Trends in Electrical Injury, 1992-2002

Paper No. PCIC- PH-083

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Abstract **- This paper updates an earlier report by the authors that studied electrical injuries from 1992 to 1998. The previous information is expanded and supplemented with fatal and nonfatal injury rates and trends through 2002. Injury numbers and rates were used to compare and trend electrical injury experience for various groups and categories. This information allowed identification of at-risk groups that could most benefit from effective electrical safety interventions. The data presented in this paper are derived from the U.S. Labor Department's Bureau of Labor Statistics' Census of Fatal Occupational Injuries (CFOI), Survey of Occupational Illnesses and Injuries (SOII) and Current Population Survey (CPS). Between 1992 and 2002, 3,378 workers died from on-the-job electrical injuries. Electricity remained the sixth leading cause of injury-related occupational death. From 1999 through 2002, 4.7% of all occupational deaths were caused by electricity, down from 5.2% in the 1992 to 1998 time period. The cause of death was listed as electrocution in 99.1% of fatal cases. Contact with overhead power lines was involved in 42% of all on-the-job electrical deaths. The construction industry accounted for 47% of all electrical deaths between 1992 and 2002, but showed overall improvement from 1995 through 2002 by reducing its electrical fatality rate from 2.2 to 1.5 per 100,000 workers. An additional 46,598 workers were nonfatally injured by electricity. Contact with electric current of machine, tool, appliance, or light fixture and contact with wiring, transformers, or other electrical components accounted for 36% and 34% of nonfatal electrical injuries, respectively. Contact with underground, buried power lines was involved with 1% of fatal injuries and 2% of nonfatal injuries. NIOSH research aimed at evaluating commercially available overhead power line proximity warning alarms is described. This research is expected to be the initial step for eventual development of a performance standard for such systems.**

Index Terms- electrical safety, electrocution, electrical injury, electrical burn, electrical shock, injury rate, fatality rate

I. INTRODUCTION [1]

Electrical accidents continue to be a significant cause of on-the-job death in U.S. industries. An earlier report by the authors [1] examined both fatal and nonfatal occupational electrical accidents for the period 1992 to 1998. This paper updates that original work by including more recent fatal and nonfatal electrical injury data, and supplementing it with injury rates and trends. Injury numbers and rates were used to compare and trend electrical injury experience for various groups and categories. This information allowed identification of at-risk groups that could most benefit from effective electrical safety interventions.

A. Data Sources

The fatality data presented in this paper are derived from the U.S. Labor Department's Bureau of Labor Statistics' (BLS) Census of Fatal Occupational Injuries (CFOI).[2] For the years between 1992 and 2002, CFOI reports 67,373 occupational fatalities. The database includes incident narratives, the source of injury, the victim's occupation, location of the incident, work activity at the time of the incident, and other details. Each case is verified through at least two documents such as a death certificate, news account, or police report. CFOI fatality numbers include fatal injuries to all workers, but exclude deaths from the September 11, 2001 terrorist attacks. Employment data used in this paper to compute fatal injury rates are taken from the BLS Current Population Survey (CPS).[3] CPS data represent civilian workers 16 years old or older.

Nonfatal electrical injury data in this paper are derived from the BLS Survey of Occupational Illnesses and Injuries (SOII). SOII provides an estimate of the nonfatal occupational injuries and illnesses that cause days away from work in the U.S. each year. SOII is a cooperative program in which employer survey reports are collected and processed by state agencies cooperating with the BLS. In 2002 for example, 182,000 business establishments were surveyed, representing nearly the entire U.S. private economy. SOII is a statistical estimate based on a stratified sample of industry

[1] The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

[2] A more complete discussion of BLS's available data, methods, and limitations can be found at the Injuries, Illnesses, and Fatalities Home Page.

[3] For more information about the Current Population Survey see the BLS website at http://www.bls.gov/cps/home.htm

TABLE 1

TOP 10 CAUSES OF FATAL OCCUPATIONAL INJURIES, BY EVENT, 1992-2002

CFOI Event Code range	Description	No. of incidents	Pct. of incidents
4000–4330	Transportation (except railway, watercraft, aircraft)	23,272	34.5
6000–6390	Violent acts	12,036	17.9
1000–1900	Falls	7,631	11.3
0100–0290	Struck by, against	6,319	9.4
0300–0490	Caught in	4,484	6.7
3100–3190	Electricity	3,378	5.0
4600–4690	Aircraft	3,102	4.6
3200–3900	Exposure to (except electricity)	2,782	4.1
4500–4590	Watercraft	1,096	1.6
5200–5290	Explosions	1,053	1.6
All other causes		2,220	3.3
Total fatal incidents		67,373	100.0

Source: BLS, CFOI 1992–2002

TABLE 2

FATAL ELECTRICAL INJURIES FOR ALL INDUSTRIES, BY EVENT, 1992–2002

Year	Event code							
	3100	3110	3120	3130	3140	3150	3190	31XX
1992	32	60	66	140	X	15	19	X
1993	32	44	100	115	5	16	12	325
1994	23	63	98	132	6	15	11	348
1995	32	55	94	139	5	17	6	348
1996	22	46	70	116	5	18	X	X
1997	14	41	71	138	5	22	7	298
1998	10	51	84	153	9	21	6	334
1999	5	51	76	125	X	13	6	X
2000	5	42	67	128	X	7	5	X
2001	9	47	78	124	X	15	8	X
2002	7	42	90	122	X	16	8	X
Total	191	542	894	1432	35	175	X	3,378
Pct.	6	16	26	42	1	5	X	--

X means no data or data do not meet publication criteria
Event code descriptions are as follows:

3100—Contact with electric current, unspecified
3110—Contact with electric current of machine, tool, appliance, or light fixture
3120—Contact with wiring, transformers, or other electrical components
3130—Contact with overhead power lines
3140—Contact with underground, buried power lines
3150—Struck by lightning
3190—Contact with electric current, n.e.c.
31XX—Contact with electric current, total

Rows may not sum to total.

Source: BLS, CFOI 1992–2002

respondents. It contains no narrative or work activity information.[4] SOII nonfatal injury estimates exclude the self-employed, federal, state, and local government employees, farms with fewer than 11 employees, and private households, but may include workers under the age of 16. Unlike CFOI, nonfatal injuries related to the events of September 11, 2001 may be included because the SOII survey design does not permit BLS to estimate these workers separately.

B. BLS Data Selected for Analysis

The data presented in this paper cover the time period from 1992 to 2002. CFOI data presented for electrical fatalities and fatality rates exclude workers less than 16 years old and military workers where noted on the tables and figures. The 2002 year was the last that industries were identified using the Standard Industrial Classification (SIC) System. Beginning with 2003 data, both CFOI and SOII began to use the North American Industrial Classification System (NAICS). Because of the differences between these two systems, BLS advises users against making comparisons between the 2003 or later industry and occupation categories and similar data from previous years.[5] For the industry classifications used in this report (SIC), mining includes oil and gas extraction and excludes independent mining contractors; agriculture includes forestry and fishing as well as landscapers and groundskeepers; transportation includes public utilities such as communications, electric, gas, water, and sewer, and; finance includes insurance and real estate.

Occasionally some data do not meet publication criteria. These data include cases where confidentiality is an issue for small case counts, where estimated data has a large standard error, and where rate data are derived from either of these sources. These data are specifically noted on the tables and figures.

Some of the analyses in this report refer to the "Events" that were associated with individual electrical injuries. Events used in CFOI and SOII are defined and assigned by BLS, and include the following electrical categories:

- Contact with electric current, unspecified
- Contact with electric current of a machine, tool, appliance, or light fixture
- Contact with wiring, transformers, or other electrical components

[4] A more complete discussion of BLS's SOII and its data, methods, and limitations can be found at BLS's Injuries, Illnesses, and Fatalities Home Page .

[5] Beginning in 2002, the SOII data were compiled using new OSHA recordkeeping guidelines and may not be completely compatible with previous years. See www.bls.gov/opub/mlr/2004/12/art2full.pdf for a more complete discussion of the differences.

