	HM	4	9	1	2	3	6	0	0	1
ALO-KO-SNL-10000-1998-0005	T	HM	7A	8	2	1	2	4			1
ALO-KO-SNL-10000-1999-0002	P	HM	2A	1	4	2	3	24	0	0	3
ALO-KO-SNL-15000-1999-0002	P	HM	5B	7	4	2	2	16	0	0	2
ALO-KO-SNL-NMSITE-1999-0002	P	HM	2B	7	4	1	3	12	0	0	1
ALO-LA-LANL-ACCCOMPLEX-1998-0017	P	W	1A1	7	4	2	2	16	3	72	1
ALO-LA-LANL-TRITFACILS-1999-0002	P	HM	7B	7	4	1	4	16	0	0	3
ALO-LA-LANL-WASTEMGT-1999-0006	P	HM	2C	7	4	1	5	20	0	0	3
CH-AA-ANLE-ANLE-1999-0001	P	HM	7E	7	4	2	4	32	0	0	3
CH-AA-ANLE-ANLEAPS-1999-0003	P	HM	7A	7	1	1	1	1	0	0	4
CH-AA-ANLE-ANLECMB-1998-0001	P	HM	5	8	2	2	2	8			3
CH-AA-ANLE-ANLEPFS-1999-0002	P	HM	7B	5.1	2	1	2	4	0	0	1
CH-AA-ANLW-ANLW-1999-0003	P	HM	2A	8	2	2	2	8	0	0	3
CH-AA-ANLW-EBR-1999-0003	P	HM	3	8	2	2	3	12	0	0	1
CH-BH-BNL-BNL-1999-0005	P	HM	7A	7	1	1	1	1			3
CH-BH-BNL-BNL-1999-0018	P	W	4	9	1	1	2	2	0	0	3
CH-BH-BNL-BNL-1999-0019	P	HM	5	8	2	1	2	4	0	0	3
CH--NBL-NBL-1999-0001	P	HM	5	7	4	1	4	16			3
HQ--GOPE-FETC-1999-0006	P	HM	7B	2.1	2	1	4	8	0	0	1
HQ--SPR-WI-1999-0002	P	HM	7A	6.1	2	1	2	4	0	0	3
ID--LITC-LANDLORD-1998-0033	T	HM	5F	7	4	1	1	4			1
ID--LITC-TRA-1999-0005	T	W	5	9	1	1	2	2			3
ID--LITC-WASTEMNGT-1999-0004	P	W	4	9	1	1	2	2			1
ID--LITC-WERF-1999-0005	P	W	2A	9	1	2	2	4	0	0	1

Table B.1. (continued)

Report Number	Pkg/Trn	HM/W	NOC	HC	W_{HC}	W_{EC}	Q_{tv}	HSR	RF	RSF	SPR
OAK--GOSF-HCF-1998-0001	P	W	1A3	7	4	2	2	16			1
OAK--LBL-EHS-1999-0001	P	HM	1A3	7	4	2	1	8	0	0	1
OAK--LBL-EHS-1999-0003	P	W	4	9	1	1	2	2	0	0	3
OAK--LLNL-LLNL-1998-0063	T	W	4	4.3	2	2	3	12			2
OH-FN-FDF-FEMP-1999-0004	P	HM	7E	7	4	2	1	8			3
OH-FN-FDF-FEMP-1999-0006	P	HM	6C	7	1	1	1	1	0	0	1
ORO--BJC-K25GENLAN-1999-0014	P	HM	7E	7	1	2	2	4	0	0	3
ORO--BJC-K25WASTMAN-1999-0001	P	W	5	9	1	1	2	2			1
ORO--BJC-K25WASTMAN-1999-0008	P	W	4	9	1	1	2	2	0	0	1
ORO--BJC-PGDPENVRES-1998-0017	T	W	5	3	2	1	2	4			1
ORO--BJC-PGDPENVRES-1999-0001	P	W	7A	9	1	1	2	2	0	0	3
ORO--BJC-PGDPENVRES-1999-0010	P	W	5B	9	1	1	2	2	0	0	3
ORO--BJC-PORTENVRES-1999-0010	P	W	7A	9	1	1	2	2	0	0	3
ORO--BJC-Y12WASTE-1999-0001	P	W	7A	9	1	1	2	2			3
ORO--BJC-Y12WASTE-1999-0003	P	W	4	9	1	2	2	4	0	0	2
ORO--BNFL-K33-1999-0007	P	W	5E	7	1	1	2	2	0	0	3
ORO--LMES-Y12DPMGMT-1999-0001	P	HM	1A3	7	4	1	2	8			3
ORO--LMES-Y12NUCLEAR-1999-0018	P	HM	1A3	7	4	1	1	4			3
ORO--ORAU-ORISE-1999-0003	P	HM	4	7	1	1	1	1	0	0	3
ORO--ORNL-X10BOPLANT-1999-0003	P	HM	1A3	7	4	2	2	16	0	0	1
ORO--ORNL-X10BOPLANT-1999-0007	P	HM	5C	7	4	1	1	4	0	0	2
ORO--ORNL-X10CASD-1999-0002	T	W	5D	9	1	2	1	2	0	0	3
ORO--ORNL-X10CHEMTEC-1998-0008	T	HM	4	4.1	2	1	1	2			1
ORO--ORNL-X10ENVIOSC-1998-0003	P	HM	2A	2.2	3	1	1	3			1
ORO--ORNL-X10HFIR-1999-0008	T	HM	5	7	4	1	1	4	0	0	1
ORO--ORNL-X10IANDC-1998-0002	T	HM	7A	7	4	2	2	16			2
ORO--ORNL-X10METCER-1999-0005	P	HM	5C	4.3	3	1	1	3	0	0	2
RFO--KHLL-FACOPS-1999-0004	P	HM	5B	9	1	2	2	4	0	0	1
RFO--KHLL-OFFSITE-1999-0001	T	HM	1A2	7	1	1	1	1			1
RFO--KHLL-PROTFORCE-1999-0001	P	HM	7A	1.4	4	2	3	24			3
RFO--KHLL-PUFAB-1999-0056	P	HM	2A	7	4	2	5	40	0	0	1

Table B.1. (continued)

Report Number	Pkg/Trn	HM/W	NOC	HC	W_{HC}	W_{EC}	Q_{tv}	HSR	RF	RSF	SPR
RFO--KHLL-TRANSOPS-1998-0004	T	HM	5	7	4	2	2	16			1
RFO--KHLL-TRANSOPS-1999-0002	P	HM	2C	7	4	1	4	16	0	0	1
RFO--KHLL-WSTMGTOPS-1999-0008	P	HM	2C	7	4	2	4	32	0	0	1
RL--PHMC-FSS-1999-0001	P	HM	1A3	7	4	2	2	16			1
RL--PHMC-FSS-1999-0014	P	HM	1A3	7	4	2	1	8	0	0	1
RL--PHMC-FSS-1999-0036	P	HM	5	7	4	1	4	16	0	0	3
RL--PHMC-GENSERVICE-1999-0003	P	HM	4	7	4	1	2	8	0	0	3
RL--PHMC-SNF-1998-0016	P	HM	7B	7	4	1	5	20			2
RL--PHMC-SNF-1999-0013	P	HM	1A3	7	4	2	1	8	0	0	3
RL--PHMC-TPLANT-1999-0009	T	HM	4	9	1	1	2	2	0	0	3
RL--PHMC-TRANS&PKG-1999-0002	T	HM	4	7	4	1	2	8			3
RL--PNNL-PNNLBOPER-1999-0028	T	HM	5	7	1	1	1	1	0	0	1
SR--WSRC-ALABF-1999-0009	T	HM	4	7	4	1	4	16			3
SR--WSRC-ALABF-1999-0011	P	HM	1A3	7	4	2	2	16	0	0	1
SR--WSRC-CIF-1999-0004	P	HM	1A3	7	4	2	2	16			1
SR--WSRC-CSWE-1999-0003	P	HM	2B	7	4	2	2	16			3
SR--WSRC-CSWE-1999-0012	P	HM	5B	8	3	1	3	9	0	0	1
SR--WSRC-FMIS-1998-0003	P	HM	5C	8	2	1	2	4			1
SR--WSRC-HCAN-1998-0032	T	HM	5A	7	4	1	1	4			1
SR--WSRC-HCAN-1999-0017	T	HM	5	7	4	1	2	8	0	0	1
SR--WSRC-HCAN-1999-0040	T	HM	1A3	7	4	2	1	8	0	0	1
SR--WSRC-HPIH-1998-0003	P	HM	7B	4.2	3	2	2	12			2
SR--WSRC-LTA-1999-0006	T	HM	1A3	7	4	2	1	8			1
SR--WSRC-LTA-1999-0018	P	HM	5	2.2	3	1	4	12	0	0	1
SR--WSRC-RBOF-1999-0008	P	HM	1A3	7	4	2	2	16	0	0	4
SR--WSRC-RBOF-1999-0009	P	HM	5F	7	4	2	3	24	0	0	3
SR--WSRC-REACK-1999-0009	P	HM	2C	7	4	1	5	20	0	0	1
SR--WSRC-SLDHZD-1999-0004	P	HM	3	7	4	2	5	40	0	0	1
SR--WSRC-TRIT-1999-0019	P	HM	2C	7	4	1	5	20	0	0	3

[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
QTY = quantity
RF = repetitive factor
RSF = repetitive significance factor
SPR = stakeholder and publicity rating
Trn = transportation related
W = Waste
WEC = event consequence measure
WHC = 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) which is directly responsible for the occurrence. Hence a reporting facility may assign some occurrences to PO that are operationally responsible, but may not be responsible and/or be 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.

Environmental Management (EM) program reported over 60% of the ORs generated during this quarters, although seven of the occurrences were caused by others (non-DOE sites or non-DOE contractors). Defense programs (DP) accounted for about a fourth of the ORs reported. Reporting a combined 142 ORs, these two programs together reported about 82% of the P&T-related ORs filed this quarter, a percentage which is consistent with past FY reporting profiles.

Non-DOE contractor "others" account for only 10% 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 Program Office, the Operations Office, or the contractor. ORPS makes no distinction between reporter and violator.

Table C.1. FY 1999 OR distribution by DOE Program Office

Code	Description	No. of ORs	
		Owner	Others
DP	Defense Programs	35	3
EH	Environmental Safety and Health	0	1
EM	Environmental Management	97	7
ER	Energy Research	3	2
FE	Fossil Energy	1	2
NE	Nuclear Energy	8	0
NN	Nonproliferation and National Security	1	0
SC	Science	10	3
RW	Radioactive Waste Management	0	0
	Totals	155	18

Table C.2 presents the listing of the number of FY 1999 ORs which were reported by the DOE Operations Office.

