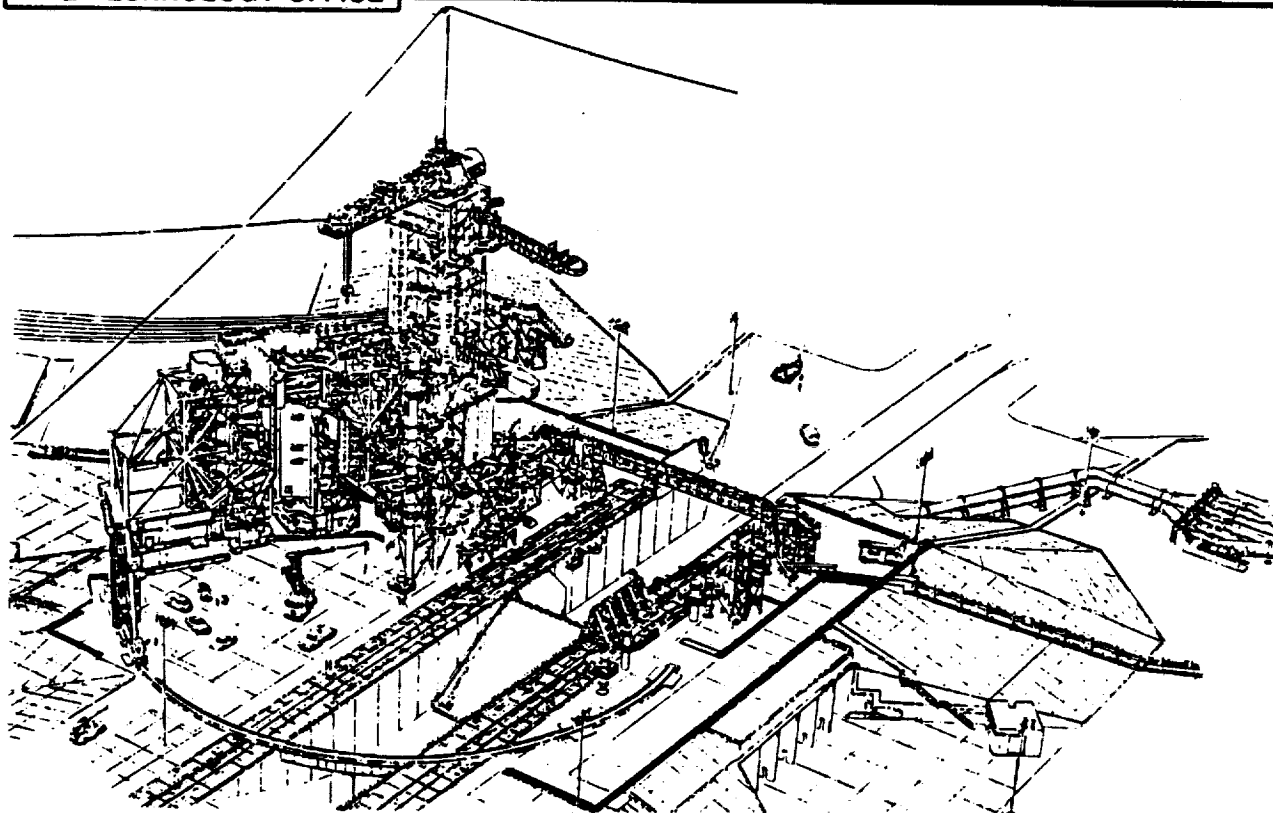


LIQUID ROCKET BOOSTER INTEGRATION STUDY



APPENDICES VOLUME V OF V

PART 1

SECTIONS 1-7

FINAL REPORT PHASE I

NAS10-11475

NOVEMBER 1988



N91-30259

(NASA-CR-188767) LIQUID ROCKET BOOSTER
 INTEGRATION STUDY. VOLUME 5, PART 1:
 APPENDICES Final Report (Lockheed Space
 Operations Co.) 256 p

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LIQUID ROCKET BOOSTER INTEGRATION STUDY

**VOLUME V OF V
APPENDICES
PART 1
SECTIONS 1-7**

**KENNEDY SPACE CENTER
NAS10-11475**

**PREPARED BY:
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LRBI FINAL REPORT CONTENTS GUIDE

VOLUME I - EXECUTIVE SUMMARY

VOLUME II - STUDY SUMMARY

SECTION 1: LRBI Study Synopsis - An assessment of the study objectives, approach, analysis, and rationale. The study findings and major conclusions are presented.

