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A Study of the Costs and Benefits of a Formal Safety Program

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Acronyms

BLS	Bureau of Labor Statistics
DOE	Department of Energy
EH	Office of Environment, Safety and Health
FTE	full-time equivalent
GNP	gross national product
GOCO	Government-owned, contractor-operated
ICRP	International Commission on Radiological Protection
LANL	Los Alamos National Laboratory
LBL	Lawrence Berkeley Laboratory
LLNL	Lawrence Livermore National Laboratory
LWC	lost workday cases
LWD	lost workday, or workdays
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
TRC	total recordable cases
W.C.	worker's compensation

A Study of the Costs and Benefits of a Formal Safety Program

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Abstract

This study reports on a review of the safety programs and performance at 13 Department of Energy contractor facilities, involving over one-half million man-years of experience. Safety performance was compared with the size of staff and safety department funding over an 11-year period (1980–1990).

Indicators of safety performance were taken as lost workdays, recordable injuries, accidental dollar losses, worker radiation dose, and worker's compensation expenditures. Safety performance was found to be independent of, or even inversely related to, safety investment. Those organizations with the largest safety programs also experienced the greatest accidental losses.

1. Introduction

The Department of Energy (DOE) administers a broad range of Government-owned laboratories and production facilities, operated by contractor organizations representing industry, universities, and nonprofit organizations (referred to as GOCO facilities). Programs are administered by a staff located in Washington, D.C., which exercises central responsibility for policy, overall planning, direction, and management of Departmental activities. DOE has an extensive field structure that plays an integral part in the management and evaluation of Departmental projects and programs.

The Department has traditionally supported strong safety programs at its contractor-operated sites, with emphasis on performance, and, more recently, compliance to regulation. DOE is responsible for the development and establishment of policies and structures that assure safety and health protection in all DOE activities as well as the appraisal of safety performance at its facilities. Further, DOE assures compliance with applicable national statutes, regulations, standards, and processes. Routine auditing for quality and tracking of performance have been a trademark of the administration of contractor programs. Funding support for safety programs has generally been very strong at all DOE sites.

Figures 1 and 2 show the total safety funding and staffing for those sites examined in this study. In Fig. 1, dollar values were normalized to 1990 values through the use of an implicit price deflator for nominal year values based on GNP. These values are plotted as a percentage of the total facility budget and manpower in Fig. 3. Figure 4 shows DOE's total lost workday (LWD) and total recordable injury (TRC) rates over the period of this study for the contractors. There is little

Figure 1. Total of safety budgets of sites surveyed in this study over 11 years.

Figure 2. Total of safety staffs of sites surveyed in this study over 11 years.

Figure 3. Safety budget and staff as a percentage of total facility operating budget and staff.

Figure 4. DOE contractor safety performance over 11 years.

difference between production and research facilities, the two types reviewed in this study. As shown in these figures, both safety funding and accident experience have been stable during most of the 1980s. Recently (1988–1989), a changing safety culture within DOE has placed added emphasis on compliance with a resultant greater safety investment. This has resulted in a near doubling of the safety staff and costs at the various contractor-operated facilities.

A relationship between safety investment and accident loss has been proposed in the literature. Curves such as those shown in Fig. 5 have been published (1, 2) and presented at national safety conferences (3). The relationship shown between safety expenditure and accident costs is intuitively appealing; however, no data has been published to determine the true validity of this relationship. In Grose's *Managing Risk: Systematic Loss Prevention for Executives* (1), the focus of this relationship is on the total cost of loss prevention as the sum of investment and identifiable losses. The message is that risk extracts a cost: you can pay for it now (investment) or later (losses). Identifiable losses can never be totally eliminated, as you can only approach the zero loss asymptote. Continuing expenditure to preclude losses simply approaches the asymptote of infinite investment.

EG&G, in its Risk Management Guide (2), presents the total cost as the sum of the safety investment and the residual accident cost, which still persists at some current level of investment. The resultant curve is the same as that of Grose. EG&G believes that zero investment in safety results in

Figure 5. Theoretical relationship between safety investment and accident costs.

maximum accident costs and that initial investments have the greatest impact, each increment thereafter yielding successively smaller returns. This view suggests that an optimum level of effort (program/investment) exists and that above this level of safety effort, investments in safety are not matched by associated reductions in accident costs.

Sweginnis (4) uses a marginal cost concept, again with the same curve. He argues that investments that

provide the greatest return per dollar should be given top priority. At low safety funding, small increases in safety program costs can result in large decreases in accident costs. The marginal cost concept illustrates that bigger safety programs are not necessarily better. This system is, perhaps, best used in determining priority of budgeting for the reduction of risks, i.e., funding those projects/programs that will provide the greatest reduction in risk.

2. Sources of Data

DOE annually publishes the *Occupational Injury and Property Damage Summary* (5), which lists lost workdays, reportable injury cases, property loss in dollars, and other accident statistics by contractor facility. The data in this report are of fairly uniform quality because of DOE regulations and report auditing. It may provide one of the best-quality accident summaries of operational experience available in the United States. OSHA does not administer or supervise the reporting of this injury data, and DOE contractor sites have not been subject to routine OSHA inspections. This creates some concern about reporting accuracy; however, DOE Order 5483.1A, "Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities," does require compliance to OSHA reporting requirements. Occurrence reporting has been audited periodically at the various sites over the study period. OSHA evaluations have found no serious record-keeping problems in approximately half of the GOCO facilities reviewed. In any event, the data are generally self-consistent, even if not entirely accurate in an absolute sense, which makes them useful for a comparison of the effectiveness of safety programs among the DOE contractor sites studied.

The cost of safety programs and safety efforts at the DOE facilities has not been followed as closely as the accident reporting. No firm guidelines exist as to what the safety funding should be. These costs have been estimated in cross-cut budget submittals, but this data is not very sound, as it is a projected estimate rather than actual costs and it is treated in different ways by the various DOE contractors. No budget category currently exists by which DOE can call out the actual cost of safety at the various sites. Each contractor does, of course, have a record of what was spent in any

given year. However, each breaks up the safety effort differently and has individual differences of organization. On-site reviews with contractor personnel and site safety managers were used to sort out a comparable cost data set. The figures provided by these managers are believed to be accurate within 5%.

Site and safety budgets were developed that included operating, manpower, and capital equipment dollars. Line item construction was not included in the cost figures studied, as this effort is sporadic and largely conducted by subcontractors. The reported facility personnel FTE (full time equivalent) count does not include construction workers or contract personnel. The disciplines of industrial safety, industrial hygiene, health physics, criticality safety, emergency preparation, bioassay, and fire protection were considered to form the core of the safety program as studied in this report. Safety costs include analytical costs of samples and measurements performed as part of the safety program and administrative support (clerical) costs. The costs and staffing of medical, environmental, hazardous material transportation, waste disposal, and fire fighters were not included.

The fiscal year runs from October 1 to September 31 and is the basis for the budget information used in this study. The accident reporting is done on an annual basis, from January 1 to December 31. In actual practice, most departments get budget authorizations late, and a comparison of fiscal year costs and annual year accident experience is felt to be satisfactory.

Only sites of more than 2000 employees were studied (Table 1), in an attempt to avoid situations in which a single long-term injury might seriously skew the statistics. The one exception, Pinellas, was included to provide a complete comparison of DOE's Defense Program facilities.

Table 1. DOE contractor sites studied.

DOE facility	Location	Avg employment*
Argonne	Chicago, IL	4160
Brookhaven	Long Island, NY	3180
Fermilab	Chicago, IL	2040
Kansas City	Kansas City, MO	6940
LANL	Los Alamos, NM	7530
LBL	Berkeley, CA	2640
LLNL	Livermore, CA	7770
Mound	Miamisburg, OH	2190
ORNL	Oak Ridge, TN	4581
Pantex	Amarillo, TX	2570
Pinellas	Clearwater, FL	1790
Sandia	Albuquerque, NM	7130
Y-12	Oak Ridge, TN	6642

* 1980-1989.

These sites represent both research laboratory operations and production operations. Though each may do some of the other's type of operation, sites are generally managed for optimization of the predominate charter. Safety performance data from the two types of sites indicates that they are similar in performance even with their differing charters (see Fig. 6). The data plotted is the average for all DOE contractors sorted by the type of mission activity. Production and research can be seen to cross as the years pass. High and low values for the sites studied in each category overlap the averages plotted. Where service organizations were a

Figure 6. DOE contractor safety performance (LWD rate) by contractor type over 11 years.

part of the managing contractor's site responsibility, these records have been integrated into the production or research figures for the 13 sites studied (see Appendix C for details).

Environmental costs are not included as they have changed so drastically over this time period. Also, environmental insult data is not yet reported in the same, self-consistent, manner as the accident data. Uniform measures of environmental impact have not been established to readily compare the consequences (i.e., costs) among the various DOE sites.

Emergency response costs (primarily site fire departments) are not included as these services are furnished in a variety of ways to the different sites. They also have little impact on the number of accidents recorded, though, of course they should play a strong role in limiting the severity of accidents and accident losses.

Though line managers are responsible for safety, and there are safety costs borne programmatically, this study focused on those costs identified as associated with a formal safety program and department. Programmatic safety costs, such as safety committees in line organizations, operational safety procedure development and reviews, and management walk-throughs are not included in the safety-cost figures as such expenditures are nearly impossible to estimate. In the early portion of this study report (1980-1984), such efforts were generally minimal. However, the last two years (1991-1992) have seen a large increase in programmatic efforts in safety as the DOE has focused on line management's responsibilities in safety. Safety assurance offices established in line organizations and the program's development of its own safety staff will make future data of the type gathered in this study much more difficult to acquire.

Most of the facilities in this study handle radioactive materials or utilize radiation-producing equipment, which results in radiation exposures to employees. Radiation doses for all DOE facilities are published annually in a summary report by the Office of Environment, Safety and Health (EH) (6). Using ICRP methodology, it is possible to estimate a potential health consequence due to cumulative radiation dose. Though these effects are not immediate and may be only calculational, various agencies have assigned a cost to them. The figure \$1000.00 per person-rem is recommended by the NRC and is used in this report.

Worker's compensation costs are also a consequence of a less-than-adequate safety control system. These costs are part of the total cost of accidents, even though they are generally accounted for in different ways than the majority of accident costs

tracked by the DOE. Worker's compensation costs were obtained from loss control officers at most of the sites reviewed, but were not available at all sites. Some contractors changed insurance carriers during the period 1980–1990 and were unable to obtain data from earlier carriers; two others did not have the data available at all. In nearly all cases, the management of worker's compensation data and experience was separate from the safety organization. A number of factors may reduce the

value of worker's compensation costs as a comparator of safety program performance. Various States have different laws as to what is covered, and different contractors define incidents as "work related" independently. There is also a difficulty in the payment of claims, which may be protracted over several years. The data presented here (Appendix C) is for actual costs/payments in the year listed and does not include administrative costs.

3. Results

Safety costs were used as the primary basis for comparison of safety investment, though other measures are plotted for the reader's review. Some departments may contract analytical work or have it done by other laboratories on site, but these costs are generally assigned to the safety department. Likewise, rather than staff for dosimetry, a company may contract out this service. The FTEs normally associated with this function would not appear in the safety head count of that company, but the costs of that effort will.

The percent of a company's budget invested in safety varied by a factor of 10 between the sites studied. The lost workday (LWD) rate was used as the primary indicator of safety experience. During site visits and interviews with the various safety managers, there was a greater expressed variation in the method of reporting total recordable cases (TRC) among the sites studied. LWD rate appeared to have more checks and balances (i.e., payroll, benefits, medical; a number of interested parties in addition to the safety department).

LWD rate varied by a factor of 10 on the average and by a factor of nearly 100 in individual years between the sites studied.

Losses for the sites studied here were all below, and some far below, the safety investment of these contractors, i.e., well to the right of the crossover noted in Fig. 5. This relationship is plotted as a function of the difference between investment and losses in Figs. 7 through 9. Figure 7 shows the average data for the years 1980 through 1989, which is little different from that of the early portion of this study (Fig. 8, 1980–1984), before any changes in reporting or safety emphasis were initiated. Two points, LANL and LLNL, lie well to the right of the majority of the data. Both of these laboratories have traditionally conducted very comprehensive safety programs, providing their own analytical support and even conducting research programs in the various safety disciplines. Though these programs have contributed outstanding technical

Figure 7. Safety costs minus accident costs for contractors studied, 1980–1989 average.

Figure 8. Safety costs minus accident costs for contractors studied, 1980–1984 average.

Figure 9. Safety costs minus accident costs for contractors studied, 1990.

support to national standards and policy development, they do not appear to have been any more effective in reducing accidents than less well developed programs.

Inclusion of the worker's compensation costs and a cost estimate for radiation dose changes the differentials only slightly; and only in the case of Brookhaven, for the 1980–1989 average, do the total accident costs exceed the safety costs. The 1990 data (Fig. 9) show a tendency for programs to move to the right as their funding has been increased (i.e., show a poorer return on investment). One program (Mound) reports a much lower accident cost for its safety investment than other sites spending comparable amounts. One might review this program to determine how it has been so effective or to determine whether accident reporting has the same accuracy as at other sites. Were it not for the rise in accident costs at the right-hand end of these curves, they would reflect well the theoretical predictions of the literature cited earlier.

The data used in all plots is summarized in Appendix B and given by individual site in Appendix C.