Table C.2. FY 1999 OR distribution by DOE Operations Office

Code	Description	No. of ORs	
		Owner	Others
ALO	Albuquerque Operations	30	2
CH	Chicago Operations	10	4
HQ	DOE Headquarters	1	2
ID	Idaho Operations	13	0
NV	Nevada Operations	1	0
OAK	Oakland Operations	8	0
OH	Ohio Field Office	3	1
ORO	Oak Ridge Operations	26	5
RFO	Rocky Flats Operations	19	1
RL	Richland Operations	17	1
SR	Savannah River Operations	28	1
	Totals	156	17
	Grand Total		173

To perform trending analysis, the outbound shipments of hazardous material and waste for all modes of transport made by the Operations Offices were used to normalize the occurrences which were reported by the sites to the different Operations Offices during FY 1994 through 1999. 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 be comprised of 10 railcars of hazardous waste or one small sample.

Using the data of Table C.2 for ORs which 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 1999, Fig. C.1. Immediately noticeable is the bar representing HQ. (Note that the safety measures have been multiplied by 1,000 to aid readability.) This metric is based upon the single FY 1999 incident reported by contractors under HQ management (such as Strategic Petroleum Reserves or Bechtel Petroleum Operations' sites) being divided by the seven shipments of hazardous

materials made by these contractor sites during FY 1999. Since this single OR (from the West Hackberry Site of the Strategic Petroleum Reserves) is being divided by a relatively small number, the metric appears disproportionately large.

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. With a glance, the chart of Fig. C.1 indicates that the Operations Offices averaged less than 20 occurrences per 1,000 shipments for the total 11,000 shipments made during FY 1999.

Further, using Tables 9–14 of Sect. 4.1 and Table C.3, Figs. C.1–C.8 were developed. They indicate the metrics for the seven NOC categories for each of the eleven 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 linear trend line 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
ALO	Albuquerque Ops	3316	2493	2137	1417	1538	1587
CH	Chicago Operations	1265	1118	778	553	749	765
HQ	DOE Headquarters	16	63	15	26	2	7
ID	Idaho Operations	718	604	312	441	339	510
NV	Nevada Operations	262	154	107	122	192	202
OAK	Oakland Operations	1880	1421	965	997	993	1120
OH	Ohio Field Office	26	1523	1048	1034	685	922
ORO	Oak Ridge Operations	3242	2994	2512	2028	1746	1725
RFO	Rocky Flats Operations	0*	0*	349	678	815	688
RL	Richland Operations	762	524	538	516	783	657
SR	Savannah River Operations	664	884	947	842	833	799
	Total	12,151	11,778	9,708	8,654	8,675	8,982

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

ORNL DWG 2000-03925

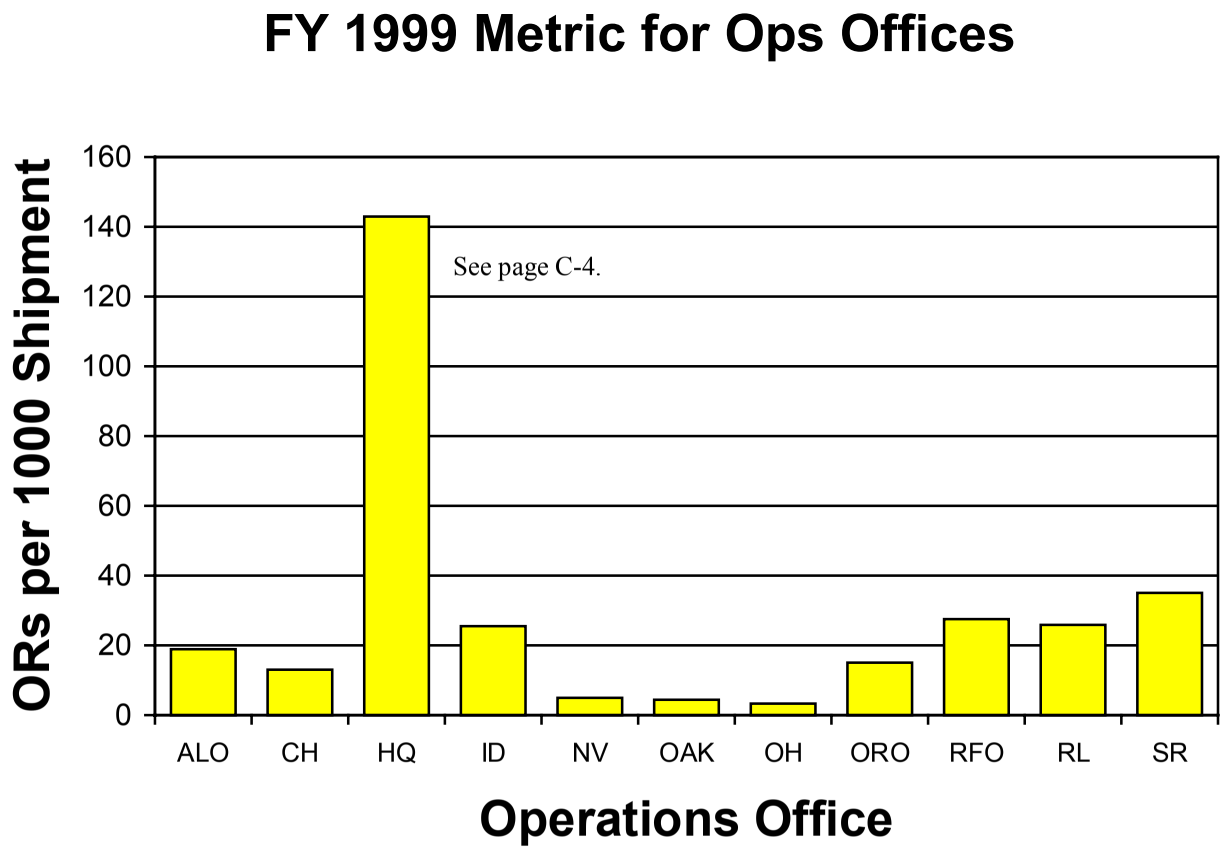

Fig C.1. FY 1999 safety measures for DOE Operations Office.

ORNL DWG 2000-04432

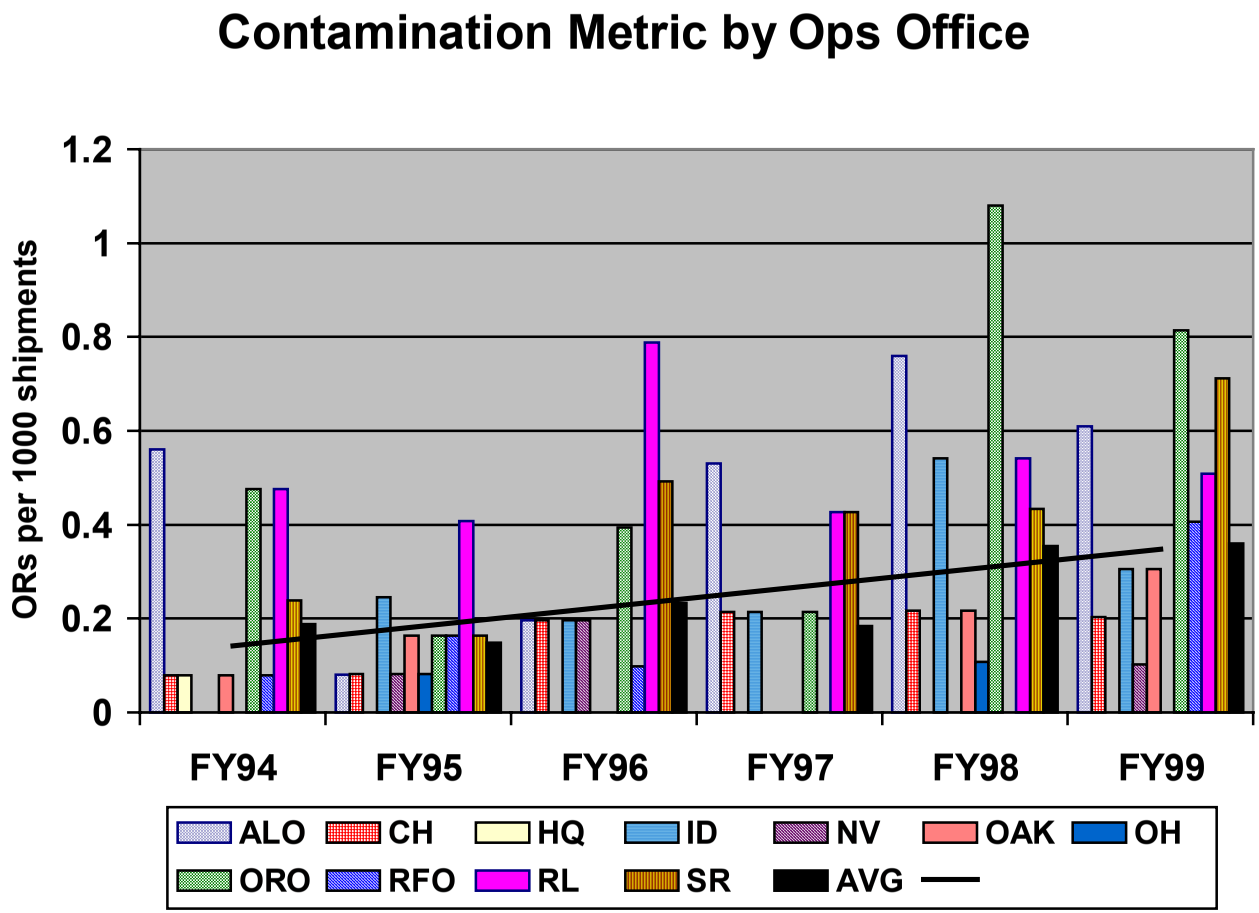

Fig. C.2 Safety metric for contamination ORs by Operations Office.