SECTION 2: Launch Site Plan - An implementation plan for the KSC launch site integration of LRB ground processing. The plan includes details in the areas of facility activations, operational schedules, costs, manpower, safety and environmental aspects.

SECTION 3: Ground Operations Cost Model (GOCM) - The updating and enhancement of this NASA provided computer-based costing model are described. Its application to LRB integration and instructions for modification and expanded use are presented.

SECTION 4: Cost - Summary and Analysis of KSC Costs.

VOLUME III - STUDY PRODUCTS

The study output has been developed in the form of nineteen derived study products. These are presented and described in the subsections of this volume.

VOLUME IV - REVIEWS AND PRESENTATIONS

The progress reviews and oral presentations prepared during the course of the study are presented here along with facing page text where available.

VOLUME V - APPENDICES

Study supporting data used or referenced during the study effort are presented and indexed to the corresponding study products.

LIST OF ABBREVIATIONS AND ACRONYMS

ADP	Automatic Data Processing
A&E	Architectual and Engineering
AF	Air Force
AI	Artificial Intelligence
AL	Aluminum
AL-Li	Aluminum Lithium Alloy
ALS	Advanced Launch Systems
ALT	Alternate
AOA	Abort Once Around
AOPL	Advanced Order Parts List
AP	Auxiliary Platform
APU	Auxiliary Power Unit
ARF	Assembly and Refurbishment Facility
ARTEMIS	Accounting, Reporting, Tracking, & Evaluation Management - Information System
ASRM	Advanced Solid Rocket Motor
ASSY	Assembly
ATO	Abort to Orbit
ATP	Authority to Proceed
AUTO	Automatic
AWCS	Automated Work Control System
BITE	Built-in Test Equipment
BLOW	Booster Liftoff Weight
BOC	Base Operations Contractor
BSM	Booster Separation Motor

C	Celsius
CAD	Computer Aided Design
CALS	Computer Aided Logistics System
CCAFS	Cape Canaveral Air Force Station
CCB	Change Control Board
CCC	Complex Control Center
CCF	Compressor Converter Facility
CCMS	Checkout, Control and Monitor Subsystem
CDDT	Countdown Demonstration Test
CDR	Critical Design Review
CEC	Core Electronics Contractor
CER	Cost Estimating Relationships
CG	Center of Gravity
CH4	Methane
CITE	Cargo Integration Test Equipment
CM	Construction Management Configuration Management
C/O	Closeout Checkout
CONC	Concrete
C of F	Cost of Facilities
COMM	Communications
CPF	Cost per Foot
CPF2	Cost per Square Foot
CPF3	Cost per Cubic Foot
CPM	Critical Path Management
CPU	Central Processing Unit
CR	Control Room
Cryo	Cryogenic
C/S	Contractor Support
CT	Crawler Transporter
CY	Calendar Year

dBase	Data Base - Software Program
dc	Direct Current
DDS	Data Processing System
DDT&E	Design, Development, Test & Engineering
DE	Design Engineering
DEQ	Direct Equivalent Head Count
DFRF	Dryden Flight Research Facility
DFI	Development Flight Instrumentation
DHC	Direct Head Count
DIST	Distributor
DOD	Department of Defense
DOS	Disk Operating System
DOT	Department of Transportation
ECLSS	Environmental Control & Life Support System
ECS	Environmental Control System
EL	Elevation
ELS	Eastern Launch Site
ELV	Expendable Launch Vehicle
EMA	Electrical Mechanical Actuator
EMERG	Emergency
EPA	Environmental Protection Agency
EPDC	Electrical Power and Distribution Control
EPL	Emergency Power Level
ET	External Tank
ET-HPF	External Tanks - Horizontal Processing Facility
ETR	Eastern Test Range
F	Fahrenheit
FAA	Federal Aviation Administration
F&D	Fill & Drain
FEP	Front End Processor
FLT	Flight

FMEA/CIL	Failures Modes & Effects Analysis/Critical Items List
FRF	Flight Readiness Firing
FRSC	Forward Reaction Control System
ft	Feet
FSS	Fixed Service Structure
FWD	Forward
FY	Fiscal Year