TABLE 3

NUMBER OF ELECTRICAL FATALITIES, BY INDUSTRY, 1992-2002

Industry	Year												
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total	Pct.
Agriculture	44	40	46	32	35	32	38	33	25	41	42	408	12
Mining	11	14	10	12	X	9	5	X	X	6	8	87	3
Construction	137	124	141	169	128	141	171	136	135	155	145	1,582	47
Manufacturing	43	41	43	23	25	23	42	28	29	25	21	343	10
Transportation	37	29	36	36	42	41	30	28	24	22	31	356	11
Wholesale	7	5	10	10	X	10	X	9	X	5	6	73	2
Retail Trade	10	13	11	11	7	9	7	6	6	X	5	X	X
Finance	5	X	X	X	X	X	X	X	X	5	X	32	1
Services	29	42	40	37	23	24	26	25	20	18	28	312	9
Public Administration	8	6	6	7	7	X	X	8	7	X	X	60	2
Non-classifiable Establishments	X	X	X	X	X	X	X	X	X	X	X	14	0
Total	X	322	347	344	279	295	330	278	256	284	289	X	100

X means no data or data do not meet publication criteria
Excludes military and workers under 16 years of age

Source: BLS, CFOI 1992–2002.

- Contact with overhead power lines
- Contact with underground, buried power lines
- Struck by lightning
- Contact with electric current, not elsewhere classified (n.e.c.)

The occupations mentioned in this paper are also defined and assigned by BLS for CFOI and SOII.

C. Electrical Injury Rates

Actual numbers of electrical injuries can indicate the overall magnitude of various electrical safety issues in the workplace. However, they are usually not useful for comparing electrical injury experience among different industries, or even from year to year in the same industry or group, because of differences in employment. Rates of injury normalize the data to account for differences in exposed populations, and so afford a more direct means to compare the electrical safety history of disparate groups.[6]

II. ELECTRICAL INJURY DATA

A. Electrical Fatalities

There were 3,378 worker fatalities classified as electrical events between 1992 and 2002[7], as shown in table 1. As in the 1992 to 1998 analysis, electricity remained the sixth leading cause of injury-related occupational death. Overall, the percentage of deaths from electrical causes from 1999 through 2002 represents 4.7% of all occupational deaths, down from 5.2% for the 1992 to 1998 time period. In 99.1% of the cases, the cause of death is listed as electrocution.

Table 2 shows that contact with overhead power lines was responsible for 42% of all on the-job electrical deaths. Contact with overhead power lines may occur during their installation, maintenance, or repair, tree trimming and pruning, when operating or working near high-reaching mobile equipment and machinery, or to workers carrying hand held objects such as ladders, tools, or construction materials. Contact with wiring, transformers, or other electrical components, is the next most common event listed, at 26%. This category involves many work activities that are normally carried out by electricians. Contact with electric current of a machine, tool, appliance, or light fixture accounted for 16% of electrical fatalities. This injury type

[6] For this paper, rates of fatal injury per 100,000 workers 16 years old or older (in one year) were computed as follows:

Fatal Injury Rate = (Fatalities during a given year / Employment) x 100,000

For example, in the year 2000, civilian employment was 136,891,000 and civilian occupational fatalities totaled 5,891, yielding a rate of fatal injury per 100,000 workers of 4.3. Similarly, using the number of electrical fatalities as the numerator, the electrical contribution to the overall electrical fatality rate per 100,000 workers was 0.19. Rates presented in this paper for nonfatal injuries were obtained from publicly available BLS data. BLS nonfatal injury rates represent the number of days away injuries to 10,000 full-time workers in one year. BLS calculated these rates as follows:

Nonfatal Injury Rate = (Number of injuries / Total hours worked by all employees during the calendar year) x 20,000,000

Where 20,000,000 = base hours for 10,000 full-time equivalent workers working 40 hours per week, 50 weeks per year

[7] There were 3,390 workers whose deaths were attributed to electrical shock or electrical burns from 1992 to 2002. 12 of these deaths were not classified as electrical events. The 3,378 deaths listed as electrical events were used in this analysis.

TABLE 4

NONFATAL ELECTRICAL INJURIES INVOLVING DAYS AWAY FROM WORK, PRIVATE INDUSTRY, BY EVENT, 1992–2002

Year	Event code							
	3100	3110	3120	3130	3140	3150	3190	31XX
1992	507	1,795	1,614	174	36	170	509	4,806
1993	453	2,111	1,531	133	74	71	620	4,995
1994	506	2,966	1,607	273	38	214	415	6,018
1995	769	1,506	1,571	155	47	172	522	4,744
1996	405	1,037	1,751	92	153	223	465	4,126
1997	365	1,413	1,390	79	52	X	386	3,710
1998	506	1,361	1,318	314	40	50	322	3,910
1999	321	1588	1261	194	92	70	700	4,224
2000	291	1265	1428	108	121	128	364	3,704
2001	327	1124	1392	77	100	135	238	3,394
2002	342	772	1077	66	X	65	634	2,967
Total	4,792	16,938	15,940	1,665	753	1,298	5,175	46,598
Pct.	10	36	34	4	2	3	11	--

X means no data or data do not meet publication criteria
Event code descriptions are as follows:

3100—Contact with electric current, unspecified
3110—Contact with electric current of machine, tool, appliance, or light fixture
3120—Contact with wiring, transformers, or other electrical components
3130—Contact with overhead power lines
3140—Contact with underground, buried power lines
3150—Struck by lightning
3190—Contact with electric current, n.e.c.
31XX—Contact with electric current, total

Rows may not sum to total.
Source: BLS - http://www.bls.gov/iif

TABLE 5

MEDIAN NUMBER OF DAYS AWAY FROM WORK FOR NONFATAL ELECTRICAL INJURIES, BY EVENT, 1992-2002

Year	Event code							
	3100	3110	3120	3130	3140	3150	3190	31XX
1992	13	3	7	33	21	6	2	5
1993	10	3	8	8	2	3	5	4
1994	4	5	4	30	15	14	6	5
1995	3	2	5	13	10	2	2	3
1996	3	4	22	5	2	3	12	7
1997	1	4	4	60	14	X	8	4
1998	10	4	6	14	137	3	2	5
1999	2	5	10	142	1	8	6	5
2000	5	4	5	15	9	10	43	5
2001	8	2	3	6	56	4	6	3
2002	10	2	4	66	X	3	4	4

X means no data or data do not meet publication criteria
Event code descriptions are as follows:

3100—Contact with electric current, unspecified
3110—Contact with electric current of machine, tool, appliance, or light fixture
3120—Contact with wiring, transformers, or other electrical components
3130—Contact with overhead power lines
3140—Contact with underground, buried power lines
3150—Struck by lightning
3190—Contact with electric current, n.e.c.
31XX—Contact with electric current, total

Source: BLS - http://www.bls.gov/iif

most often occurs to electricians, non-construction laborers, and heating, ventilation and air conditioning workers. It is often associated with wiring or grounding problems on tools and equipment. Contact with underground, buried power lines was responsible for about 1% of electrical fatalities, and is generally associated with installation or repair of buried power lines.

Table 3 shows the number of electrical fatalities in several industries. 47% of all electrical deaths between 1992 and 2002 occurred in construction. The construction industry has approximately 7 million wage and salary workers and another 1.9 million who are self-employed. Nearly two-thirds of establishments in the construction industry employ fewer than 5 people.[8]

Agricultural and transportation industries accounted for 12% and 11% of all electrical deaths, respectively. Of the 356 total electrical fatalities in the transportation industry group, 42% of the workers involved were identified as electric power installers and repairers. For electric power line installers and repairers, contact with overhead power lines was involved in 47% of fatalities, and contact with wiring, transformers, or other electrical components in 33%.

B. Nonfatal Electrical Injury

Table 4 shows the distribution by event of the 46,598 nonfatal electrical injuries estimated to have occurred from 1992 to 2002 in the U.S. The percentage of nonfatal accidents attributable to specific events is strikingly different than that of fatalities. For example, contact with overhead power lines was involved in only 4% of nonfatal electrical injuries compared to 42% for fatalities. Contact with electric current of machine, tool, appliance, or light fixture and contact with wiring, transformers, or other electrical components accounted for 36% and 34% of nonfatal electrical injuries, respectively. Contact with underground, buried power lines was involved in 2% of nonfatal injuries.