ORNL DWG 2000-04433

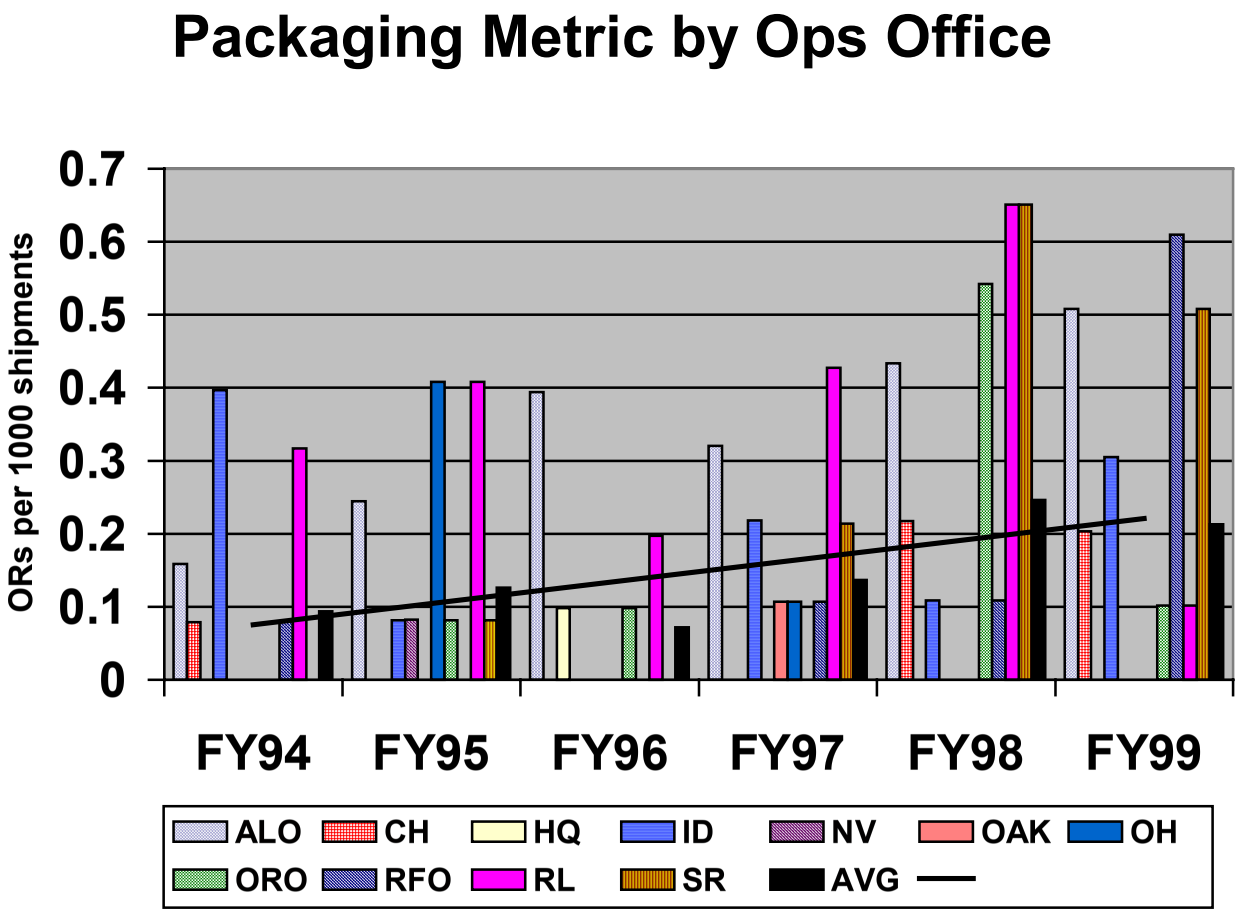

Fig. C.3. Safety metric for packaging ORs by Operations Office.

ORNL DWG 2000-04434

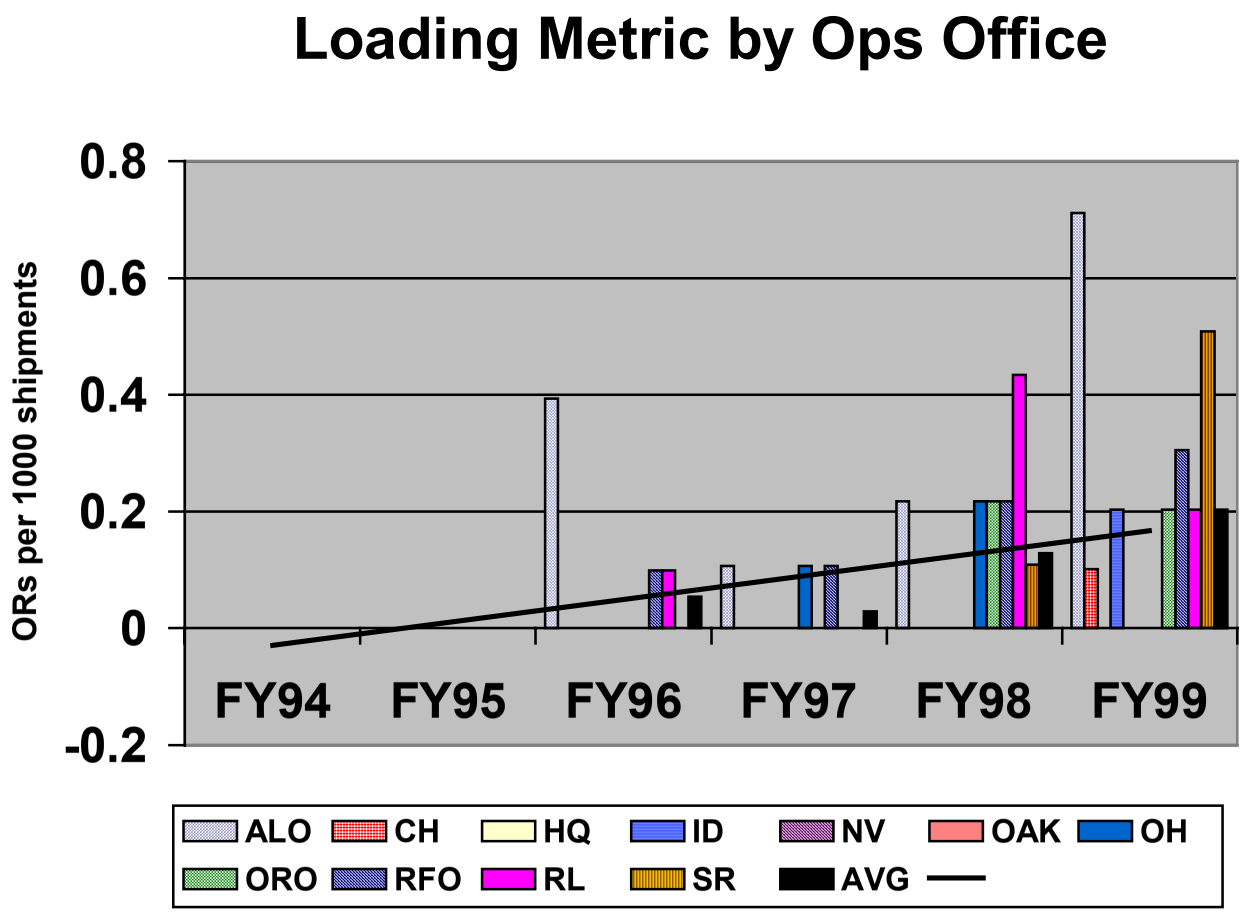

Fig. C.4 Safety metric for loading, unloading, or storage incident to transport ORs by Operations Office.

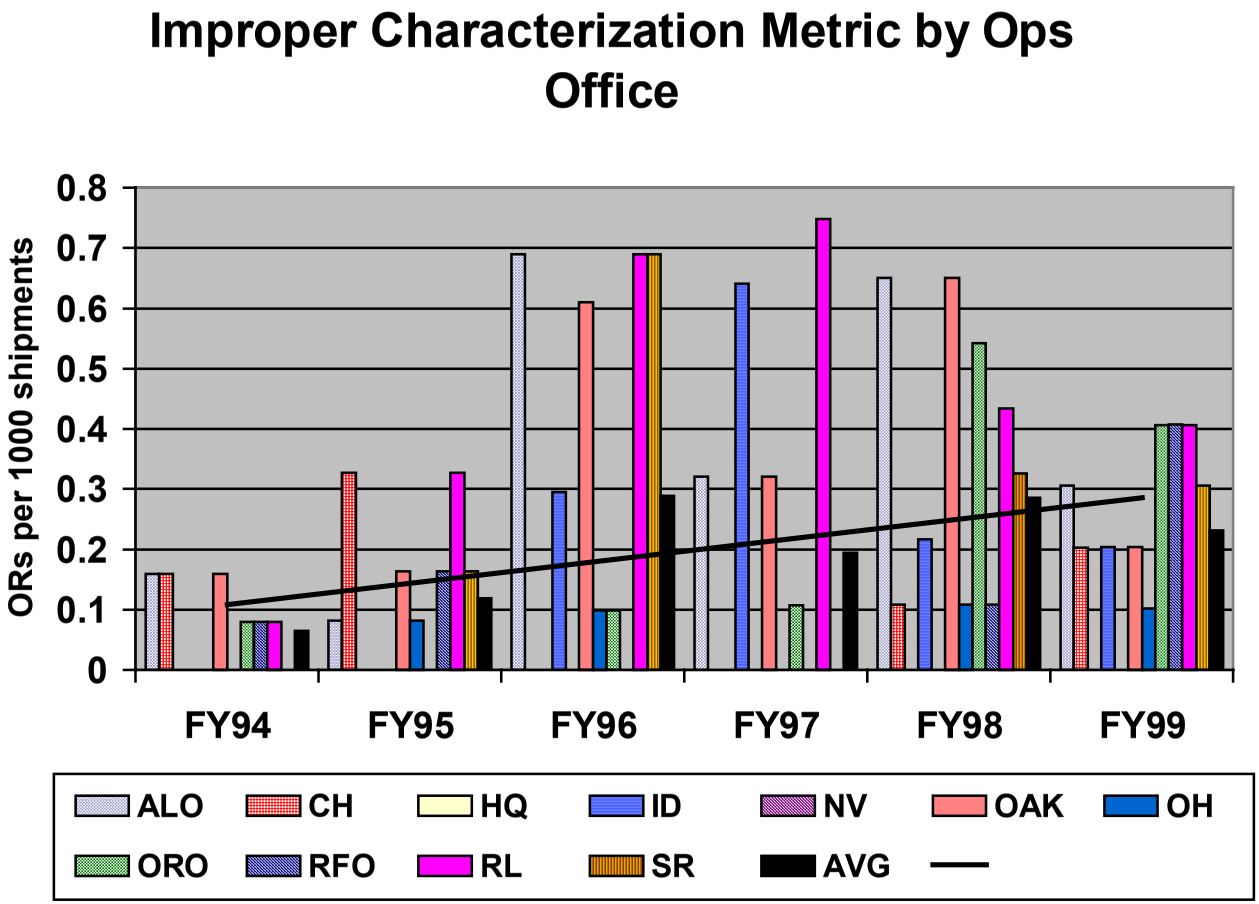

Fig. C.5. Safety metric for improper HAZMAT characterization ORs by Operations Office.