Figure 10 compares the LWD rate to the percent of a site's total budget invested in safety, averaged over the years 1980–1989, for the 13 sites included in this study. There is a clear but weak positive correlation between safety investment and safety performance. The regression line plotted (data in table B1) has an R-squared value of 0.26 and significant standard errors. Perhaps of most interest are those points furthest from the line. Mound has been pointed out previously for its low relative LWD rate, and on this chart, Brookhaven appears somewhat high for its relative funding position. The Brookhaven safety staff have conducted an extensive analysis of their reporting and performance.

A plot of LWD rate against safety staff, shown in Fig. 11, is similar, but the correlation is even weaker.

Figure 10. LWD rate compared to percent of site budget spent on safety, 1980–1989 average.

Figure 11. LWD rate compared to percent of site personnel committed full time to safety, 1980–1989 average.

Another way of looking at the manpower committed and lost is shown in Fig. 12. The two variables are relatively independent, with the regression line mainly flat between 1.5 and 2.5. However, the point at the extreme right (Fermilab) might bear review. Absolute values are shown in Fig. 13, where there is no correlation between the number of FTEs invested and the number lost (R-squared values near zero). Within the DOE complex, contractor safety staffs have a large number of functions that are not all related to reduction of lost-time injuries.

The data is even more scattered when comparing TRC to safety investment, as shown in Figs. 14 and 15.

Figures 16 and 17 provide a more direct cost comparison. Both as a percentage of operation funds and in absolute dollars, the experience of the 13 contractor sites surveyed is that there is a weak positive correlation

Figure 12. Percent of contractor staff in safety compared to the percent of staff lost accidentally per year, 1980–1989 average.

Figure 15. Total reportable case rate compared to percent of site personnel committed full time to safety, 1980–1989 average.

Figure 13. Average safety personnel compared to average lost manpower, 1980–1989 average.

Figure 16. Percent of contractor budget invested in safety compared to percent of contractor budget lost through accident, 1980–1989 average.

Figure 14. Total reportable case rate compared to percent of site budget spent on safety, 1980–1989 average.

Figure 17. Average safety investment compared to average dollar loss, 1980–1989 average.

Figure 18. LWD rate compared to percent of site budget spent on safety, 1990.

Figure 20. Percent of contractor staff in safety compared to the percent of staff lost accidentally per year, 1990.

Figure 19. LWD rate compared to percent of site personnel committed full time to safety, 1990.

Figure 21. Safety personnel compared to lost manpower, 1990.

(R-squared values range from 0.25 to 0.56) between what is invested in a formal safety program and the loss experience of that company. The correlation shown in Fig. 17 is most likely driven by size rather than any dependent relationship. Though one would accept that large companies might both spend more on safety and lose more through accidents, one would not have anticipated that on a relative basis larger (better?) safety organizations would result in poorer safety performance.

Figures 18 through 24 show recent (1990) data, which are even more scattered. Though the LWD rate (Fig. 18) correlates positively to the percent of the site's budget spent on safety, this correlation is due almost entirely to one point at the extreme right (Pantex). The same is true of the relationship in Fig. 23, despite the R-squared value of 0.44.

The data was compared in 5-year blocks, 1980–1984 and 1985–1989, to see whether practices or relationships were different during the study period.

Figure 22. Total reportable case rate compared to percent of site budget spent on safety, 1990.

As seen in Figs. 25 and 26, no clear difference from the overall average (Fig. 10) is obvious. The correlations are all positive but weak (R-squared values of 0.23, 0.26, and 0.28).

Worker's compensation data, though less complete (11 of 13 sites available for 1990, fewer for earlier time periods), shows the same trends (Fig. 27). The greater the percentage of a site's operating budget that is devoted to a formal safety program, the greater the worker's compensation cost experience. Worker's compensation experience is not independent of the

other data presented here; for example, higher LWD experience will result in higher worker's compensation. However, the worker's compensation expense is recorded and tracked independently, and, generally, by different organizations at a site, and so it gives a check on the other data presented. The total loss due to accidents, including the cost estimate for radiation dose and worker's compensation costs, is compared with the operating budget in Fig. 28. The relationship is more strongly dependent (R-squared value of 0.62) than any of the other comparisons.

Figure 23. Percent of contractor budget invested in safety compared to percent of contractor budget lost through accident, 1990.

Figure 25. LWD rate compared to percent of site budget spent on safety, 1980-1984 average.

Figure 24. Safety investment compared to dollar loss, 1990.

Figure 26. LWD rate compared to percent of site budget spent on safety, 1985-1989 average.

Figure 27. Worker's compensation cost dependency on safety program percent of operating budget, 1990.

Figure 28. Total loss dependency on safety program, 1990.

4. Discussion

Though safety performance and safety investment each varied by a factor of 10 for the sites studied, no obvious cost-benefit relationship exists. There is a weak correlation that indicates that the greater the investment, the greater the loss, counter to popular safety literature. The range of data is, however, all located in one region of interest (i.e., facilities committing more to safety than they normally lose accidentally). Actual data from facilities/operations not traditionally providing such strong safety support might be instructive. Kolar (7) reports a much broader range of safety performance of DOE contractors than that exhibited by the limited sites of this study. Inclusion of those at the extremes of performance may provide more insight as to possible relationships to funding support.

Though operations vary at the various sites studied, there is no clear difference as to degree of hazard. Multidiscipline research laboratories have accident experience interwoven with more routine production facilities. There is also no obvious impact from such major events as a change of operating contractor (reported by 4 of the 13 facilities during the period covered) or the Tiger Team assessments. It may be only coincidence that sites have experienced greater injury rates following the Tiger Team work. Rather, the most dramatic changes resulted from changes of reporting practice (Brookhaven and Sandia) or employee attitudes (Pantex, following a layoff announcement).

In a Ph.D. thesis, Shafai-Sahrai (8) reported on factors that might explain the differences in occupational accident experience of similar facilities.

Factors that he considered were: (1) top management's support and involvement in safety, (2) formal education level of workers, (3) age of the employees, (4) company recreational programs, (5) promoting safety through the employee's family, (6) safety rules, (7) marital status of the workers, (8) worker's length of service in a company, (9) company age, (10) accident record-keeping system, (11) first-line supervisor's relative span of control, (12) relative age of production machinery and equipment, (13) physical workplace conditions, (14) safety devices and controls on machinery, and (15) safety committees. Safety investment was not a specific factor of his study. Several factors were found supportive of improved safety, top management involvement and supervisor span of control being the strongest. Quality and quantity of safety rules and safety committees (two popular DOE approaches) did not appear to be significant factors in the attainment of a good safety performance record. Interestingly, Shafai-Sahrai found that those companies with the better record-keeping systems had considerably lower work injury rates. Intangibles such as employee morale and public perception were not included in his study, nor were they considered in this report.

Radiation safety costs were a significant factor in many of the facilities studied. From 5 to 50% of the safety budget is spent in this area, which contributes little to immediate accident losses. Lawsuits involving radiation (or anything else) have created costs that are not included here. Lost time due to radiation injury is practically nonexistent. In general, costs associated with

Figure 29. Radiation exposure of DOE contractor employees. (Reproduced from Ref. 9.)

incidents, cleanup, investigation, and support are included in this study. Radiation exposure among DOE workers has been relatively stable at a level far below regulatory limits throughout the period covered (Fig. 29, from Ref. 9). Using the NRC value of \$1000 per person-rem in the time period 1980-1989, some facilities would show 30 to 40% of their losses associated with radiation-dose-related consequences. By 1990, dose reduction efforts had reduced this impact to 1-5% of the total loss for even those facilities having the highest dose totals. Additional effort in this area is unlikely to improve DOE's safety performance.

Though most of the sites studied had worker's compensation costs on the order of 0.1%, two showed costs above 1% (Brookhaven and Pantex).

5. Conclusions

The traditionally accepted, and intuitively appealing, relationship between safety investment and safety performance is not supported in this study.

Figure 30. LWD rate comparison between DOE and general industry.

The general rise in safety performance indicators (decline in safety) among DOE contractors is somewhat disturbing. The comparison to general industry (Bureau of Labor Statistics) shown in Fig. 30 indicates this rise to be a reflection of a nationwide trend and considerably less than that experienced by some other industries. This rise may reflect a greater awareness of reporting requirements or a general public concern with workplace safety. It may also be driven by things such as repetitive motion injuries, which were not recognized as workplace related in earlier years, or by an increased focus on paperwork, which drives the safety professional from the field to his desk.

In general, despite an increased focus on safety and considerably increased investment in safety, both in absolute dollars and as a percentage of facility operating budget, nothing has changed. The same trends exist in the 1980-1984, 1985-1989, and 1990 data; and safety performance has not changed appreciably.

Reviewing the trends plotted and performance averages of the 13 facilities, two safety goals appear possible: (1) lose less than 1% of your operating budget annually, and (2) lose less than 0.1% of your work force to lost time injuries annually. It also appears that 2% of the operating budget invested in safety provides an adequate loss control program.

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Appendix A

Explanation of Terms

Full-time equivalent (FTE) is the number of personnel employed over a year. 2000 man-hours worked = 1 FTE; 50 weeks, 40 hours per week.

Total recordable cases (TRC) are those cases involving an occupational injury or illness that requires medical care; first aid cases are not included.

Lost workdays (LWD) are those days that the employee would have worked, but could not because of occupational injury or illness. LWC is the number of lost workday cases. The incident rate equals the number of injuries times 200,000 divided by the total hours worked by all employees during the time period covered, a rate for 100 full-time employees. The LWD rate is thus the number of lost workdays for 200,000 employee-hours worked.

The "accidental dollar loss estimate" is adapted from an EG&G technique of "cost index," published in their annual *Occupational Injury and Property Damage Summary* (5). A loss value of \$1,000,000.00 is assigned for each fatality, \$2,000.00 is assigned for each reportable case and each lost workday case, \$1,000.00 is counted for each lost workday, and a value of \$10,000.00 is attributed to each type A or B incident. These added costs are attributed to the costs of incident investigation, record keeping, management time, etc. Fire and nonfire property losses are as reported by contractors to the DOE data base in Idaho. No implication as to the value of human life is made by these figures; they serve only for comparison of contractor safety experience.

Appendix B

Data Summary Tables

The safety performance of security forces was included in facility figures until it was established as a separate reporting category with DOE in 1986. Some sites did not immediately separate the security force numbers out of the general site population; these exceptions are noted in the appendix. The numbers affected were relatively small (<5%) and have not been corrected back into the totals. The injury experience of plant support functions, i.e., gardeners, janitors, and crafts, was separated at some sites in the late 1980s. These were added back into the totals to maintain comparability. Only LANL has traditionally contracted this function out to another company. These records for LANL are therefore separated and not included in this study.

Some values have been multiplied by 10 to plot them on the same scale as others for comparison.

Table B1. Data summary from all sites.

Table B2. DOE LWD performance compared with that of general industry (Bureau of Labor Statistics).

Table B3. Regression analysis output for various comparisons.

Table B1. Summary of data from all sites.

Data Summary

Contractor	TRC r 1980-84	TRC r 1985-89	TRC r 1980-89	TRC r 1990	LWD r 1980-84	LWD r 1985-89	LWD r 1980-89	LWD r 1990
Argonne	2.06	2.30	2.18	3.00	13.46	12.76	13.11	26.40
Brookhaven	2.12	4.34	3.23	5.60	14.60	31.76	23.18	32.70
FermiLab	2.34	3.44	2.89	3.30	22.52	38.46	30.49	44.60
Kansas City	0.96	0.84	0.90	2.40	2.98	3.30	3.14	9.40
LANL	2.00	3.90	2.95	3.60	12.82	12.96	12.89	28.00
LBL	1.84	2.41	2.12	2.97	20.08	19.05	19.56	27.04
LLNL	2.34	1.74	2.04	2.30	14.84	19.05	16.95	22.42
Mound	0.62	0.62	0.62	0.70	3.78	5.92	4.85	6.80
ORNL	0.78	0.46	0.62	2.50	6.42	2.30	4.36	11.00
Pantex	1.42	1.60	1.51	5.80	9.94	47.10	28.52	108.30
Pinellas	0.32	1.54	0.93	5.00	2.40	9.62	6.01	28.10
Sandia	1.26	1.22	1.24	4.00	8.18	10.28	9.23	25.10
Y-12	1.00	1.08	1.04	6.50	3.02	8.12	5.57	92.00
Average	1.47	1.96	1.71	3.67	10.39	16.98	13.68	35.53

Table B1. (Cont.)

Contractor	Safety Investment						
	\$ % 1980-84	\$ % 1985-89	\$ % 1980-89	\$ % 1990	FTE % 1980-84	FTE % 1985-89	FTE % 1980-89
Argonne	1.49	1.68	1.58	1.87	1.79	1.85	1.82
Brookhaven	0.94	1.04	0.99	1.41	1.66	1.69	1.68
FermiLab	2.93	2.65	2.79	2.99	2.48	2.72	2.60
Kansas City	0.29	0.39	0.34	0.87	0.27	0.29	0.28
LANL	1.46	1.45	1.45	2.32	2.34	2.43	2.39
LBL	1.57	1.69	1.63	2.09	1.76	1.74	1.75
LLNL	1.63	1.51	1.57	1.81	2.79	2.71	2.75
Mound	2.52	2.86	2.69	4.52	2.88	4.38	3.63
ORNL	1.27	1.53	1.40	3.51	1.96	2.46	2.21
Pantex	1.81	3.04	2.43	8.16	1.77	2.20	1.98
Pinellas	0.44	0.99	0.71	1.46	0.58	0.91	0.75
Sandia	0.48	0.44	0.46	0.82	0.83	0.72	0.78
Y-12	1.51	1.58	1.55	3.51	0.87	1.56	1.22
Average	1.41	1.60	1.51	2.72	1.69	1.97	1.83
							2.73
							4.08
							1.32
							0.90
							3.51

Table B1. (Cont.)

