PRESENTATION 4.3.9

OSF | WEATHER SUPPORT OFFICE

EFFECTIVITY OF ATMOSPHERIC ELECTRICITY ON LAUNCH AVAILABILITY

SPACE TRANSPORTATION PROPULSION TECHNOLOGY SYMPOSIUM AT PENNSYLVANIA STATE UNIVERSITY

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Table 1: Number of Thunderstorm Days at KSC

SUMMARY OF THUNDERSTORMS BY MONTH FOR EACH YEAR

	MONTHS												
YEAR	1	2	3	4	5	6	7	8	9	10	11	12	YRSUM
1957	0	0	3	1	12	9	16	15	10	2	1	2	71
1958	1	2	4	3	5	10	8	14	9	2	1	0	59
1959	1	1	2	5	9	11	10	10	11	5	0	0	65
1960	0	2	4	3	6	17	21	11	9	4	0	0	77
1961	0	0	4	3	6	13	8	14	7	2	0	1	58
1962	0	3	3	3	4	17	19	22	10	3	1	0	85
1963	1	1	2	2	8	11	13	14	3	3	1	0	59
1964	0	0	1	4	2	7	9	17	6	0	3	2	51
1965	1	1	5	2	3	13	21	11	2	2	1	0	62
1966	0	1	1	1	14	9	10	11	17	1	0	0	65
1967	0	1	1	0	2	21	23	9	7	1	0	2	67
1968	1	1	2	3	7	12	10	11	6	11	0	0	64
1969	0	1	3	5	8	10	19	18	9	3	1	1	78
1970	0	2	4	1	1	9	15	11	9	2	0	1	55
1971	0	4	4	1	5	20	19	11	6	13	3	1	87
1972	4	3	5	3	10	8	11	17	1	5	3	1	71
1973	1	0	4	4	7	9	13	11	10	1	1	1	62
1974	0	0	3	3	10	16	21	15	12	3	1	1	85
1975	0	0	2	2	10	21	15	18	15	5	0	0	88
1976	0	0	4	0	17	10	19	10	14	1	0	2	77
1977	2	1	1	1	10	13	17	15	12	3	2	3	80
1978	2	0	1	2	8	12	24	6	8	3	1	1	68
1979	1	2	2	1	11	13	16	15	10	2	1	0	74
1980	2	1	0	4	8	13	13	7	9	4	1	0	62
1981	0	2	1	1	5	7	14	14	8	2	0	3	57
1982	1	2	3	6	7	14	17	16	8	1	3	3	81
1983	2	4	4	3	4	13	13	17	8	7	1	6	82
1984	2	3	1	4	6	9	11	10	5	0	3	1	55
1985	0	0	1	4	9	14	13	19	11	10	1	1	83
1986	2	2	4	0	5	16	15	16	7	4	2	1	74
1987	1	3	7	2	5	10	15	10	13	0	5	0	71
1988	1	0	2	2	5	6	13	15	5	2	1	1	53
1989	1	2	3	6	7	17	15	11	9	5	1	0	77
NOBS	1013	924	1009	990	1023	990	1023	1023	990	1023	990	1023	12021
N TSTRMS	27	45	91	85	236	410	496	441	286	112	39	35	2303
PER CENT	2.7	4.9	9.0	8.6	23.1	41.4	48.5	43.1	28.9	10.9	3.9	3.4	19.2

Table 2: Percentage Frequency of Thunderstorms at KSC From 33 Year Period of Record (1957 - 1989)