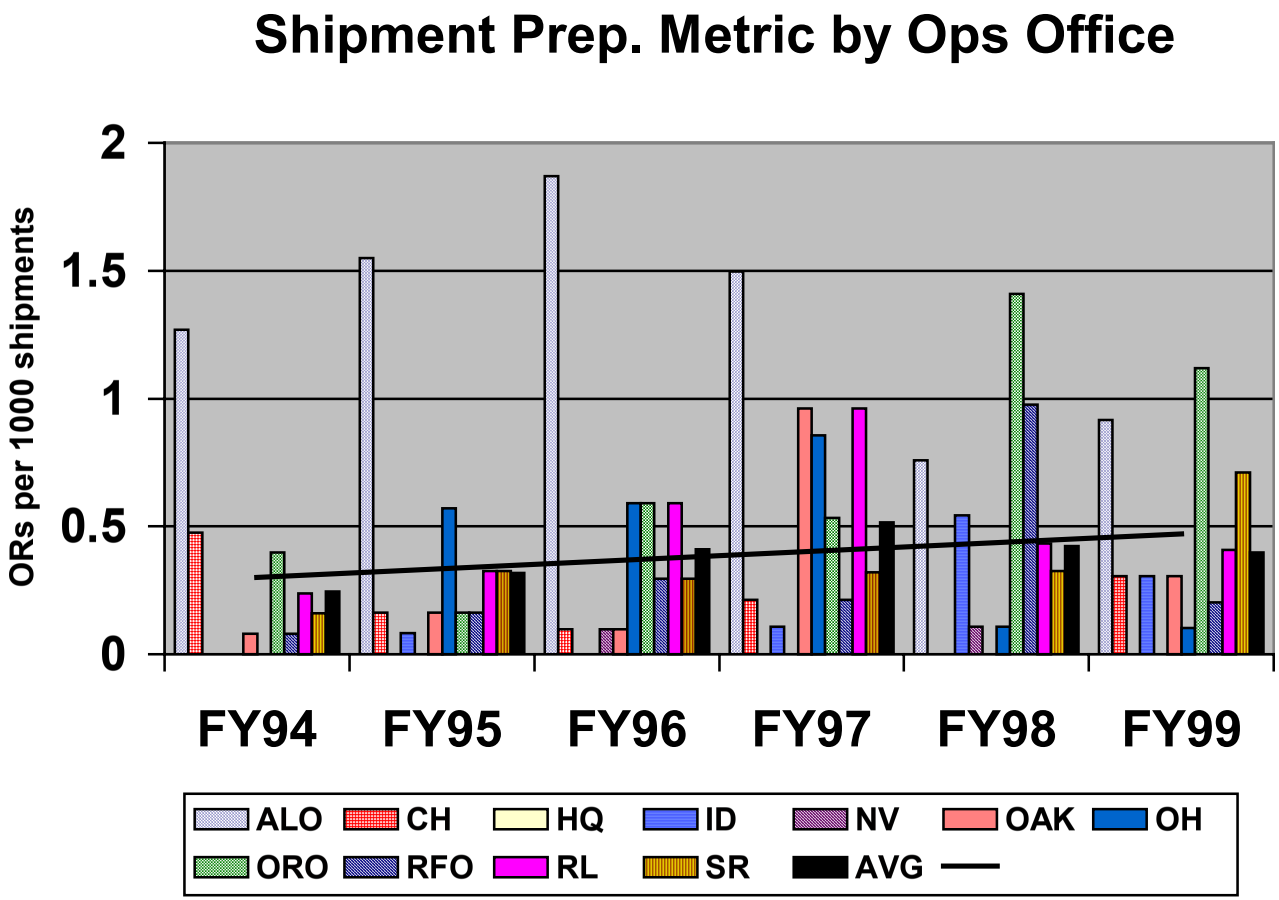

Fig. C.6. Safety metric for shipment preparation ORs by Operations Office.

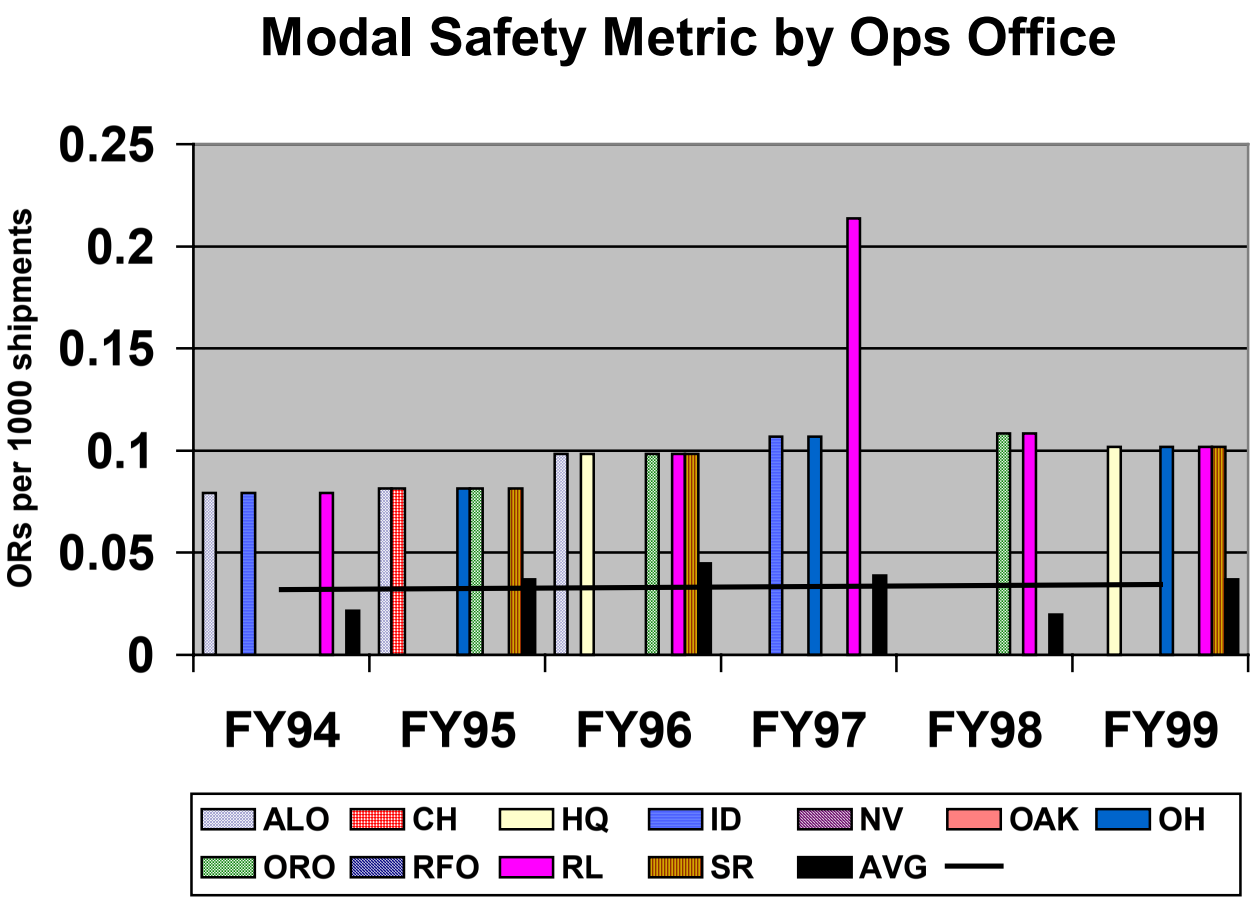

Fig. C.7. Safety metric for modal safety ORs by Operations Office.

ORNL DWG 2000-04438

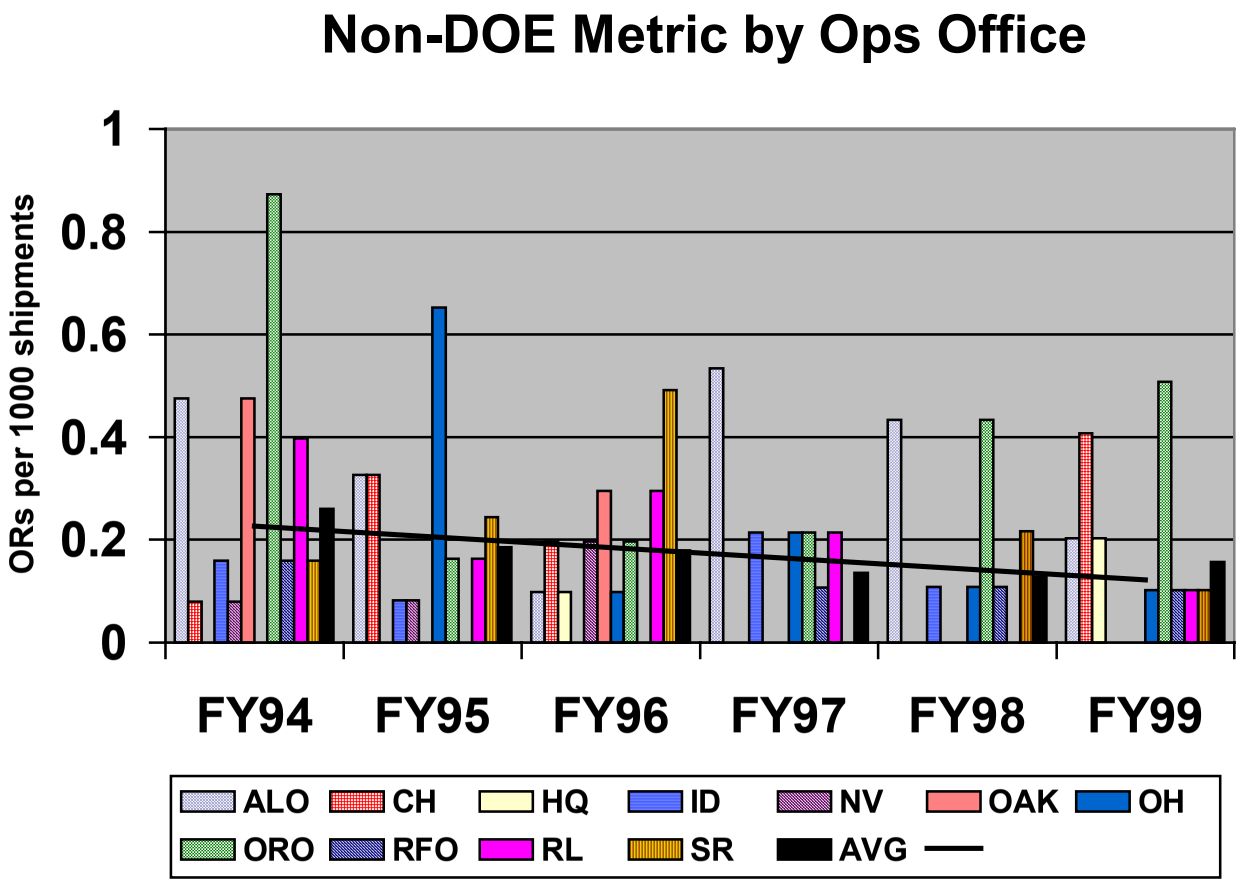

Fig. C.8. Safety metric for non-DOE ORs by Operations Office.

Using the linear trend line as an indicator reveals that only ORs for modal safety and ORs which were created by non-DOE contractors are definitely decreasing. 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 less than one OR reported to them per 1000 shipments conducted.

To review a specific NOC of an Operations Office to determine the trend of a certain type of occurrence, a moving average is more appropriate. The moving average analysis projects values in the forecast period based on the average value of the variable over a specific number of preceding periods (in this case, two). Because it smoothes out fluctuations, a moving average provides trend information that a simple average of all historical data would mask.

Based on analyses of Sect. 4.2 revealing that contamination and packaging ORs were tending to increase, it was decided to see if a moving average could be used to reveal which specific Operations Offices were demonstrating an increase in contamination ORs. Keep in mind that contamination ORs include occurrences resulting from both radioactive and hazardous material incidents.