Contractor	1980-89 Safety FTE	1990 Safety FTE	1980-89 FTEs Lost	1980-89 % FTE Lost	1990 FTEs Lost	1990 % FTE Lost
Argonne	75.60	79	2.00	0.05	4.10	0.103
Brookhaven	53.30	69	3.18	0.10	4.40	0.137
FermiLab	52.95	75	2.75	0.14	4.60	0.205
Kansas City	19.50	35	0.84	0.01	2.20	0.036
LANL	179.50	252	3.90	0.05	8.70	0.111
LBL	46.10	49	1.95	0.07	2.80	0.108
LLNL	214.49	232	5.00	0.06	7.30	0.090
Mound	79.40	116	0.45	0.02	0.60	0.027
ORNL	102.50	207	0.71	0.02	2.00	0.043
Pantex	51.20	105	2.37	0.09	7.80	0.303
Pinellas	13.30	22	0.44	0.03	1.80	0.106
Sandia	55.20	69	2.70	0.04	7.80	0.103
Y-12	72.50	196	1.46	0.03	22.00	0.394
Average	78.12	115.85	2.13	0.05	5.85	0.14

Table B1. (Cont.)

Contractor	1980-89 Site Budget M\$	1980-89 Safety K\$	1980-89 Safety \$ %	1980-89 Lost K\$	1980-89 % of Site Oper. \$ Lost	1980-89 S\$-A\$ K\$	1980-89 (S\$-A\$)% Site Budget
Argonne	\$260	\$4,110	1.58	\$786	0.30	\$3,324	1.28
Brookhaven	\$205	\$2,050	0.99	\$1,452	0.71	\$598	0.29
FermiLab	\$141	\$3,890	2.79	\$1,165	0.83	\$2,725	1.94
Kansas City	\$473	\$1,640	0.34	\$439	0.09	\$1,201	0.25
LANL	\$668	\$9,750	1.45	\$1,810	0.27	\$7,940	1.19
LBL	\$162	\$2,660	1.63	\$680	0.42	\$1,980	1.22
LLNL	\$800	\$12,590	1.57	\$2,967	0.37	\$9,623	1.20
Mound	\$145	\$3,930	2.69	\$176	0.12	\$3,754	2.59
ORNL	\$404	\$5,750	1.40	\$280	0.07	\$5,470	1.35
Pantex	\$121	\$3,107	2.43	\$1,089	0.90	\$2,018	1.67
Pinellas	\$102	\$780	0.71	\$204	0.20	\$576	0.57
Sandia	\$836	\$3,820	0.46	\$1,113	0.13	\$2,707	0.32
Y-12	\$376	\$6,010	1.55	\$607	0.16	\$5,403	1.44
Average	\$335	\$4,622	1.51	\$982	0.35	\$3,640	0.90

Table B1. (Cont.)

Contractor	1990 Site Budget M\$	1990 Safety M\$	1990 Safety \$ %	1990 Accident M\$	1990 % of Site Oper. \$ Lost	1990 S\$-A\$ K\$	1990 (S\$-A\$)% Site Budget
Argonne	\$361	6.74	1.87	\$1.37	0.38	\$5,371	1.49
Brookhaven	\$271	3.82	1.41	\$1.69	0.62	\$2,126	0.78
FermiLab	\$191	5.73	2.99	\$1.48	0.77	\$4,255	2.22
Kansas City	\$541	4.71	0.87	\$0.89	0.16	\$3,824	0.71
LANL	\$950	22.02	2.32	\$3.06	0.32	\$18,954	2.00
LBL	\$196	4.09	2.09	\$1.08	0.55	\$3,008	1.53
LLNL	\$1,071	19.89	1.81	\$2.46	0.23	\$17,428	1.63
Mound	\$170	7.69	4.52	\$0.23	0.13	\$7,465	4.38
ORNL	\$510	17.89	3.51	\$1.83	0.36	\$16,063	3.15
Pantex	\$163	13.29	8.16	\$2.33	1.43	\$10,964	6.73
Pinellas	\$124	1.80	1.46	\$0.65	0.52	\$1,153	0.93
Sandia	\$1,086	8.90	0.82	\$2.88	0.27	\$6,014	0.55
Y-12	\$550	19.31	3.51	\$6.60	1.20	\$12,710	2.31
Average	\$476	10.45	2.72	\$2.04	0.53	\$6,431	1.67

Table B1. (Cont.)

Contractor	1980-84 Safety M\$	1980-84 Accident M\$	1980-84 S\$-A\$ K\$	Person*Rem		Worker's Comp	
				1980-89	1990	1980-89 K\$	1990
Argonne	\$3.60	\$0.86	\$2,740	118	64	N/A	\$509.0
Brookhaven	\$1.66	\$0.85	\$806	203	91	\$433.7	\$294.0
FermiLab	\$3.31	\$0.64	\$2,671	85	35	\$234.8	(\$245.6)
Kansas City	\$1.13	\$0.38	\$754	3	0	\$104.5	\$146.0
LANL	\$7.96	\$1.67	\$6,290	555	213	N/A	\$923.1
LBL	\$2.30	\$0.68	\$1,617	37	14	\$521.7	\$803.0
LLNL	\$10.23	\$2.87	\$7,361	63	28	\$1,269.0	\$1,734.0
Mound	\$2.85	\$0.16	\$2,695	103	4	N/A	N/A
ORNL	\$4.49	\$0.39	\$4,105	139	29	\$214.6	\$344.3
Pantex	\$1.72	\$0.84	\$883	109	24	N/A	\$532.6
Pinellas	\$0.38	\$0.15	\$232	6	2	N/A	\$153.2
Sandia	\$3.22	\$1.10	\$2,122	72	33	N/A	\$408.9
Y-12	\$4.38	\$0.42	\$3,965	77	31	N/A	\$1,717.9
Average	\$3.15	\$0.85	\$2,132	120.73	43.69		

Table B1. (Cont.)

Total Losses

Contractor	K \$	% of Oper. Budget	
	1990	1980-89	1990
Argonne	\$1,942.0	N/A	0.54
Brookhaven	\$2,079.0	1.11	0.77
FermiLab	\$1,744.0*	1.12	0.66
Kansas City	\$1,032.0	0.11	0.19
LANL	\$4,198.1	N/A	0.44
LBL	\$1,900.3	0.77	0.97
LLNL	\$4,224.0	0.54	0.39
Mound	N/A	N/A	N/A
ORNL	\$2,200.3	0.16	0.43
Pantex	\$2,886.6	N/A	1.77
Pinellas	\$803.2	N/A	0.65
Sandia	\$3,323.9	N/A	0.31
Y-12	\$8,349.9	N/A	1.52
Average			

* Average worker's compensation costs used

Table B2. DOE LWD performance compared with that of general industry (BLS).

Year	Contractor Performance by Type				LWD r Total DOE and Contractors	Industry Performance LWD r				
	LWD r					All	Manufacturing		Automotive	Meat Packing
	Production	Research	Service	Construction						
80	10.2	12.1	29.7	36.8	16.4	65.2	86.7	67.4	178.2	
81	7.6	9.3	23.9	42.6	13.5	40.0	42.0	23.0	104.0	
82	4.8	10.7	27.4	40.2	12.8	40.0	38.0	28.0	83.0	
83	6.5	12.2	17.4	54.5	14.9	53.0	45.0	38.0	92.0	
84	5.4	12.5	44.8	58.2	15.8	54.0	45.0	36.0	136.0	
85	6.6	14.0	37.7	41.6	15.8	51.0	44.0	36.0	112.0	
86	6.4	14.4	24.9	32.7	15.4	65.8	85.2	82.1	178.8	
87	4.0	13.7	24.4	29.0	14.2	60.0	58.0	134.0	158.0	
88	7.2	11.3	18.2	41.1	15.9	72.0	68.0	188.0	163.0	
89	18.6	14.2	18.9	46.4	19.9	78.7	113.0	173.9	250.9	
90	32.2	20.7	30.3	91.6	33.5	84.0	79.0	227.0	233.0	
91	33.4	26.6	36.3	84.1	34.8					

Table B3. Regression analysis output for various comparisons.

Fig. 10. LWD Rate 1980-1989		Fig. 12. Percent of Contractor	
Constant	4.482	Constant	0.0319
Std Err of Y Est	8.461	Std Err of Y Est	0.0376
R Squared	0.257	R Squared	0.0862
No. of Observations	13	No. of Observations	13
Degrees of Freedom	11	Degrees of Freedom	11
X Coefficient(s)	6.105	X Coefficient(s)	0.0120
Std Err of Coef.	3.132	Std Err of Coef.	0.0118
Fig. 16. Percent of Budget		Fig. 17. Avg. Safety Invest	
Constant	1.024	Constant	1494180
Std Err of Y Est	0.704	Std Err of Y Est	2297602
R Squared	0.254	R Squared	0.5578
No. of Observations	13	No. of Observations	13
Degrees of Freedom	11	Degrees of Freedom	11
X Coefficient(s)	1.372	X Coefficient(s)	3184
Std Err of Coef.	0.709	Std Err of Coef.	855
Fig. 18. LWD Rate 1990		Fig. 23. Percent of Budget	
Constant	7.460	Constant	0.9585
Std Err of Y Est	23.86	Std Err of Y Est	1.5428
R Squared	0.442	R Squared	0.4381
No. of Observations	13	No. of Observations	13
Degrees of Freedom	11	Degrees of Freedom	11
X Coefficient(s)	10.32	X Coefficient(s)	3.298
Std Err of Coef.	3.496	Std Err of Coef.	1.126
Fig. 25. LWD Rate 1980-1984		Fig. 26. LWD Rate 1985-1989	
Constant	4.471	Constant	2.692
Std Err of Y Est	6.080	Std Err of Y Est	12.33
R Squared	0.235	R Squared	0.283
No. of Observations	3	No. of Observations	13
Degrees of Freedom	11	Degrees of Freedom	11
X Coefficient(s)	4.194	X Coefficient(s)	8.906
Std Err of Coef.	2.283	Std Err of Coef.	4.278
Fig. 27. Worker's Comp		Fig. 28. Total Loss	
Constant	0.0762	Constant	0.2322
Std Err of Y Est	0.1142	Std Err of Y Est	0.3286
R Squared	0.2837	R Squared	0.6164
No. of Observations	11	No. of Observations	11
Degrees of Freedom	9	Degrees of Freedom	9
X Coefficient(s)	0.0331	X Coefficient(s)	0.1916
Std Err of Coef.	0.0175	Std Err of Coef.	0.0504

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Individual Site Data

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C1. Argonne

Argonne is a multiprogram national R&D laboratory. Security injury statistics were separated from other site data in 1987. A Tiger Team appraisal was conducted in October 1990. No worker's compensation data is available prior to 1985.

Table C1. Argonne site data.

Year	TRC r	LWD r	Lab Budget	Safety Budget	\$ %	10*\$%	Lab Staff	Safety Staff	FTE %	10°FTE%
1980	2.00	7.90	\$272	\$3.40	1.25	12.52	5162	93.4	1.81	18.09
1981	2.30	15.00	\$246	\$3.50	1.42	14.20	4964	82.5	1.66	16.62
1982	1.80	19.50	\$234	\$3.50	1.50	14.99	4341	78.6	1.81	18.11
1983	2.20	13.50	\$225	\$3.70	1.65	16.46	4187	77.0	1.84	18.39
1984	2.00	11.40	\$242	\$3.90	1.61	16.12	4117	75.1	1.82	18.24
1985	2.40	8.90	\$235	\$4.32	1.84	18.38	3900	72.6	1.86	18.62
1986	2.10	17.50	\$250	\$4.17	1.67	16.69	3689	67.8	1.84	18.38
1987	2.10	13.20	\$273	\$4.38	1.61	16.08	3693	66.4	1.80	17.98
1988	2.20	13.20	\$297	\$4.80	1.61	16.14	3763	67.9	1.80	18.04
1989	2.70	11.00	\$325	\$5.43	1.67	16.68	3815	75.0	1.97	19.66
1990	3.00	26.40	\$361	\$6.74	1.87	18.70	4015	79.4	1.98	19.78
			M\$	M\$						
Avg 80-84	2.06	13.46	\$244	\$3.60	1.49	14.86	4554.2	81.3	1.79	17.89
Avg 85-89	2.30	12.76	\$276	\$4.62	1.68	16.79	3772.0	69.9	1.85	18.54
Avg 80-89	2.18	13.11	\$260	\$4.11	1.58	15.83	4163.1	75.6	1.82	18.21

Table C1. (Cont.)

	Argonne				FTEs Lost	% FTEs	Type A+B	Property	\$s Lost	% Oper.	
	Year	TRCs	LWCs	LWDs	Fatalities	Accidently	Lost	Incidents	Loss \$	Accidently	\$ Lost
C-5	1980	97	46	375	0	1.5	0.029	1	\$1,896	\$672.90	0.25
	1981	100	60	660	0	2.6	0.053	0	\$25,556	\$1,005.56	0.41
	1982	67	40	739	0	3.0	0.068	1	\$82,061	\$1,045.06	0.45
	1983	85	54	521	0	2.1	0.050	0	\$59,475	\$858.48	0.38
	1984	80	42	449	0	1.8	0.044	1	\$14,036	\$717.04	0.30
	1985	80	31	303	0	1.2	0.031	1	\$16,750	\$551.75	0.23
	1986	73	38	612	0	2.4	0.066	0	\$6,400	\$840.40	0.34
	1987	71	35	449	0	1.8	0.049	0	\$0	\$661.00	0.24
	1988	82	49	483	0	1.9	0.051	0	\$46,169	\$791.17	0.27
	1989	99	58	400	0	1.6	0.042	0	\$2,450	\$716.45	0.22
	1990	118	47	1034	0	4.1	0.103	0	\$5,685	\$1,369.69	0.38
									K\$		
	Avg 80-84	85.8	48.4	548.8	0.0	2.20	0.048	0.6	\$36,605	\$859.80	0.35
	Avg 85-89	81.0	42.2	449.4	0.0	1.80	0.048	0.2	\$14,354	\$712.15	0.26
	Avg 80-89	83.4	45.3	499.1	0.0	2.00	0.048	0.4	\$25,479	\$785.98	0.30

Table C1. (Cont.)

