NASA National Aeronautics and Space Administration

FY 1988 Safety Program Status Report

NASA Safety Division
Office of Safety, Reliability, Maintainability
and Quality Assurance
Washington, D.C. 20546

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SAFETY PROGRAM OVERVIEW

The flawless launch and safe return of the Space Shuttle Discovery at the end of FY 1988 marks the success of NASA's extensive return-to-flight effort. The re-evaluation and approval by senior program management of all hazard reports associated with the National Space Transportation System (NSTS) served to highlight and re-emphasize to all levels of the workforce the necessity of thoughtful hazard recognition. This effort required the close coordination and participation of NASA and contractor personnel from every activity level. With the successful completion of this enormous undertaking, NASA launched STS-26R on September 29, 1988.

The NSTS Program continues a vigorous risk reduction effort to enhance the safety of the workforce and of flight vehicles. Each field installation actively pursues the identification of hazards through both structured analysis and employee recommendations. Risk reduction recommendations are reviewed by the NSTS System Safety Review Panel, prioritized and forwarded to management for resolution. Safety has been accepted as an integral part of the program review process.

NASA's new centralized safety program was fully implemented in FY 1988, producing significant results in the areas of risk management and institutional and programmatic safety, and generating a heightened safety awareness throughout NASA. Various new management issuances, policies, handbooks, standards, and other documents were developed, validated, or revised. A revised NASA Safety Standard for Lifting Devices and Equipment, which further defines safe lifting requirements to limit personnel injuries and hardware losses during lifting operations, was published. A new agency policy on risk management was published as a result of new safety program initiatives begun after the Challenger mishap. A blueprint for an "Enhanced Safety Plan" was developed at the Headquarters level as an aid in strategic planning for the next 5 years. The Space Shuttle Program published new guidelines for conducting failure analyses to better standardize the Shuttle Hazard Analysis effort and identify critical safety items.

The NASA Management Instruction for Mishap Reporting and Investigating (NMI 8621.1) was revised to clarify responsibilities and to correspond with new organizational alignments. Also, dollar values for equipment and property losses were raised. The NMI went into effect late in the fiscal year, September 6, 1988, but interim guidelines for mishap reporting were distributed to the field installations in December 1987. While most mishaps were categorized according to the definitions with the lower threshold values, a clarification of reporting requirements resulted in Headquarters' receiving more information about less serious mishaps than in previous years.

NMI 8621.1E required the maintenance of an automated mishap database at each facility. Headquarters has sponsored the development of the Mishap Reporting and Corrective Action System (MR/CAS) software since 1985. All field installations received an upgraded version of the MR/CAS which improved data tranmissions as well as accessing and analyzing mishap data.

The NASA Safety Reporting System (NSRS) was expanded to cover payloads under the cognizance of the Jet Propulsion Laboratory and the Goddard Space Flight Center. First implemented in 1987 to cover the NSTS program, the NSRS will be further expanded to include all NASA and contractor activities.

NASA continued striving to reduce occupational injury and illness claims during FY 1988. The agency has met the President's goal of a 3-percent reduction in occupational injuries/illnesses per year over a period of 5 years. All NASA installations made appreciable efforts to recognize, evaluate, and control safety and health problems. Throughout the agency, specific attention was given to indoor air pollution, respiratory protection, hazard communication, ventilation, hazardous waste, radon, confined space entries and asbestos abatement.

Employee participation, involvement, and consultation in safety-related activities increased. Participation was encouraged through open meetings and training sessions, at seminars, during inspections, through membership on safety committees or panels, by participation in awareness programs, and by review and comments on standards and policies. The distribution of educational materials such as fliers, posters, billboards, and message boards for all personnel was expanded. Special messages were provided in safety newsletters and safety releases to emphasize the individual employee's importance in the success of the safety program.

NASA will continue to strive for maximum safety awareness and excellence in all activities. The field installations and Headquarters will continue to work together to maintain an emphasis on safety.

Charles W. Mertz
Director, Safety Division

FY 1988
NASA SAFETY STATISTICS

Fatalities	0		
		OSHA Recordable	NASA Work-Related
Total Injuries/Illnesses		272	146
Lost Time Injuries/Illnesses		133	82
Lost Wages	$128,136		
Chargeback Billing	$5,107,134		
Material Losses	$2,771,000		
Total Losses	$8,006,270		

NASA OCCUPATIONAL INJURY/ILLNESS RECORD

Injuries and illness are divided into two classes, lost time cases and no-lost time cases. A lost time case is defined by OSHA as a nonfatal, traumatic injury that causes loss of time from work or disability beyond the day or shift when the injury occurred, or a nonfatal illness/disease that causes loss of time from work or disability at any time. A no-lost time case is a nonfatal injury (traumatic) or illness/disease (nontraumatic) that does not meet the definition of a lost time case.

NASA Headquarters Safety Division tracks those clearly work-related injury/ illness cases for which preventive action or corrective action plans may be developed to prevent recurrence. OSHA recordable injuries and illnesses include all compensable injury/illness claim cases. This information is provided by the NASA Headquarters Occupational Safety and Health Division to the Department of Labor.

Headquarters tracks injury/illness frequency rates, i.e., the number of injuries/ illnesses per 200,000 hours worked. OSHA is now calculating rates according to the number of injury/illness cases per 100 employees. Several charts in this report reflect these formulas.

Table 1 shows the FY 1988 work-related injury/illness statistics for all NASA field installations. The overall work-related lost time rate of 0.37 is a slight increase from the FY 1987 value of 0.35.

TABLE 1. NASA WORK-RELATED INJURIES/ILLNESSES BY INSTALLATION - FISCAL YEAR 1988

			TOTAL INJURY/ ILLNESS DATA			LOST TIME INJURY/ILLNESS DATA					PERFORMANCE VS GOAL FOR FY 88	
	NO. OF EMPLOYEES	HOURS WORKED IN K	NO. CASES	FREQ. RATE 1987	FREQ. RATE 1988	NO. CASES	NO. DAYS	FREQ. RATE 1987	FREQ. RATE 1988	SEVERITY RATE	CUM. RATE	TARGET RATE
ARC/DFRF	2,291	4,696	38	1.49	1.62	19	327	0.56	0.81	13.93	0.81	0.40
GSFC/WFF	3,605	7,400	22	0.51	0.59	16	167	0.33	0.43	4.51	0.43	0.30
HQ	1,785	3,346	2	1.95	0.12	1	2	0.22	0.30	0.60	0.30	0.40
JSC	3,634	6,204	9	0.36	0.29	6	100	0.26	0.19	3.22	0.19	0.30
KSC	2,283	4,915	20	0.51	0.81	12	280	0.26	0.49	11.39	0.49	0.30
LaRC	2,764	5,310	21	0.38	0.79	8	49	0.17	0.30	1.85	0.30	0.30
LeRC	2,764	5,141	13	1.02	0.51	13	251	0.86	0.51	9.76	0.51	0.50
MSFC	3,332	6,652	21	0.40	0.63	7	12	0.14	0.21	0.75	0.21	0.30
SSC	159	244	0	1.34	0	0	0	1.34	0	0	0	0
NASA	22,617	43,908	146	--	0.66	82	1188	--	0.37	5.41	0.37	0.40
LAST YEAR	22,453	42,991	155	0.72	--	75	775	0.35	--	3.60	0.35	0.40

1. Total injury/illness frequency rate = number of cases per 200,000 hours worked.
2. Lost time injury/illness frequency rate = number of lost workday cases per 200,000 hours worked.
3. Injury/illness severity rate = number of lost workdays per 200,000 hours worked.

Figure 1 illustrates the relative position of the NASA OSHA recordable lost time injury/illness rate compared to other Federal agencies having more than 15,000 employees in FY 1987 and FY 1988. Within the Federal Government, NASA has ranked second since FY 1984.

Figure 2 plots the NASA OSHA recordable lost time injury/illness rates for the last 11 years against those of other Federal agencies and select private sector industries. NASA's rates have been consistently lower than those of the Federal Government and the private sector. The most recent statistics available from the Department of Labor for the private sector aerospace industry are for FY 1987.

Figure 3 illustrates NASA's excellent overall injury/illness record over the last 11 years as compared to all other Federal agencies, the private sector, private sector manufacturing industry, and the private sector aerospace industry. The most recent statistics available from the Department of Labor for the private sector aerospace industry are for FY 1987.

Figure 4 shows how the FY 1988 NASA work-related lost time injury/illness frequency rates at the NASA field installations compared to the overall NASA rate of 0.37 and NASA's overall goal of 0.40.

Figure 5 compares the number of NASA employees to the number of lost time cases over the past 11 years. Since 1982 there has been a steady decrease in the number of no-lost time injury cases among NASA federal employees.

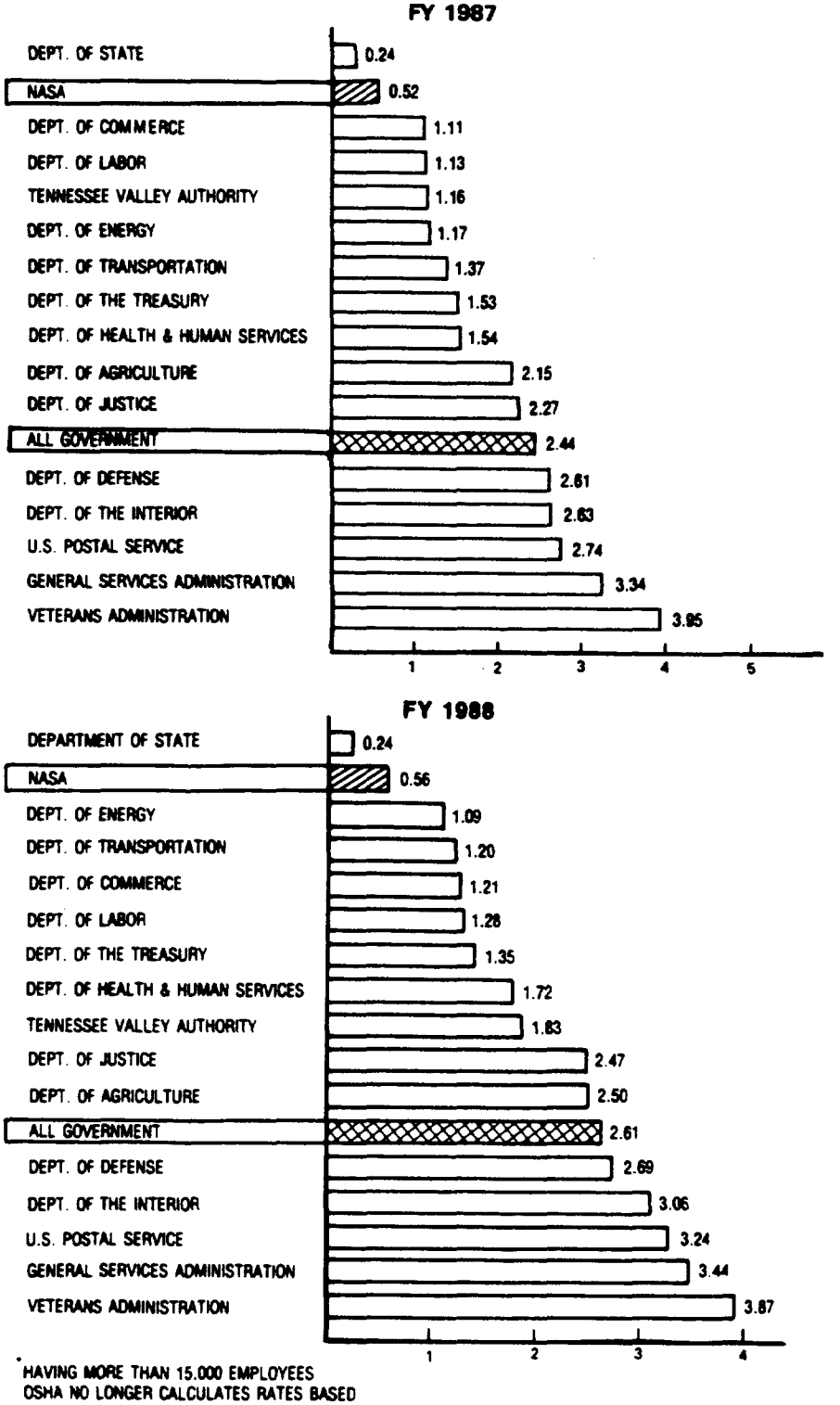
Figure 6 plots the NASA work-related lost time frequency rate, no-lost time rate, and the total rate. FY 1988 was the first year the number of work-related lost time cases exceeded the number of no-lost time cases.