The BLS "nature of injury" classification was also used to examine nonfatal electrical injuries. The nature of injury or illness describes the principal physical characteristic of a disabling condition, such as an electrical shock or electrical burn. BLS classifies all burns from an electrical source (arc

[8] BLS website: http://stats.bls.gov/oco/cg/cgs003.htm

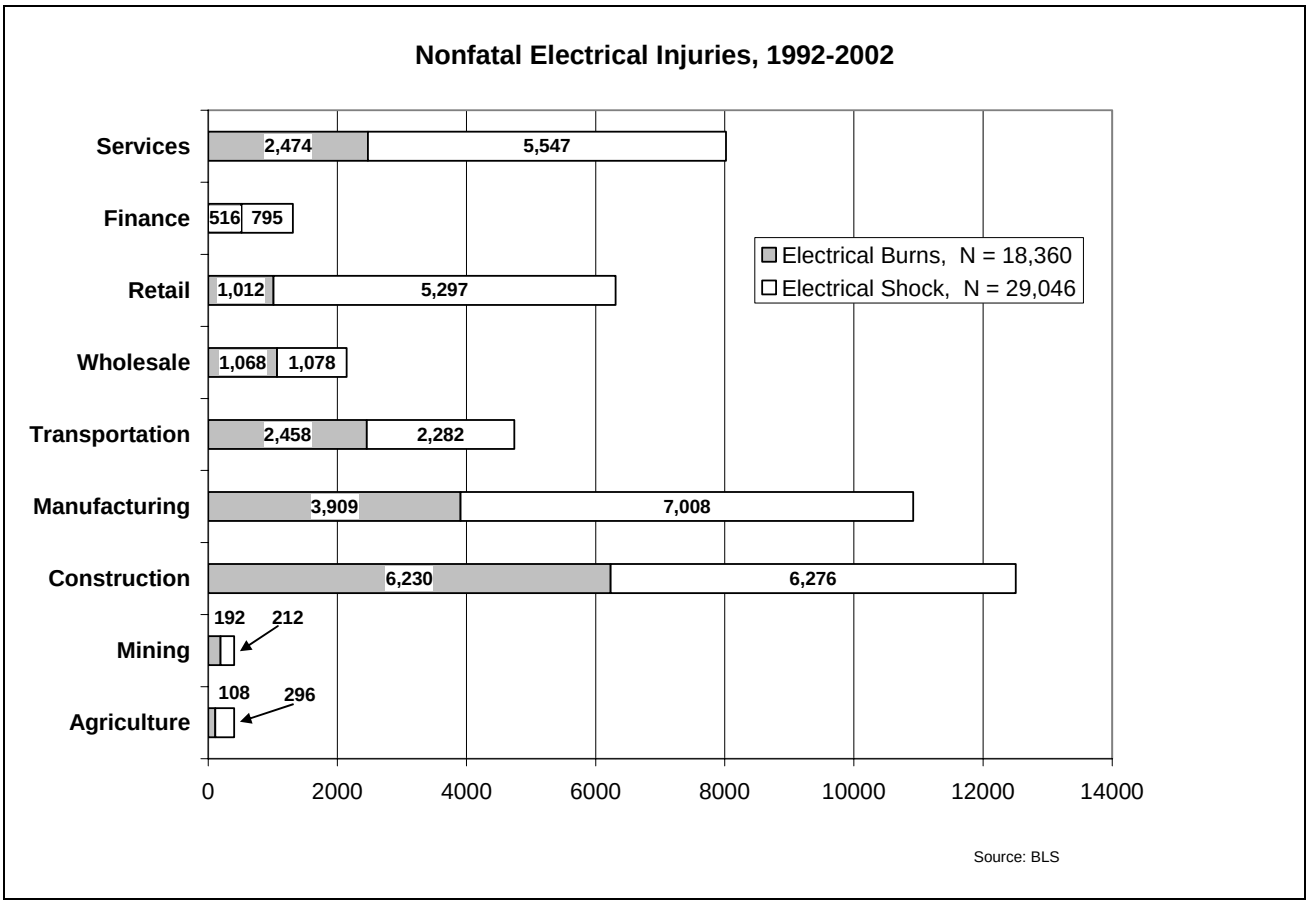

Figure 1. Distribution of nonfatal electrical shocks and electrical burns, by industry.

radiation burns, thermal burns, electrical current conduction through a body part, etc.) as electrical burns. Figure 1 shows that nonfatal electrical injuries between 1992 and 2002 included over 18,000 burn injuries and over 29,000 electrical shocks. The ratio of electrical shock to electrical burn injuries varies considerably among the industry groups.

Table 5 reports the median number of days away from work (due to the injury) for nonfatal injuries, listed by event code for each year. Overall, contact with overhead power lines and underground power lines resulted in the most severe injuries, as measured by days away from work.

TABLE 6

TEN OCCUPATIONS SUSTAINING THE MOST FATAL ELECTRICAL INJURIES, 1992-2002

Occupation	Total
Electricians and apprentices	566
Construction laborers	259
Electrical power installers and repairers	237
Groundskeepers and gardeners, except farm	134
Truck drivers	119
Farm workers	118
Laborers except construction	112
Carpenters	98
Managers and administrators, n.e.c.	91
Painters, construction and maintenance	71
Subtotal	1,805
Percent of total electrical fatalities	54%

Source: BLS, CFOI 1992–2002.

C. Hazardous Occupations

Table 6 shows occupations ranked by the total number of electrical fatalities sustained in each between 1992 and 2002. Electricians and their apprentices sustained the most electrical fatalities and electric power installers and repairers ranked third. These groups obviously have an increased exposure to electrical hazards, but other occupations listed, such as construction laborers and groundskeepers, are typically not recognized as having a high risk of electrical injury [2] [3].

III. ELECTRICAL FATALITY RATES

Overall, rates of on-the-job fatality from all causes decreased from 1994 to 2002. As shown in figure 2, rates of electrical