SUMMARY OF THUNDERSTORMS BY HOUR/MONTH

HOUR (EST)	MONTHS 1	2	3	4	5	6	7	8	9	10	11	12
0	0.0	0.1	0.5	0.6	0.7	0.9	1.2	2.2	2.6	0.8	0.2	0.1
1	0.1	0.2	0.6	0.4	0.7	0.6	1.1	1.4	2.4	1.4	0.1	0.0
2	0.4	0.0	0.8	0.3	0.7	0.9	0.7	0.7	1.6	1.1	0.3	0.0
3	0.1	0.2	1.0	0.1	0.4	0.9	0.2	0.9	1.3	0.9	0.4	0.1
4	0.3	0.3	0.8	0.2	0.7	1.0	0.6	0.9	1.6	1.1	0.3	0.3
5	0.3	0.3	1.2	0.2	0.4	0.5	0.9	0.5	1.0	0.8	0.2	0.1
6	0.0	0.3	0.7	0.1	0.3	0.8	0.4	1.2	1.3	0.5	0.2	0.1
7	0.0	0.1	0.8	0.3	0.3	0.5	1.4	1.0	1.2	0.5	0.3	0.0
8	0.1	0.1	0.6	0.4	0.3	0.5	1.3	0.8	0.8	0.7	0.2	0.0
9	0.3	0.2	0.6	0.2	0.5	0.5	0.9	1.3	1.2	0.4	0.3	0.2
10	0.2	0.3	0.8	0.5	1.0	1.0	1.0	1.2	2.4	0.3	0.3	0.3
11	0.2	0.5	0.8	0.8	1.8	2.9	2.5	4.1	2.4	0.4	0.2	0.0
12	0.2	0.4	1.2	1.2	3.2	5.0	6.6	5.8	2.2	1.2	0.4	0.5
13	0.1	0.8	1.1	1.7	3.7	9.1	11.7	8.5	1.9	1.1	0.6	0.6
14	0.1	0.3	1.2	1.9	5.3	12.8	17.0	14.0	7.0	1.2	0.5	0.3
15	0.2	0.8	0.8	1.9	5.8	14.0	19.1	16.8	7.6	1.9	0.6	0.7
16	0.3	0.5	1.0	1.8	6.3	14.9	19.5	16.2	6.9	2.2	0.6	0.5
17	0.1	0.6	0.8	1.8	7.4	13.6	18.8	14.0	7.4	1.8	0.6	0.9
18	0.2	0.2	1.3	1.2	7.1	11.4	15.5	12.0	6.4	2.3	0.8	0.5
19	0.4	0.4	1.6	1.4	6.3	8.6	10.7	6.3	6.1	2.5	0.3	0.2
20	0.4	0.6	1.2	1.0	4.6	6.4	6.5	5.6	4.8	1.9	0.5	0.1
21	0.0	0.6	1.1	0.8	3.3	4.3	4.9	3.6	3.8	1.1	0.6	0.1
22	0.1	0.4	0.9	0.9	1.6	2.6	2.6	2.2	3.0	0.9	0.4	0.2
23	0.2	0.4	0.7	0.6	1.4	1.6	2.2	1.9	1.9	0.8	0.3	0.0
NOBS	24265	22175	24190	23756	24548	23758	24550	24548	23758	24550	23756	24539
NTSTRMS	43	84	221	203	640	1144	1504	1255	812	281	92	58
PCT	0.2	0.4	0.9	0.9	2.6	4.8	6.1	5.1	3.4	1.1	0.4	0.2

RTLP

EFFECT OF LIGHTNING ADVISORY ON GROUND OPERATIONS

- STOPS ACTIVITIES INVOLVING PERSONNEL WHO ARE NOT WITHIN A SHIELDED ENVIRONMENT
- STOPS EXPLOSIVE/ORDINANCE OPERATIONS
- STOPS SRM GRAIN INSPECTION
- STOPS SYSTEM MAINTENANCE AND REPAIR ON OUTSIDE COMMUNICATIONS AND POWER LINES
- FORCES CLOSURE OF VAB, OPF, AND OMRF HIGHBAY DOORS
- CABLES CAN NOT BE CONNECTED/DISCONNECTED TO CT AND MLP INTERFACES
- STOPS ORDINANCE INSPECTION OPERATIONS
- STOPS ORDINANCE DELIVERY
- STOPS OPERATIONS REQUIRING CROSSING OF PCR/ORBITER INTERFACE