Upon review of the resulting Figs. C.9–C.15, it was determined that nothing significant was revealed by using a moving average on the individual Operations Offices. In fact, it is difficult to tell whether ALO or ID is displaying a tendency toward increased contamination ORs. For sure, OAK (Fig. C.14) is showing a steady increase, from 0.15 to 0.3 ORs per 1000 shipments. But OAK's increase does not seem significant when compared to ORO's (Fig. C.16) increase from 0.35 to 0.7 or for that matter, CH (Fig. C.10), which remains at a constant 0.2 ORs per 1000 shipments. So it is obvious that at least one more data point will be necessary before any valid conclusions can be drawn based upon moving average trend lines. Hence a similar treatment was not performed for ORs related to packaging.

ORNL DWG 2000-04689

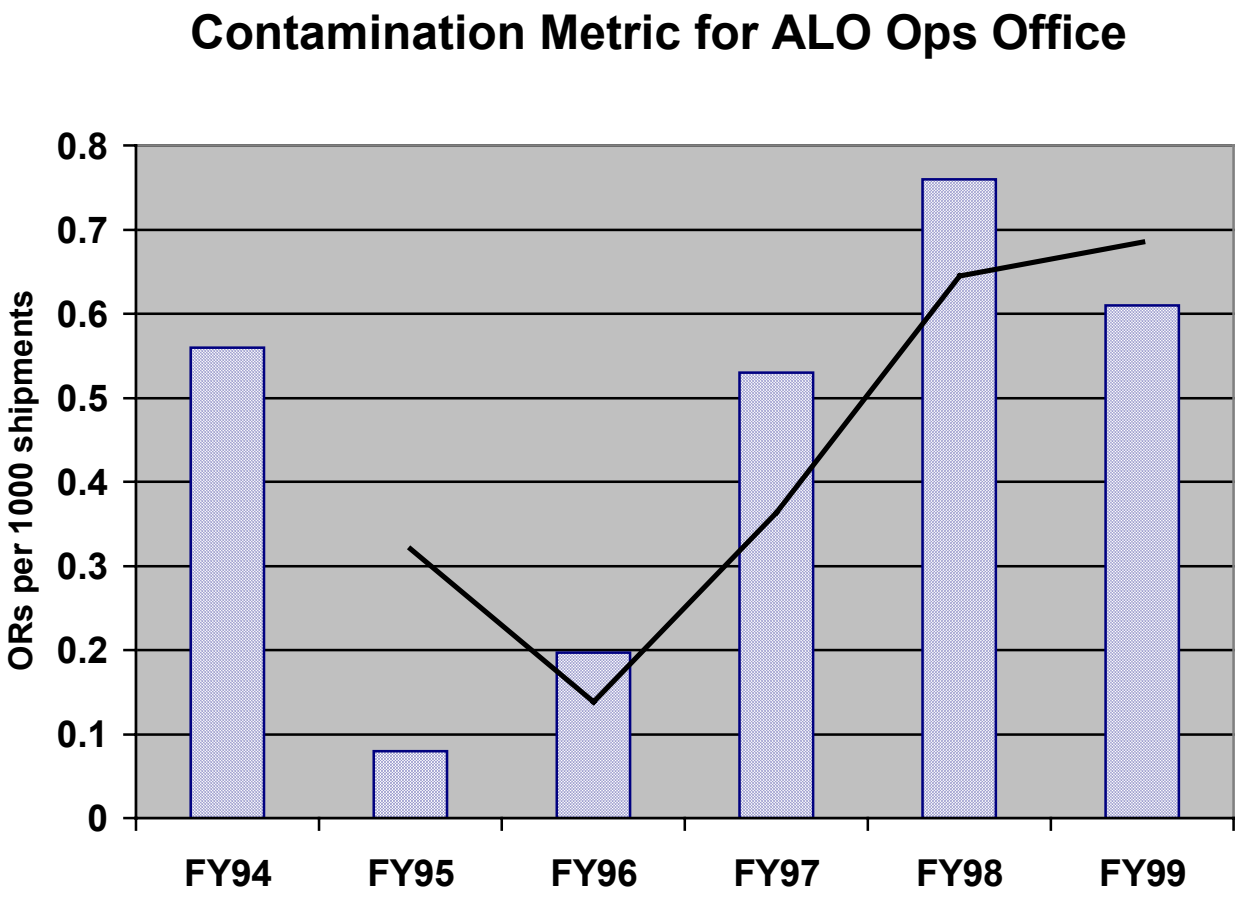

Fig. C.9. Safety metric for contamination ORs for ALO.

ORNL DWG 2000-04690

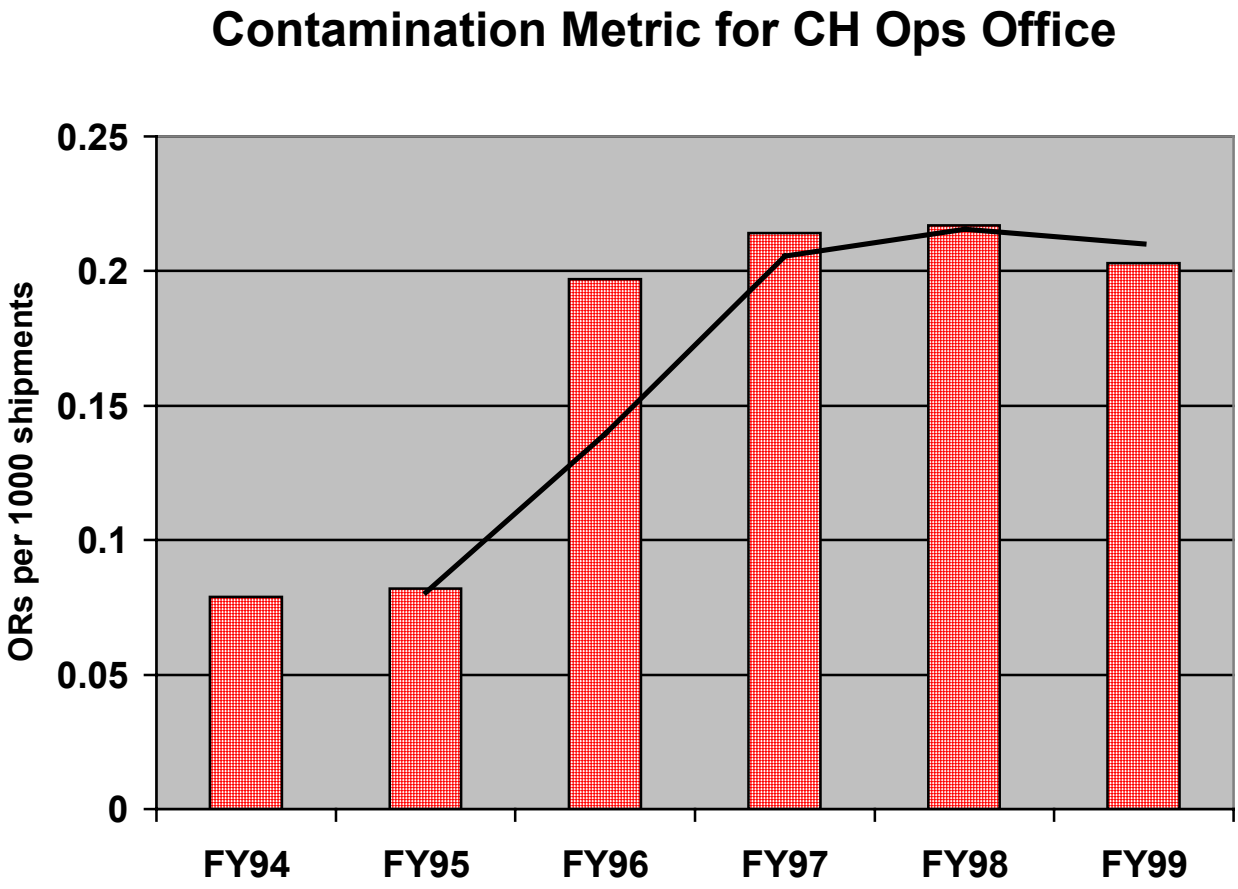

Fig. C.10. Safety metric for contamination ORs for CH.

ORNL DWG 2000-04691

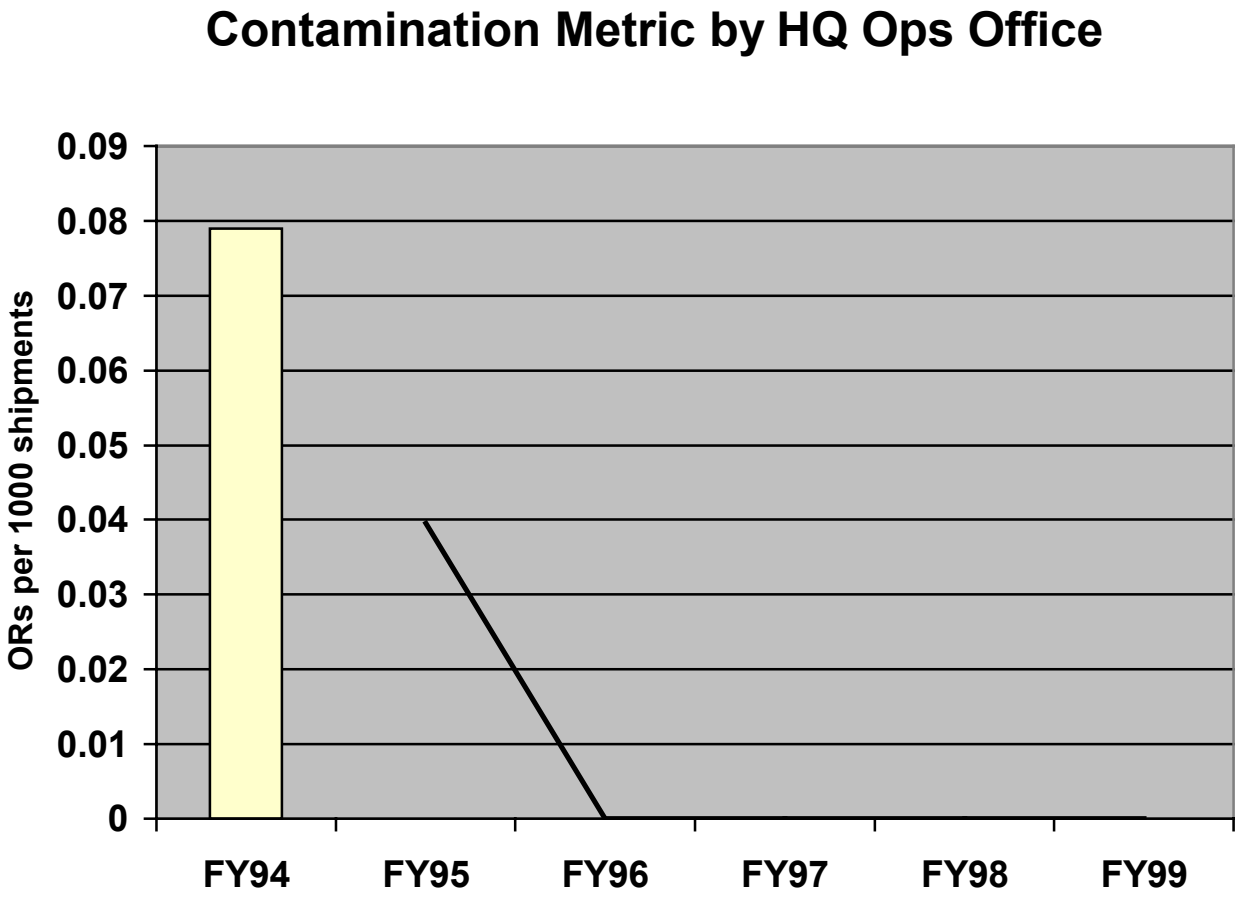

Fig. C.11. Safety metric for contamination ORs for HQ.