Table 2 shows the work-related lost time rates for both NASA civil service and contractor employees by installation. The contractor rate of 1.06 reflects a 22% increase from last year.

Figure 7 compares the FY 1988 work-related lost time frequency rates of NASA federal employees at each installation with the previous year's rate and an average rate taken over the previous 3 years (FY 1985 - FY 1987).

Figure 8 compares the FY 1988 work-related lost time frequency rates of NASA contractor employees at each installation with the previous year's rate and an average rate taken over the previous 3 years (FY 1985 - FY 1987).

OSHA REPORTABLE LOST-TIME INJURY/ILLNESS RATES IN SELECTED FEDERAL AGENCIES*



*HAVING MORE THAN 15,000 EMPLOYEES
OSHA NO LONGER CALCULATES RATES BASED ON 200,000 HOURS WORKED

Figure 1

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OSHA RECORDABLE
LOST-TIME OCCUPATIONAL INJURY/ILLNESS RATES
PRIVATE SECTORS-ALL FEDERAL AGENCIES-NASA

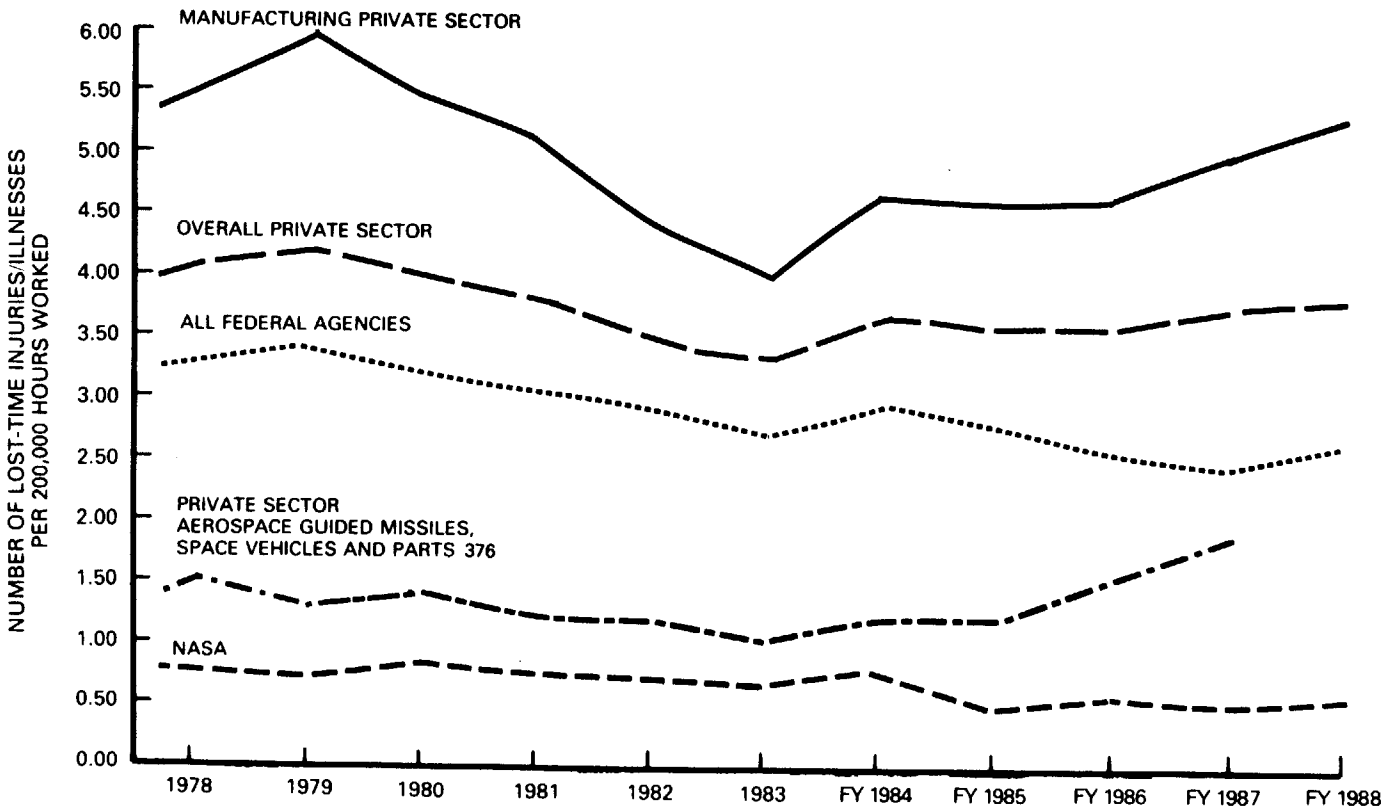

Figure 2

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TOTAL OSHA RECORDABLE OCCUPATIONAL INJURY/ILLNESS RATES
PRIVATE SECTORS-ALL FEDERAL AGENCIES-NASA

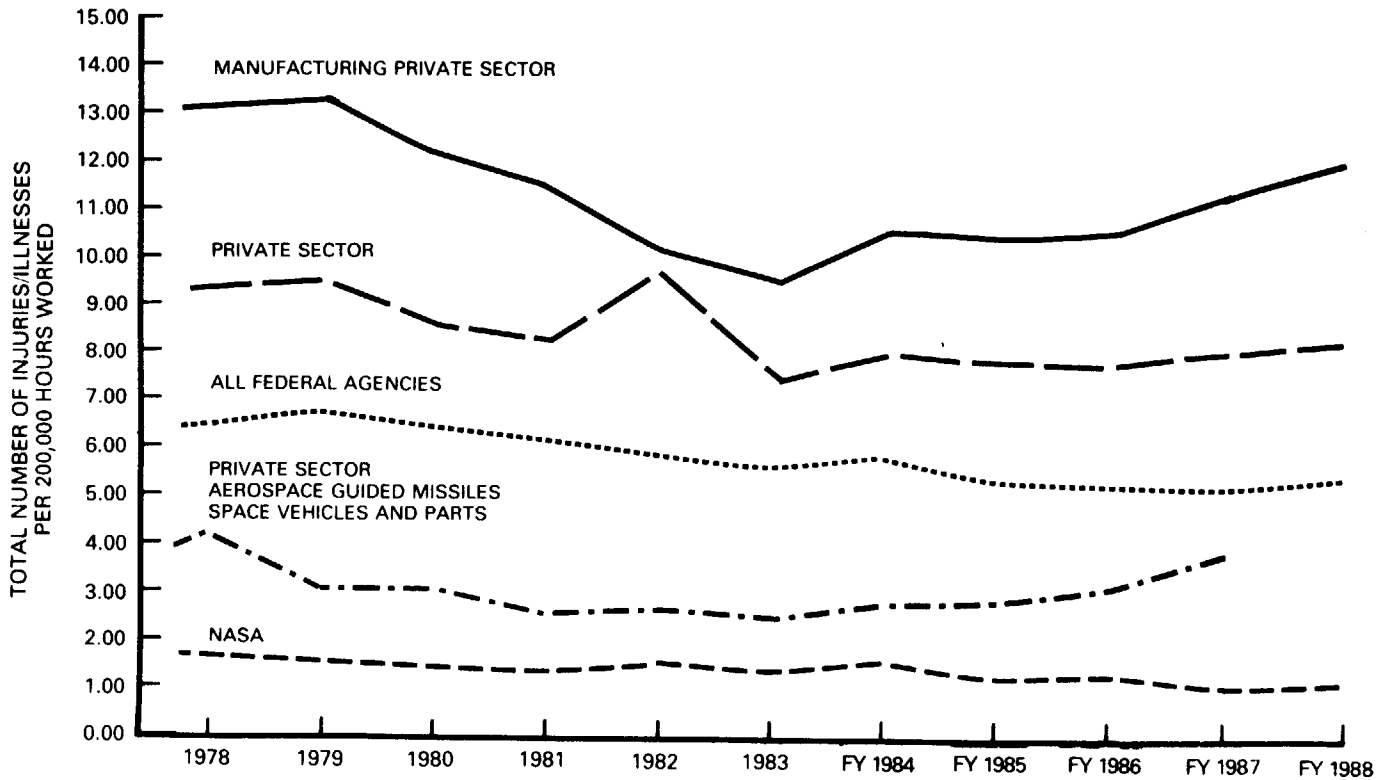

Figure 3

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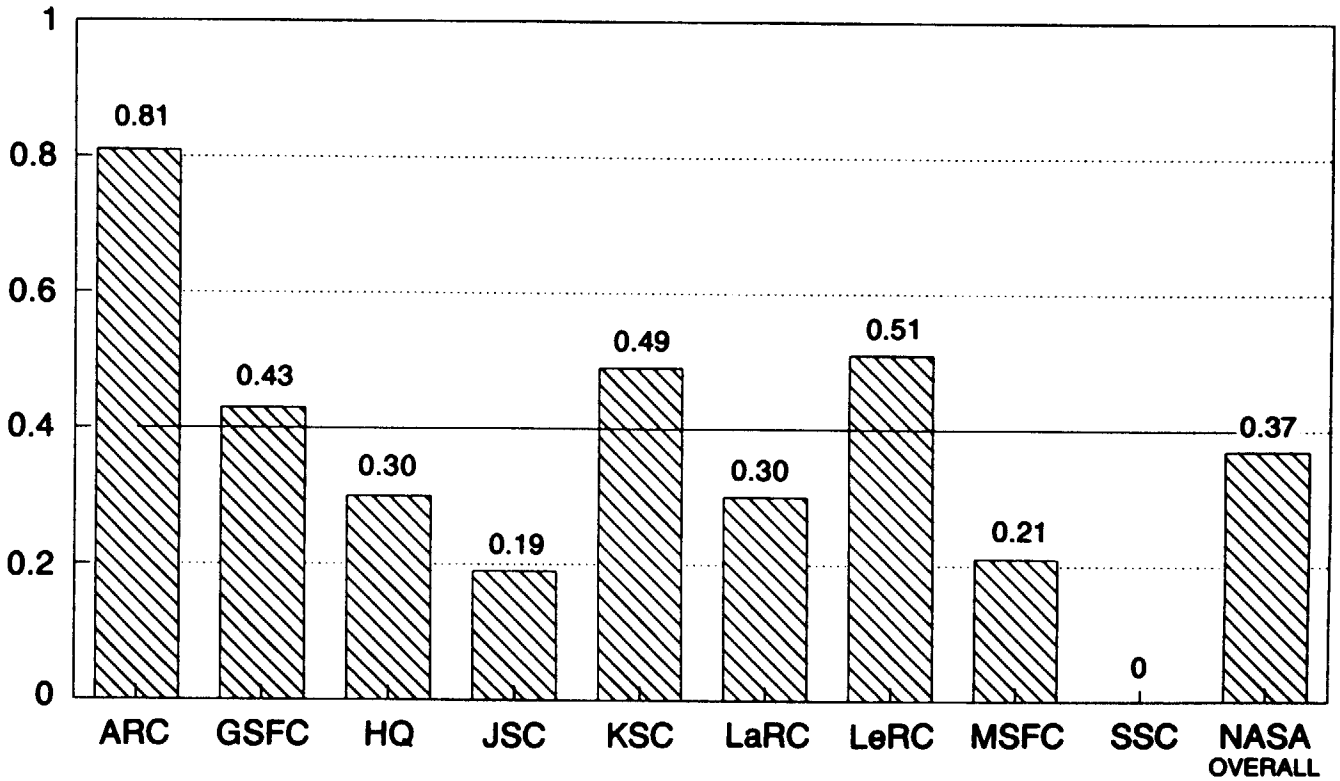
NASA WORK-RELATED LOST TIME RATES BY CENTER FY 1988