Argonne		Person	\$1,000	Acc. + Rad.	Acc. + Rad.	Worker's	Total	Worker's Comp
Year	Rem	per ManRem	\$ Lost	% Lost	Comp Costs	% Lost	% of Oper. \$	
1980	201	\$201	\$874	0.32	n/a			
1981	196	\$196	\$1,202	0.49	n/a			
1982	151	\$151	\$1,196	0.51	n/a			
1983	114	\$114	\$972	0.43	n/a			
1984	115	\$115	\$832	0.34	n/a			
1985	87	\$87	\$639	0.27	\$157	0.34	0.067	
1986	76	\$76	\$916	0.37	\$443	0.54	0.177	
1987	84	\$84	\$745	0.27	\$249	0.36	0.091	
1988	91	\$91	\$882	0.30	\$387	0.43	0.130	
1989	61	\$61	\$777	0.24	\$292	0.33	0.090	
1990	64	\$64	\$1,434	0.40	\$509	0.54	0.141	
		K\$	K\$		K\$			
Avg 80-84	155	\$155	\$1,015	0.42				
Avg 85-89	80	\$80	\$792	0.29	\$306	0.40	0.111	
Avg 80-89	118	\$118	\$904	0.35

Figure C1.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C1.2. Lost workdays per 200k man-hr, safety staff as percent of Laboratory manpower.

Figure C1.3. Total reportable case rate, percent of Laboratory budget spent on safety.

Figure C1.4. Percent of budget lost accidentally, percent of Laboratory budget spent on safety.

C2. Brookhaven

Brookhaven is a multiprogram national R&D laboratory. This Laboratory changed its reporting criteria for injury incidents in 1986, in response to DOE audits of its OSHA-like logs, to a more strict interpretation of requirements. This change resulted in an increase that is obvious in Fig. C2.1. The high dollar loss value observed in 1986 in Fig. C2.4 is due to two fatalities and three serious incidents that year. Security is included in the site statistics until 1989. A Tiger Team appraisal was conducted in March 1990.

Table C2. Brookhaven site data.

C-12	Year	TRC r	LWD r	Lab Budget	Safety Budget	\$ %	10*\$%	Lab Staff	Safety Staff	FTE %	10*FTE%
	1980	3.40	20.20	\$153.3	\$1.50	0.98	9.78	3308	58	1.75	17.53
	1981	2.00	15.70	\$166.3	1.64	0.99	9.86	3226	52	1.61	16.12
	1982	1.60	9.60	\$175.9	1.77	1.00	10.05	3115	51	1.64	16.37
	1983	1.40	9.00	\$188.5	1.68	0.89	8.92	3109	54	1.74	17.37
	1984	2.20	18.50	\$200.9	1.72	0.86	8.56	3170	50	1.58	15.77
	1985	3.20	16.80	\$209.3	1.84	0.88	8.77	3157	50	1.58	15.84
	1986	4.20	35.30	\$218.8	2.00	0.92	9.16	3138	50	1.59	15.93
	1987	4.10	29.00	\$225.7	2.26	1.00	9.99	3119	53	1.70	16.99
	1988	4.50	38.00	\$243.1	2.60	1.07	10.71	3189	53	1.66	16.62
	1989	5.70	39.70	\$263.3	3.50	1.33	13.27	3245	62	1.91	19.11
	1990	5.60	32.70	\$271.4	3.82	1.41	14.07	3222	69	2.14	21.42
				M\$	M\$						
	Avg 80-84	2.12	14.60	\$177.0	\$1.66	0.94	9.43	3185.6	53.0	1.66	16.63
	Avg 85-89	4.34	31.76	\$232.0	\$2.44	1.04	10.38	3169.6	53.6	1.69	16.90
	Avg 80-89	3.23	23.18	\$204.5	\$2.05	0.99	9.91	3177.6	53.3	1.68	16.77

Table C2. (Cont.)

	Brookhaven				Fatal	FTEs Lost	% FTEs	Type A+B	Property	\$s Lost	% Oper.
	Year	TRCs	LWCs	LWDs	cases	Accidently	Lost	Incidents	Loss \$	Accidently	\$ Lost
C-13	1980	130.0	120.0	780.0	0.0	3.1	0.094	0	\$11,635	\$1,292	0.84
	1981	73.0	68.0	573.0	0.0	2.3	0.071	0	\$39,950	\$895	0.54
	1982	56.0	47.0	329.0	0.0	1.3	0.042	0	\$47,600	\$583	0.33
	1983	47.0	35.0	310.0	0.0	1.2	0.040	0	\$82,000	\$556	0.29
	1984	76.0	54.0	637.0	0.0	2.5	0.080	0	\$49,800	\$947	0.47
	1985	109.0	77.0	580.0	0.0	2.3	0.073	0	\$146,255	\$1,098	0.52
	1986	133.0	97.0	1126.0	2.0	4.5	0.144	3	\$161,117	\$3,777	1.73
	1987	132.0	81.0	927.0	0.0	3.7	0.119	0	\$3,137	\$1,356	0.60
	1988	155.0	96.0	1320.0	0.0	5.3	0.166	0	\$0	\$1,822	0.75
	1989	195.0	91.0	1361.0	0.0	5.4	0.168	1	\$253,000	\$2,196	0.83
	1990	191.0	104.0	1104.0	0.0	4.4	0.137	0	\$0	\$1,694	0.62
									K\$		
	Avg 80-84	76.4	64.8	525.8	0.0	2.10	0.066	0.0	\$46,197	\$854	0.48
	Avg 85-89	144.8	88.4	1062.8	0.4	4.25	0.134	0.8	\$112,702	\$2,050	0.88
	Avg 80-89	110.6	76.6	794.3	0.2	3.18	0.100	0.4	\$79,449	\$1,452	0.71

Table C2. (Cont.)

Brookhaven		Person	\$1,000	Acc. + Rad.	Acc. + Rad.	Worker's	Total	Worker's Comp.
Year	Rem	per ManRem	\$ Lost	% Lost	Comp Costs	% Lost	% of Oper. \$	
1980	347	\$347	\$1,639	1.07	\$346	1.29	0.226	
1981	300	\$300	\$1,195	0.72	\$374	0.94	0.225	
1982	202	\$202	\$785	0.45	\$365	0.65	0.208	
1983	269	\$269	\$825	0.44	\$402	0.65	0.213	
1984	289	\$289	\$1,236	0.62	\$449	0.84	0.223	
1985	264	\$264	\$1,362	0.65	\$757	1.01	0.361	
1986	211	\$211	\$3,988	1.82	\$408	2.01	0.186	
1987	170	\$170	\$1,526	0.68	\$521	0.91	0.231	
1988	149	\$149	\$1,971	0.81	\$254	0.92	0.104	
1989	136	\$136	\$2,332	0.89	\$215	0.97	0.082	
1990	91	\$91	\$1,785	0.66	\$294	0.77	0.108	
		\$K	\$K		\$K			
Avg 80-84	281	\$281	\$1,136	0.64	\$387	0.86	0.219	
Avg 85-89	186	\$186	\$2,236	0.96	\$431	1.15	0.186	
Avg 80-89	234	\$234	\$1,686	0.82	\$409	1.02	0.200

Figure C2.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C2.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C2.3. Total reportable case rate, percent of Laboratory budget spent on safety.

Figure C2.4. Percent of budget lost accidentally, percent of Laboratory budget spent on safety.

Figure C2.5. Percent of operating budget lost by year, including actual accident losses, estimated radiological consequences, and reported worker's compensation expenditures.

C3. Fermilab

Fermilab is the national accelerator laboratory, conducting focused R&D. Individual programs and departments hire their own safety staff/professionals for mini safety departments. The central safety department provides oversight and additional expertise as needed. FTEs and costs were combined for comparison with the other sites. OSHA reporting was improved in 1985, with some observed effect on TRC. A Tiger Team appraisal was conducted in May 1992.

Table C3. Fermilab site data.

Year	TRC r	LWD r	Lab	Safety	\$ %	10*\$%	Lab	Safety	FTE %	10*FTE%
			Budget	Budget			Staff	Staff		
1980	4.6	74.4	\$84.6	\$2.09	2.47	24.72	1823	44	2.41	24.14
1981	2.9	14.8	\$96.2	\$2.64	2.74	27.45	1947	46	2.36	23.63
1982	2.4	16.6	\$107.1	\$3.95	3.69	36.90	1931	52	2.69	26.93
1983	0.9	4.7	\$132.1	\$3.95	2.99	29.90	2058	55	2.67	26.72
1984	0.9	2.1	\$140.8	\$3.91	2.78	27.78	2188	49	2.24	22.39
1985	2.6	19.5	\$151.0	\$4.11	2.72	27.22	2125	51	2.40	24.00
1986	3.7	75.0	\$152.8	\$3.86	2.53	25.26	2108	52	2.47	24.67
1987	3.6	39.6	\$166.9	\$4.47	2.68	26.78	2000	51	2.55	25.50
1988	3.5	26.6	\$179.1	\$4.42	2.47	24.67	2035	60	2.95	29.48
1989	3.8	31.6	\$195.6	\$5.54	2.83	28.32	2150	69.5	3.23	32.33
1990	3.3	44.6	\$191.4	\$5.73	2.99	29.93	2265	75	3.31	33.11
			M\$	M\$						
Avg 80-84	2.34	22.52	\$112.1	\$3.31	2.93	29.35	1989.4	49.2	2.48	24.76
Avg 85-89	3.44	38.46	\$169.1	\$4.48	2.65	26.45	2083.6	56.7	2.72	27.20
Avg 80-89	2.89	30.49	\$140.6	\$3.89	2.79	27.90	2036.5	53.0	2.60	25.98

C-21

Table C3. (Cont.)

Fermilab										
Year	TRCs	LWCs	LWDs	Fatal Cases	FTEs Lost Accidently	% FTEs Lost	Type A+B Incidents	Property Loss \$	\$s Lost Accidently	% Oper. \$ Lost
1980	88	72	1419	0	5.7	0.311	0	\$40,197	\$1,779	2.10
1981	58	28	300	0	1.2	0.062	0	\$15,348	\$487	0.51
1982	48	46	326	0	1.3	0.068	0	\$18,900	\$533	0.50
1983	24	18	121	0	0.5	0.024	0	\$4,100	\$209	0.16
1984	21	17	53	0	0.2	0.010	1	\$48,000	\$187	0.13
1985	63	39	480	0	1.9	0.090	1	\$1,204,500	\$1,899	1.26
1986	90	62	1832	0	7.3	0.348	0	\$28,800	\$2,165	1.42
1987	80	53	884	0	3.5	0.177	1	\$1,054,000	\$2,214	1.33
1988	83	55	621	0	2.5	0.122	0	\$48,100	\$945	0.53
1989	102	74	848	0	3.4	0.158	0	\$30,208	\$1,230	0.63
1990	86	58	1162	0	4.6	0.205	0	\$25,441	\$1,475	0.77
								K\$		
Avg 80-84	47.8	36.2	443.8	0.0	1.78	0.089	0.2	\$25,309	\$639	0.57
Avg 85-89	83.6	56.6	933.0	0.0	3.73	0.179	0.4	\$473,122	\$1,691	1.00
Avg 80-89	65.7	46.4	688.4	0.0	2.75	0.135	0.3	\$249,215	\$1,165	0.83

Table C3. (Cont.)

Fermilab							
Year	Person rem	\$1000 per ManRem	Acc. + Rad. \$ Lost	Acc. + Rad. % Lost	Worker's Comp Costs	Total % Lost	Worker's Comp % of Oper. \$
1980	185	\$185	\$1,964	2.32	\$511.5	2.93	0.605
1981	127	\$127	\$614	0.64	\$174.6	0.82	0.182
1982	116	\$116	\$649	0.61	\$172.5	0.77	0.161
1983	95	\$95	\$304	0.23	\$206.2	0.39	0.156
1984	63	\$63	\$250	0.18	\$30.7	0.20	0.022
1985	72	\$72	\$1,971	1.31	\$94.3	1.37	0.062
1986	70	\$70	\$2,235	1.46	\$255.3	1.63	0.167
1987	58	\$58	\$2,272	1.36	\$377.4	1.59	0.226
1988	40	\$40	\$985	0.55	\$329.4	0.73	0.184
1989	23	\$23	\$1,253	0.64	\$195.9	0.74	0.100
1990	35	\$35	\$1,510	0.79	(\$245.6)	0.66	-0.128
		K\$	K\$		K\$		
Avg 80-84	117	\$117	\$756	0.80	\$219.1	1.02	0.225
Avg 85-89	53	\$53	\$1,743	1.06	\$250.5	1.21	0.148
Avg 80-89	85	\$85	\$1,250	0.93	\$234.8	1.12	0.187

Figure C3.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C3.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C3.3. Total reportable case rate, percent of Laboratory budget spent on safety.