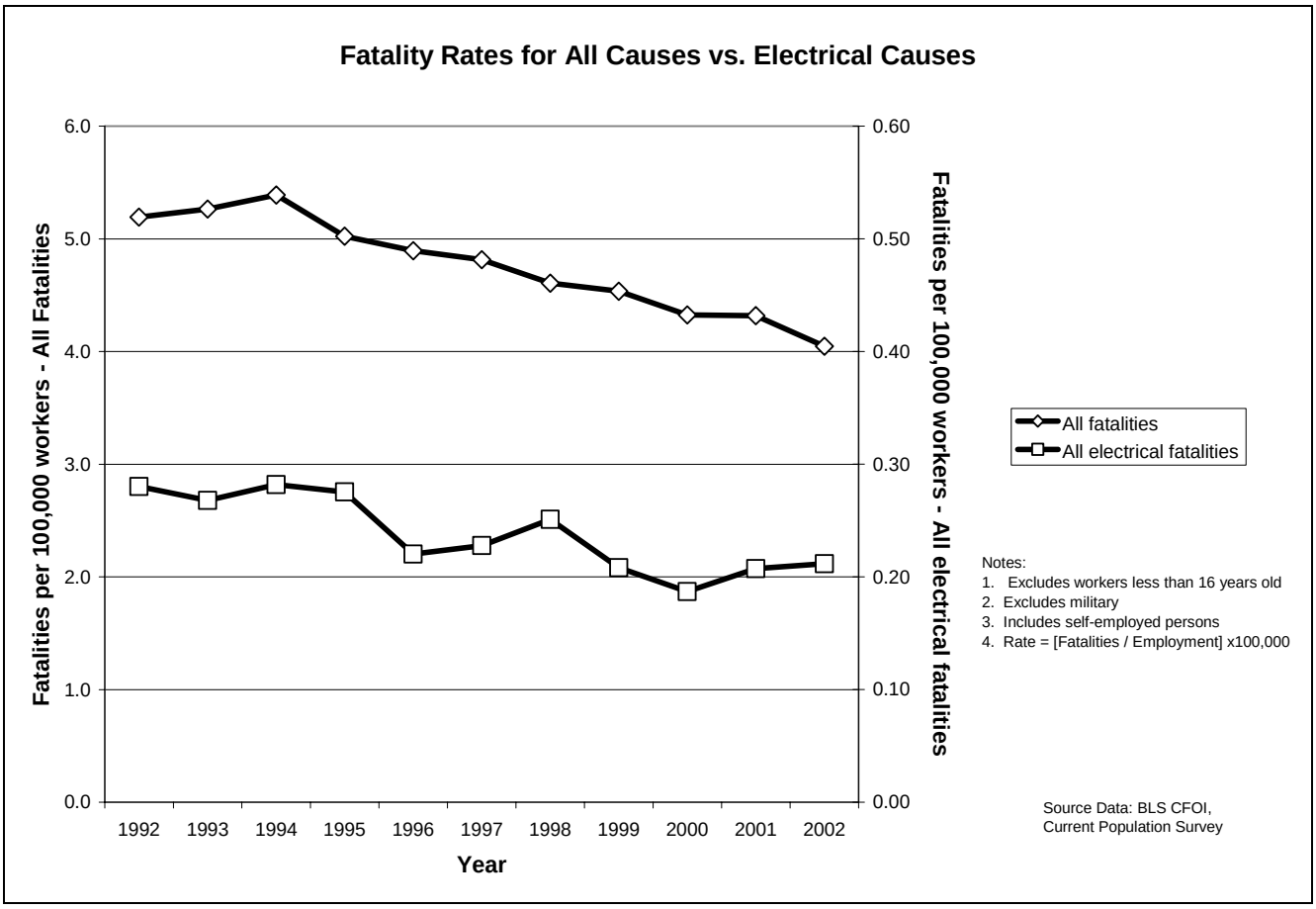

Figure 2. Electrical fatality rates compared to the fatality rates from all causes, for all industries.

fatality generally tracked this overall decline. In 1994 the overall fatality rate per 100,000 workers was 5.4. In 2002 it declined to 4.0. The electrical fatality rate decreased from 0.28 in 1992 to a low of 0.19 in 2000, but climbed to 0.21 in both 2001 and 2002.

A. Rates by Event

Figure 3 shows fatal electrical injury rates for 1992 through 2002, categorized by the electrical event involved. Data not meeting BLS's publication criteria have been omitted from figures 3, 4, 6, 7, and 11 and are specifically noted on each figure. Contact with overhead power lines was clearly the most common type of fatal electrical accident. Although yearly fluctuations occurred, it generally ranged from 0.10 to 0.12 per 100,000 workers, showing no sustained improvement. The second most common type of electrical injury involved was contact with wiring, transformers, or other electrical components. This category also showed no sustained improvement during the study period, remaining in the 0.06 to 0.08 range. Rates for contact with electric current of machines, tools, appliances, or light fixtures remained between 0.03 and 0.04 for the past several years. Rates for all remaining types of electrical events remained below 0.02 per 100,000 workers between 1996 and 2002.

B. Rates by Industry Group

Figure 4 displays electrical fatality rates in major industry groups. As described earlier, the "All-industry" curve is produced by dividing the total annual number of electrical fatalities by the total employment. The rates for individual industries are calculated similarly, but use employment figures for each industry as the denominator.

Three industry groups, construction, mining, and agriculture had electrical fatality rates that were consistently above the all-industry average. The construction industry had the highest rate of electrical fatalities each year studied with the exception of 1993 and 2002 when it was surpassed by the mining industry. Construction accounted for 47% of all electrical deaths between 1992 and 2002, but the industry showed overall improvement between 1995 and 2002, reducing its electrical fatality rate from 2.2 to 1.5 per 100,000 workers. The mining industry exhibited significant fluctuations in its electrical fatality rate, with an increase from 0.8 in 1998 to 1.6 in 2002. The agriculture industry

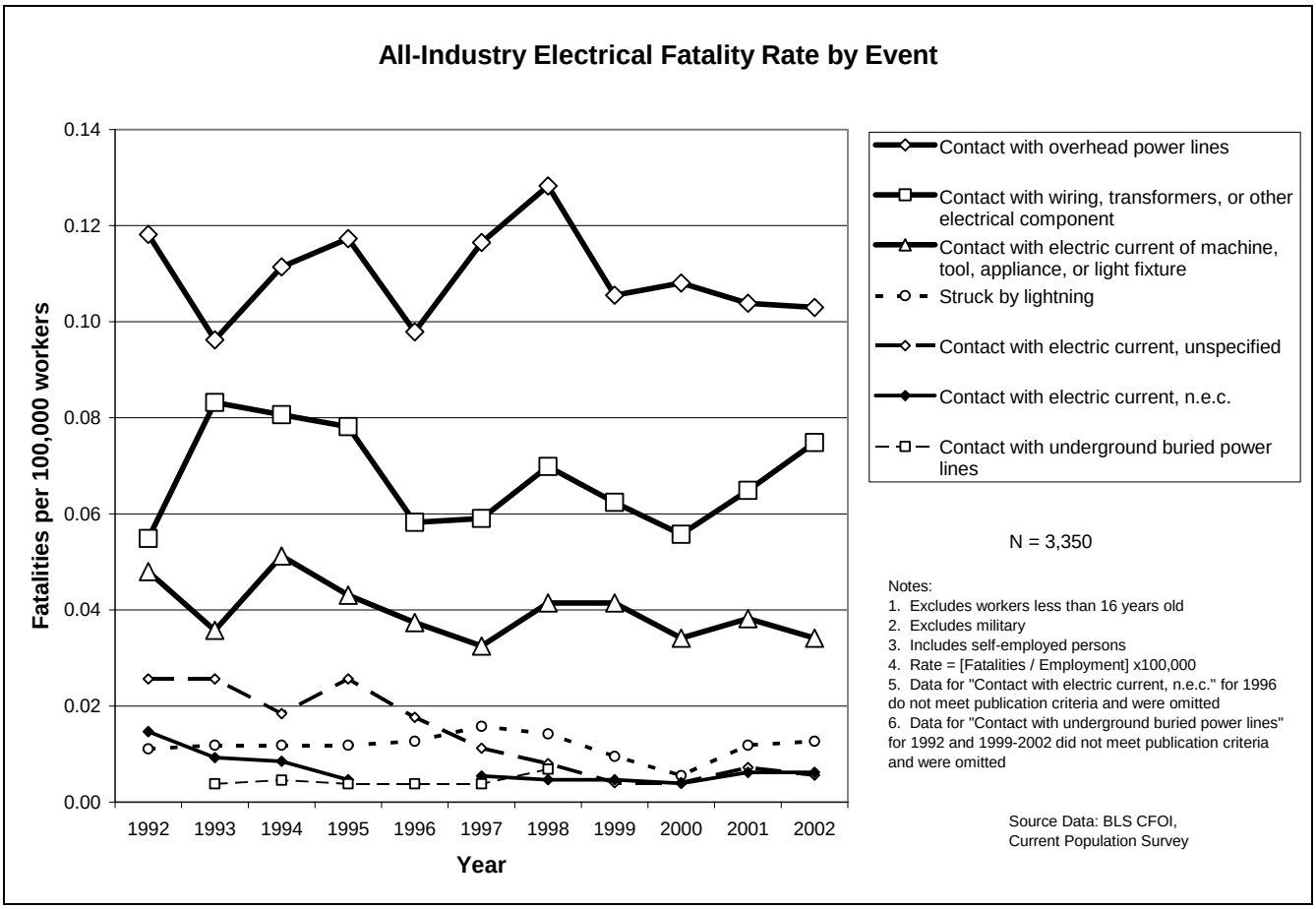

Figure 3. Electrical fatality rates presented by event for all industries.

data suggests improvement between 1992 and 2000, but in 2001 and 2002 electrical fatality rates climbed back to levels near those found 10 years earlier. The transportation industry had electrical fatality rates that remained at or just above the all-industry rates from 1992 to 2002. Since this category includes public utility workers, electric power line installation and repair may account for many of the fatal electrical injuries.

The manufacturing, wholesale, retail, finance, services, and public administration sectors all had electrical fatality rates at or below the all-industry average rates for the study period and were omitted to simplify figure 4.