NASA FY 1988 GOAL = 0.40

Figure 4

NUMBER OF NASA EMPLOYEES AND WORK RELATED LOST TIME CASES VS. TIME 1978-1988

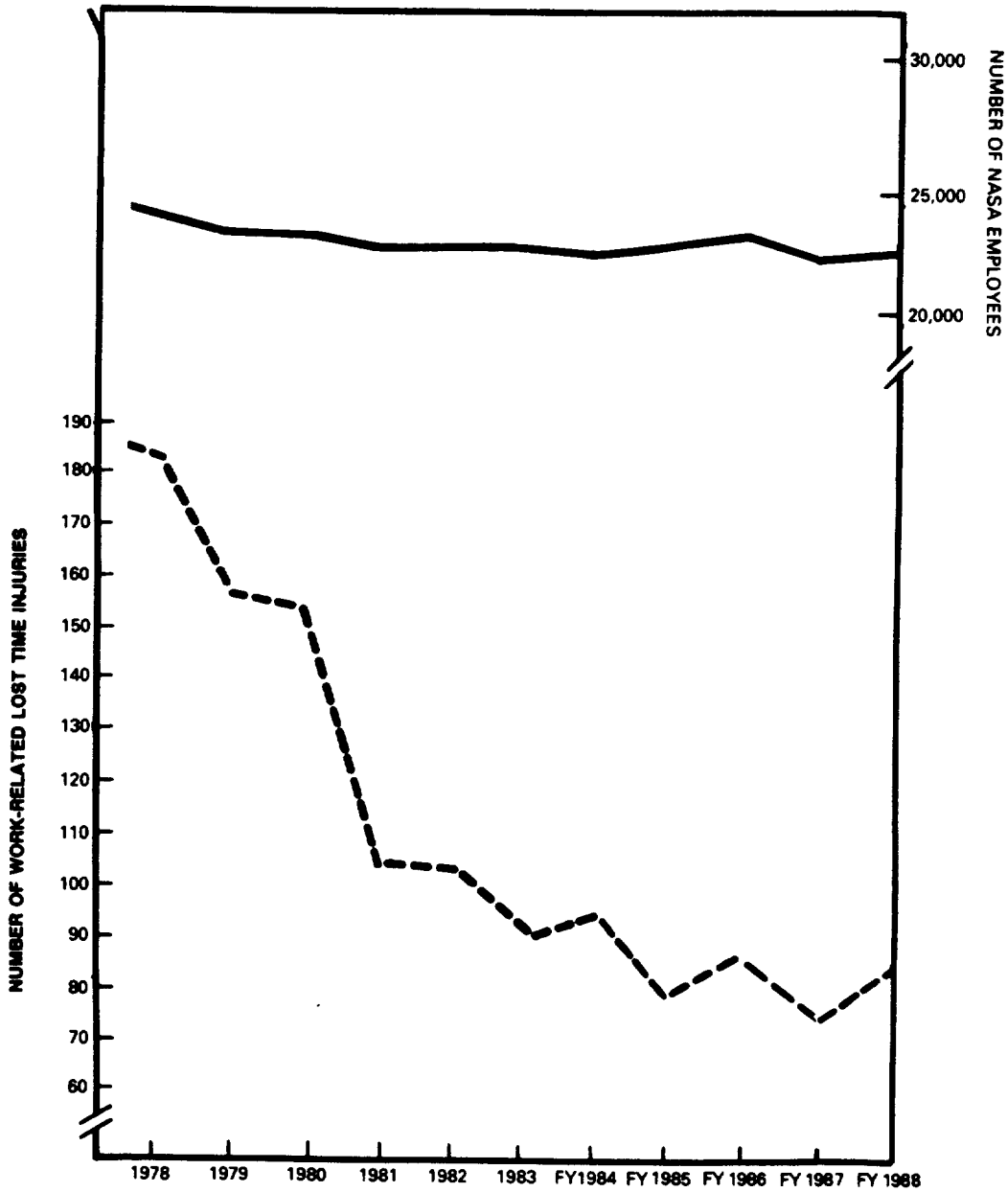


Figure 5

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NASA WORK-RELATED INJURY/ILLNESS* RATES**
1978-1988

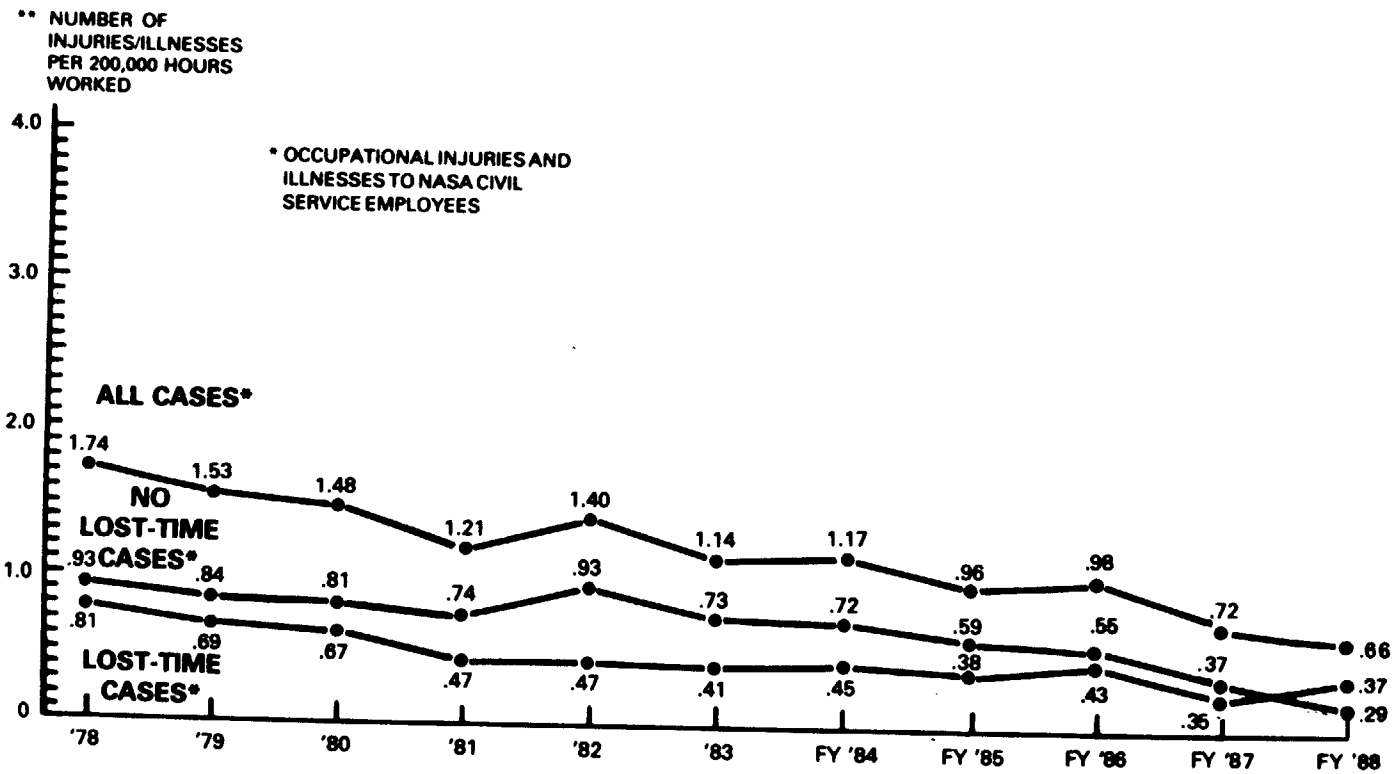

Figure 6
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Rev. 11-2-89

TABLE 2. NASA COMBINED WORK-RELATED INJURIES/ILLNESSES BY INSTALLATION - FISCAL YEAR 1988
CIVIL SERVICE AND CONTRACTOR EMPLOYEES

	HOURS (K) CIV. SERV. EMPLOYEES	NO. L-T CASES	FREQ. RATE	HOURS (K) CONTRACTOR EMPLOYEES	NO. L-T CASES	FREQ. RATE	HOURS (K) COMBINED TOTAL	TOTAL L-T CASES	COMBINED FREQ. RATE
ARC/DFRF	4,696	19	0.81	3,827	30	1.57	8,522	49	1.15
GSFC/WFF	7,400	16	0.43	6,886	34	0.99	14,286	50	0.70
HQ	3,346	1	0.30	1,104	5	0.91	4,450	6	0.27
JPL	--	--	--	12,107	77	1.27	12,107	77	1.27
JSC	6,204	6	0.19	8,644	74	1.71	14,848	80	1.08
KSC	4,915	12	0.49	24,745	122	0.99	29,660	134	0.90
LaRC	5,310	8	0.30	4,580	28	1.22	9,980	36	0.73
LeRC	5,141	13	0.51	2,093	20	1.94	7,204	33	0.92
MSFC	6,652	7	0.21	12,447	21	0.34	19,099	28	0.29
SSC	244	0	0	2,321	7	0.60	2,566	7	0.55
NASA	43,908	82	0.37	78,754	418	1.06	122,662	500	0.82
LAST YEAR	42,991	75	0.35	77,682	339	0.87	120,672	414	0.69

Lost time injury/illness frequency rate = number of lost workday cases per 200,000 hours worked.