RTLP

EFFECT OF LIGHTNING ADVISORY ON GROUND OPERATIONS

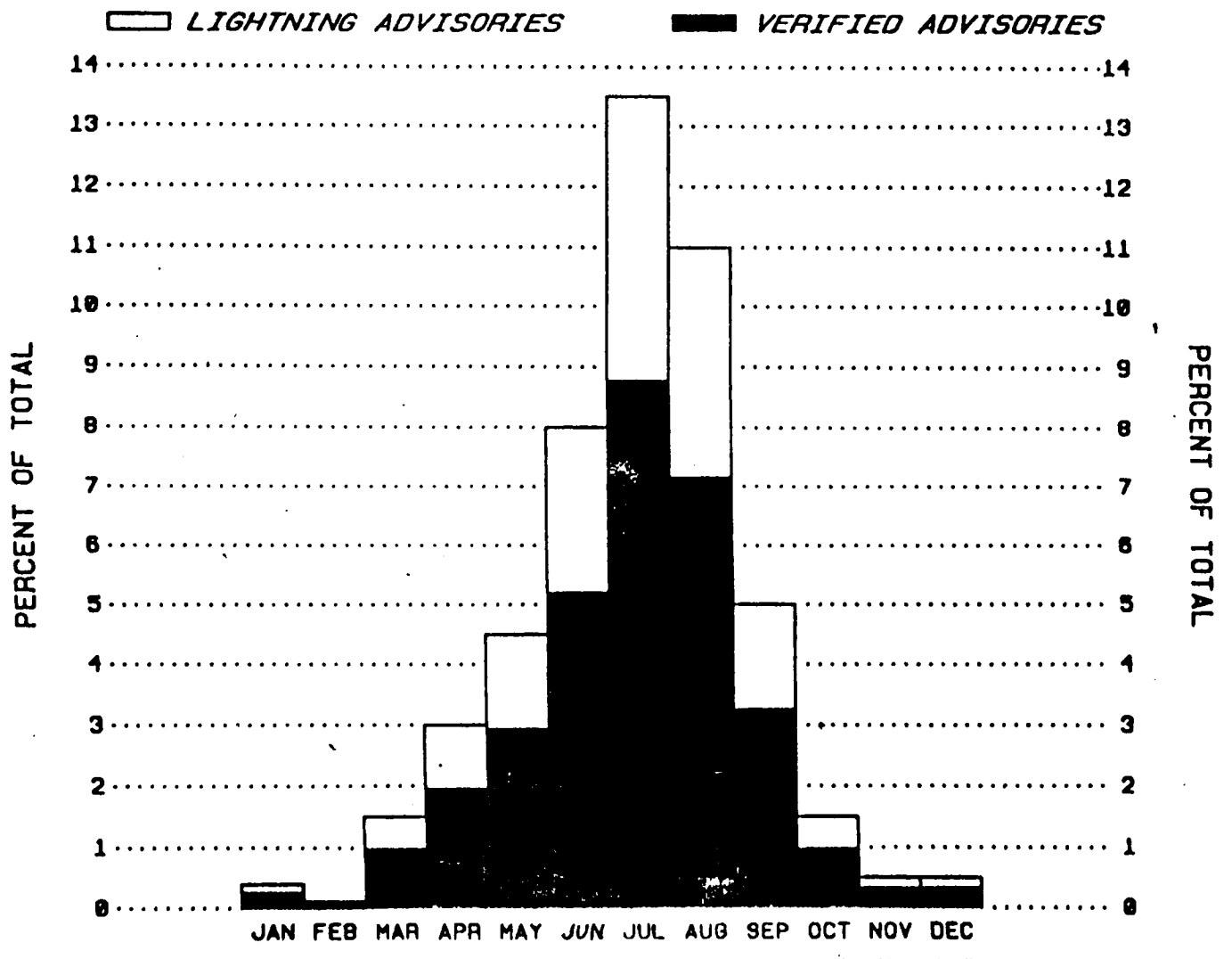
- STOPS AIRCAFT OPERATIONS (STA; T-38) AT THE SLF
- CREW CAN STOP SHUTTLE ROLL-OUT
- STOPS VPF HYPERGOLIC OPERATIONS
- SRM SEGMENTS, ORBITER, ET, PAYLOADS, IN CANISTER AND SHUTTLE MOVEMENT CAN NOT BEGIN
- STOPS OUTSIDE LOGISTICS OPERATIONS
- PREVENTS USAGE OF OIS HEADSETS ON PAD APRON