C. Rates by Event, for Selected Industries

Figures 5 through 7 show electrical fatality rates by event for the construction, agriculture, and transportation industry groups. As already noted, each of these groups had electrical fatality rates above the all-industry annual rates between 1992 and 2002.[9] Only the top two or three event categories are included for each industry group in order to simplify the figures, but the number of fatalities listed (N) represents all electrical fatalities for that group, including those omitted for clarity.

1) The Construction Industry: Figure 5 shows that contact with overhead power lines killed more construction workers that any other single type of electrical accident from 1992 to 2002, but the data for this category suggest a sustained decline since 1998. Over the same period, contact with wiring, transformers, or other electrical components and the contact with electric current of machine, tool, appliance, or light fixture fatality rates remained essentially unchanged.

2) The Agricultural Industry: Figure 6 shows that, except for 1994, contact with overhead power lines caused 50% or more of electrical fatalities in agriculture each year from 1992 to 2002. The total annual rates for agriculture through 2000 suggest a downward trend overall, but this was followed by a sharp rise in 2001, due in large part to contact with overhead power lines.

[9] Specific event rate data for mining do not meet publication criteria and were omitted.

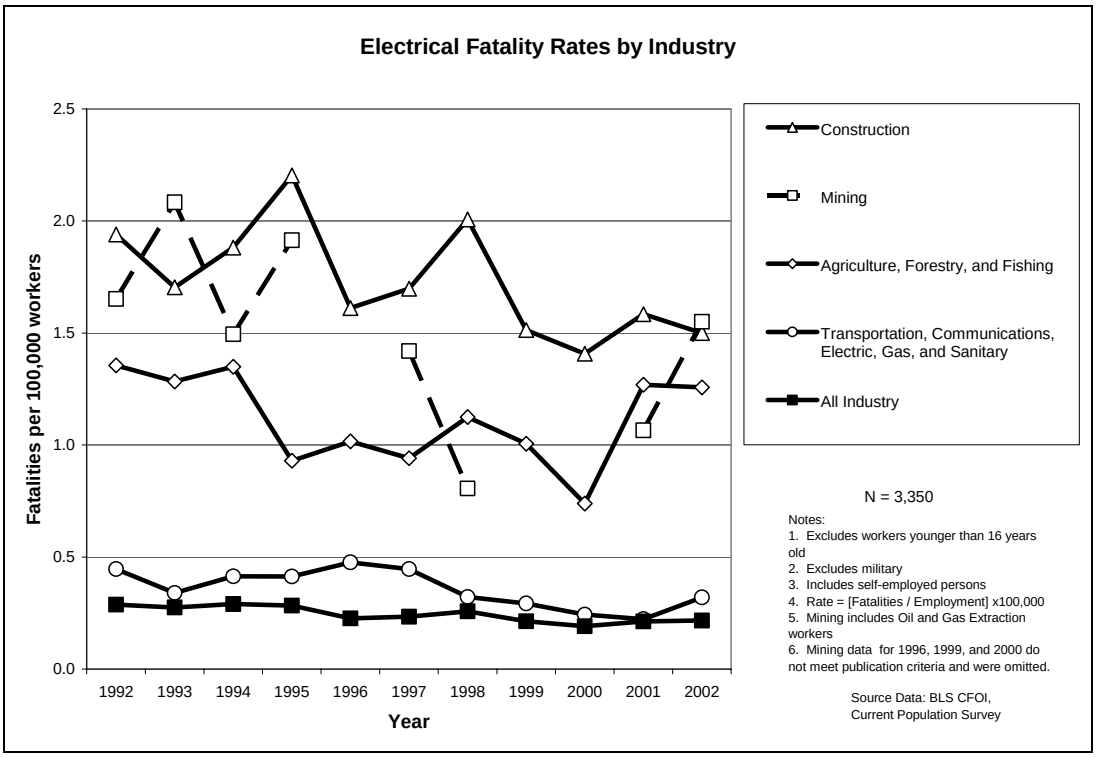

Figure 4. Electrical fatality rates presented by industry classification.

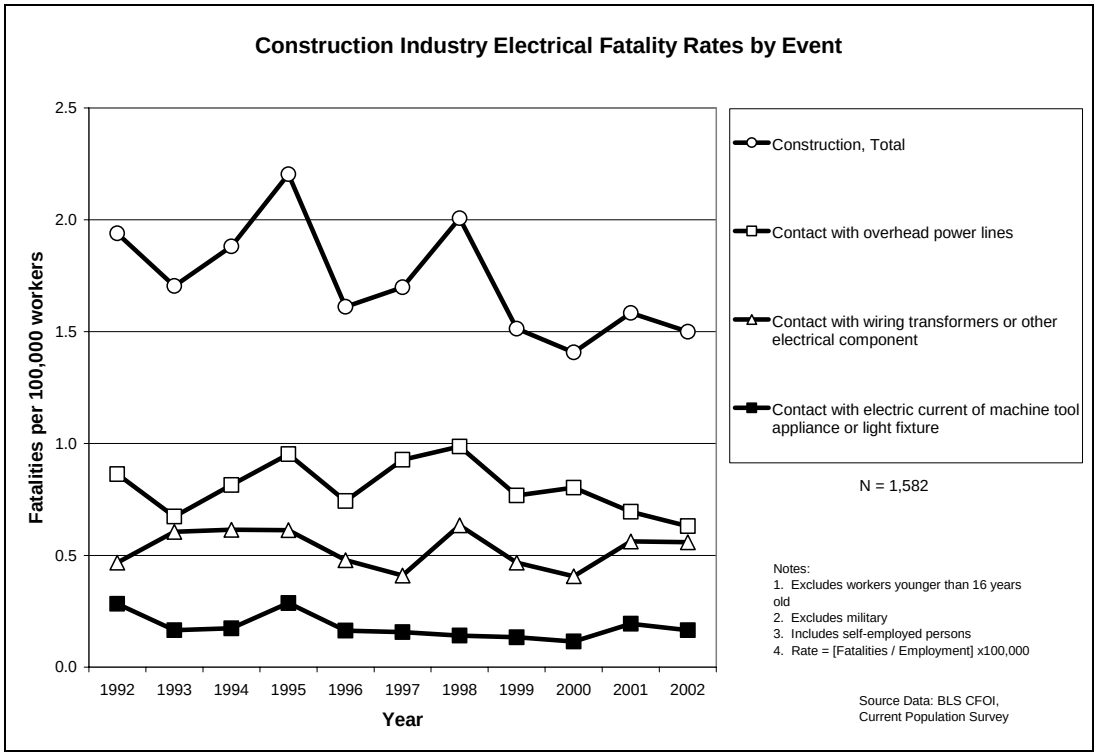

Figure 5. Electrical fatality rates for the construction industry, presented by event.