NASA FEDERAL EMPLOYEES
WORK-RELATED LOST TIME INJURY/ILLNESS RATES

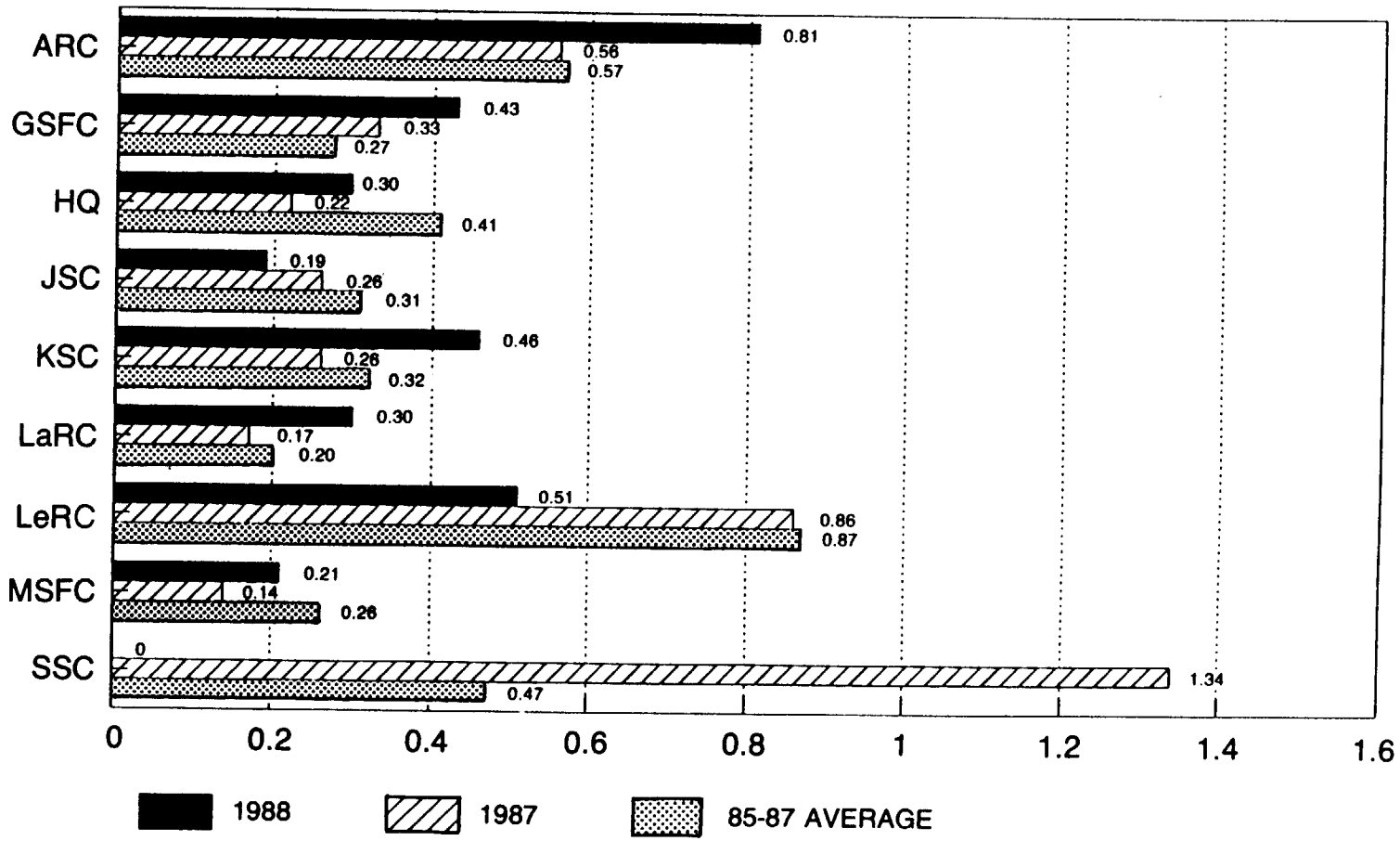

Figure 7

CONTRACTOR EMPLOYEES
WORK-RELATED LOST TIME INJURY/ILLNESS RATES

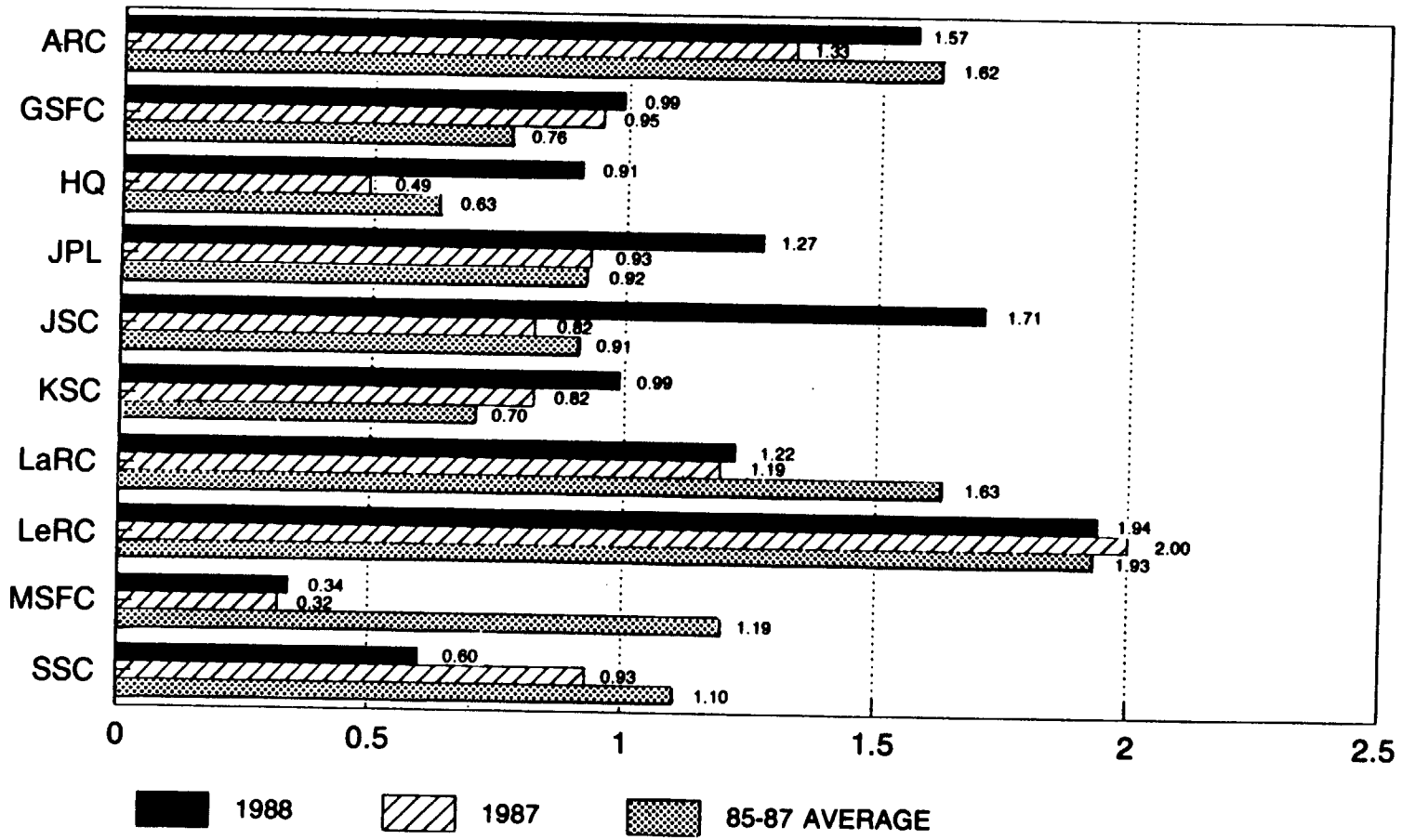

Figure 8

CHARGEBACK BILLING

Chargeback is defined by OSHA as a system under which the United States Department of Labor pays compensation and medical costs attributed to injuries that occurred after December 1, 1960. The Department of Labor then bills the agency that employed the individual who received compensation or benefits. In any given year, most of the chargeback billing is a result of illnesses and injuries that occurred in previous years. Only 3.3%, or $165,000, of the chargeback billing costs paid by NASA in FY 1988 was for injuries that actually occurred during that year.

Figure 9 illustrates the relationship between chargeback billing and all other mishap- and injury-related costs. These costs include lost wages (continuation of pay) as well as aviation, automobile, fire, and other reportable mishaps. Of the $8.0 million total loss for FY 1988, $5 million, or 63%, was paid out in chargeback billing costs. In FY 1988, chargeback billing costs have exceeded those associated with material losses and lost wages combined.

Figure 10 illustrates the trend of chargeback billing in the Federal Government and in NASA for the last 11 years. While the Federal Government's chargeback billing costs continue to increase, NASA's appear to have stabilized at around $5 million annually.

COST OF FY 1988 NASA MISHAPS/INJURIES
*TOTAL LOSS = $8,006,270

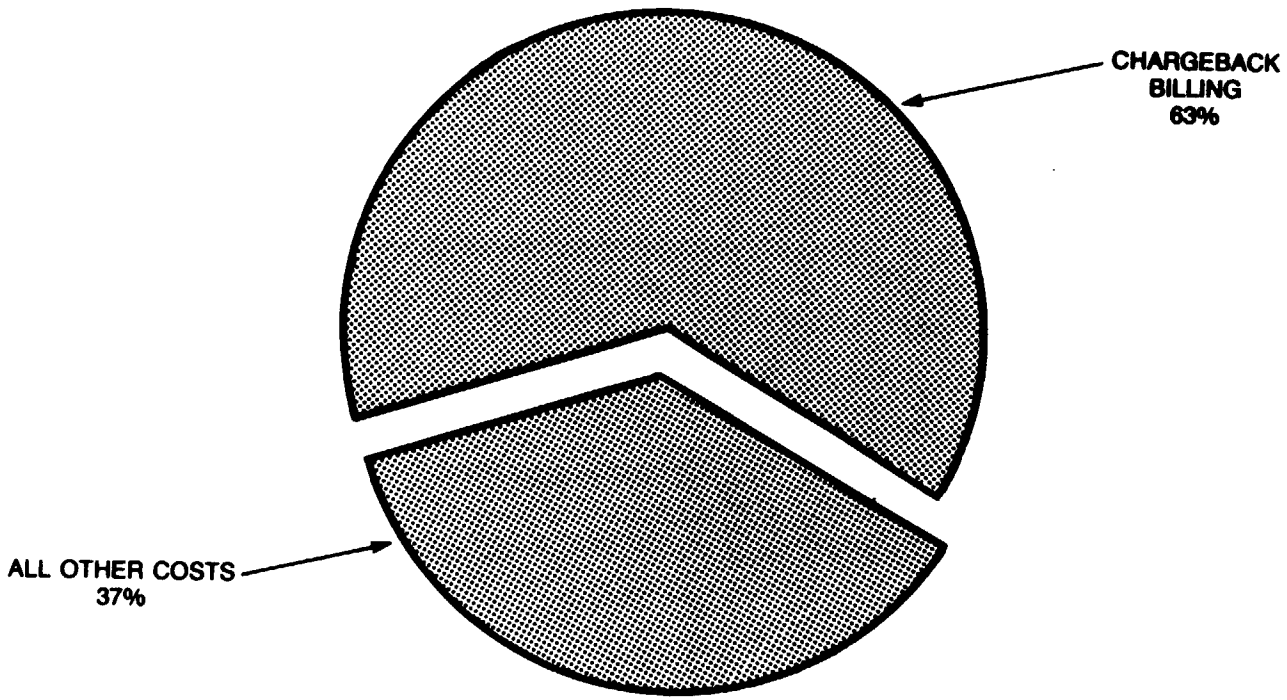

Figure 9

* DOES NOT INCLUDE
COST OF MISSION FAILURES
AND TEST OPERATIONS LOSSES

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Rev. 11-2-88

TIME HISTORY OF (OWCP) CHARGEBACK BILLINGS
COSTS FOR ALL FEDERAL GOVERNMENT AGENCIES AND NASA
(IN MILLIONS OF DOLLARS)