Figure C3.4. Percent of budget lost accidentally, percent of Laboratory budget spent on safety.

Figure C3.5. Percent of operating budget lost by year, including actual accident losses, estimated radiological consequences, and reported worker's compensation expenditures.

C4. Kansas City Plant

The Kansas City Plant is primarily a production facility. It has a very small radiation safety effort. There was a change of contractor, from Bendix to Allied Signal, in 1987; however, it is too early to determine whether the past three years constitute a trend. A Tiger Team appraisal was conducted in November 1989.

Table C4. Kansas City Plant site data.

C-30	Year	TRC r	LWD r	Plant Budget	Safety Budget	\$ %	10*\$%	Plant Staff	Safety Staff	FTE %	10*FTE%
	1980	1.1	1.3	\$285.4	\$0.97	0.34	3.41	6153	18	0.29	2.93
	1981	1.2	2.1	\$343.4	\$1.00	0.29	2.90	6573	17	0.26	2.59
	1982	0.9	1.6	\$402.4	\$1.08	0.27	2.69	6767	19	0.28	2.81
	1983	0.8	6.0	\$457.2	\$1.19	0.26	2.61	7168	19	0.27	2.65
	1984	0.8	3.9	\$481.1	\$1.41	0.29	2.93	7501	19	0.25	2.53
	1985	0.5	1.6	\$520.4	\$1.76	0.34	3.39	7690	20	0.26	2.60
	1986	0.6	5.2	\$517.9	\$2.06	0.40	3.98	7127	19	0.27	2.67
	1987	0.8	1.6	\$508.9	\$1.48	0.29	2.90	6847	18	0.26	2.63
	1988	0.9	2.7	\$627.0	\$2.19	0.35	3.50	6993	20	0.29	2.86
	1989	1.4	5.4	\$588.6	\$3.27	0.56	5.56	6571	26	0.40	3.96
	1990	2.4	9.4	\$541.1	\$4.71	0.87	8.70	6219	35	0.56	5.63
				M\$	M\$						
	Avg 80-84	0.96	2.98	\$393.9	\$1.13	0.29	2.91	6832.4	18.4	0.27	2.70
	Avg 85-89	0.84	3.30	\$552.6	\$2.15	0.39	3.87	7045.6	20.6	0.29	2.94
	Avg 80-89	0.90	3.14	\$473.2	\$1.64	0.34	3.39	6939.0	19.5	0.28	2.82

Table C4. (Cont.)

C-31	Kansas City Plant Year	TRCs	LWCs	LWDs	Fatal Cases	FTEs Lost Accidently	% FTEs Lost	Type A+B Incidents	Property Loss \$	\$s Lost Accidently	% Oper. \$ Lost
	1980	63	7	77	0	0.3	0.005	0	\$5,195	\$222.2	0.08
	1981	74	10	135	0	0.5	0.008	1	\$44,901	\$357.9	0.10
	1982	60	15	103	0	0.4	0.006	1	\$47,384	\$310.4	0.08
	1983	53	11	413	0	1.7	0.023	0	\$12,241	\$553.2	0.12
	1984	60	14	282	0	1.1	0.015	0	\$8,955	\$439.0	0.09
	1985	39	12	123	0	0.5	0.006	0	\$14,336	\$239.3	0.05
	1986	44	12	354	0	1.4	0.020	0	\$47,365	\$513.4	0.10
	1987	49	16	104	0	0.4	0.006	1	\$282,391	\$526.4	0.10
	1988	63	12	180	0	0.7	0.010	0	\$107,035	\$437.0	0.07
	1989	89	16	338	0	1.4	0.021	1	\$233,804	\$791.8	0.13
	1990	144	19	558	0	2.2	0.036	0	\$1,700	\$885.7	0.16
									K\$		
	Avg 80-84	62.0	11.4	202.0	0.0	0.81	0.012	0.4	\$23,735	\$376.54	0.10
	Avg 85-89	56.8	13.6	219.8	0.0	0.88	0.012	0.4	\$136,986	\$501.59	0.09
	Avg 80-89	59.4	12.5	210.9	0.0	0.84	0.012	0.4	\$80,361	\$439.06	0.09

Table C4. (Cont.)

Kansas City Plant Year	Person Rem	\$1000 per ManRem	Acc. + Rad. \$ Lost	Acc. + Rad. % Lost	Worker's Comp costs	Total % Lost	Worker's Comp % of Oper. \$
1980	2	\$2	\$224	0.08	\$28.1	0.09	0.010
1981	4	\$4	\$362	0.11	\$63.0	0.12	0.018
1982	1	\$1	\$311	0.08	\$55.4	0.09	0.014
1983	1	\$1	\$554	0.12	\$107.6	0.14	0.024
1984	4	\$4	\$443	0.09	\$78.5	0.11	0.016
1985	11	\$11	\$250	0.05	\$142.1	0.08	0.027
1986	1	\$1	\$514	0.10	\$295.4	0.16	0.057
1987	0	\$0	\$526	0.10	\$51.2	0.11	0.010
1988	1	\$1	\$438	0.07	\$96.4	0.09	0.015
1989	0	\$0	\$792	0.13	\$127.3	0.16	0.022
1990	0	\$0	\$886	0.16	\$146.0	0.19	0.027
		K\$	K\$		K\$		
Avg 80-84	2.4	\$2	\$379	0.09	\$66.5	0.11	0.016
Avg 85-89	2.6	\$3	\$504	0.09	\$142.5	0.12	0.026
Avg 80-89	2.5	\$3	\$442	0.09	\$104.5	0.11	0.021

Figure C4.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C4.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C4.3. Total reportable case rate, percent of Plant budget spent on safety.

Figure C4.4. Percent of budget lost accidentally, percent of Plant budget spent on safety.

Figure C4.5. Percent of operating budget lost by year, including actual accident losses, estimated radiological consequences, and reported worker's compensation expenditures.

C5. LANL

LANL is a multiprogram national R&D laboratory. The Laboratory was unable to provide safety budget data for 1980 and 1981. The figures used were derived from projections based on following years. There was a Tiger Team appraisal in November 1991. The site was unable to retrieve worker's compensation data prior to 1985.

Table C5. LANL site data.

	Year	TRC r	LWD r	Lab	Safety	\$ %	10*\$%	Lab	Safety	FTE %	10*FTE%
				Budget	Budget			Staff	Staff		
C-39	1980	1.4	7.9	\$383	\$5,750	1.50	15.01	6,836	164	2.40	23.99
	1981	1.5	7.9	\$453	\$6,800	1.50	15.01	7,163	172	2.40	24.01
	1982	1.9	12.9	\$507	\$7,794	1.54	15.37	7,184	178	2.48	24.78
	1983	2.2	17.4	\$552	\$8,392	1.52	15.20	7,104	166	2.34	23.37
	1984	3.0	18.0	\$628	\$7,696	1.23	12.25	7,454	154	2.07	20.66
	1985	5.1	15.9	\$715	\$8,450	1.18	11.82	7,917	160	2.02	20.21
	1986	4.3	8.7	\$786	\$9,934	1.26	12.64	8,011	179	2.23	22.34
	1987	4.1	13.9	\$844	\$11,403	1.35	13.51	7,997	190	2.38	23.76
	1988	2.8	10.4	\$893	\$14,478	1.62	16.21	7,788	205	2.63	26.32
	1989	3.2	15.9	\$917	\$16,798	1.83	18.32	7,811	227	2.91	29.06
	1990	3.6	28.0	\$950	\$22,016	2.32	23.17	7,820	252	3.22	32.23
				M\$	K\$						
	Avg 80-84	2.00	12.82	\$505	\$7,286	1.46	14.57	7,148	167	2.34	23.36
	Avg 85-89	3.90	12.96	\$831	\$12,213	1.45	14.50	7,905	192	2.43	24.34
	Avg 80-89	2.95	12.89	\$668	\$9,750	1.45	14.54	7,527	180	2.39	23.85

Table C5. (Cont.)

C-40	LANL				Fatal	FTEs Lost	% FTEs	Type A+B	Property	\$s Lost	% Oper.
	Year	TRCs	LWCs	LWDs	Cases	Accidently	Lost	Incidents	Loss \$	Accidently	\$ Lost
	1980	99	56	543	0	2.2	0.032	0	\$63,863	\$917	0.239
	1981	116	62	599	0	2.4	0.033	3	\$77,900	\$1,063	0.235
	1982	131	87	895	0	3.6	0.050	2	\$61,590	\$1,413	0.279
	1983	157	85	1251	1	5.0	0.070	1	\$71,000	\$2,816	0.510
	1984	225	114	1362	0	5.4	0.073	1	\$107,355	\$2,157	0.344
	1985	403	142	1259	0	5.0	0.064	0	\$60,793	\$2,410	0.337
	1986	343	115	701	0	2.8	0.035	1	\$59,331	\$1,686	0.215
	1987	323	145	1102	0	4.4	0.055	0	\$106,001	\$2,144	0.254
	1988	222	104	807	0	3.2	0.041	0	\$62,250	\$1,521	0.170
	1989	253	100	1243	0	5.0	0.064	0	\$27,500	\$1,977	0.216
	1990	281	143	2166	0	8.7	0.111	0	\$48,000	\$3,062	0.322
									K\$		
	Avg 80-84	145.6	80.8	930.0	0.2	3.72	0.052	1.4	\$76,342	\$1,673	0.332
	Avg 85-89	308.8	121.2	1022.4	0.0	4.09	0.052	0.2	\$63,175	\$1,948	0.234
	Avg 80-89	227.2	101.0	976.2	0.1	3.90	0.052	0.8	\$69,758	\$1,810	0.271

Table C5. (Cont.)

LANL	Person	\$1000 per	Acc. + Rad.	Acc. + Rad.	Worker's	Total	Worker's Comp
Year	Rem	ManRem	\$ Lost	% Lost	Comp Costs	% Lost	% of Oper. \$
1980	427	\$427	\$1,344	0.35	n/a		
1981	630	\$630	\$1,693	0.37	n/a		
1982	690	\$690	\$2,103	0.41	n/a		
1983	700	\$700	\$3,516	0.64	n/a		
1984	808	\$808	\$2,965	0.47	n/a		
1985	714	\$714	\$3,124	0.44	\$775.0	0.55	0.108
1986	535	\$535	\$2,221	0.28	\$795.2	0.38	0.101
1987	376	\$376	\$2,520	0.30	\$806.8	0.39	0.096
1988	370	\$370	\$1,891	0.21	\$335.8	0.25	0.038
1989	302	\$302	\$2,279	0.25	\$538.7	0.31	0.059
1990	213	\$213	\$3,275	0.34	\$923.1	0.44	0.097
		K\$	K\$		K\$		
Avg 80-84	651	\$651	\$2,324	0.45			
Avg 85-89	459	\$459	\$2,407	0.30	\$650.3	0.37	0.078
Avg 80-89	555	\$555	\$2,366	0.37

Figure C5.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C5.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C5.3. Total reportable case rate, percent of Laboratory budget spent on safety.

Figure C5.4. Percent of budget lost accidentally, percent of Laboratory budget spent on safety.

C6. LBL

LBL is an R&D laboratory, largely accelerator focused. Plant Services were separated out of the Laboratory's safety data population in 1989. Those figures have been integrated back into the totals for this comparison. A Tiger Team appraisal was conducted in January 1991.

Table C6. LBL site data.

	Year	TRC r	LWD r	Lab Budget	Safety Budget	\$ %	10*\$%	Lab Staff	Safety Staff	FTE %	10*FTE%
C47	1980	1.6	15.2	\$144.0	\$2.39	1.66	16.62	2795	58	2.08	20.75
	1981	1.6	17.7	\$144.0	\$2.58	1.79	17.90	2893	60	2.07	20.74
	1982	2.1	26.3	\$138.3	\$1.98	1.43	14.30	2644	40	1.51	15.13
	1983	2.1	22.3	\$143.5	\$2.01	1.40	14.01	2619	41	1.57	15.65
	1984	1.8	18.9	\$165.0	\$2.56	1.55	15.53	2762	43	1.56	15.57
	1985	1.7	16.3	\$168.6	\$2.54	1.51	15.08	2686	40	1.49	14.89
	1986	2.7	26.1	\$169.4	\$2.77	1.64	16.36	2464	40	1.62	16.23
	1987	2.6	25.5	\$174.5	\$3.04	1.74	17.40	2426	46	1.90	18.96
	1988	2.0	16.6	\$183.2	\$3.25	1.78	17.76	2483	46	1.85	18.53
	1989	3.0	10.7	\$193.2	\$3.49	1.81	18.08	2578	47	1.82	18.23
	1990	3.0	27.0	\$196.0	\$4.09	2.09	20.88	2559	49	1.91	19.15
				M\$	M\$						
	Avg 80-84	1.84	20.08	\$147.0	\$2.30	1.57	15.67	2742.6	48.4	1.76	17.57
	Avg 85-89	2.41	19.05	\$177.8	\$3.02	1.69	16.94	2527.4	43.8	1.74	17.37
	Avg 80-89	2.12	19.56	\$162.4	\$2.66	1.63	16.30	2635.0	46.1	1.75	17.47

Table C6. (Cont.)