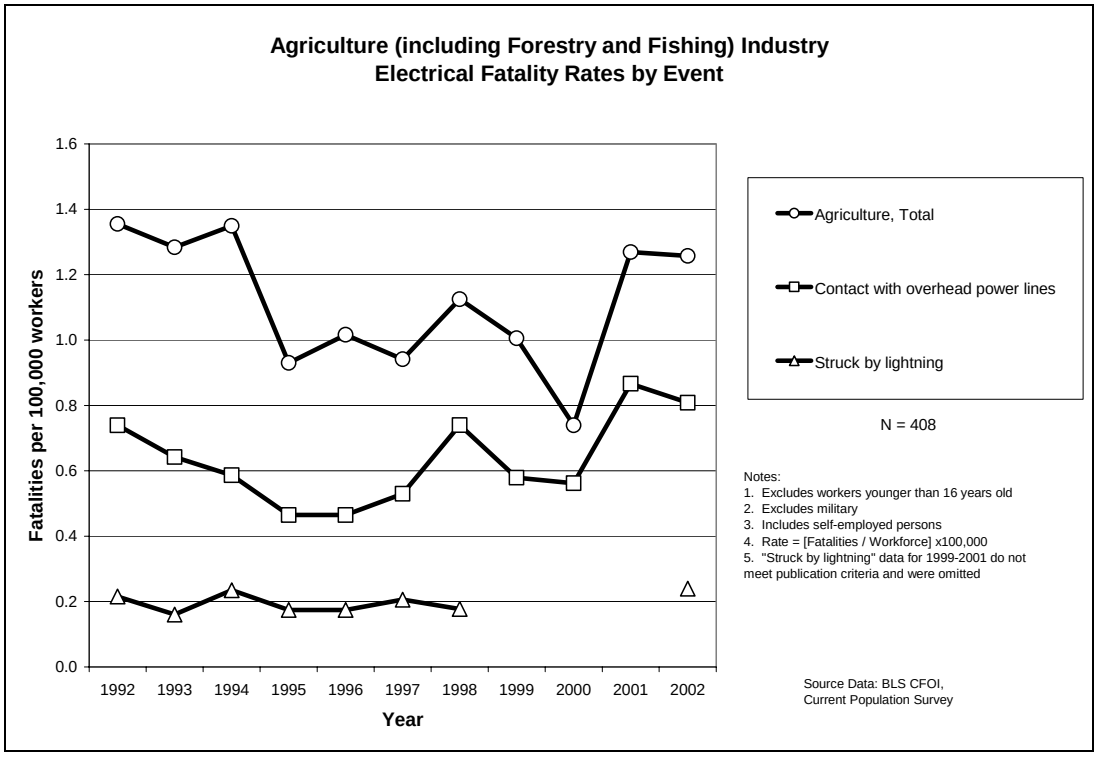

Figure 6. Electrical fatality rates for agricultural industries, presented by event.

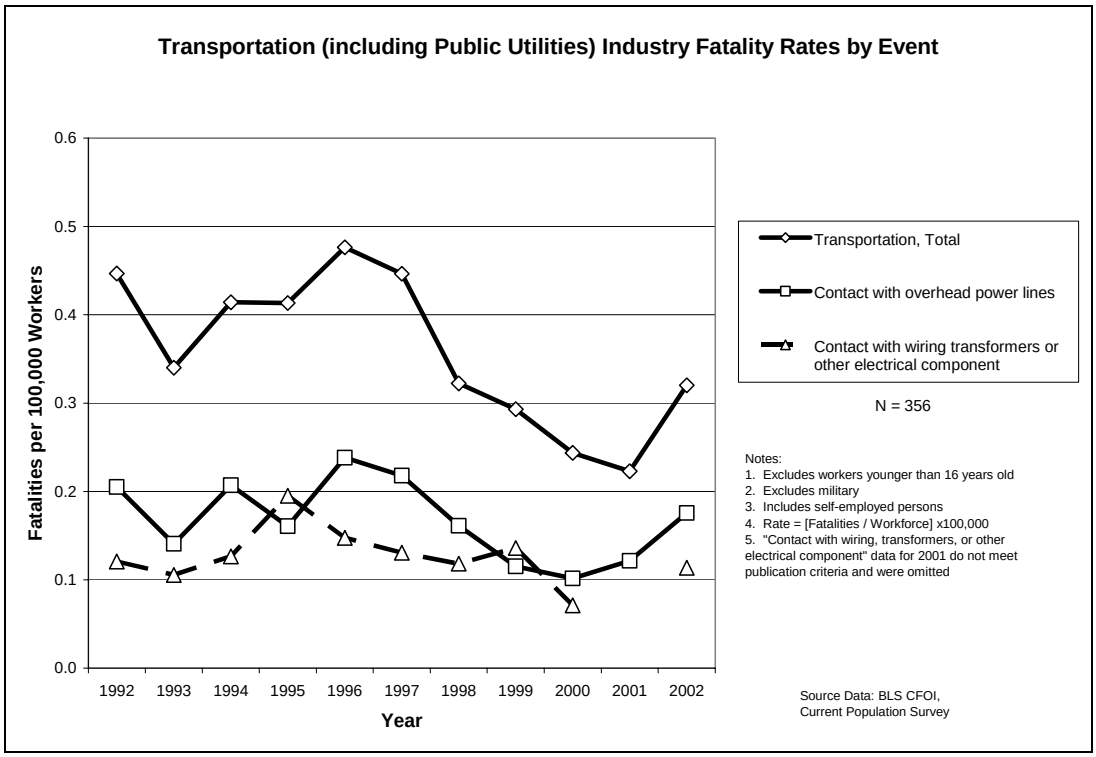

Figure 7. Electrical fatality rates for transportation industries, presented by event.

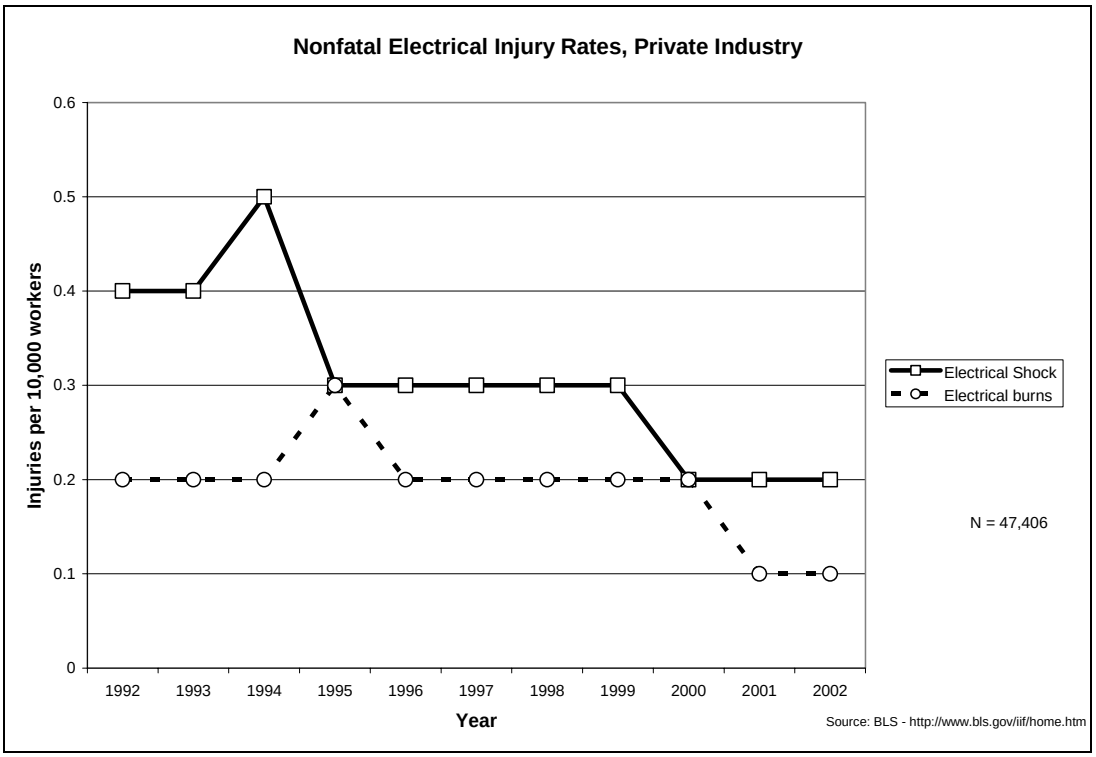

Figure 8. Rates of nonfatal electrical shock and burn injuries for all industries.

3) The Transportation Industry: As shown in figure 7, the total annual electrical fatality rates in transportation were trending downward through 2001, but the rate rose in the last year of the study period due to increases in contact with overhead power lines and contact with wiring, transformers, or other electrical components. Many of these injuries occurred in the electrical utility sector of this industry group.

IV. NONFATAL ELECTRICAL INJURY RATES

Figure 8 shows the overall rates of electrical shock and burn injuries for the 1992 to 2002 period. The electrical shock injury rate remained steady from 2000 to 2002 at 0.2 per 10,000 workers. The electrical burn rate remained steady in 2001 to 2002 at 0.1.

A. Rates by Industry Group

Figure 9 shows the nonfatal electrical burn injury rates for the four industries that were at or above the all-industry aggregate for 1992 through 2002. The construction industry had the highest nonfatal electrical burn rates, but exhibited a clear downward trend after 1996. Nevertheless, the 2002 rate for construction was still more than double the all-industry rate. The mining industry rates had significant variation over the period, with a significant rise from 1997 to 2000, but no sustained trend. The nonfatal electrical burn injury rates for the transportation industry seem to be trending downward.