LIGHTNING AFFECTS TO FACILITIES, EQUIPMENT & PERSONNEL SAFETY

FACILITY/GROUP	ADVERSE WEATHER WARNING	VULNERABLE TO LIGHTING STRIKE		POSSIBLE IMPACT			PERSONNEL SAFETY
		DIRECT	INDIRECT	LAUNCH	SCHED.	COST	
COMPLEXES A & B	WORK CONT. EXC. LL						
RSS / FSS	HIGH WINDS ONLY	NO	NO	NO	NO	NONE	ON TOP
PCR	YES	NO	YES	NO	YES	YES	YES
FUEL/OXIDER HYPERGOL	NO	NO	NO	NO	NO	NONE	NO
SCAPE REST AREA	YES	NO	NO	NO	NO	NONE	NO
ORD. RECEIVE/INSP	YES	YES	YES	NO	YES	YES	YES
PAYLOAD CANISTER	YES	YES	YES	NO	YES	YES	YES
CT	YES	YES	YES	NO	YES	YES	YES
CRAWLERWAY	WNDS ONLY NO	NO	NO	NO	YES	YES	YES
VAB	EXC ORD NO	NO	YES	NO	YES	YES	ON TOP
ROOF	YES	NO	YES	NO	YES	YES	ON TOP
LCC	NO	NO	YES	NO	YES	YES	ON TOP
OPF	YES	NO	YES	NO	YES	YES	OUTSIDE
HYPER SCRUBBER	YES	YES	YES	NO	YES	YES	OUTSIDE
SRB CARRIER & RR	YES	NO	NO	NO	YES	YES	OUTSIDE
SRB REC & REFURB	YES	NO	YES	NO	YES	YES	YES
HMF	YES	NO	YES	NO	YES	YES	YES
CDSC	NO	NO	NO	NO	NO	NO	NO
OUTSIDE COMM CABLE PLNT	NO	YES	YES	NO	YES	YES	YES
PROG SUPT COMM NET	YES	NO	YES	NO	NO	YES	YES
SPIF/SMAB	YES	NO	YES	NO	YES	YES	YES
COMPLEX 40	YES	NO	YES	YES	YES	YES	YES
COMPLEX 41	YES	NO	YES	YES	YES	YES	YES
COMPLEX 39 A & B	YES	NO	YES	YES	YES	YES	YES
ESA-60	YES	YES	YES	NO	YES	YES	YES
SPIN TEST FAC	YES	YES	YES	NO	YES	YES	YES
HANGAR AO	YES	NO	NO	NO	NO	NO	ON TOP
FACS CRITICAL TO LAUNCH	YES		YES	YES	YES	YES	YES
AC POWER DISTRIBUTION	NO	YES	YES	NO	YES	YES	YES
GUARD SHACK	YES	YES	YES	NO	NO	NO	YES