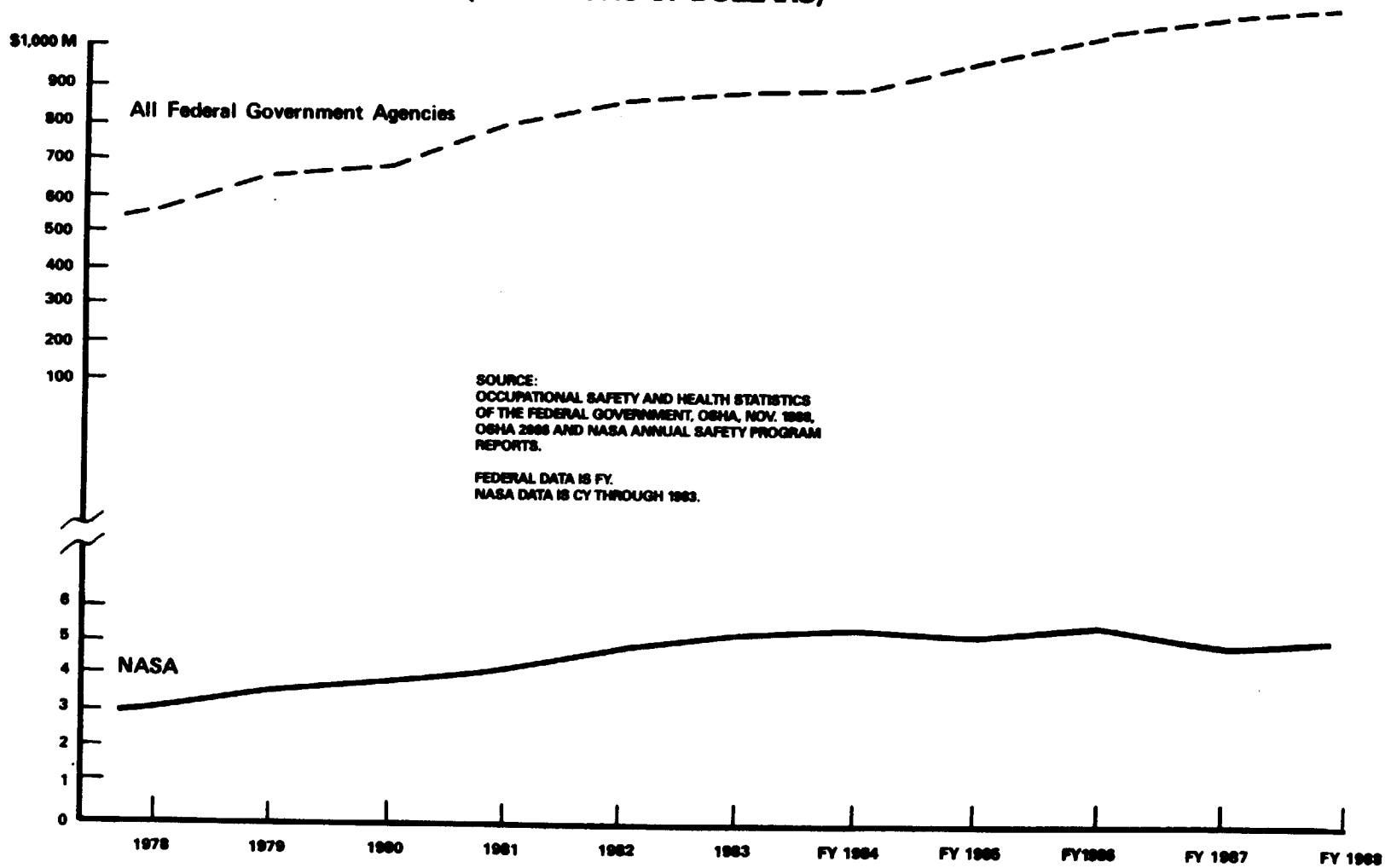

Figure 10
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Rev. 11-2-89

MATERIAL LOSSES

Table 3 lists the statistics for NASA material losses during FY 1988. Rescheduling and equipment replacement costs from major mission failures are not included in these statistics. The revised NASA Management Instruction for Mishap Reporting and Investigating (NMI 8621.1E) clarified mishap reporting requirements for the field installations. The significant increase in the number of mishaps reported in FY 1988 compared to the previous year may be attributable to the clearer definition of reporting requirements rather than an increase in actual mishaps.

Figure 11 illustrates the total costs of material losses over the last 11 years.

Figure 12 illustrates the cost of aircraft losses over the last 11 years. The loss of the Convair 990 in FY 1985 represents the most costly aviation mishap in recent years. This year's single aviation mishap occurred at JSC's Ellington Airfield, runway 35L. During normal landing procedures after a high altitude flight, WB-57F NASA 928 drifted to the right side of the runway approximately 3,300 feet from the approach end. The nose gear drag brace failed when the aircraft rolled off the runway. The gear folded back, allowing the aircraft to skid to a stop on the nose radome. Final cost of the mishap was $9,149.

Figure 13 shows the cost of NASA automobile accidents for the last 11 years.

NASA experienced 5 minor fires resulting in $48,000 in damage in FY 1988. NASA's excellent record in fire experience, as illustrated in Figure 14, is a reflection of aggressive fire prevention programs throughout the agency.

TABLE 3. NASA MATERIAL LOSSES BY INSTALLATION - FISCAL YEAR 1988
(COSTS ARE IN THOUSANDS OF DOLLARS)

	AUTO MISHAPS				AIRCRAFT MISHAPS		FIRE LOSSES		OTHER MISHAPS		TOTALS		
	GOV		POV								TORT	NO.	
	NO.	COST	NO.	COST	NO.	COST	NO.	COST	NO.	COST	COSTS	MISHAPS	COST
ARC/DFRF	0	0	0	0	0	0	1	10	8	209	0	9	219
GSFC/WFF	2	1	0	0	0	0	0	0	1	16	0	3	17
HQ	0	0	0	0	0	0	0	0	0	0	0	0	0
JPL	1	1	0	0	0	0	0	0	1	10	0	2	11
JSC	2	4	0	0	1	9	0	0	5	15	0	8	28
KSC	33	48	1	1	0	0	2	25	55	833	0	91	907
LaRC	0	0	0	0	0	0	1	11	5	183	2	6	196
LeRC	0	0	0	0	0	0	0	0	5	9	0	5	9
MSFC	7	6	0	0	0	0	1	2	25	1,280	0	33	1,288
SSC	0	0	0	0	0	0	0	0	3	96	0	3	96
NASA	45	60	1	1	1	9	5	48	108	2,651	2	160	2,771
LAST YEAR	27	34	9	5.3	1	275	8	17.3	67	8,118	42.8	113	8,492.3

1. Auto Mishaps for GOVs include GSA leased vehicles and for POVs, rental cars.
2. Tort Costs are for claims paid in this reporting period.