LBL										
Year	TRCs	LWCs	LWDs	Fatal Cases	FTEs Lost Accidently	% FTEs Lost	Type A+B Incidents	Property Loss \$	\$s Lost Accidently	% Oper. \$ Lost
1980	41	28	382	0	1.5	0.055	1	\$22,867	\$553	0.38
1981	44	29	477	0	1.9	0.066	2	\$0	\$643	0.45
1982	53	35	661	0	2.6	0.100	0	\$0	\$837	0.61
1983	53	34	557	0	2.2	0.085	0	\$10,890	\$742	0.52
1984	47	31	485	0	1.9	0.070	0	\$3,486	\$644	0.39
1985	43	34	411	0	1.6	0.061	0	\$0	\$565	0.34
1986	64	44	618	0	2.5	0.100	0	\$15,100	\$849	0.50
1987	62	42	604	0	2.4	0.100	0	\$20,000	\$832	0.48
1988	50	35	406	0	1.6	0.065	0	\$9,772	\$586	0.32
1989	78	48	277	0	1.1	0.043	0	\$18,300	\$547	0.28
1990	76	62	692	0	2.8	0.108	0	\$114,628	\$1,083	0.55
								K\$		
Avg 80-84	47.6	31.4	512.4	0.0	2.05	0.075	0.6	\$7,449	\$684	0.47
Avg 85-89	59.4	40.6	463.2	0.0	1.85	0.073	0.0	\$12,634	\$676	0.38
Avg 80-89	53.5	36.0	487.8	0.0	1.95	0.074	0.3	\$10,042	\$680	0.42

Table C6. (Cont.)

LBL Year	Person Rem	\$1000 per ManRem	Acc. + Rad. \$ Lost	Acc. + Rad. % Lost	Worker's Comp Costs	Total % Lost	Worker's Comp % of Oper. \$
1980	91	\$91	\$644	0.45	\$258.4	0.63	0.179
1981	31	\$31	\$674	0.47	\$285.4	0.67	0.198
1982	35	\$35	\$872	0.63	\$535.7	1.02	0.387
1983	26	\$26	\$768	0.54	\$653.1	0.99	0.455
1984	38	\$38	\$682	0.41	\$566.8	0.76	0.344
1985	46	\$46	\$611	0.36	\$489.1	0.65	0.290
1986	27	\$27	\$876	0.52	\$582.1	0.86	0.344
1987	30	\$30	\$862	0.49	\$697.2	0.89	0.400
1988	27	\$27	\$613	0.33	\$575.8	0.65	0.314
1989	16	\$16	\$563	0.29	\$573.1	0.59	0.297
1990	14	\$14	\$1,097	0.56	\$803.3	0.97	0.410
		K\$	K\$		K\$		
Avg 80-84	44	\$44	\$728	0.50	\$459.9	0.81	0.313
Avg 85-89	29	\$29	\$705	0.40	\$583.5	0.73	0.328
Avg 80-89	37	\$37	\$717	0.45	\$521.7	0.77	0.321

Figure C6.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C6.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C6.3. Total reportable case rate, percent of Laboratory budget spent on safety.

Figure C6.4. Percent of budget lost accidentally, percent of Laboratory budget spent on safety.

Figure C6.5. Percent of operating budget lost by year, including actual accident losses, estimated radiological consequences, and reported worker's compensation expenditures.

C7. LLNL

LLNL is a multipurpose national R&D laboratory. Plant Engineering (crafts, gardeners, janitors, and other facility support) was separated out of the reporting statistics in 1986. Those figures have been integrated back into the totals for this comparison. The Safety Department provides safety staff to programs on a matrix basis as the programs are willing to pay. These figures are included in this study. The high LWD value noted in 1985 in Fig. C7.1 is thought to be due to an excessive overtime effort to meet a major national milestone. A Tiger Team appraisal was conducted in February 1990.

Table C7. LLNL site data.

	Year	TRC r	LWD r	Lab	Safety	\$ %	10*\$ %	Lab	Safety	FTE %	10*FTE %
				Budget	Budget			Staff	Staff		
C-56	1980	3.0	14.2	\$462.10	\$8.61	1.86	18.63	7017	214.9	3.06	30.63
	1981	2.4	12.6	\$584.90	\$9.10	1.55	15.55	7236	205.4	2.84	28.39
	1982	2.1	13.2	\$618.50	\$9.43	1.52	15.24	7370	194.9	2.64	26.45
	1983	2.2	15.5	\$677.80	\$11.30	1.67	16.67	7450	198.6	2.67	26.66
	1984	2.0	18.7	\$808.50	\$12.73	1.57	15.75	7776	214.5	2.76	27.58
	1985	2.7	36.4	\$888.30	\$14.59	1.64	16.42	8063	237.9	2.95	29.51
	1986	1.4	15.64	\$932.10	\$14.50	1.56	15.55	8020	229.8	2.87	28.65
	1987	1.6	12.68	\$977.40	\$14.67	1.50	15.01	8280	225.4	2.72	27.22
	1988	1.6	15.15	\$999.20	\$14.97	1.50	14.98	8219	209.7	2.55	25.51
	1989	1.5	15.39	\$1,055.60	\$16.01	1.52	15.16	8247	213.8	2.59	25.92
	1990	2.3	22.42	\$1,070.50	\$19.89	1.86	18.58	8128	231.7	2.85	28.51
				M\$	M\$						
	Avg 80-84	2.34	14.84	\$630.36	\$10.23	1.64	16.37	7370	205.66	2.79	27.94
	Avg 85-89	1.74	19.05	\$970.52	\$14.94	1.54	15.42	8166	223.32	2.74	27.36
	Avg 80-89	2.04	16.95	\$800.44	\$12.59	1.59	15.90	7768	214.49	2.77	27.65

Table C7. (Cont.)

	LLNL				Fatal Cases	FTEs lost Accidently	% FTEs Lost	Type A+B Incidents	Property Loss \$	\$s lost Accidently	% Oper. \$ Lost
	Year	TRCs	LWCs	LWDs							
C-57	1980	181	84	863	1	3.5	0.049	1	\$3,512,152	\$5,915	1.280
	1981	156	68	838	2	3.4	0.046	2	\$7,000	\$3,313	0.566
	1982	140	60	885	0	3.5	0.048	2	\$103,900	\$1,409	0.228
	1983	153	99	1066	0	4.3	0.057	0	\$83,991	\$1,654	0.244
	1984	146	116	1346	0	5.4	0.069	2	\$162,636	\$2,053	0.254
	1985	197	167	2681	0	10.7	0.133	2	\$579,534	\$4,009	0.451
	1986	110	88	1254	0	5.0	0.063	1	\$236,470	\$1,896	0.203
	1987	131	98	1050	0	4.2	0.051	1	\$5,000	\$1,523	0.156
	1988	129	97	1245	1	5.0	0.061	1	\$3,477,073	\$6,184	0.619
	1989	123	98	1269	0	5.1	0.062	0	\$5,000	\$1,716	0.163
	1990	189	131	1822	0	7.3	0.090	0	\$0	\$2,462	0.230
									K\$		
	Avg 80-84	155.2	85.4	999.6	0.6	4.0	0.054	1.4	\$773,936	\$2,869	0.455
	Avg 85-89	138.0	109.6	1499.8	0.2	6.0	0.073	1.0	\$860,615	\$3,066	0.316
	Avg 80-89	146.6	97.5	1249.7	0.4	5.0	0.064	1.2	\$817,276	\$2,967	0.371

Table C7. (Cont.)

LLNL Year	Person Rem	\$1000 per ManRem	Acc. + Rad. \$ lost	Acc. + Rad. % Lost	Worker's Comp Costs	Total % Lost	Worker's Comp % of Oper. \$
1980	77	\$77	\$5,992	1.30	\$314	1.36	0.068
1981	78	\$78	\$3,391	0.58	\$424	0.65	0.072
1982	102	\$102	\$1,511	0.24	\$654	0.35	0.106
1983	80	\$80	\$1,734	0.26	\$1,991	0.55	0.294
1984	82	\$82	\$2,135	0.26	\$832	0.37	0.103
1985	63	\$63	\$4,072	0.46	\$1,562	0.63	0.176
1986	62	\$62	\$1,958	0.21	\$1,836	0.41	0.197
1987	28	\$28	\$1,551	0.16	\$1,282	0.29	0.131
1988	28	\$28	\$6,212	0.62	\$1,945	0.82	0.195
1989	34	\$34	\$1,750	0.17	\$1,845	0.34	0.175
1990	28	\$28	\$2,490	0.23	\$1,734	0.39	0.162
		K\$	K\$		K\$		
Avg 80-84	84	\$84	\$2,953	0.47	\$843	0.60	0.134
Avg 85-89	43	\$43	\$3,109	0.32	\$1,694	0.49	0.175
Avg 80-89	63	\$63	\$3,031	0.38	\$1,269	0.54	0.158

Figure C7.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C7.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C7.3. Total reportable case rate, percent of Laboratory budget spent on safety.

Figure C7.4. Percent of budget lost accidentally, percent of Laboratory budget spent on safety.

Figure C7.5. Percent of operating budget lost by year, including actual accident losses, estimated radiological consequences, and reported worker's compensation expenditures.

C8. Mound

Mound is primarily a production facility with some R&D. It separated security performance figures out of the general site statistics in 1987. There was a change of contractor, from Monsanto to EG&G, in 1988. A Tiger Team appraisal was conducted in October 1989. The insurance carrier was unwilling to provide worker's compensation expenditure data.

Table C8. Mound site data.

Year	TRC r	LWD r	Plant Budget	Safety Budget	\$ %	10*\$%	Lab Staff	Safety Staff	FTE %	10*FTE%
1980	0.3	0.0	\$75.6	\$2.24	2.96	29.58	1840	62	3.37	33.70
1981	0.8	5.2	\$90.2	\$2.52	2.79	27.89	1952	58	2.97	29.71
1982	0.6	2.5	\$118.3	\$2.58	2.18	21.81	2104	54	2.57	25.67
1983	0.7	3.4	\$130.5	\$2.66	2.04	20.36	2207	55	2.49	24.92
1984	0.7	7.8	\$162.0	\$4.24	2.62	26.17	2348	70	2.98	29.81
1985	0.8	2.7	\$172.2	\$3.84	2.23	22.32	2423	65	2.68	26.83
1986	0.4	3.0	\$177.7	\$3.27	1.84	18.39	2357	61	2.59	25.88
1987	0.6	4.7	\$175.1	\$5.18	2.96	29.58	2281	128	5.61	56.12
1988	0.5	6.9	\$177.4	\$7.51	4.23	42.34	2212	134	6.06	60.58
1989	0.8	12.3	\$171.8	\$5.23	3.04	30.44	2161	107	4.95	49.51
1990	0.7	6.8	\$170.3	\$7.69	4.52	45.15	2205	116	5.26	52.61
			M\$	M\$						
Avg 80-84	0.62	3.78	\$115.3	\$2.85	2.52	25.16	2090.2	59.8	2.88	28.76
Avg 85-89	0.62	5.92	\$174.8	\$5.01	2.86	28.61	2286.8	99.0	4.38	43.78
Avg 80-89	0.62	4.85	\$145.1	\$3.93	2.69	26.89	2188.5	79.4	3.63	36.27

Table C8. (Cont.)

Mound				Fatal	FTEs Lost	% FTEs	Type A+B	Property	\$s Lost	% Oper.	
	Year	TRCs	LWCs	LWDs	Cases	Accidently	Lost	Incidents	Loss \$	Accidently	\$ Lost
C-66	1980	6	0	0	0.0	0.0	0.000	1	\$10,212	\$32.2	0.04
	1981	16	4	101	0.0	0.4	0.021	0	\$8,333	\$149.3	0.17
	1982	14	4	56	0.0	0.2	0.011	0	\$69,539	\$161.5	0.14
	1983	16	7	81	0.0	0.3	0.015	0	\$24,160	\$151.2	0.12
	1984	18	11	203	0.0	0.8	0.035	0	\$19,650	\$280.7	0.17
	1985	22	8	71	0.0	0.3	0.012	0	\$25,603	\$156.6	0.09
	1986	11	4	74	0.0	0.3	0.013	0	\$3,525	\$107.5	0.06
	1987	15	6	110	1.0	0.4	0.019	1	\$10,981	\$1,173.0	0.67
	1988	12	4	157	0.0	0.6	0.028	0	\$1,500	\$190.5	0.11
	1989	16	6	260	0.0	1.0	0.048	2	\$38,753	\$362.8	0.21
	1990	16	8	149	0.0	0.6	0.027	0	\$28,003	\$225.0	0.13
									K\$		
	Avg 80-84	14.0	5.2	88.2	0.0	0.35	0.017	0.2	\$26,379	\$155.0	0.13
	Avg 85-89	15.2	5.6	134.4	0.2	0.54	0.024	0.6	\$16,072	\$198.1	0.11
	Avg 80-89	14.6	5.4	111.3	0.1	0.45	0.020	0.4	\$21,226	\$176.5	0.12

Table C8. (Cont.)

Mound	Person	\$1000 per	Acc. + Rad.	Acc. + Rad.	Worker's
Year	Rem	ManRem	\$ Lost	% Lost	Comp Costs
1980	71	\$71	\$103	0.14	n/a
1981	97	\$97	\$246	0.27	n/a
1982	100	\$100	\$262	0.22	n/a
1983	115	\$115	\$266	0.20	n/a
1984	144	\$144	\$425	0.26	n/a
1985	211	\$211	\$368	0.21	n/a
1986	151	\$151	\$259	0.15	n/a
1987	59	\$59	\$1,232	0.70	n/a
1988	65	\$65	\$256	0.14	n/a
1989	21	\$21	\$384	0.22	n/a
1990	4	\$4	\$229	0.13	n/a
		K\$	K\$		
Avg 80-84	105	\$105	\$260	0.22	
Avg 85-89	101	\$101	\$499	0.29	
Avg 80-89	103	\$103	\$380	0.25

Figure C8.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C8.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C8.3. Total reportable case rate, percent of Laboratory budget spent on safety.