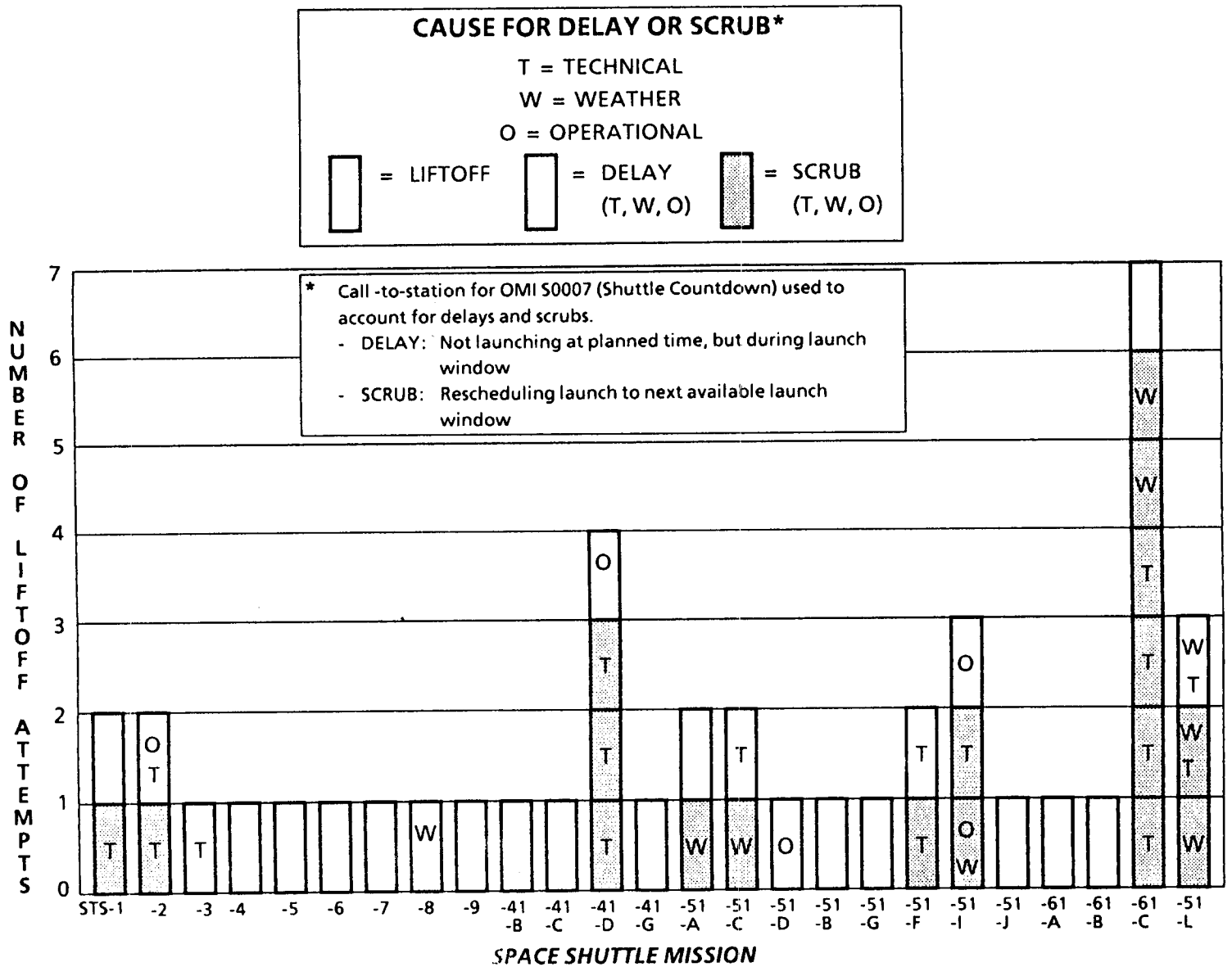
NASA TE-CID-3/INSTRUMENTATION AND MEASUREMENTS BRANCH