ORNL DWG 2000-04692

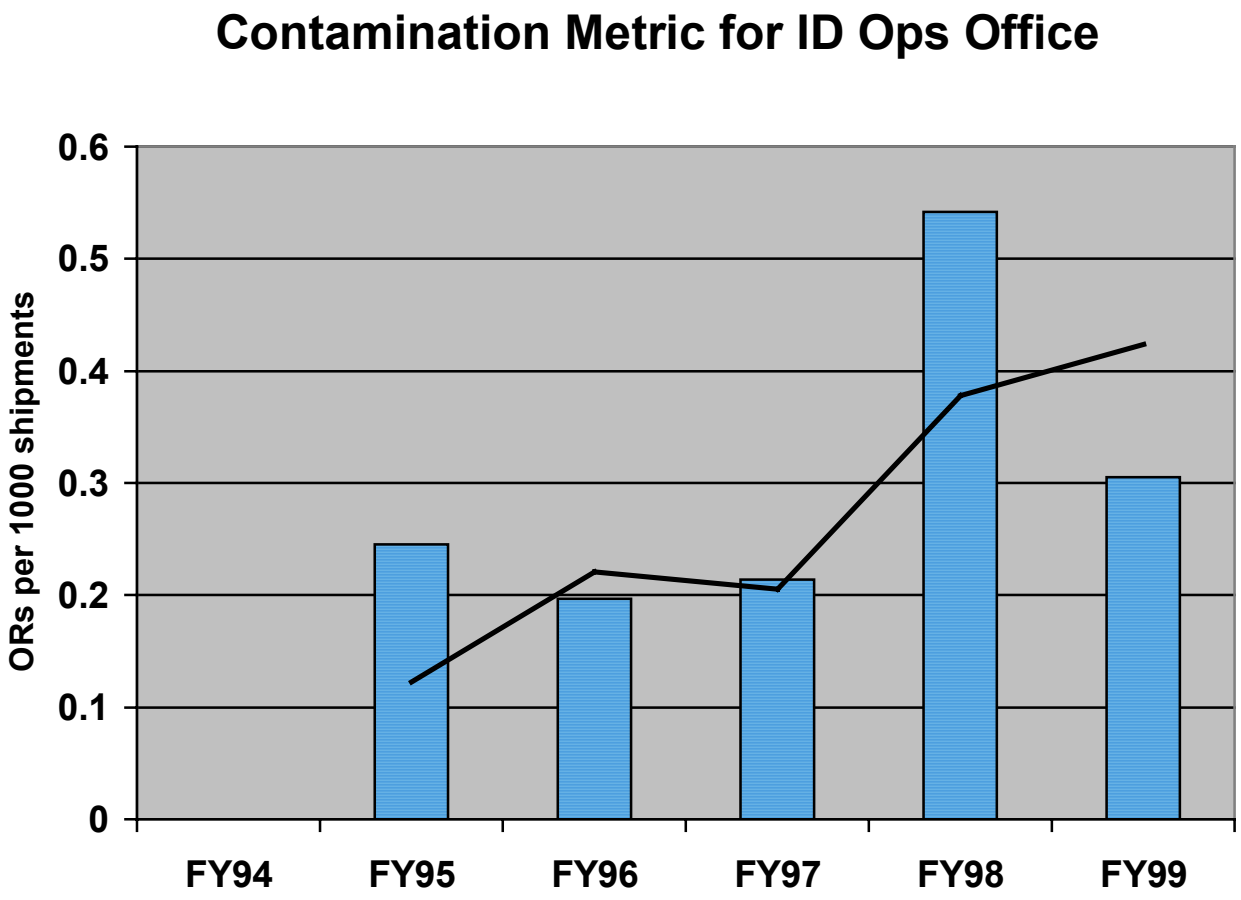

Fig. C.12. Safety metric for contamination ORs for ID.

ORNL DWG 2000-04693

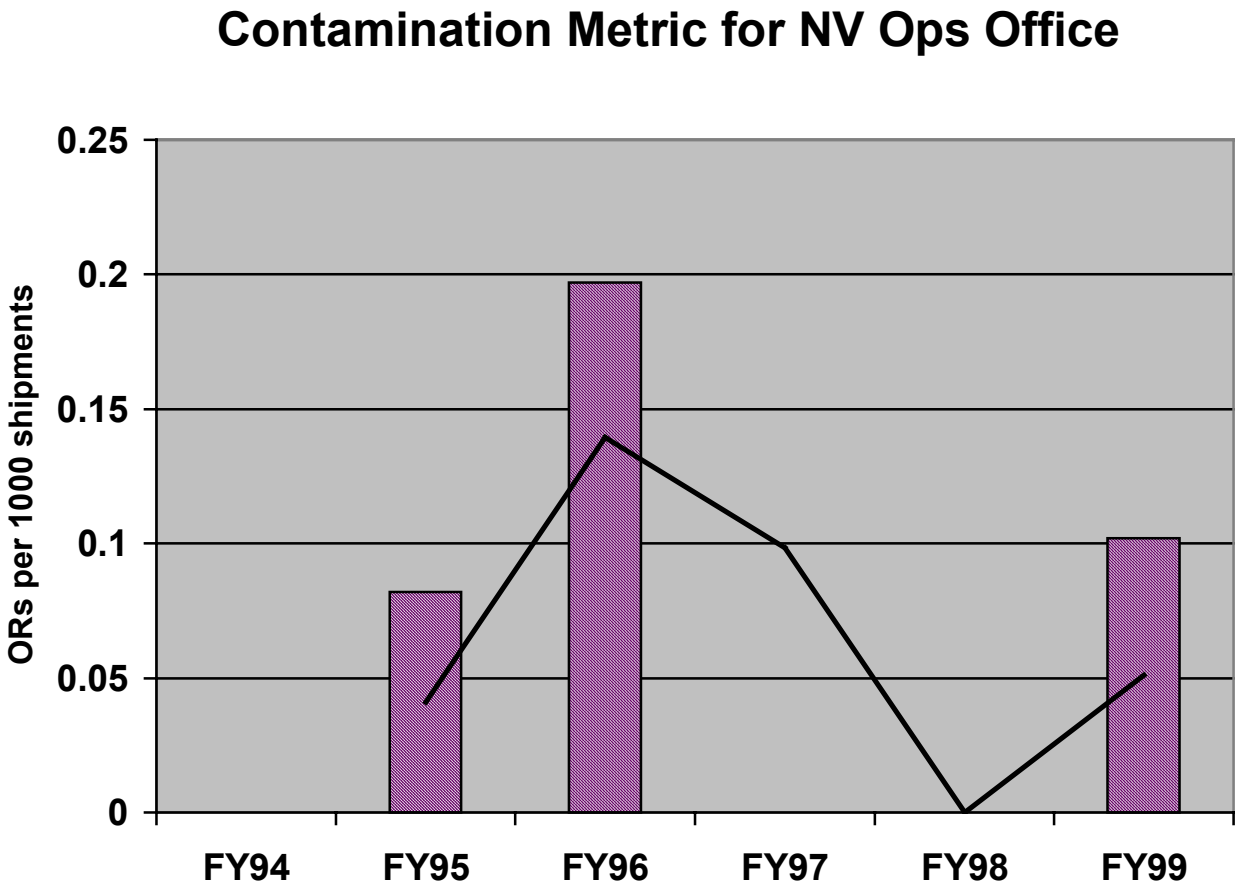

Fig. C.13. Safety metric for contamination ORs for NV.

ORNL DWG 2000-04694

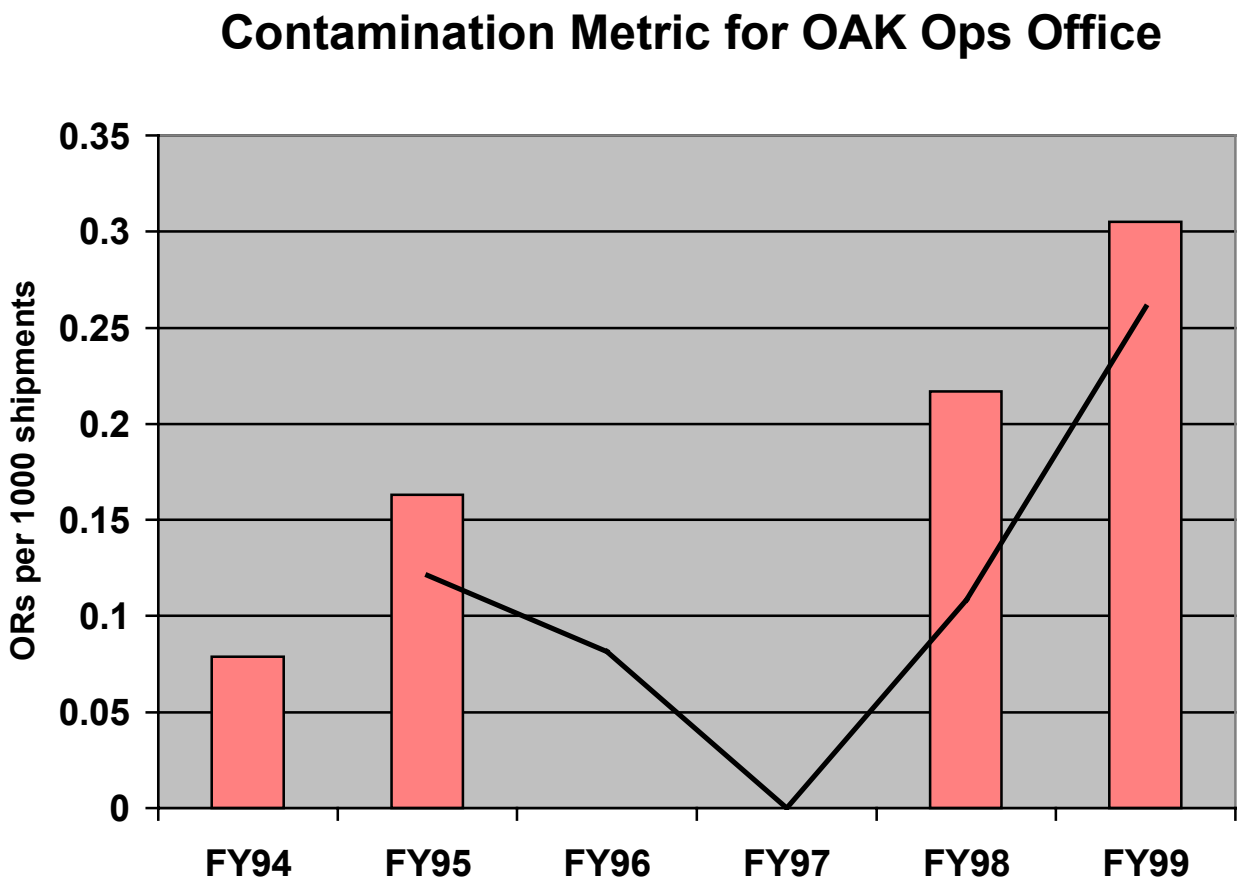

Fig. C.14. Safety metric for contamination ORs for OAK.