Figure C8.4. Percent of budget lost accidentally, percent of Laboratory budget spent on safety.

C9. ORNL

ORNL is a multiprogram national R&D laboratory. There was a change of contractor, from Union Carbide to Martin Marietta, in 1984. The safety performance values used here are those supplied by EG&G Management Information System reports. A Tiger Team appraisal was conducted in November 1990.

Table C9. ORNL site data.

	Year	TRC r	LWD r	Lab Budget	Safety Budget	\$ %	10*\$%	Lab Staff	Safety Staff	FTE %	10*FTE%
C-73	1980	1.0	9.6	\$329.8	\$3.87	1.17	11.75	5185	102.6	1.98	19.79
	1981	1.0	3.6	\$350.0	\$4.50	1.29	12.85	5183	99.9	1.93	19.27
	1982	0.6	5.2	\$347.7	\$4.55	1.31	13.08	4834	95.9	1.98	19.84
	1983	0.6	4.4	\$351.0	\$4.50	1.28	12.82	4562	88.6	1.94	19.42
	1984	0.7	9.3	\$381.6	\$5.02	1.32	13.15	4617	92.0	1.99	19.93
	1985	0.3	2.0	\$417.5	\$4.89	1.17	11.72	4416	92.2	2.09	20.88
	1986	0.4	5.8	\$478.0	\$4.86	1.02	10.16	4238	90.2	2.13	21.28
	1987	0.4	0.0	\$461.2	\$6.39	1.38	13.85	4399	100.4	2.28	22.82
	1988	0.6	0.7	\$451.8	\$8.09	1.79	17.90	4449	116.6	2.62	26.21
	1989	0.6	3.0	\$471.1	\$10.80	2.29	22.93	4618	146.3	3.17	31.68
	1990	2.5	11.0	\$509.7	\$17.89	3.51	35.09	4618	206.9	4.48	44.80
				M\$	M\$						
	Avg 80-84	0.78	6.42	\$352.0	\$4.49	1.27	12.73	4876.2	95.8	1.96	19.65
	Avg 85-89	0.46	2.30	\$455.9	\$7.00	1.53	15.31	4424.0	109.1	2.46	24.57
	Avg 80-89	0.62	4.36	\$404.0	\$5.75	1.40	14.02	4650.1	102.5	2.21	22.11

Table C9. (Cont.)

	ORNL			Fatal Cases	FTEs Lost Accidently	% FTEs Lost	Type A+B Incidents	Property Loss \$	\$s Lost Accidently	% Oper. \$ Lost
	Year	TRCs	LWCs							
C-74	1980	41	17	409	0	1.6	0.032	1	\$3,500	\$539 0.16
	1981	41	13	155	0	0.6	0.012	0	\$190,898	\$454 0.13
	1982	24	7	211	0	0.8	0.017	0	\$0	\$273 0.08
	1983	24	6	172	0	0.7	0.015	0	\$0	\$232 0.07
	1984	27	5	366	0	1.5	0.032	0	\$0	\$430 0.11
	1985	11	2	80	0	0.3	0.007	1	\$5,000	\$121 0.03
	1986	17	4	226	0	0.9	0.021	2	\$84,010	\$372 0.08
	1987	17	0	0	0	0.0	0.000	0	\$1,842	\$36 0.01
	1988	25	5	31	0	0.1	0.003	0	\$42,989	\$134 0.03
	1989	26	6	132	0	0.5	0.011	0	\$15,650	\$212 0.04
	1990	110	35	493	1	2.0	0.043	0	\$43,993	\$1,827 0.36
									K\$	
	Avg 80-84	31.4	9.6	262.6	0.0	1.05	0.022	0.2	\$38,880	\$385 0.11
	Avg 85-89	19.2	3.4	93.8	0.0	0.38	0.008	0.6	\$29,898	\$175 0.04
	Avg 80-89	25.3	6.5	178.2	0.0	0.71	0.015	0.4	\$34,389	\$280 0.07

Table C9. (Cont.)

ORNL							
Year	Person rem	\$1000 per ManRem	Acc. + Rad. \$ Lost	Acc. + Rad. % Lost	Worker's Comp Costs	Total % Lost	Worker's Comp % of Oper. \$
1980	205	\$205	\$744	0.23	\$131.3	0.27	0.040
1981	188	\$188	\$642	0.18	\$274.7	0.26	0.078
1982	154	\$154	\$427	0.12	\$89.4	0.15	0.026
1983	170	\$170	\$402	0.11	\$95.4	0.14	0.027
1984	157	\$157	\$587	0.15	\$107.8	0.18	0.028
1985	115	\$115	\$236	0.06	\$187.7	0.10	0.045
1986	136	\$136	\$508	0.11	\$241.8	0.16	0.051
1987	148	\$148	\$184	0.04	\$361.4	0.12	0.078
1988	75	\$75	\$209	0.05	\$361.1	0.13	0.080
1989	41	\$41	\$253	0.05	\$295.7	0.12	0.063
1990	29	\$29	\$1,856	0.36	\$344.3	0.43	0.068
		K\$	K\$		K\$		
Avg 80-84	175	\$175	\$560	0.16	\$139.72	0.20	0.040
Avg 85-89	103	\$103	\$278	0.06	\$289.54	0.12	0.064
Avg 80-89	139	\$139	\$419	0.11	\$214.63	0.16	0.053

Figure C9.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C9.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C9.3. Total reportable case rate, percent of Laboratory budget spent on safety.

Figure C9.4. Percent of budget lost accidentally, percent of Laboratory budget spent on safety.

Figure C9.5. Percent of operating budget lost by year, including actual accident losses, estimated radiological consequences, and reported worker's compensation expenditures.

C10. Pantex

Pantex is primarily a production facility. The site indicates that it has made no change in its OSHA reporting practices, but it believes that the change in occurrence rate is due largely to the effects of a layoff and contract negotiations on morale. A Tiger Team appraisal was conducted in October 1989. The contractor changed insurance carriers in 1981 and was unable to obtain worker's compensation data prior to that date.

Table C10. Pantex site data.

Year	TRC r	LWD r	Plant Budget	Safety Budget	\$ %	10*\$ %	Plant Staff	Safety Staff	FTE %	10*FTE %
1980	1.00	7.70	\$65,686	\$1,367	2.08	20.81	2165	37	1.71	17.09
1981	1.30	17.30	\$80,025	\$1,435	1.79	17.93	2280	39	1.71	17.11
1982	1.60	6.10	\$102,492	\$1,733	1.69	16.91	2413	45	1.86	18.65
1983	2.20	10.60	\$111,023	\$1,974	1.78	17.78	2583	47	1.82	18.20
1984	1.00	8.00	\$123,158	\$2,098	1.70	17.04	2668	47	1.76	17.62
1985	1.30	20.60	\$136,665	\$2,474	1.81	18.10	2777	50	1.80	18.01
1986	1.00	23.90	\$141,349	\$2,606	1.84	18.44	2844	53	1.86	18.64
1987	0.50	7.30	\$141,258	\$2,867	2.03	20.30	2705	55	2.03	20.33
1988	1.30	40.40	\$151,840	\$5,811	3.83	38.27	2662	61	2.29	22.92
1989	3.90	143.30	\$152,441	\$8,709	5.71	57.13	2604	78	3.00	29.95
1990	5.80	108.30	\$162,943	\$13,294	8.16	81.59	2572	105	4.08	40.82
			K\$	K\$						
Avg 80-84	1.42	9.94	\$96,477	\$1,721	1.81	18.09	2422	43.0	1.77	17.73
Avg 85-89	1.60	47.10	\$144,711	\$4,493	3.04	30.45	2718	59.4	2.20	21.97
Avg 80-89	1.51	28.52	\$120,594	\$3,107	2.43	24.27	2570	51.2	1.98	19.85

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Table C10. (Cont.)

	Pantex				FTEs Lost	% FTEs	Type A+B	Property	\$s Lost	% Oper.	
	Year	TRCs	LWCs	LWDs	Fatalities	Accidently	Lost	Incidents	Loss \$	Accidently	\$ Lost
C-83	1980	20	6	155	0	0.6	0.029	1	\$5,356	\$222	0.339
	1981	27	12	350	0	1.4	0.061	0	\$4,871	\$433	0.541
	1982	37	5	139	0	0.6	0.023	0	\$5,952	\$229	0.223
	1983	54	20	255	0	1.0	0.039	0	\$67,167	\$470	0.423
	1984	26	12	201	0	0.8	0.030	1	\$2,546,000	\$2,833	2.300
	1985	34	20	539	0	2.2	0.078	0	\$0	\$647	0.473
	1986	22	16	549	0	2.2	0.077	0	\$0	\$625	0.442
	1987	11	5	156	0	0.6	0.023	1	\$31,168	\$229	0.162
	1988	26	15	832	0	3.3	0.125	1	\$571,900	\$1,496	0.985
	1989	74	48	2751	0	11.0	0.423	1	\$699,000	\$3,704	2.430
	1990	104	58	1946	0	7.8	0.303	0	\$59,893	\$2,330	1.430
									K\$		
Avg 80-84	32.8	11.0	220.0	0.0	0.88	0.036	0.4	\$525,869	\$837	0.868	
Avg 85-89	33.4	20.8	965.4	0.0	3.86	0.142	0.6	\$260,414	\$1,340	0.926	
Avg 80-89	33.1	15.9	592.7	0.0	2.37	0.092	0.5	\$393,141	\$1,089	0.903	

Table C10. (Cont.)

Pantex							
Year	Person Rem	\$1,000 per ManRem	Acc. + Rad. \$ Lost	Acc. + Rad. % Lost	Worker's Comp Costs	Total % Lost	Worker's Comp % of Oper. \$
1980	157	\$157	\$379	0.58	n/a		
1981	211	\$211	\$644	0.80	n/a		
1982	113	\$113	\$342	0.33	\$268	0.60	0.26
1983	117	\$117	\$587	0.53	\$337	0.83	0.30
1984	154	\$154	\$2,987	2.43	\$394	2.74	0.32
1985	141	\$141	\$788	0.58	\$359	0.84	0.26
1986	97	\$97	\$722	0.51	\$840	1.11	0.59
1987	36	\$36	\$265	0.19	\$1,083	0.95	0.77
1988	26	\$26	\$1,522	1.00	\$1,063	1.70	0.70
1989	34	\$34	\$3,738	2.45	\$1,719	3.58	1.13
1990	24	\$24	\$2,354	1.44	\$533	1.77	0.33
		K\$	\$K		\$K		
Avg 80-84	150	\$150	\$988	0.93			
Avg 85-89	67	\$67	\$1,407	0.95	\$1,013	1.64	0.69
Avg 80-89	109	\$109	\$1,197	0.94			

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Figure C10.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Pantex

Figure C10.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C10.3. Total reportable case rate, percent of Plant budget spent on safety.

Figure C10.4. Percent of budget lost accidentally, percent of Plant budget spent on safety.

C11. Pinellas

Pinellas is primarily a production facility. Worker's compensation data is unavailable prior to 1986. The site changed its managing contractor in 1992.

Table C11. Pinellas site data.

C-80	Year	TRC r	LWD r	Plant Budget	Safety Budget	\$ %	10*\$%	Plant Staff	Safety Staff	FTE %	10*FTE%
	1980	0.40	1.50	\$57.6	\$0.25	0.43	4.29	1521	9	0.59	5.92
	1981	0.20	0.00	\$67.7	\$0.29	0.42	4.22	1586	9	0.57	5.67
	1982	0.30	0.00	\$86.6	\$0.35	0.40	4.04	1745	9	0.52	5.16
	1983	0.40	5.90	\$99.6	\$0.45	0.45	4.49	1849	11	0.59	5.95
	1984	0.30	4.60	\$111.4	\$0.56	0.50	5.00	1909	12	0.63	6.29
	1985	0.50	8.30	\$119.5	\$0.99	0.83	8.26	1980	14	0.71	7.07
	1986	0.30	0.90	\$119.2	\$0.93	0.78	7.83	1973	14	0.71	7.10
	1987	1.60	10.10	\$118.5	\$0.97	0.82	8.18	1875	13	0.69	6.93
	1988	3.00	6.50	\$119.7	\$1.47	1.22	12.25	1710	22	1.29	12.87
	1989	2.30	22.30	\$119.3	\$1.53	1.28	12.80	1701	20	1.18	11.76
	1990	5.00	28.10	\$123.9	\$1.80	1.46	14.56	1671	22	1.32	13.17
				M\$	M\$						
Avg 80-84		0.32	2.40	\$84.6	\$0.38	0.44	4.41	1722.0	10.0	0.58	5.80
Avg 85-89		1.54	9.62	\$119.2	\$1.18	0.99	9.86	1847.8	16.6	0.91	9.14
Avg 80-89		0.93	6.01	\$101.9	\$0.78	0.71	7.14	1784.9	13.3	0.75	7.47

Table C11. (Cont.)