G&A	General and Administrative
G,g	Acceleration of Gravity
GAL	Gallons
GDSS(GD)	General Dynamics Space Systems
GEN	Generator
GFE	Government Furnished Equipment
GH₂	Gaseous Hydrogen
GHe	Gaseous Helium
GLOW	Gross Liftoff Weight
GLS	Ground Launch Sequencer
GN₂	Gaseous Nitrogen
GN&C	Guidance, Navigation & Control
GOAL	Ground Operations Aerospace Language
GOX	Gaseous Oxygen
GOCM	Ground Operations Cost Model
GPC	General Purpose Computer
GPM	Gallons Per Minute
GRD	Ground
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
GTSI	Grumman Technical Services, Inc.
GUCP	Ground Umbilical Carrier Plate

H2	Hydrogen
HAZGAS	Hazardous Gas
HB	High Bay
HDP	Holddown Post
He	Helium
HIM	Hardware Interface Module
HMF	Hypergolics Maintenance Facility
HPF	Horizontal Processing Facility
HQ	Headquarters
HVAC	Heating, Ventilation, and Air Conditioning
HW	Hardware
HYD	Hydraulic(s)
HYPER	Hypergolic
Hz	Hertz

IBM	International Business Machines
ICD	Interface Control Document
I/F	Interface
ILC	Initial Launch Capability
INST	Instrumentation
INTEG	Integration
IOC	Initial Operational Capability
IPR	Interum Problem Report
IRD	Interface Requirements Document
IUS	Interial Upper Stage

JSC	Johnson Space Center
-----	----------------------

K	Thousands
	Kelvin
KLB	Thousands of Pounds
KSC	Kennedy Space Center
KW	Kilowatt
LAC	Launch Accessories Contractor
LC-39	Launch Complex 39
LCC	Life Cycle Cost
	Launch Control Center
LCH4	Liquid Methane
LESC	Lockheed Engineering and Science Company
LETF	Launch Equipment Test Facility
LEO	Low Earth Orbit
LH2	Liquid Hydrogen
Li	Lithium
LN2	Liquid Nitrogen
LNG	Liquid Natural Gas
LO2	Liquid Oxygen
LOX	Liquid Oxygen
LPS	Launch Processing System
LRB	Liquid Rocket Booster
LRB-HPF	Liquid Rocket Booster Horizontal Processing Facility
LRBI	Liquid Rocket Booster Integration
LRU	Line Replaceable Unit
LSE	Launch Support Equipment
LSOC	Lockheed Space Operations Company
LUT	Launcher Umbilical Tower
MAX	Maximum
MECO	Main Engine Cutoff
MDAC	McDonnell Douglas Astronautics Company
MIL	Military

MIN	Minimum
MLP	Mobile Launch Platform
MMC	Martin-Marietta Corporation
MMH	Mono Methyl Hydrazine
MOD	Mission Operations Directorate
MOU	Memorandum of Understanding
MP	Manpower
MPS	Main Propulsion System
MSBLS	Microwave Scanning Beam Landing System
MSFC	Marshall Space Flight Center
MST	Mobile Service Tower
MTI	MortonThiokol, Inc.
N2	Nitrogen
NASA	National Aeronautics and Space Administration
NDE	Non-Destructive Evaluation
NDT	Non-Destructive Test
NF	Nose Fairing
N2O2	Nitrogen Tetroxide
NPL	Nominal Power Level
NPSH	Not positive Suction Head
NRC	National Research Council
NSTL	National Space Technology Laboratories (Stennis Space Center)
NSTS	National Space Transportation System
NWS	National Weather Service
OAA	Orbiter Access Arm
OIS	Operational Intercommunications System
OJT	On-the-job Training
O&M	Operations and Maintenance
OMD	Operating and Maintenance Documentation

OMI	Operations and Maintenance Instruction
OMRF	Orbiter Maintenance and Refurbishment Facility
OMRSD	Operational Maintenance Requirements and Specifications Document
OMS	Orbital Maneuvering System
OPF	Orbiter Processing Facility
OPS	Operations
OMBUU	Orbiter Mid Body Umbilical Unit
ORB	Orbiter
ORD	Operational Readiness Date
ORI	Operational Readiness Inspection
OSHA	Occupational Safety & Health Administration
OTV	Operational Television