Figure 10 shows nonfatal electrical shock injury rates for the four industries that have been at or above the all-industry aggregate rates. Construction again has the highest rates. Although it reached a low for the study period in 2002, it was still more than three times the all-industry rate.

B. Rates by Event

Figure 11 shows nonfatal electrical injury rates for the construction industry (combined shocks and burns), including rates for specific events. The total nonfatal electrical injury rates for construction were several times the annual aggregate rates for all industries over most of the study period, but had a significant overall decline during this time, from a high of 3.0 in 1993 to 1.0 in 2002. The most common event was contact with wiring, transformers, or other electrical components.

Figure 12 shows nonfatal electrical injury rates for the transportation industry (combined shocks and burns). The total nonfatal electrical injury rates for transportation were generally only slightly higher than the aggregate rates for all industries over most of the study period, with the most common event being contact with wiring, transformers, or other electrical components. The transportation industry data show no sustained improvement, compared to the slight drop indicated for the all-industry aggregate.

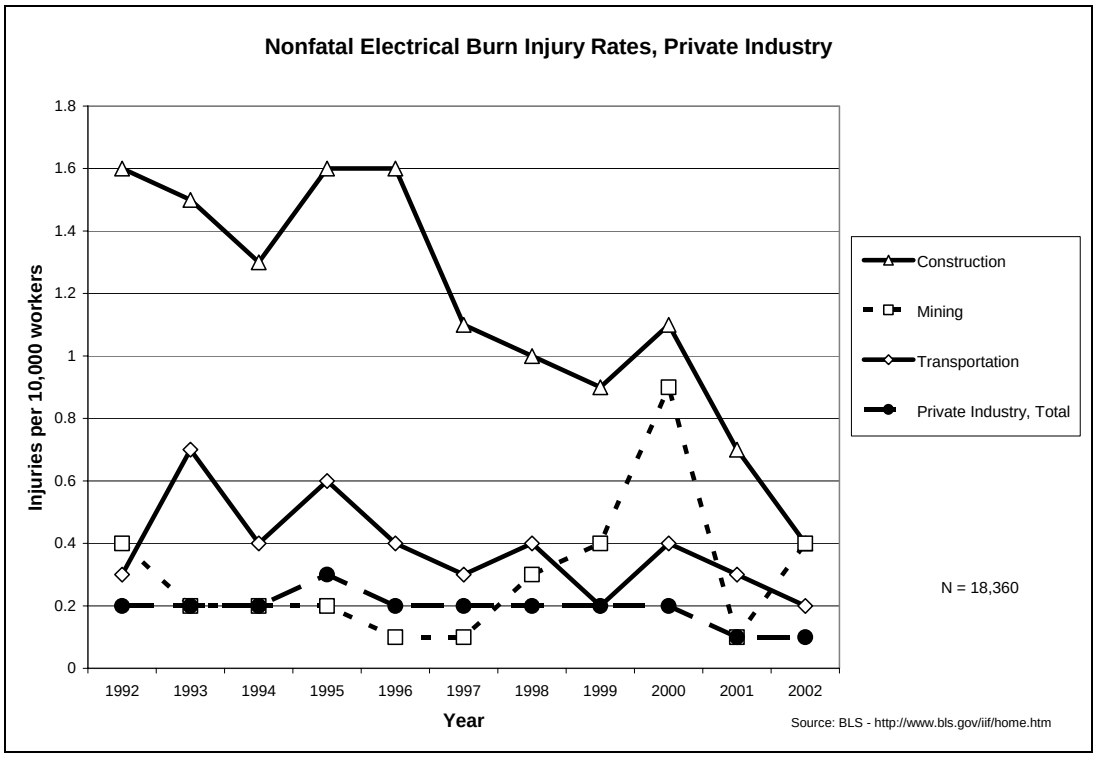

Figure 9. Nonfatal electrical burn injury rates, presented by industry.

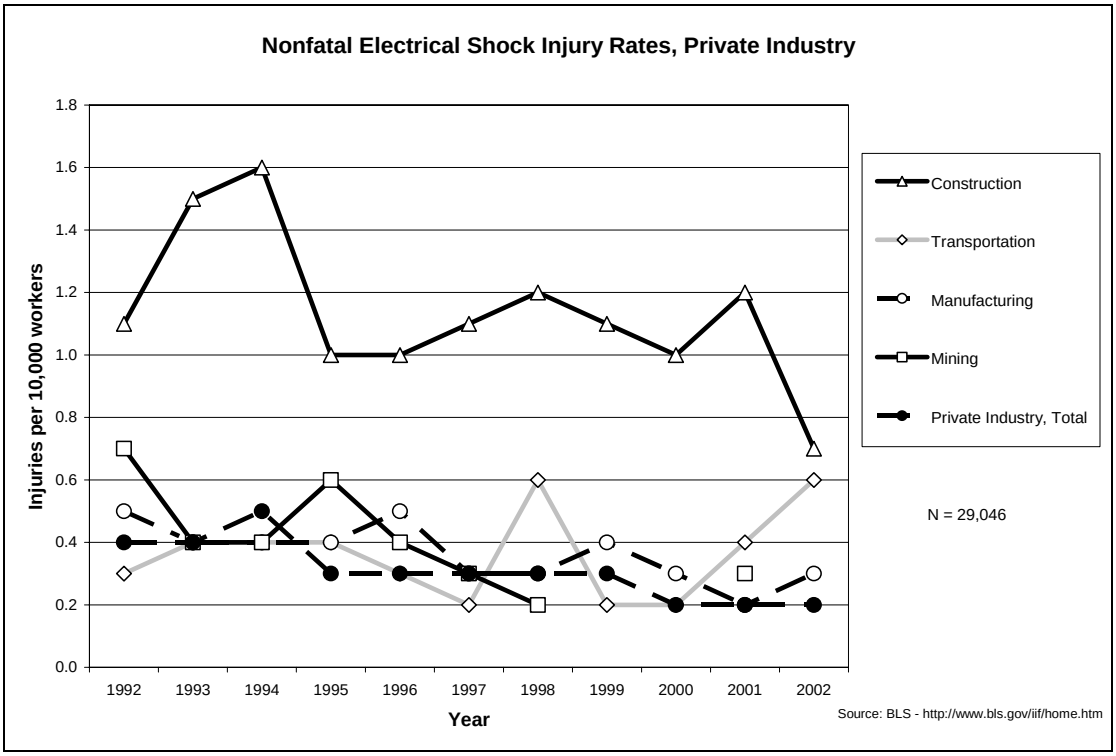

Figure 10. Private industry nonfatal electrical shock injury rates, presented by industry.

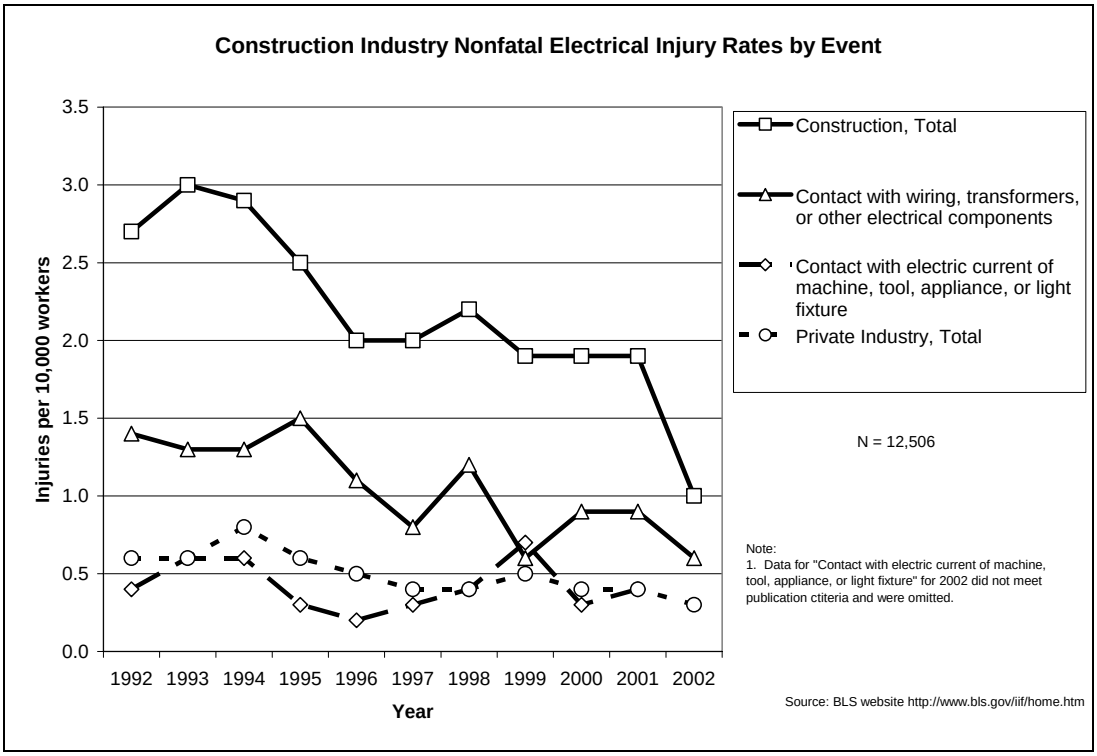

Figure 11. Nonfatal electrical injury rates for the construction industry, presented by event.