ORNL DWG 2000-04695

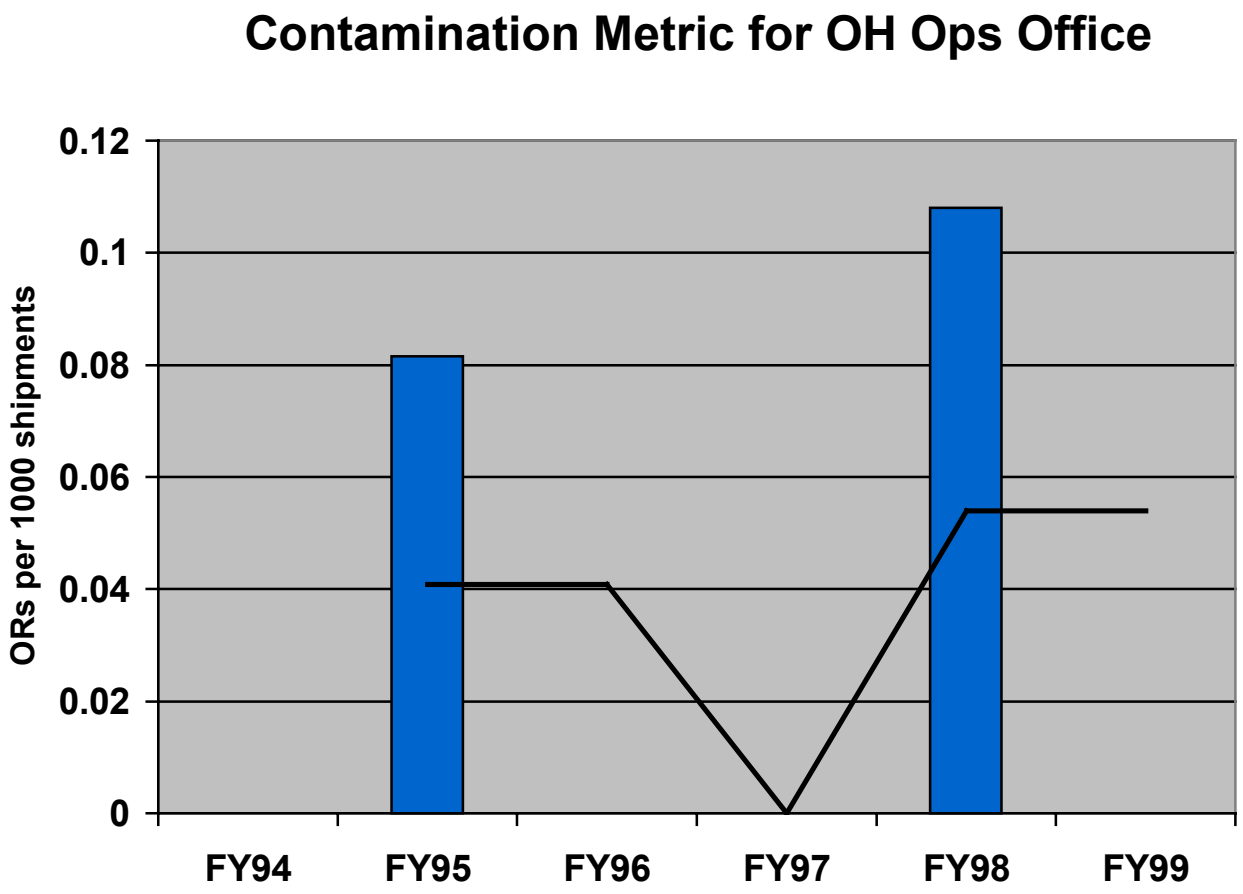

Fig. C.15. Safety metric for contamination ORs for OH.

ORNL DWG 2000-04696

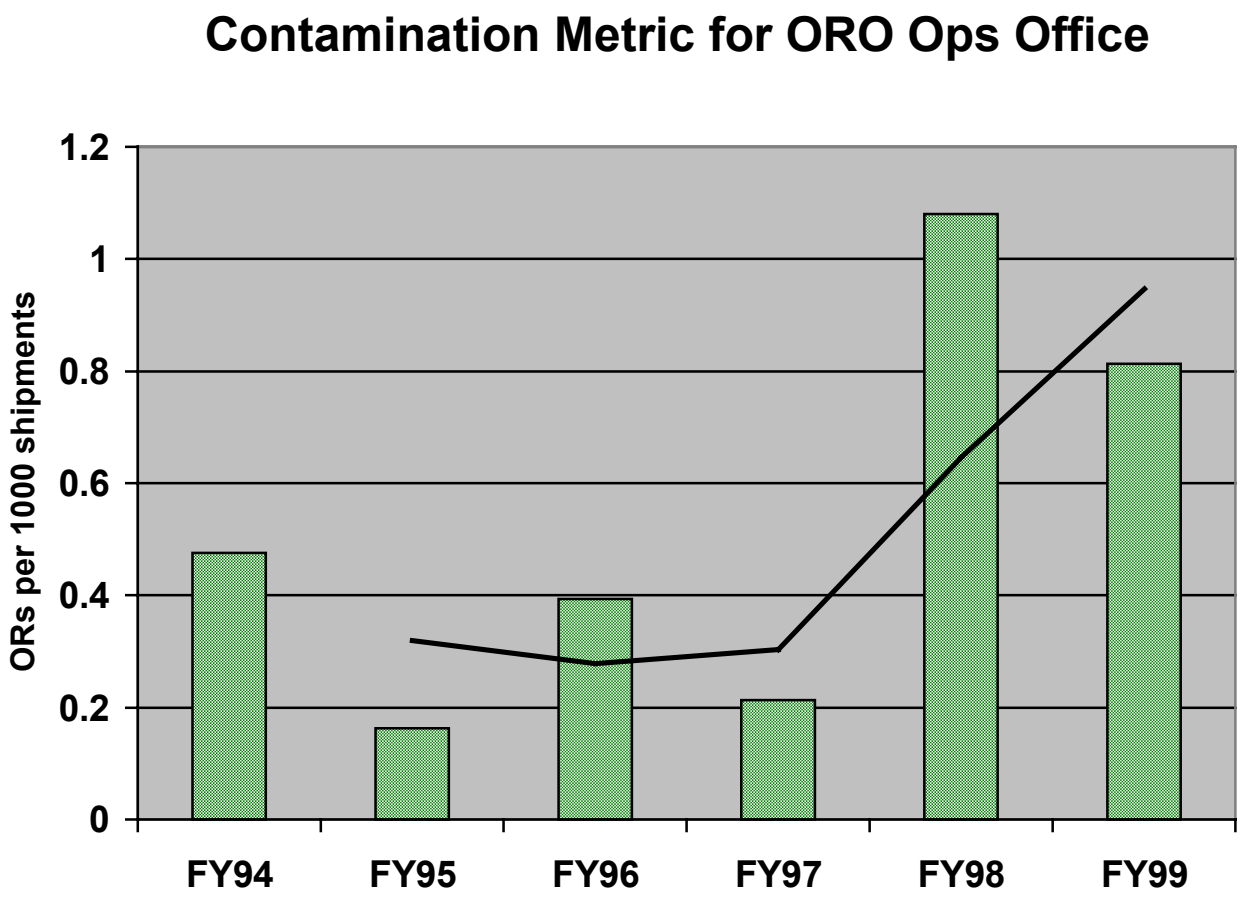

Fig. C.16. Safety metric for contamination ORs for ORO.

ORNL DWG 2000-04697

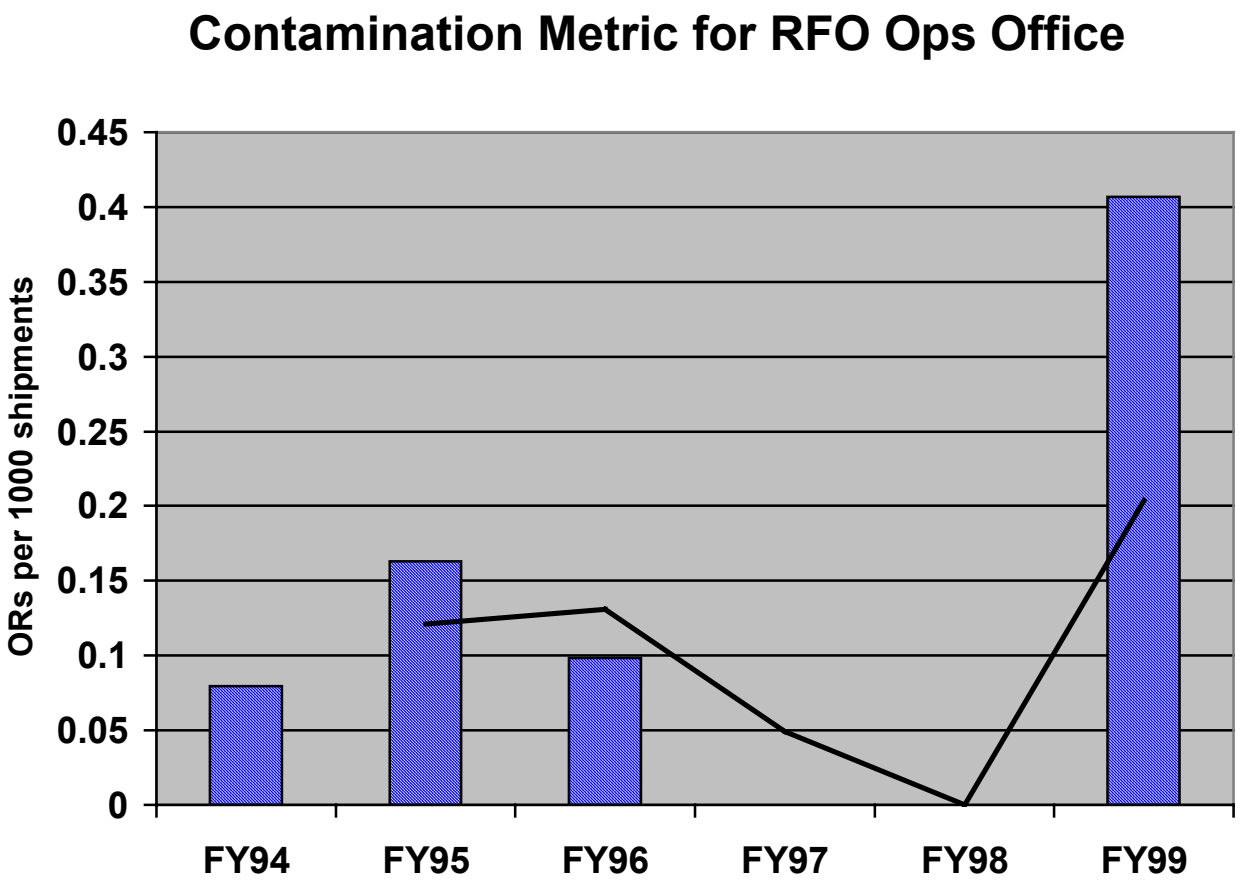

Fig. C.17. Safety metric for contamination ORs for RFO.