PA	Public Affairs
PAWS	Pan Am World Services, Inc.
P/A	Propulsion/Avionics Module
P _c	Engine Combustion Chamber Pressure
PC	Personal Computer
PCM	Pulse Code Modulator
PCR	Payload Changeout Room
PDR	Preliminary Design Review
PER	Preliminary Engineering Report
PGHM	Payload Ground Handling Mechanism
PIC	Pyro Initiator Controller
PIF	Payload Integration Facility
P/L	Payload
PMM	Program Model Number
PMS	Permanent Measuring System
PO	Purchase Order
POP	Programs Operations Plan
PR	Problem Report
PRACA	Problem Reporting and Corrective Action
PRCBD	Program Review Control Board Directive

PRC	Planning Research Corporation
PRD	Program Requirements Document
PRESS	Pressure, pressurization
PROP	Propellant
PRR	Preliminary Requirements Review
PSI	Pounds Per Square Inch
psia	Pounds Per Square Inch Absolute
psig	Pounds Per Square Inch Gage
PSP	Process Support Plan
PT&I	Payroll Taxes and Insurance
P&W	Pratt & Whitney Company
Q	Dynamic Pressure
QA	Quality Assurance
Q-Alpha	Dynamic Pressure x Angle of Attack
QC	Quality Control
QD	Quick Disconnect
QTY	Quantity
R	Ranking
RAM	Random Access Memory
RCS	Reaction Control System
R&D	Research and Development
RF	Radio Frequency
RFP	Request for Proposal
RIC	Rockwell International Corporation
ROM	Rough Order of Magnitude
RP-1	Propellant (Kerosene Related Petroleum Product)
RPL	Rated Power Level
RPS	Record and Playback System
RPSF	Rotation, Processing & Surge Facility

R/R	Remove/Replace
RSLS	Redundant Set Launch Sequencer
RSS	Rotating Service Structure
R&T	Research and Technology
RTLS	Return to Launch Site
SAIL	Shuttle Avionics Integration Laboratory
SAB	Shuttle Assembly Building
SCAPE	Self-Contained Atmospheric Protective Ensemble
SDI	Strategic Defense Initiative
SDV	Shuttle Derivative Vehicle
SEB	Source Evaluation Board
SEC	Second(s), Secondary
SGOS	Shuttle Ground Operations Simulator
SIES	Supervision, Inspection & Engineering Services
SIT	Shuttle Integrated Test
	System Integrated Test
SLC-6	Shuttle Launch Complex No.6
SLF	Shuttle Landing Facility
SOFI	Spray On Foam Insulation
SOW	Statement of Work
SPC	Shuttle Processing Contractor
SPF	Software Production Facility
SPDMS	Shuttle Processing Data Management System
SRB	Solid Rocket Booster
SRM	Solid Rocket Motor
SRSS	Shuttle Range Safety System
SR&QA	Safety, Reliability and Quality Assurance
SSC	Stennis Space Center (NSTL)
SSME	Space Shuttle Main Engine
SSV	Space Shuttle Vehicle
STD	Standard
STS	Space Transportation System

SUBSTA	Substation
SW	Switch
S/W	Software
TAL	Transatlantic Landing
TBD	To Be Determined
T&C/O	Test and Checkout
TFER	Transfer
T-0	Liftoff Time
TOPS	Technical Operating Procedures
TPS	Thermal Protection System
TSM	Tail Service Mast
TTV	Termination/Test/Verification
TVA	Thrust Vector Activator
TVC	Thrust Vector Control
T/W	Thrust to Weight Ratio
TYP	Typical
ULCE	Unified Life Cycle Engineering
UMB	Umbilical
UPS	Unintegrated Power System
USAF	United States Air Force
USS	Utility Substation
V	Volt(s)
VAB	Vehicle Assembly Building
VAFB	Vandenberg Air Force Base
VIB	Vertical Integration Building
VLS	Vandenberg Launch Site
VPF	Vertical Processing Facility

WAD	Work Authorization Document
WBS	Work Breakdown Structure
WIP	Work in Progress
WSMR	White Sands Missile Range
WTR	Western Test Range

VOLUME V

SECTION 1

LRB GROUND OPERATIONS PLAN

VOLUME V APPENDIX 1

RETRIEVAL/DISASSEMBLY/REFURBISHMENT

TABLE OF CONTENTS

1.1	SCENARIO
1.2	FACILITY REQUIREMENTS
1.3	GSE/LSE
1.4	OPERATIONAL TIMELINES
1.5	MANPOWER
1.6	COSTS

VOLUME V APPENDIX 1

RETRIEVAL/DISASSEMBLY/REFURBISHMENT

During the flight hardware downselection process, both MSFC Phase-A study contractors considered reusable booster configurations. As a result of independent mid-term trade studies, both MMC and GDSS subsequently eliminated the reusable booster configurations from further study. Prior to this downselection, a cursory evaluation of the launch site requirements for LRB retrieval, disassembly and refurbishment was performed. The study methodology utilized is typical to the techniques described in Volume III of this report.