NASA MATERIAL LOSSES DUE TO MISHAPS*
(IN MILLIONS OF DOLLARS)
1978-1988

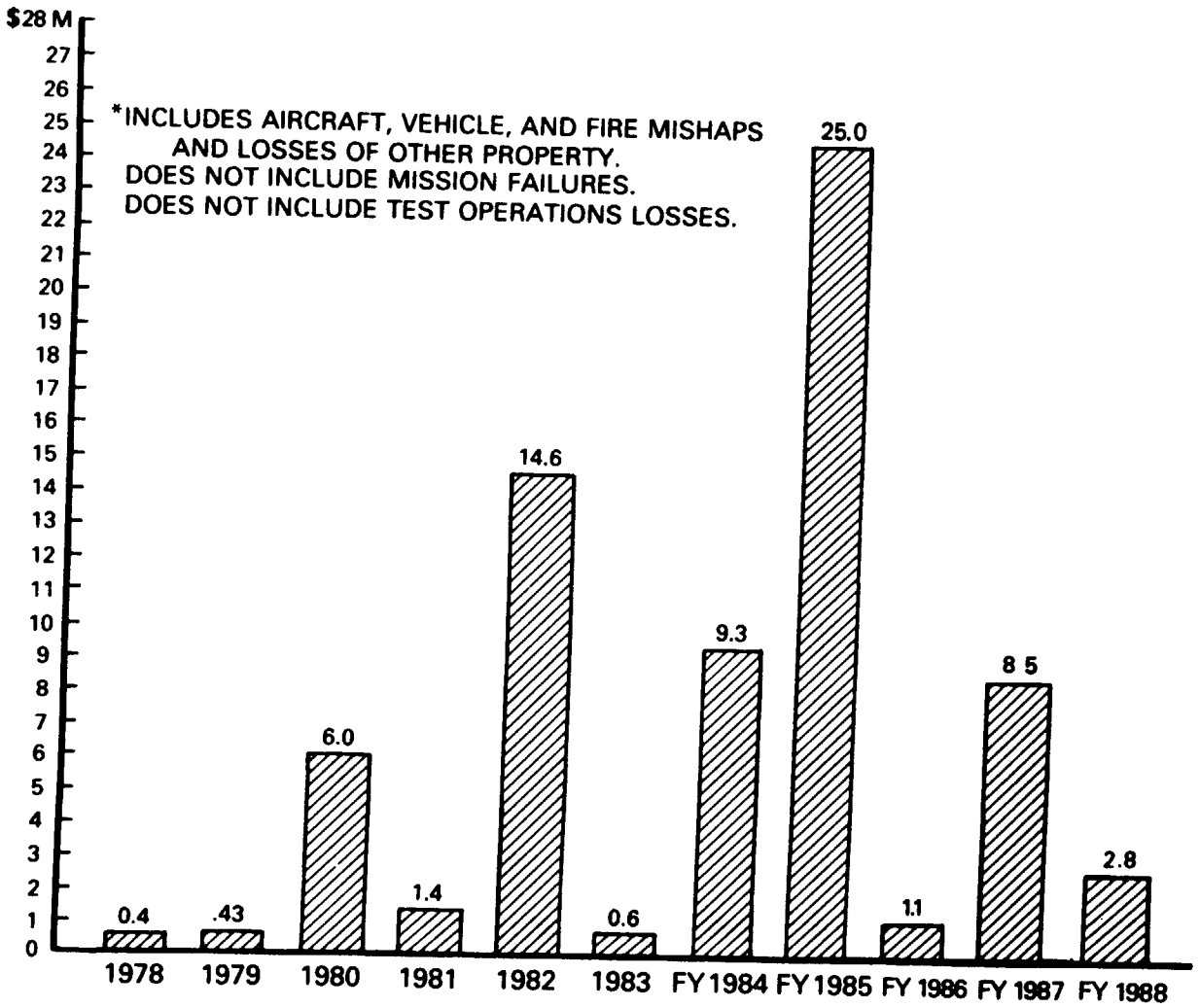

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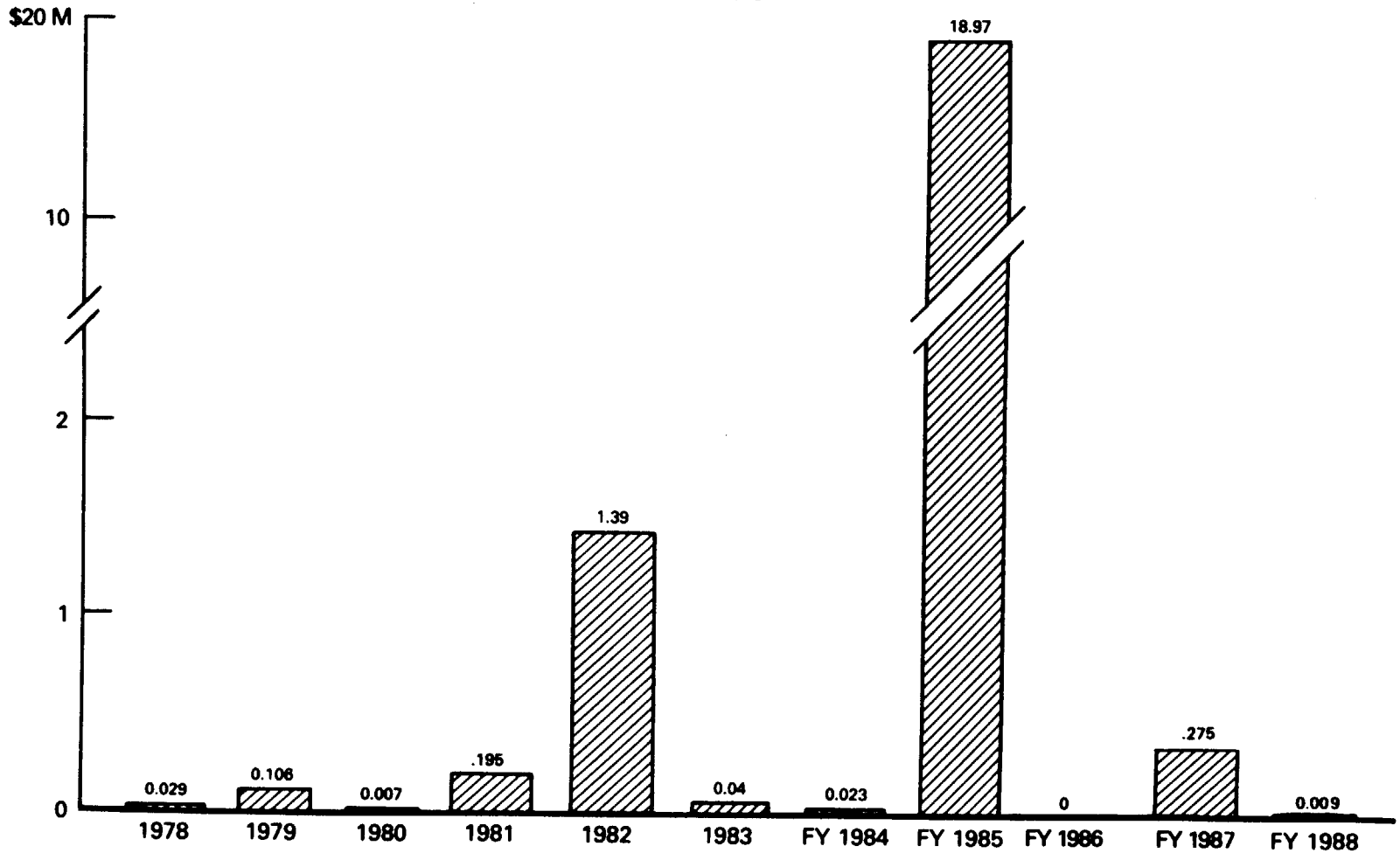
Figure 11

NASA AIRCRAFT LOSSES
(IN MILLIONS OF DOLLARS)
1978-1988



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Rev. 11-2-89

Figure 12

NASA MOTOR VEHICLE ACCIDENT LOSSES
GOV AND POV
(IN THOUSANDS OF DOLLARS)
1978-1988

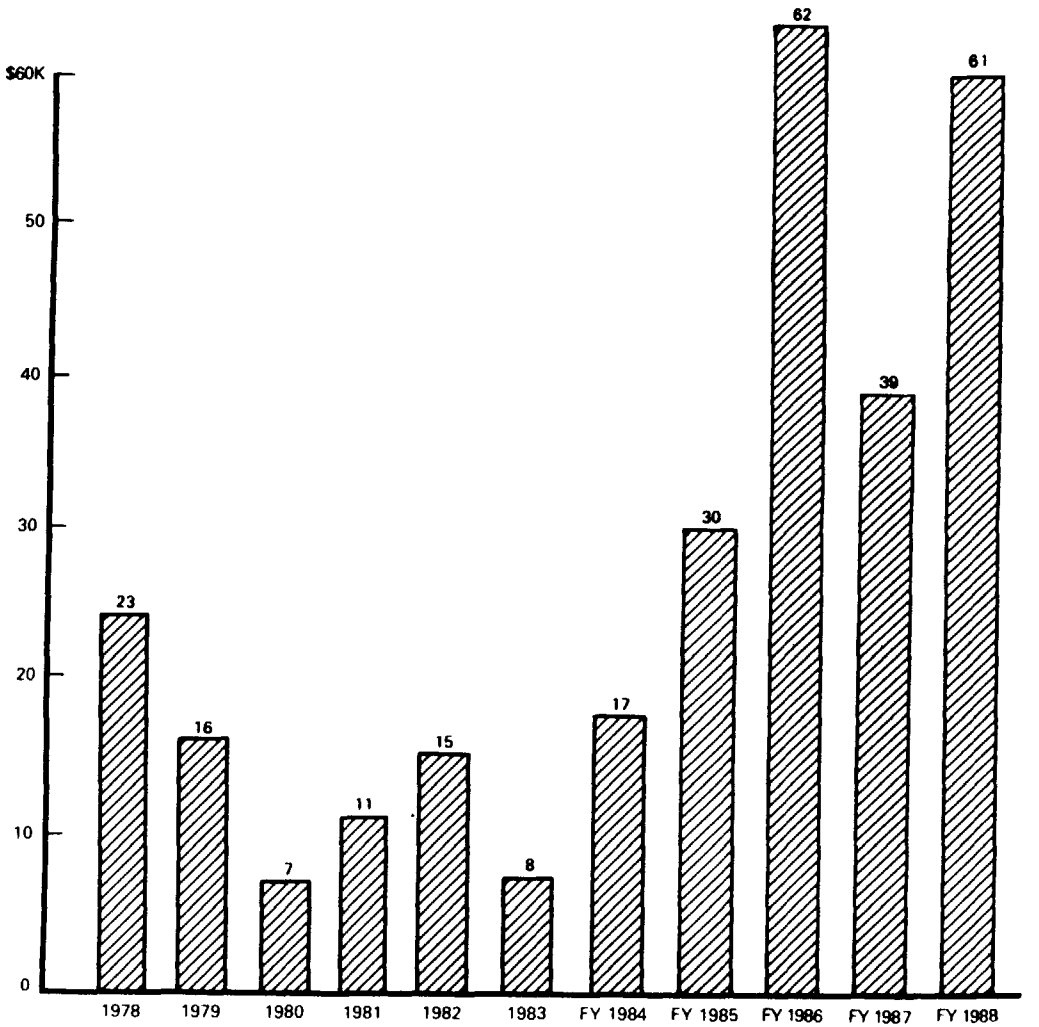

Figure 13
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NASA FIRE LOSSES
(IN MILLIONS OF DOLALRS)
1978-1988

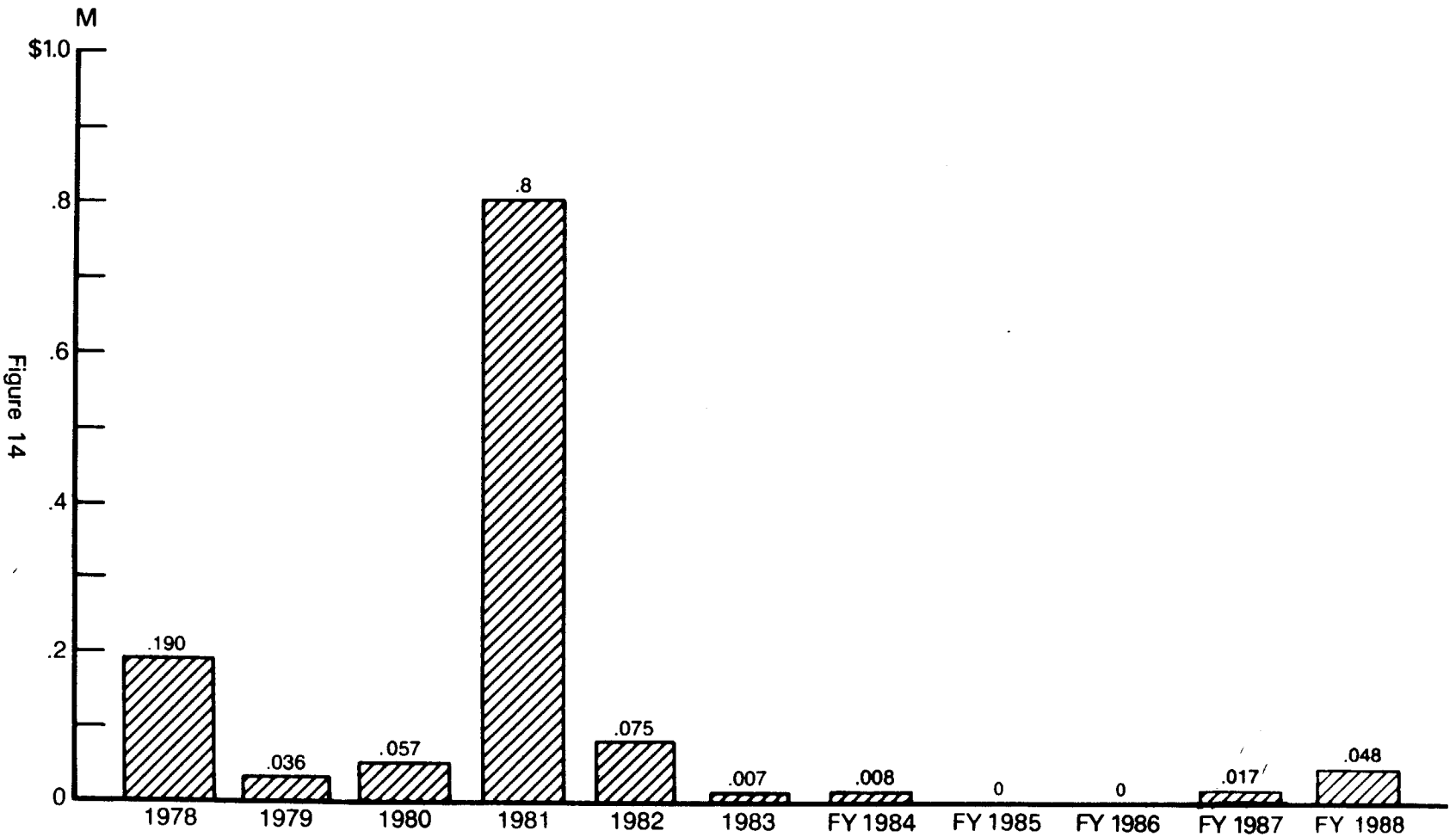

Figure 14

DOES NOT INCLUDE TEST OPERATIONS OR MISSION FAILURES

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NASA MISHAP DEFINITIONS

TYPE A MISHAP: A mishap causing death, damage to equipment or property equal to or exceeding $500,000, destruction of an aircraft, or destruction of space hardware. NASA Type A mishaps are investigated by a board appointed by the appropriate program or institutional Associate Administrator.