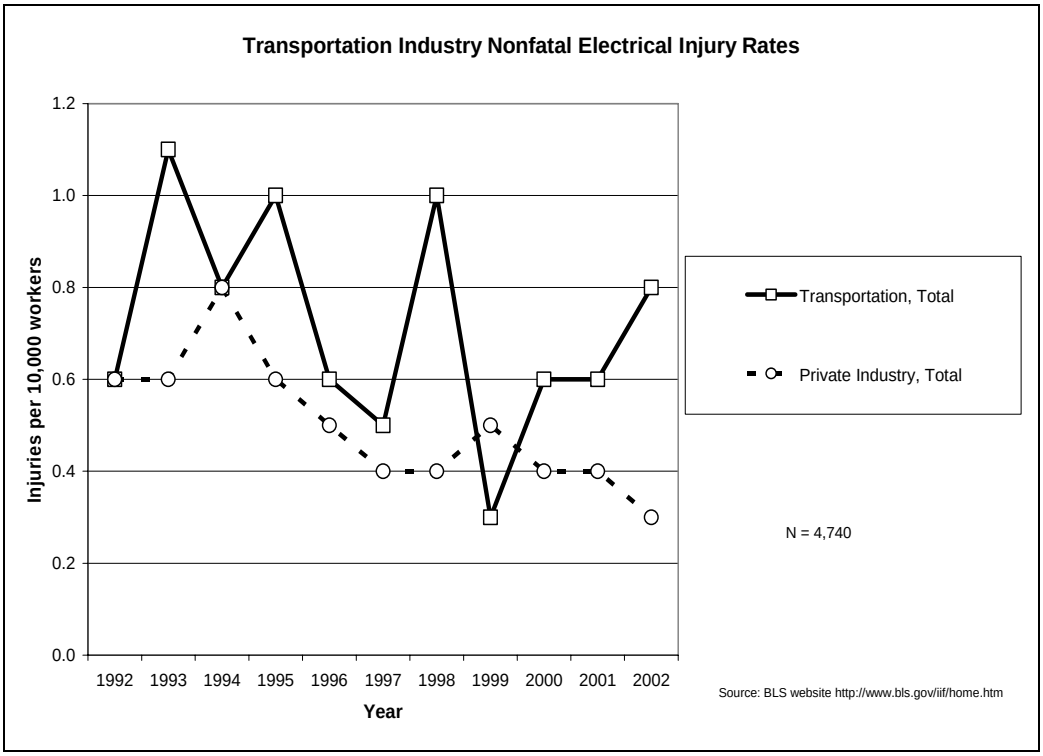

Figure 12. Nonfatal electrical injury rates for the transportation industries.

V. DISCUSSION

The annual rate of fatal occupational injuries in the U.S. from all causes displayed a general decline between 1992 and 2002, and fatal electrical injury rates likewise had an overall decline. The annual rate of nonfatal electrical injuries also declined over this period. Despite these improvements however, electricity remained the sixth leading cause of fatal worker injuries in 2002. Closer inspection of data reveal that certain industries have electrical injury rates much higher than all-industry aggregate values, and that several common work activities and circumstances can be linked to most injuries. This section suggests target areas that warrant increased electrical safety research and prevention efforts. These recommendations are based on injury numbers and rates for both fatal and nonfatal electrical injuries, as well as their classification by industry and event, as detailed earlier in this paper.

A. Construction Industry

Although both fatal and nonfatal electrical injury rates for construction have declined overall in recent years, they were still approximately 5-times and 3-times all-industry levels, respectively, in 2002. Fatalities were most often tied to contact with overhead power lines. These contacts were usually through hand held items such as ladders, tools and materials, or by mobile equipment like cranes [1]. The next most common cause of electrical fatalities was contact with wiring, transformers, or other electrical components, and often involved tasks normally associated with electricians. Nonfatal electrical injuries in construction had contact with wiring, transformers, or other electrical components, and contact with electric current of machine, tool, appliance, or light fixture, as the two most common causes. The latter is normally associated with wiring or grounding problems on tools or equipment.

An initiative currently underway at the NIOSH Pittsburgh Research Laboratory (PRL) is focusing on the problem of power line contacts by mobile equipment in the construction industry by examining the performance of commercially available power line proximity warning systems. Such systems are marketed as a means to warn mobile equipment operators of impending power line contact. They are cited as an acceptable safety precaution in currently proposed language that amends mobile crane regulations [4], but as yet no recognized standard exists against which to judge their performance. NIOSH PRL, coordinating with system manufacturers, large commercial mobile crane operators, OSHA, and organized labor, will conduct full scale tests of available power line proximity warning systems to objectively assess and document their capabilities and limitations. This work could serve as the initial step for eventual development of a performance standard for such systems.

B. Mining Industry

Due to the relatively small employment in the mining industry, injury rates can behave erratically. Even with wide fluctuations however, the annual rate of electrical fatalities in mining was well above all-industry levels for much of the study period, ranging from 3- to 7-times greater. Although the data suggest some improvement through 1998, the 2002 rate rose to a level comparable to construction.

C. Agricultural Industries

Electrical fatality rates for agriculture ranged from 3- to 5-times all-industry levels between 1992 and 2002, and showed no sustained improvement. Contact with overhead power lines was the leading cause of these deaths, followed by lightning strikes.

D. Transportation Industries

Transportation had fatal and nonfatal electrical injury rates higher than all-industry levels for most of the study period, although data for fatalities suggest a decline between 1996 and 2001. As explained earlier in this paper, the transportation industry classification includes utility workers such as those that install and maintain electrical power lines, and this group likely sustained many of these injuries due to their greater exposure to electrical hazards. The most common cause of fatalities was contact of overhead power lines. Contact with wiring, transformers, or other electrical components was the leading cause for nonfatal injury.

E. Shocks vs. Burns

All but 30 of the 3,378 fatal electrical injuries in CFOI for 1992 through 2002 were attributed to electrical shock. Of the 47,406 nonfatal electrical injuries categorized by the nature of injury[10], 18,360 were electrical burns and 29,046 were electrical shocks. The ratio varied among different industries, but overall, the annual rate of nonfatal electrical burns decreased more over the study period than did the rate for nonfatal shocks.

F. Occupations

Within the occupations most often involved in electrical fatalities, based on categories used in CFOI, some were not surprising, such as electricians and electrician apprentices, and electric power installers and repairers. Others were less

[10] While 47,406 nonfatal electrical injuries are categorized in SOII by the nature of injury, only 46,598 are categorized by electrical event.

likely to be recognized as jobs with significant risk of electrical injury, such as construction laborers, groundskeepers and gardeners, truck drivers, and farmers.

VI. SUMMARY

This paper analyzed 1992 to 2002 U.S. occupational electrical injury data from the BLS CFOI and SOII databases. The study examined fatal and nonfatal electrical injuries with respect to the industries represented and the circumstances surrounding the incidents, as well as the occupations involved and prevalence of burn injuries. Both injury numbers and rates were used to compare and trend electrical injury experience for various groups and categories. This information was then used to identify populations that could most benefit from effective electrical safety interventions.

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