ORNL DWG 2000-04698

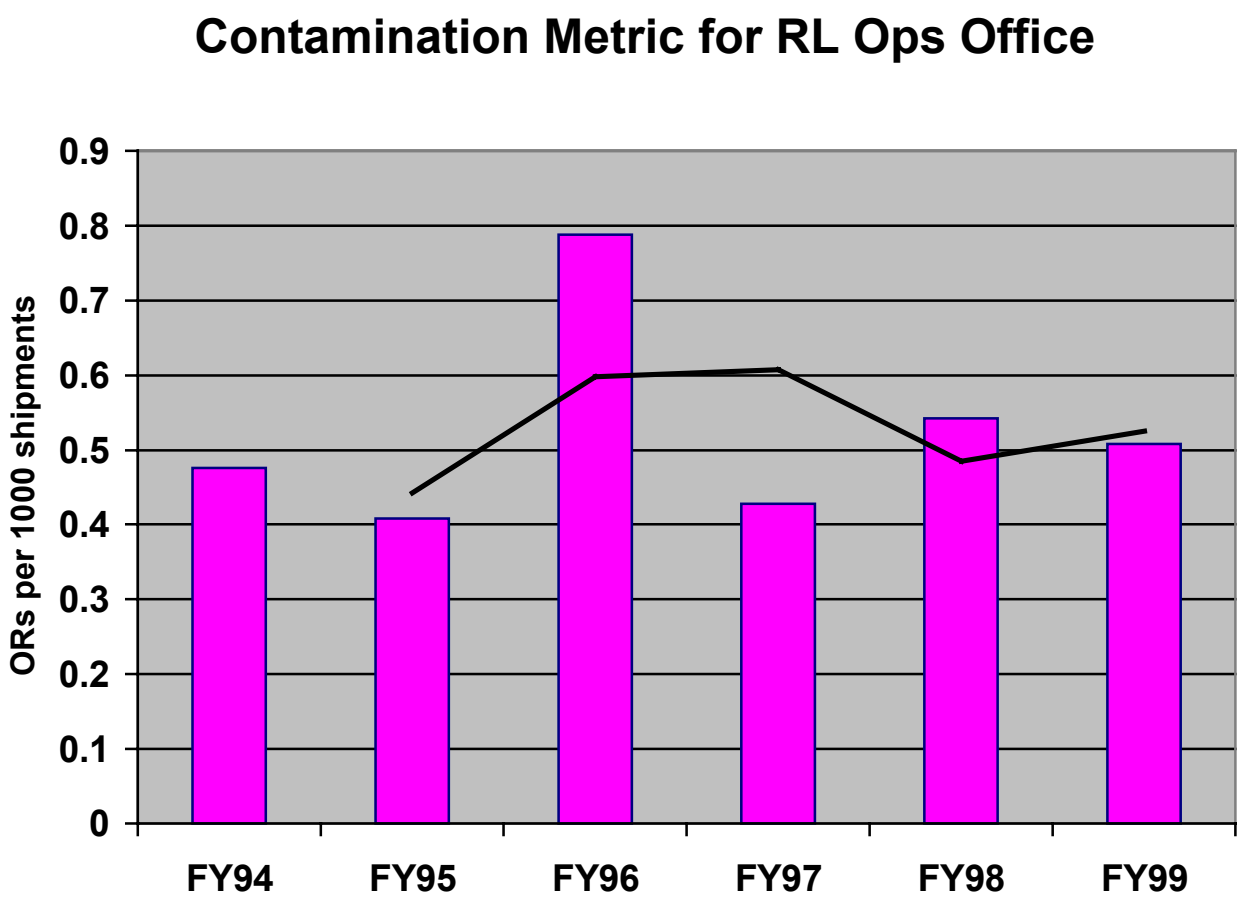

Fig. C.18. Safety metric for contamination ORs for RL.

ORNL DWG 2000-04699

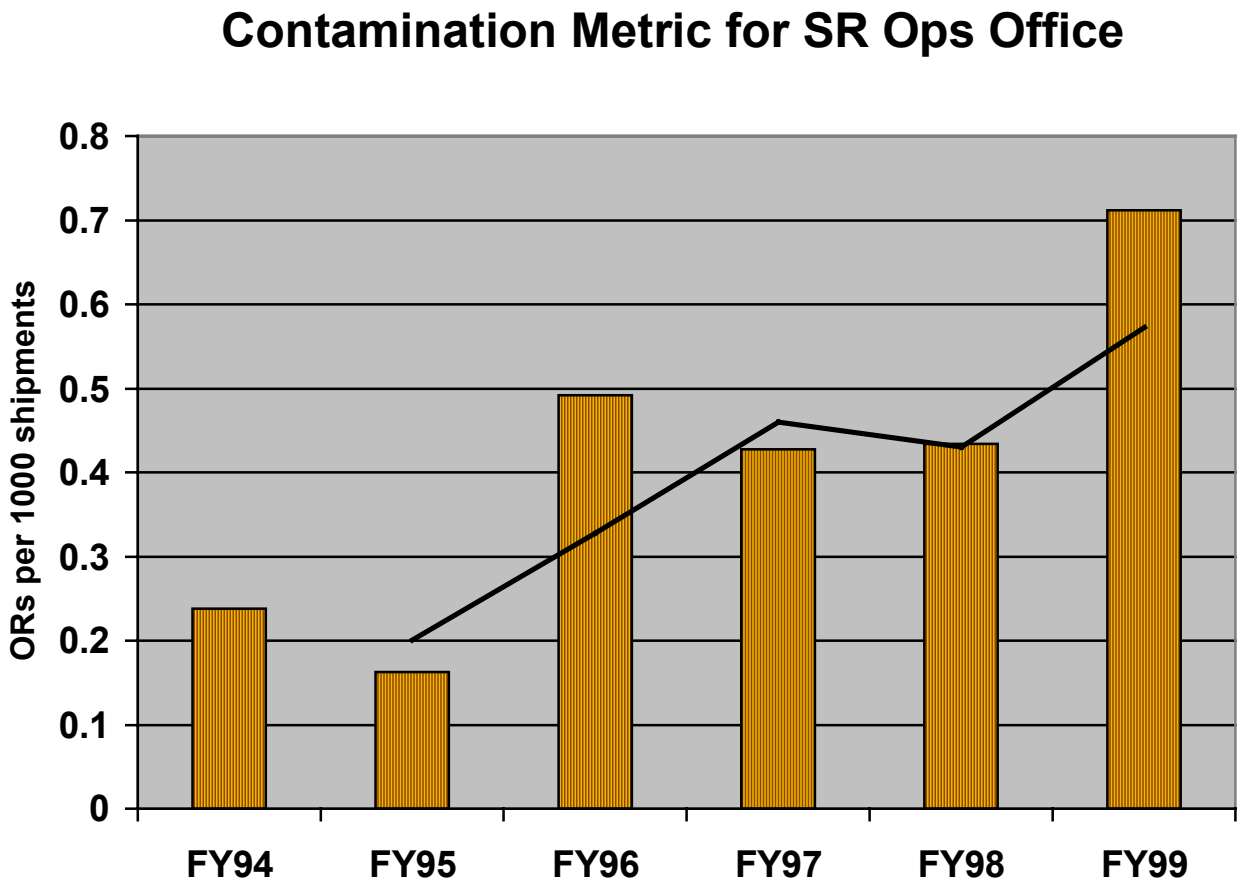

Fig. C.19. Safety metric for contamination ORs for SR.

Similar charts of safety measures by FY cannot be generated for Program Offices because shipments are not reported to ETAS with a classification for Program Offices. Moreover, Program Office shipments cannot be developed by summing the shipments of sites which are under a Program Office's jurisdiction because a DOE contractor site often performs work for multiple Program Offices. Part of a site's work force might perform work for defense while another major portion of the site might perform work for environmental programs. (For example, ORNL performed work for three different Program Offices during FY 1999.) Too, for mileage and shipment purposes, Operations Offices cannot be strictly associated with one particular Program Office.

For completeness, Table C.4 shows the occurrence report distribution by Program Office for all reports contained in the SMIP P&T Occurrence Database. Table C.5, FY 1999 OR distribution by contractor organization, presents a listing of the number of ORs that DOE contractors reported to the ORPS this FY. 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	194	44
EH	Environmental Safety and Health	0	1
EM	Environmental Management	422	54
ER	Energy Research	45	12
FE	Fossil Energy	4	3
NE	Nuclear Energy	30	0
NN	Nonproliferation and National Security	1	1
SC	Science	30	10
UE	Uranium Enrichment	7	0
	Totals	733	125
	Grand Total		858

Table C.5. FY 1999 OR distribution by contractor organizations

Code	Description	No. of ORs	
		Owner	Others
ANLE	Argonne, Illinois East	2	3
ANLW	Argonne, Illinois West	4	0
BHI	DOE Headquarters	1	0
BNL	Brookhaven National Laboratory	3	1
BNFL	BNFL, Inc.	2	0
BNLV	Battelle National Laboratory Nevada	1	0
BWO	Babcock and Wilcock of Ohio, Inc.	1	0
ETTP	East Tennessee Technology Park (K-25 Plant)	5	1
FEMP FD	Fernald Environmental Management Project	2	1
GOPE	Government Operated/Owned	0	1
GOSF	Deprecated Contractor	1	0
KCP	Kansas City Plant	3	0
KHLL	Rocky Flats Env. Technology Site	19	1
LANL	Los Alamos National Laboratory	6	1
LBL	Lawrence Berkeley National Laboratory	2	0
LITC	Lockheed Idaho Technologies Company	13	0
LLNL	Lawrence Livermore National Laboratory	5	0
MCTC	MACTEC-ERS	1	0
MK	Morrison-Knudsen Environmental Services	1	0
NBL	New Brunswick Laboratory	1	0
ORAU	Oak Ridge Associated Universities	1	0
ORNL	Oak Ridge National Laboratory	10	1
PANTEX	Pantex Plant	13	0
PGDP	Paducah Gaseous Diffusion Plant	2	1
PHMC	Project Hanford Management Contractor	13	1
PNNL	Pacific Northwest National Laboratory	3	0
PORTEN VRES	Portsmouth Gaseous Diffusion Plant	0	1
SNL	Sandia National Laboratory	7	1
SPR	Strategic Petroleum Reserves	2	0
Y12	Oak Ridge Y-12 Site	5	1
WSRC	Westinghouse Savannah River Company	28	1
	Totals	156	17
	Grand Total		173