1.1 SCENARIO

The following recovery scenario has been employed for the station set impact analysis.

- Fully recoverable LRB
- Downrange wet recovery with parachutes
- LRB secured to the deck of the recovery barge (no tow back)
- Partial safing and initial washdown occurring on the recovery barge
- Recovery barge tug to CCAFS
- LRB barge removal by travel lift to ground transporter
- Final safing and washdown
- Disassembly as required
- Parachutes to the KSC parachute facility (by truck)

- Engines to the LRB engine manufacturer for refurbishment (by plane)
- LRB to the manufacturer for refurbishment (by barge)

This scenario was selected for study primarily because it most closely resembled the current SRB recovery scenario, in comparison to the proposed alternate LRB recovery options of down-range wet or dry recovery of the propulsion/avionics module only; or the RTLS LRB toss-back and tow-back options. The downrange wet full recovery is feasible, practical, and reliable. It has the lowest technical risk and the launch site operations are established.

1.2 FACILITY REQUIREMENTS

The station set configuration must provide capability to support the following:

- Recovery barge operations and maintenance
- LRB safing and washdown
- LRB disassembly
- LRU handling, storage and transportation to the refurbishment sites

Our current facility concept envisions a new facility for LRB safing and washdown, sized to accommodate one LRB; a new facility for LRB disassembly including office and logistics areas, sized to accommodate one LRB flight set; and a new barge dockage/slip area, sized to accommodate two recovery barges.

The decision to proceed with new facilities in lieu of modifying the existing SRB Hangar AF facilities is based on technical and schedule issues. The increased LRB diameters and lengths cannot be accommodated by the Hangar AF facilities. Modification activity will disrupt SRB/STS recovery and disassembly operations, impact SRB refurbishment schedules and potentially have a ripple effect to the STS flight rate.

The preferred facility siting plan is south and adjacent to the CCAFS Hangar AF facilities. This site eliminates extensive dredging in the Banana River, required to support the recovery barge traffic from the Port Canaveral locks to the Hangar AF area.

This station set requires approximately 85,000 square feet of facility under roof, and approximately 90,000 square feet of combined apron/dockage area, with at least 200 feet fronting the Banana River.

End-to-end implementation can be accomplished in approximately 24 months utilizing a design/build concept or 36 months utilizing conventional implementation techniques. These conceptual durations exclude the time required to prepare and process the environmental impact statements.

1.3 GSE/LSE

It must be recognized that the ground support equipment and launch support equipment for LRB retrieval and disassembly is in the early conceptual stage. The following is a preliminary list of unique systems and equipment expected to be required at this station set.

- **GSE**

- High pressure de-ionized water spray system - robot controlled
- Hazardous waste containment system
- Engine handling equipment

- **LSE**

- Recovery barge (2)
- Commercial Tug (2)
- Travel lift - 150 ton (1)

1.4 OPERATIONAL TIMELINES

The LRB operational timelines are not expected to differ radically from the projected 1996 timelines for SRB retrieval and disassembly. The following is a synopsis of the projected LRB operational timelines for one LRB flight set.

- Pre-launch OPS 7 days
- At sea recovery OPS 2 days
- Safing and washdown 3 days
- Disassembly 7 days

These timelines are not expected to be schedule critical at the launch site.

1.5 MANPOWER

The LRB processing manpower requirements are expected to be similar to the current SRB headcount, in support to retrieval and disassembly. LRB headcount will peak at 160 SPC type personnel and 60 civil servant and BOC type personnel in FY 1998 and remain constant through the program duration. Initial staffing must start in FY 1995, for training and certification, and initial headcount is projected at 50% of the peak staffing level.

All personnel will be stationized. This is consistent with the staffing philosophy presented in Volume III Section 6 of this report. As LRB/STS flight rate ramps up and SRB/STS flights are phased out, the opportunity exists to transition SRB retrieval and disassembly personnel to the LRB program. This could occur as early as FY 1997.