TYPE B MISHAP: A mishap resulting in permanent disability to one or more persons, hospitalization of five or more persons, or damage to equipment or property costing from $250,000 to less than $500,000. NASA Type B mishaps are investigated by a board appointed by the director of the field installation.

TYPE C MISHAP: A mishap resulting in damage to equipment or property costing from 25,000 to less than $250,000, or causing occupational injury or illness that results in a lost workday (or workdays) or restricted duty. NASA Type C mishaps are analyzed locally by committees or individuals unless circumstances dictate a more formal investigation.

MISSION FAILURE: Any event of such a serious nature that it prevents accomplishment of the majority of the primary mission objectives. Mission failures are usually investigated by a formal board.

TEST FAILURE: An unexpected event that jeopardizes a test, prevents accomplishment of major test objectives, causes premature test termination, or destroys test hardware, test stands, or monitoring equipment. Test failures generally result in monetary losses of $25,000 or more, have significant impact on a particular program, or have political or public visibility. A program may call for the use of low cost models and other test items that are specifically designed to meet certain test conditions where damage is likely to occur. When these models are damaged or destroyed, circumstances will determine if a failure has in fact occurred or if the damage was a likely result of the test. Test failures are investigated or analyzed as determined by program personnel. (When a part or assembly fails without causing a significant monetary loss or program delay, a test failure, according to this definition, has not occurred.)

INCIDENT: An unplanned occurrence that results in injuries to personnel of less severity than those in a Type C mishap or that results in property loss or damage in excess of $500 but less than $25,000. A close call that could generate widespread interest may be included in this category.

CLOSE CALL: An unplanned occurrence in which there is no injury, property damage, or interruption of work, but which has the potential for any of these.

COSTS: Direct costs of repair, retest, delays, replacement, or recovery of NASA property including manhours, material, and contract costs but excluding indirect costs of cleanup, investigation, injury, and normal operational delay.

NASA MISHAP: Any unplanned event or anomaly that may be classified as a Type A, B, or C mishap, incident, or mission or test failure that involves NASA personnel, equipment, or facilities.

NASA CONTRACTOR MISHAP: Any unplanned event or anomaly that may be classified as a Type A, B, or C mishap, incident, or mission or test failure that involves NASA contractor personnel or equipment in support of operations at NASA. These are normally investigated by the contractor and reviewed by NASA, or depending upon the circumstances, investigated separately by NASA when directed by a NASA official with board appointment authority.

N.B: These definitions appear in NMI 8621.1D which was revised in September 1988. The new NMI 8621.1E provides higher threshold dollar values for Types A, B, and C equipment/property mishaps. Most mishaps reported in FY 1988 were categorized according to the definitions appearing in this document.

MISHAP STATISTICS

Tables 4 and 5 show the significant mishaps that were reported by the NASA field installations as having significance beyond the minor dollar losses or injury incident categories.

Figure 15 presents an 11-year overview of NASA Type A, Type B, and Type C mishaps. Each Type B and C mishap resulted in property damage of an amount greater than $25,000. Type B and C personal injuries are reflected in Tables 1 and 2. The dollar limits for each category have escalated over the years due to inflation and policy changes.

Figure 16 presents an 11-year history of NASA's total losses from chargeback billing costs, lost wages, and material losses due to mishaps.

Table 6 compares the number of major mishaps experienced by the individual field installations, the lost-time rate of civil service and contractor employees, and the cost of material losses for the fiscal year against the installations' goals and the previous year's totals.

TABLE 4. FATALITIES

	1978	1979	1980	1981	1982	1983	1984H	1985	1986	1987	1988
NASA EMPLOYEES	0	1	0	4	1	0	0	0	3	0	0
CONTRACTOR EMPLOYEES	1	0	0	5	1	0	1	1	6	1	1
OTHERS	0	0	0	0	0	0	0	0	3	0	0
TOTALS	1	1	0	9	2	0	1	1	12*	1	1

*7 from Challenger mishap

TABLE 5. NASA TYPE A/B/C MISHAPS BY FIELD INSTALLATION

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
ARC/DFRF	1/3	0/6	0/0	2/3	2/3	1/0/2	1/0/5	1/0/1	0/0/0	0/0/1	0/0/1
GSFC/WFF	0/0	0/1	1/1	0/3	1/0	1/0/1	0/0/0	0/0/1	1/0/0	0/0/1	0/0/0
HQ	0/0	0/0	0/0	0/0	0/0	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0
JPL									0/0/0	0/0/0	0/0/0
JSC	0/0	0/2	1/0	2/0	0/1	0/0/0	0/0/0	0/0/0	1/0/0	1/1/0	0/0/0
KSC	0/0	0/0	0/1	5/3	1/2	0/0/1	0/0/0	0/0/6	1/0/2	1/0/0	0/1/3
LaRC	0/1	0/0	0/0	3/4	1/0	0/0/0	0/0/0	1/0/0	0/0/2	0/0/0	0/0/2
LeRC	0/0	1/1	0/0	0/2	0/0	0/0/2	0/0/0	1/0/1	0/0/0	1/0/0	0/0/0
MSFC	0/0	0/0	2/1	1/0	4/2	0/1/2	2/0/0	0/0/0	0/0/0	2/0/3	0/1/7
SSC	0/0	0/0	0/0	1/1	1/0	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0	0/0/1
TOTALS	1/5	1/10	4/3	14/16	10/8	2/1/8	3/0/5	3/0/9	3/0/4	5/1/5	0/2/14

1. Type "C" was first defined in 1983 and partially replaced the previously defined Type "B" mishap.
2. Types "B" and "C" individual injuries are not shown on this table. See Table 1.