ESTIMATE OF LOST MANHOURS



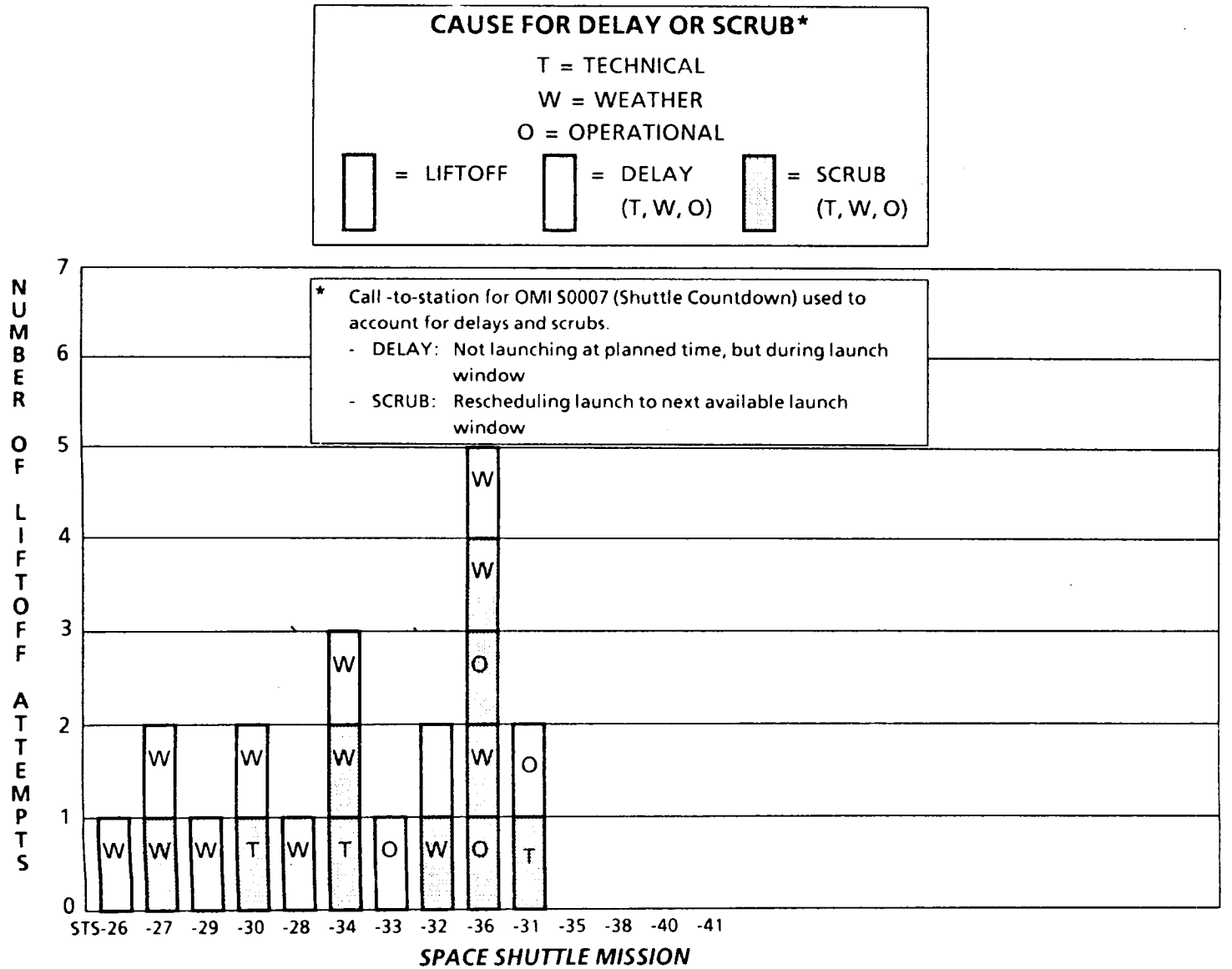
SHUTTLE LAUNCH HISTORY

Chart #1



SHUTTLE LAUNCH HISTORY

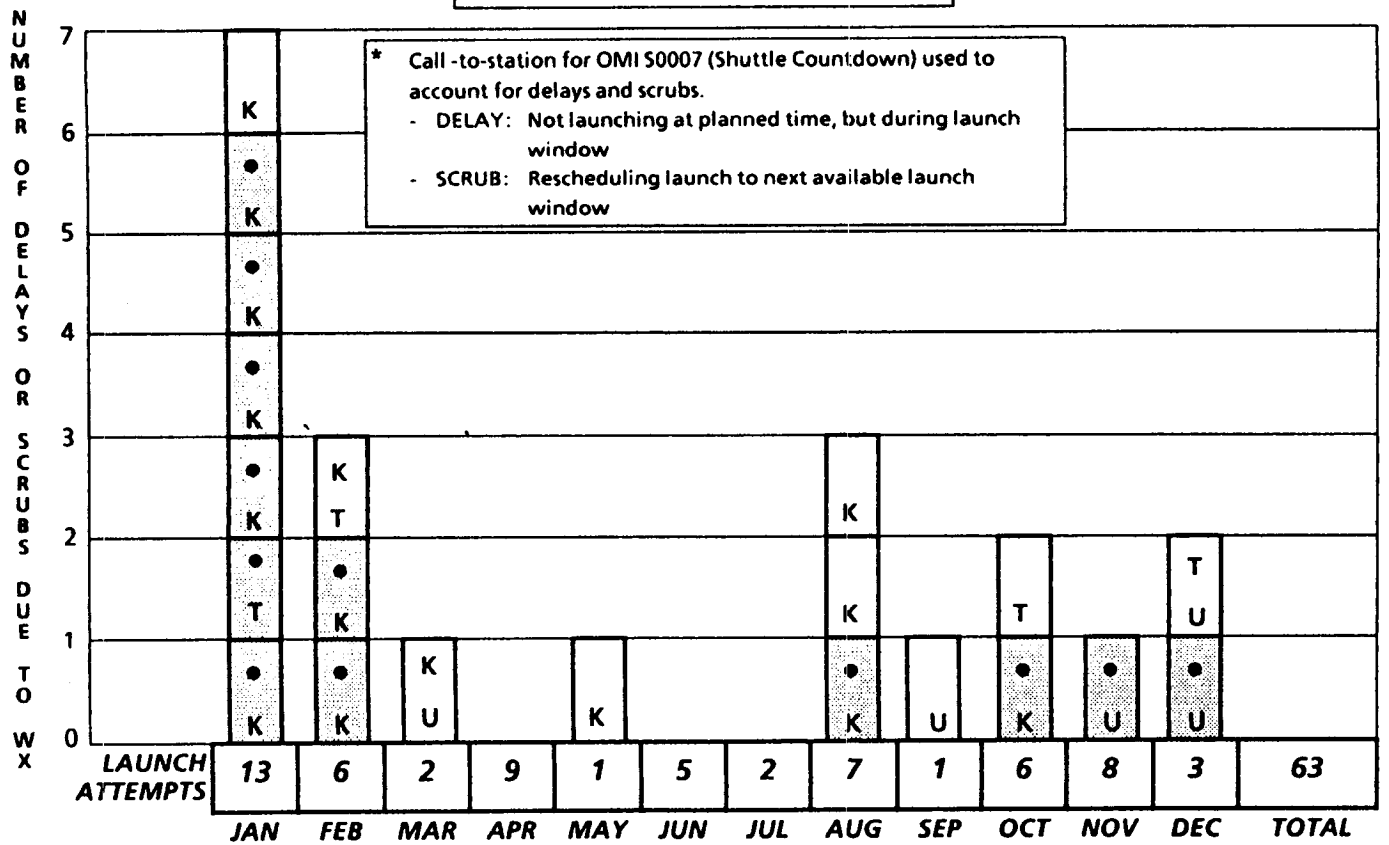
Chart #2



SHUTTLE LAUNCH WEATHER HISTORY

CAUSE FOR DELAY OR SCRUB *

K = KSC WX/WINDS
T = TAL WX/WINDS
U = UPPER LEVEL WINDS
▯ = WX DELAY
●▯ = WX SCRUB



WSO APPLIED METEOROLOGY UNIT

Synopsis

- **Definition** - A proposed facility in Cape area that would:
  - support a dialogue between Research and Operations focused on solving weather problems.
  - develop and test new technology, techniques, and processes.
  - provides support to the SSP operational forecast facilities at JSC/SMG and KSC/CCFF.

- **Goal** - Statement
  - AMU will provide a focused environment conducive to advancing the reliability and accuracy of weather support to space flight operations.

JOINT NASA/USAF AIRBORNE FIELD MILL PROGRAM

OBJECTIVES