1.6 COSTS

The total Life Cycle Cost (LCC) for LRB retrieval and disassembly is currently projected at approximately \$185.0 million. This includes the non-recurring costs conceptualized at \$50.0 million (includes 40% NASA wrap factor) and the recurring costs estimated at \$135.0 million. The recurring costs are based upon a projected total manpower requirement of 2420 man years, at a burdened cost of \$50,000 per man year; and commercial tug leasing for 122 LRB/STS flights at \$100,000 per flight. The Life Cycle Costs are in FY 1987 dollars, and are rough-order of magnitude.

The LCC specifically excludes costs for the following:

- LRB refurbishment
- LRB engine refurbishment
- Recurring spares
- Hazardous waste handling
- SRB de-activation

VOLUME V

SECTION 2

LRB PROCESSING TIMELINES

VOLUME V - SECTION 2
APPENDIX

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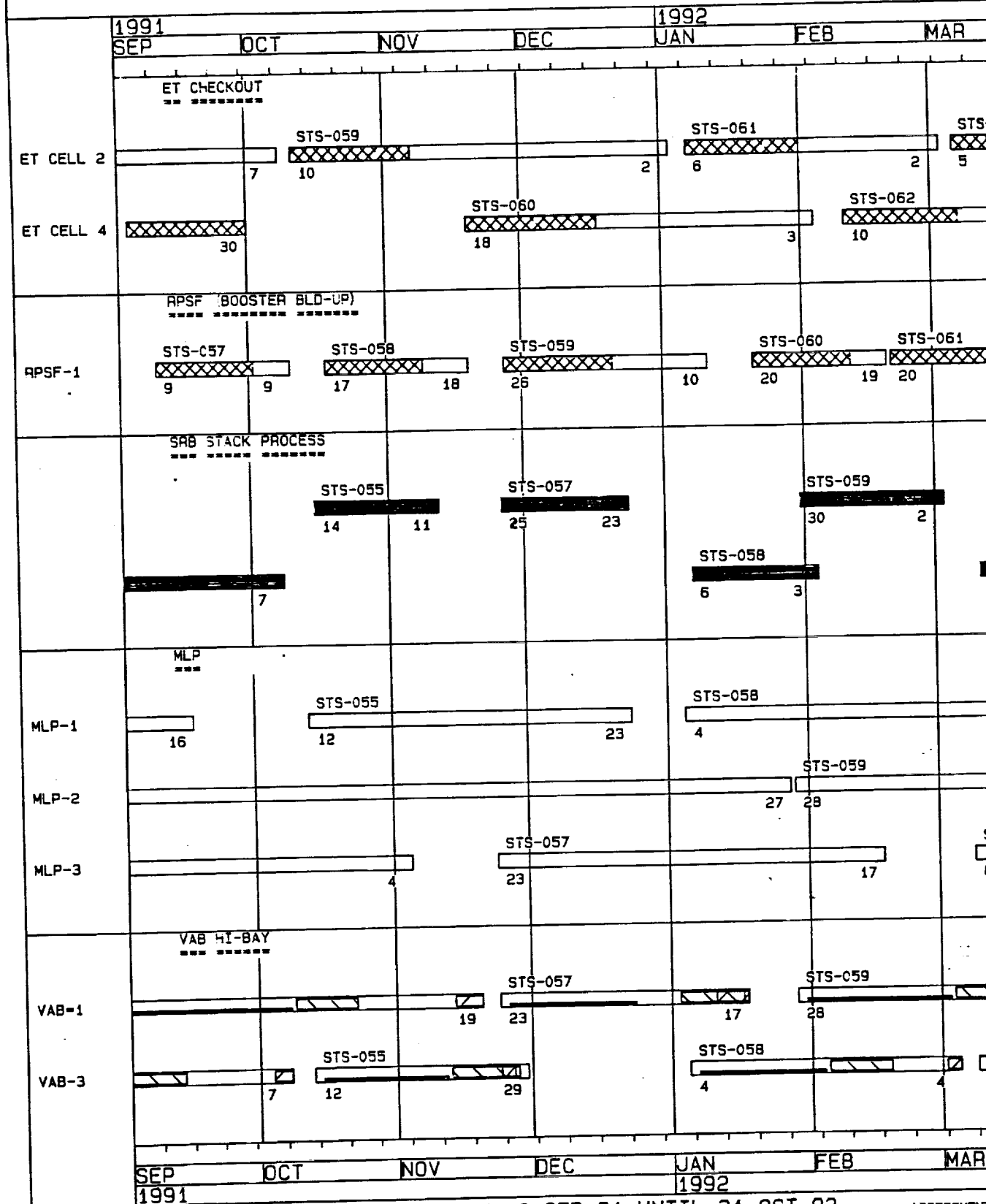
- 2.1 ET/SRB BASELINE FACILITY UTILIZATION (FY 1992 THRU FY 2007)
- 2.2 ET/SRB FACILITY OPEN PERIODS (FY 1992 THRU 2007)
- 2.3 ORBITER/SSV FACILITY UTILIZATION (FY 1990 THRU FY 2007)