Pinellas

Year	TRCs	LWCs	LWDs	Fatal	FTEs Lost Accidently	% FTEs Lost	Type A+B Incidents	Property Loss \$	\$s Lost Accidently	% Oper. \$ Lost
1980	6	2	24	0	0.1	0.006	0	\$0	\$40	0.07
1981	3	0	0	0	0.0	0.000	0	\$0	\$6	0.01
1982	6	0	0	0	0.0	0.000	0	\$14,147	\$26	0.03
1983	8	6	113	0	0.5	0.024	1	\$158,300	\$309	0.31
1984	6	5	93	0	0.4	0.019	1	\$234,747	\$360	0.32
1985	11	7	175	0	0.7	0.035	0	\$4,100	\$215	0.18
1986	5	4	17	0	0.1	0.003	0	\$3,300	\$38	0.03
1987	33	10	203	0	0.8	0.043	0	\$39,300	\$328	0.28
1988	48	6	106	0	0.4	0.025	0	\$8,457	\$222	0.19
1989	38	13	364	0	1.5	0.086	0	\$25,183	\$491	0.41
1990	79	22	442	0	1.8	0.106	0	\$3,800	\$648	0.52
								K\$		
Avg 80-84	5.8	2.6	46.0	0.0	0.18	0.011	0.4	\$81,439	\$148	0.18
Avg 85-89	27.0	8.0	173.0	0.0	0.69	0.037	0.0	\$16,068	\$259	0.22
Avg 80-89	16.4	5.3	109.5	0.0	0.44	0.025	0.2	\$48,753	\$204	0.20

Table C11. (Cont.)

Pinellas		Safety Budget	Person rem	\$1,000 per ManRem	Acc. + Rad. \$ Lost	Acc. + Rad. % Lost	Worker's Comp. Costs	Total % Lost	Worker's Comp. % of Oper. \$
Year									
1980		\$247	1 1	\$11	\$51	0.09	n/a		
1981		\$286	1 1	\$11	\$17	0.03	n/a		
1982		\$350	7	\$7	\$33	0.04	n/a		
1983		\$447	9	\$9	\$318	0.32	n/a		
1984		\$557	9	\$9	\$369	0.33	n/a		
1985		\$987	9	\$9	\$224	0.19	n/a		
1986		\$933	4	\$4	\$42	0.04	\$23.2	0.05	0.019
1987		\$969	2	\$2	\$330	0.28	\$46.7	0.32	0.039
1988		\$1,466	1	\$1	\$223	0.19	\$30.9	0.21	0.026
1989		\$1,527	1	\$1	\$492	0.41	\$27.8	0.44	0.023
1990		\$1,804	2	\$2	\$650	0.52	\$153.2	0.65	0.124
		K\$		\$K	\$K		\$K		
Avg 80-84		\$377	9.4	\$9	\$158	0.19			
Avg 85-89		\$1,176	3.4	\$3	\$262	0.22			
Avg 80-89		\$777	6.4	\$6	\$210	0.21			

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Figure C11.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C11.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C11.3. Total reportable case rate, percent of Plant budget spent on safety.

Figure C11.4. Percent of budget lost accidentally, percent of Plant budget spent on safety.

C12. Sandia

Sandia is a multiprogram national R&D laboratory. It hired additional safety staff in 1988 and found that it had been under-reporting injuries and LWD. Its improved reporting has come about by establishing better reporting ties with medical and payroll. The step increase is obvious in Fig. C12.1. The site separated security figures in 1987. A Tiger Team appraisal was conducted in May 1991. No worker's compensation data is available prior to 1986.

Table C12. Sandia site data.

	Year	TRC r	LWD r	Lab Budget	Safety Budget	\$ %	10* \$ %	Lab Staff	Safety Staff	FTE %	10*FTE %
C-98	1980	1.3	8.2	\$515	\$2.35	0.46	4.57	6792	60	0.88	8.83
	1981	1.2	5.7	\$593	\$2.65	0.45	4.48	6935	58	0.84	8.36
	1982	1.2	10.6	\$659	\$2.94	0.45	4.46	6862	56	0.82	8.16
	1983	1.2	7.2	\$732	\$3.71	0.51	5.06	7024	58	0.83	8.26
	1984	1.4	9.2	\$848	\$4.43	0.52	5.22	7326	58	0.79	7.92
	1985	1.6	5.2	\$908	\$4.10	0.45	4.52	7178	51	0.71	7.11
	1986	1.4	7.8	\$956	\$3.84	0.40	4.02	7216	49	0.68	6.79
	1987	1.0	8.1	\$1,032	\$4.40	0.43	4.27	7317	49	0.67	6.70
	1988	0.8	6.4	\$1,056	\$4.75	0.45	4.50	7298	55	0.75	7.54
	1989	1.3	23.9	\$1,058	\$5.06	0.48	4.78	7382	58	0.79	7.86
	1990	4.0	25.1	\$1,086	\$8.90	0.82	8.19	7631	69	0.90	9.04
				M\$	M\$						
	Avg 80-84	1.26	8.18	\$669	\$3.22	0.48	4.76	6987.8	58.0	0.83	8.31
	Avg 85-89	1.22	10.28	\$1,002	\$4.43	0.44	4.42	7278.2	52.4	0.72	7.20
	Avg 80-89	1.24	9.23	\$836	\$3.82	0.46	4.59	7133.0	55.2	0.78	7.75

Table C12. (Cont.)

Sandia				Fatal	FTEs Lost	% FTEs	Type A+B	Property	\$s Lost	% Oper.	
Year	TRCs	LWCs	LWDs	Cases	Accidently	Lost	Incidents	Loss \$	Accidently	\$ Lost	
C-99	1980	88	55	560	0	2.2	0.033	0	\$664,532	\$1,511	0.293
	1981	84	51	399	0	1.6	0.023	0	\$12,280	\$681	0.115
	1982	85	62	778	0	3.1	0.045	0	\$40,000	\$1,112	0.169
	1983	88	67	530	0	2.1	0.030	1	\$24,400	\$874	0.119
	1984	106	73	689	0	2.8	0.038	1	\$255,614	\$1,313	0.155
	1985	119	75	397	0	1.6	0.022	0	\$10,800	\$796	0.088
	1986	105	76	595	0	2.4	0.033	0	\$24,000	\$981	0.103
	1987	77	41	607	0	2.4	0.033	3	\$65,052	\$938	0.091
	1988	58	41	472	0	1.9	0.026	0	\$21,002	\$691	0.065
	1989	96	70	1781	0	7.1	0.097	2	\$98,990	\$2,232	0.211
	1990	312	131	1957	0	7.8	0.103	0	\$38,918	\$2,882	0.265
										K\$	
Avg 80-84	90.2	61.6	591.2	0.0	2.4	0.034	0.4	\$199,365	\$1,098	0.16	
Avg 85-89	91.0	60.6	770.4	0.0	3.1	0.042	1.0	\$43,969	\$1,128	0.11	
Avg 80-89	90.6	61.1	680.8	0.0	2.7	0.038	0.7	\$121,667	\$1,113	0.13	

Table C12. (Cont.)

Sandia		Person	\$1000 per	Acc. + Rad.	Acc. + Rad.	Worker's	Total	Worker's Comp.
Year	Rem	ManRem	\$ Lost	% Lost	Comp Costs	% Lost	% of Oper. \$	
1980	9.2	\$92	\$1,603	0.31	n/a			
1981	6.7	\$67	\$748	0.13	n/a			
1982	11.7	\$117	\$1,229	0.19	n/a			
1983	10.8	\$108	\$982	0.13	n/a			
1984	7.4	\$74	\$1,387	0.16	n/a			
1985	6.8	\$68	\$864	0.10	n/a			
1986	5.0	\$50	\$1,031	0.11	\$381.3	0.15	0.040	
1987	5.4	\$54	\$992	0.10	\$607.5	0.16	0.059	
1988	5.6	\$56	\$747	0.07	\$566.5	0.12	0.054	
1989	3.8	\$38	\$2,270	0.21	\$794.2	0.29	0.075	
1990	3.3	\$33	\$2,915	0.27	\$408.9	0.31	0.038	
		K\$	K \$		K\$			
Avg 80-84	9.2	\$92	\$1,190	0.18				
Avg 85-89	5.3	\$53	\$1,181	0.12				
Avg 80-89	7.2	\$72	\$1,185	0.15

Figure C12.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C12.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C12.3. Total reportable case rate, percent of Laboratory budget spent on safety.

Figure C12.4. Percent of budget lost accidentally, percent of Laboratory budget spent on safety.

C13. Y-12

Y-12 is primarily a production facility. There was a change of managing contractor, from Union Carbide to Martin Marietta, in 1984. Y-12 went to full BLS reporting in 1990, but a single year is too early to determine whether a step change has occurred. Values for 1991 were reported to be lower than for 1990, but still higher than the previous trend. A Tiger Team appraisal was conducted in September 1989. The site was unable to obtain worker's compensation data prior to 1982.

Table C13. Y-12 site data.

C-106	Year	TRC r	LWD r	Plant Budget	Safety Budget	\$ %	10*\$%	Plant Staff	Safety Staff	FTE %	10*FTE%
	1980	1.2	1.3	\$161.8	\$1.62	1.00	10.02	4258	28	0.66	6.58
	1981	0.9	5.2	\$218.1	\$2.78	1.27	12.74	4739	25	0.53	5.28
	1982	1.0	2.1	\$294.9	\$5.36	1.82	18.16	6097	61	1.00	10.00
	1983	1.1	5.5	\$330.9	\$5.93	1.79	17.93	6262	64	1.02	10.22
	1984	0.8	1.0	\$377.5	\$6.21	1.65	16.46	6369	74	1.16	11.62
	1985	1.2	4.4	\$436.5	\$6.54	1.50	14.99	6440	76	1.18	11.80
	1986	1.0	6.1	\$464.7	\$6.29	1.35	13.53	6285	80	1.27	12.73
	1987	1.1	3.1	\$448.5	\$5.50	1.23	12.26	6118	85	1.39	13.89
	1988	0.9	7.9	\$501.1	\$8.04	1.60	16.04	5809	102	1.76	17.56
	1989	1.2	19.1	\$529.4	\$11.86	2.24	22.39	5919	130	2.20	21.96
	1990	6.5	92.0	\$549.9	\$19.31	3.51	35.11	5585	196	3.51	35.09
				M\$	M\$						
	Avg 80-84	1.00	3.02	\$276.64	\$4.38	1.51	15.06	5545.0	50.4	0.87	8.74
	Avg 85-89	1.08	8.12	\$476.05	\$7.64	1.58	15.84	6114.2	94.6	1.56	15.59
	Avg 80-89	1.04	5.57	\$376.35	\$6.01	1.55	15.45	5829.6	72.5	1.22	12.16

Table C13. (Cont.)

C-107	Y-12			Fatal Cases	FTEs Lost Accidently	% FTEs Lost	Type A+B Incidents	Property Loss \$	\$s Lost Accidently	% Oper. \$ Lost	
	Year	TRCs	LWCs								LWDs
	1980	80	7	81	0	0.3	0.008	1	\$203,760	\$469	0.29
	1981	53	10	322	0	1.3	0.027	0	\$9,500	\$458	0.21
	1982	66	5	145	0	0.6	0.010	0	\$18,058	\$305	0.10
	1983	76	11	386	0	1.5	0.025	0	\$42,804	\$603	0.18
	1984	55	5	69	0	0.3	0.004	0	\$53,000	\$242	0.06
	1985	91	17	329	0	1.3	0.020	3	\$30,542	\$606	0.14
	1986	66	8	422	0	1.7	0.027	0	\$91,648	\$662	0.14
	1987	63	5	180	0	0.7	0.012	0	\$22,414	\$338	0.08
	1988	61	15	515	0	2.1	0.035	0	\$126,936	\$794	0.16
	1989	73	32	1203	0	4.8	0.081	0	\$186,281	\$1,599	0.30
	1990	387	100	5497	0	22.0	0.394	0	\$129,606	\$6,601	1.20
									K\$		
	Avg 80-84	66.0	7.6	200.6	0.0	0.80	0.014	0.2	\$65,424	\$415	0.15
Avg 85-89	70.8	15.4	529.8	0.0	2.12	0.035	0.6	\$91,564	\$800	0.17	
Avg 80-89	68.4	11.5	365.2	0.0	1.46	0.025	0.4	\$78,494	\$607	0.16	

Table C13. (Cont.)

Y-12 Year	Person REM	\$1000 per ManRem	Acc. + Rad. \$ Lost	Acc. + Rad. % Lost	Worker's Comp Costs	Total % Lost	Worker's Comp % of Oper. \$
1980	42	\$42	\$511	0.32	n/a		
1981	53	\$53	\$511	0.23	n/a		
1982	67	\$67	\$372	0.13	\$160.3	0.18	0.054
1983	46	\$46	\$649	0.20	\$356.9	0.30	0.108
1984	63	\$63	\$305	0.08	\$701.8	0.27	0.186
1985	50	\$50	\$656	0.15	\$746.0	0.32	0.171
1986	198	\$198	\$860	0.18	\$1,101.6	0.42	0.237
1987	103	\$103	\$441	0.10	\$1,188.5	0.36	0.265
1988	76	\$76	\$870	0.17	\$1,350.9	0.44	0.270
1989	71	\$71	\$1,670	0.32	\$1,599.1	0.62	0.302
1990	31	\$31	\$6,632	1.21	\$1,717.9	1.52	0.312
		K\$	K\$		K\$		
Avg 80-84	54	\$54	\$469	0.19			
Avg 85-89	100	\$100	\$899	0.18	1197.22	0.43	0.251
Avg 80-89	77	\$77	\$684	0.19

Figure C13.1. Lost workdays per 200k man-hr, 10 times safety budget percentage.

Figure C13.2. Lost workdays per 200k man-hr, 10 times safety manpower percentage.

Figure C13.3. Total reportable case rate, percent of Plant budget spent on safety.

Figure C13.4. Percent of budget lost accidentally, percent of Plant budget spent on safety.

END

DATE
FILMED
5/3/94