- USE NEW MEXICO TECH FLIGHT EXPERIENCE GAINED IN THE SUMMER 1988 AND 1989 FLIGHT CAMPAIGNS AT KENNEDY SPACE CENTER.
- BUILD AN AIRBORNE FIELD MILL DATA BASE AND ANALYZE WITH METEOROLOGICAL DATA IN ORDER TO RECOMMEND CHANGES TO THE WEATHER LAUNCH COMMIT CRITERIA.
- RECOMMEND, OR NOT, THE NEED FOR AN AIRBORNE FIELD MILL MEASUREMENT CAPABILITY ON DAY-OF-LAUNCH.

GOAL

- INCREASE LAUNCH AVAILABILITY AND REDUCE THE CHANCE FOR WEATHER HOLDS/DELAYS

RTLP GOALS/OPERATIONAL BENEFITS

OPERATIONAL BENEFITS OF JOINT PROGRAM:

- **MINIMIZE IMPACT OF ADVERSE WEATHER ON:**
  - **GROUND SYSTEMS AND OPERATIONS**
    - REDUCE FALSE ALARMS IN LIGHTNING WARNINGS
    - IMPROVE LIGHTNING HARDENING OF GROUND EQUIPMENT
    - VERIFY RELIABILITY OF LIGHTNING PROTECTION SYSTEMS
  - **FLIGHT SYSTEMS AND OPERATIONS (ULV/ELV; ALS; NSTS)**
    - REFINE LAUNCH CONSTRAINTS DUE TO TRIGGERED LIGHTNING
    - POSSIBLY WIDEN LAUNCH WINDOWS IN MARGINAL CONDITIONS