VOLUME V

SECTION 2

LRB PROCESSING TIMELINES

ET/SRB FACILITIES
FISCAL



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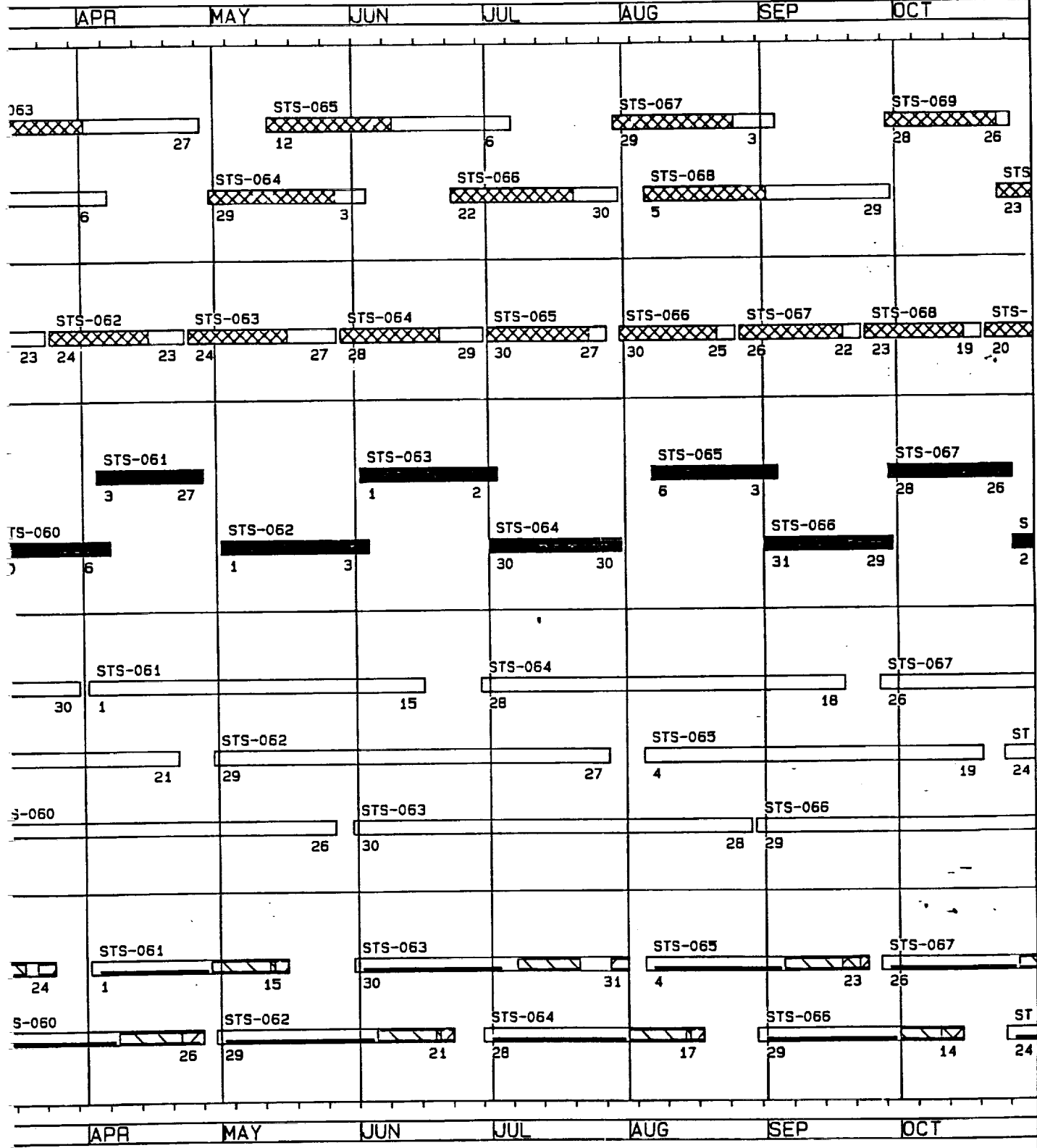
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FACILITY UTILIZATION