NASA TYPE 'A', 'B', AND 'C' MISHAPS
1978-1988

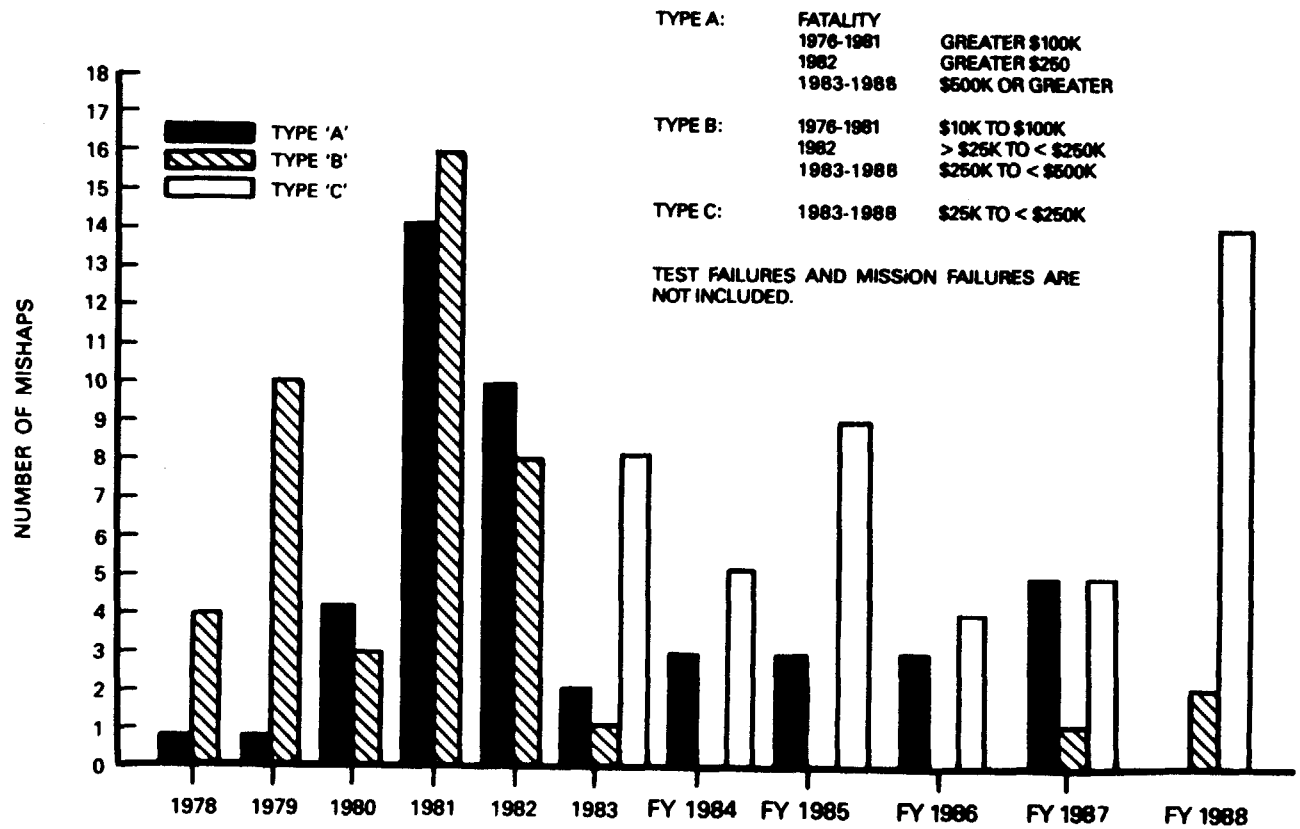

Figure 15

NASA HQ QS88-643 (1)
Rev. 11-2-89

TOTAL COSTS TO NASA DUE TO MISHAPS*
(IN MILLIONS OF DOLLARS)
1978-1988

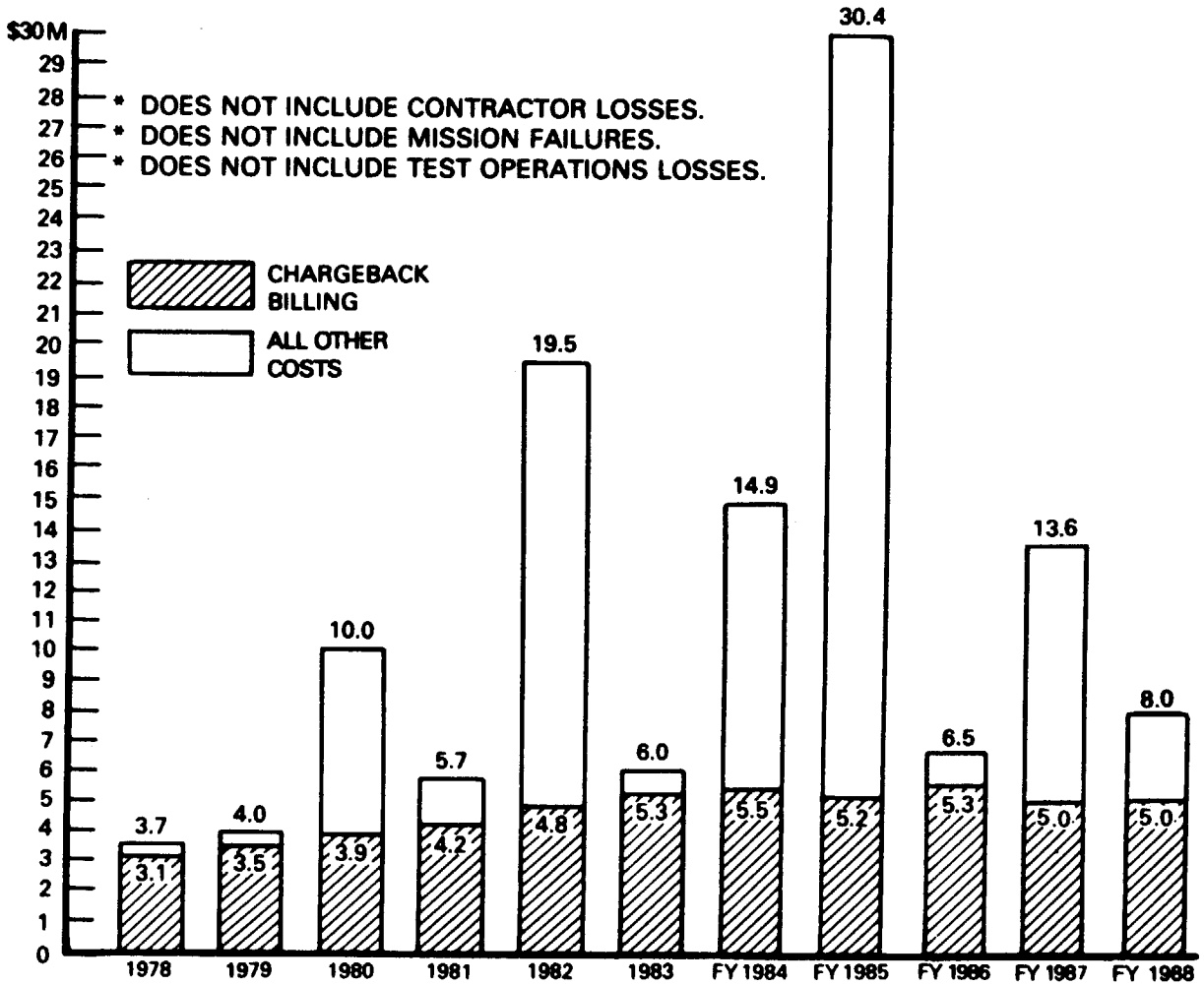

Figure 16
29

TABLE 6. GOAL STATUS FOR FISCAL YEAR 1988
October 1, 1987 - September 30, 1988

	TYPE A & B MISHAPS			TYPE C MISHAPS			NASA EMPLOYEE L-T RATE			CONTRACTOR EMPLOYEE L-T RATE			MONETARY LOSSES ($K)		
	1987	GOAL 1988	STATUS	1987	GOAL 1988	STATUS	1987	GOAL 1988	STATUS	1987	GOAL 1988	STATUS	1987	GOAL 1988	STATUS
ARC	0	0	0	1	1	1	0.56	0.40	0.81	1.33	1.50	1.57	128	50	219
GSFC	0	0	0	1	0	0	0.33	0.30	0.43	0.95	0.45	0.99	51.4	70	17
HQ	0	0	0	0	0	0	0.22	0.40	0	0.49	0.40	0.91	21.4	2	0
JPL	0	0	0	0	0	0	--	--	--	0.93	--	1.27	10	--	11
JSC	2	0	0	0	1	0	0.26	0.30	0.19	0.82	0.90	1.76	734.2	3	28
KSC	1	1	1	0	1	3	0.26	0.30	0.49	0.82	0.70	0.99	5,143.9	500	907
LaRC	0	0	0	0	0	2	0.17	0.30	0.30	1.19	1.50	1.22	46.6	250	196
LeRC	1	0	0	0	0	0	0.86	0.50	0.51	2.00	1.50	1.94	19.1	50	9
MSFC	2	0	1	3	1	7	0.14	0.30	0.21	0.32	1.00	0.34	2,326.7	10	1,288
SSC	0	0	0	0	0	1	1.34	0	0	0.93	0.80	0.60	0	25	96
NASA	6	1	2	5	4	14	0.35	0.40	0.37	0.87	0.85	1.06	8,492.3	1,000	2,771

MAJOR MISHAPS IN FY 1988

NASA CAUSEWAY FATALITY
KENNEDY SPACE CENTER
(TYPE A/CONTRACTOR)

On April 4, 1988, at approximately 11:38 a.m., a leased 49-passenger tour bus heading west on the NASA Causeway struck the privately owned vehicle of a contractor employee on the left side as it entered the "C" Avenue intersection. The employee sustained severe injuries and was pronounced dead on arrival at Jess Parrish Memorial Hospital following transport by KSC ambulance. The operator of the tour bus was not injured, but three of the tour patrons were treated for minor injuries at Jess Parrish Memorial Hospital and released.

At the time of the collision, there were several witnesses at the scene. Through the testimony of these witnesses, an analysis of the traffic signal at this location, and other physical evidence, it was determined that the operator of the bus drove into the intersection in violation of a stop signal. As the tour bus approached the intersection the traffic signal changed to yellow and then to red. The operator of the bus stated he felt he could not stop in time for the red light without throwing his passengers out of their seats. The other driver proceeded out into the path of the bus without being aware that it had not stopped.

PVM-1 LEAK TEST MISHAP
MORTON THIOKOL, INC., WASATCH DIVISION
MARSHALL SPACE FLIGHT CENTER
(TYPE B)

On July 9, 1988, during the third shift in Test Bay T-24 at Morton Thiokol, Inc., Wasatch Division, the leak test of the Capture Feature/Primary O-Rings, Center Joint of PVM-1 failed. Personnel on the next shift documented the anomaly. The primary cause was an error in test setup configuration. Reversed high and low pressure connections on the leak test console allowed about 1000 psi into the Capture Feature/Primary O-Rink Cavity.

As part of a fragmented effort in setting up and performing the joint test, untrained personnel were selected to perform the Center Joint setup. The

Investigation Board concluded that the personnels' lack of training was the primary contributor to the mishap. Additionally, the Board found that the absence of checkpoints in the relatively new Department Instruction used to control the test setup was a strong contributor. In contrast, the method previously used had 18 control checkpoints. The Board also noted that operating and quality personnel could not recall any engineering or middle management personnel being present to observe or comment on the operations.

The Board strongly recommended that trained personnel be used for all critical operations and that use of Department Instructions be limited to those functions that have no deleterious impact on hardware.

RCS THRUSTER OVERTEMP MISHAP
MARQUARDT COMPANY, DOWNEY, CALIFORNIA
KENNEDY SPACE CENTER
(TYPE B per NMI 8621.1E)

On September 6, 1988, at the Marquardt Company in Downey, California, three RCS Primary Thruster Injector/Chamber Assemblies were damaged during a Cerachrome insulation baking process when the oven temperature control system malfunctioned. The temperature should have been limited to 625° F; however, it was permitted to reach an estimated 1400° F. The thruster units should have been rejected at this point, but Quality Assurance was not notified. As a result, the full extent of the damage was not determined until the severe discoloration of titanium alloy and columbium parts was noted during the post baking weighing process on September 20, 1988. Other reporting discrepancies, due primarily to a misconception that "in process" mishaps did not have to be reported, resulted in delays in notifying the Rockwell Problem Action Center, DCAS, and the Downey NASA Safety Office. The approximate replacement cost for all three units is $750,000.

Corrective action includes: (1) installing redundant separate high temperature cutoffs on the oven power supply with appropriate alarm systems, providing 100% oven temperature surveillance, and (2) re-emphasizing reporting procedures to ensure all appropriate persons/groups in both Contractor and NASA organizations are promptly notified in the event of a mishap.

TYPE C PROPERTY DAMAGE MISHAPS

Ames Research Center

While conducting the required pre-run inspection of the 11-Foot Transonic Wind Tunnel, tunnel mechanics noted metal debris. Further inspection revealed damage to the aluminum blades and inlet guide vanes. The primary cause was documented as human factors, working environment. Final cost of the mishap was $160,000.

Kennedy Space Center

The Pad B, side #2 shaft, lower stabilizer roller was sheared during PGHM retraction. The primary cause of the mishap was equipment failure due to a design deficiency. Final cost of the mishap was $25,000.

While pressurizing an oxidizer tank ullage with helium to balance the pressure across motorized valve (MV) 102, a procedural error resulted in a pressure spike of approximately 400 psig that ruptured the burst disc. Final cost of the mishap was $42,560.

A lifting beam was damaged while lifting the Ocean Test Fixture (OTF). During the lift, the OTF rotated 30° to 40°. The force of the top beam on the flange area in the center of the lifting beam resulted in the bending of the lower beam. The mishap was attributed to equipment failure due to a design deficiency. Final cost of the mishap was $40,000.

Langley Research Center

A tube in the lead bath heater of the Hypersonic CF4 Tunnel failed and sprayed lead over insulation, wiring, etc. The cause of the mishap was equipment failure due to a design deficiency. Final cost of the mishap was $57,183.

The main parachute failed to deploy during an X-29 model drop test at the Plum Tree Test Site. The cause of the mishap was equipment failure due to a design deficiency. Final cost of the mishap was $122,780.

Marshall Space Flight Center

A Low Pressure Oxidizer Turbo Pump containing approximately 30 ounces of water was returned to Canoga Park from the Santa Susana Field Laboratory. The pump had been exposed to rain during the move. The mishap was the

result of personnel inexperience and a lack of training. Final cost of the mishap was $25,000.

A new chilled water line was installed in the Marshall Space Flight Center Computer Facility, room C-260 of building 4663. A leak in a section of the pipe resulted in extensive damage to IBM 3380 computer hardware. The primary cause of the mishap was personnel inexperience and a lack of training. Final cost of the mishap was $59,644.

A crane was being moved from building 4552 to the railhead area of the Marshall Space Flight Center when the "A" frame section struck an overpass resulting in damage to the crane and the overpass. The mishap was the result of personnel inexperience and a lack of training. Final cost of the mishap was $100,000.

At Morton Thiokol, Inc., Utah, a nose cap was damaged beyond repair during grit blast operations. The cause of the mishap was personnel inexperience. Final cost of the mishap was $135,000.

Two Reaction Wheel Assemblies (RWAs) were being evacuated prior to a functional test in the 156F clean room at the Marshall Space Flight Center. The vent port screws were overtorqued and stripped causing contamination to the RWAs. The RWAs had to be returned to the vendor to open the housing for cleaning. The mishap was attributed to inadequate task supervision. Final cost of the mishap was $70,000.

The Data Management Unit (DMU) in building 579 Hardware/Software Lab of the Marshall Space Flight Center was damaged when it was over voltaged/currented during a power-up operation. Power supplies were not checked before power-up. The cause of the mishap was personnel inexperience. Final cost of the mishap was $74,000.

A SRB-TVC Lower Assembly Reservoir was damaged when the high pressure fill and low pressure return lines were mistakenly reversed. The mishap was due to personnel inexperience. Final cost of the mishap was $50,000.

Stennis Space Flight Center

After tests were conducted on current flow meters in Building 2204, the primary tank ruptured, resulting in damage to that tank and an adjoining tank. The primary cause of the mishap was equipment failure due to material defects. Final cost of the mishap was $95,000.

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