YEAR - 1992

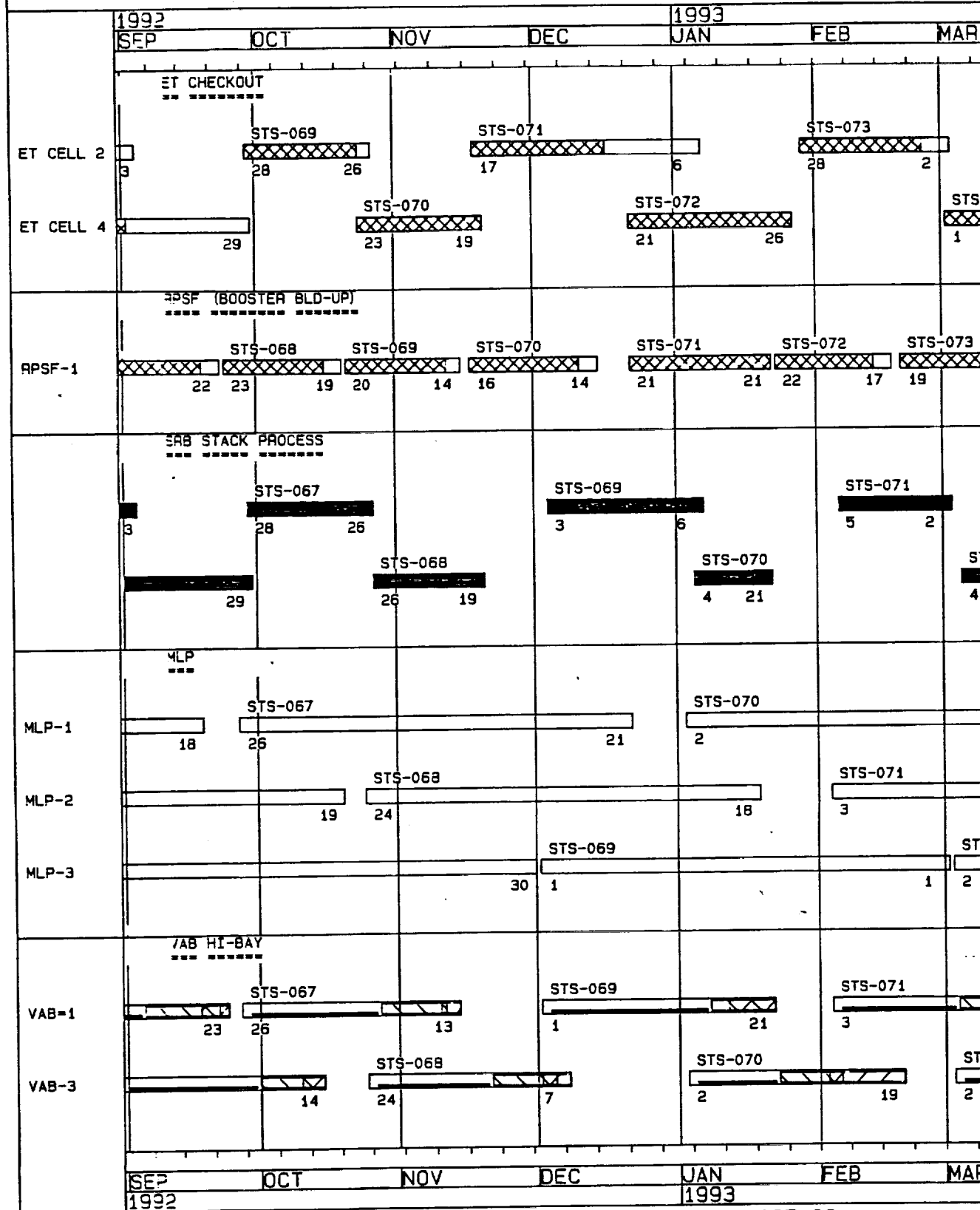


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Figure 2.1-1. FY 1992 ET/SRB Facility Utilization.

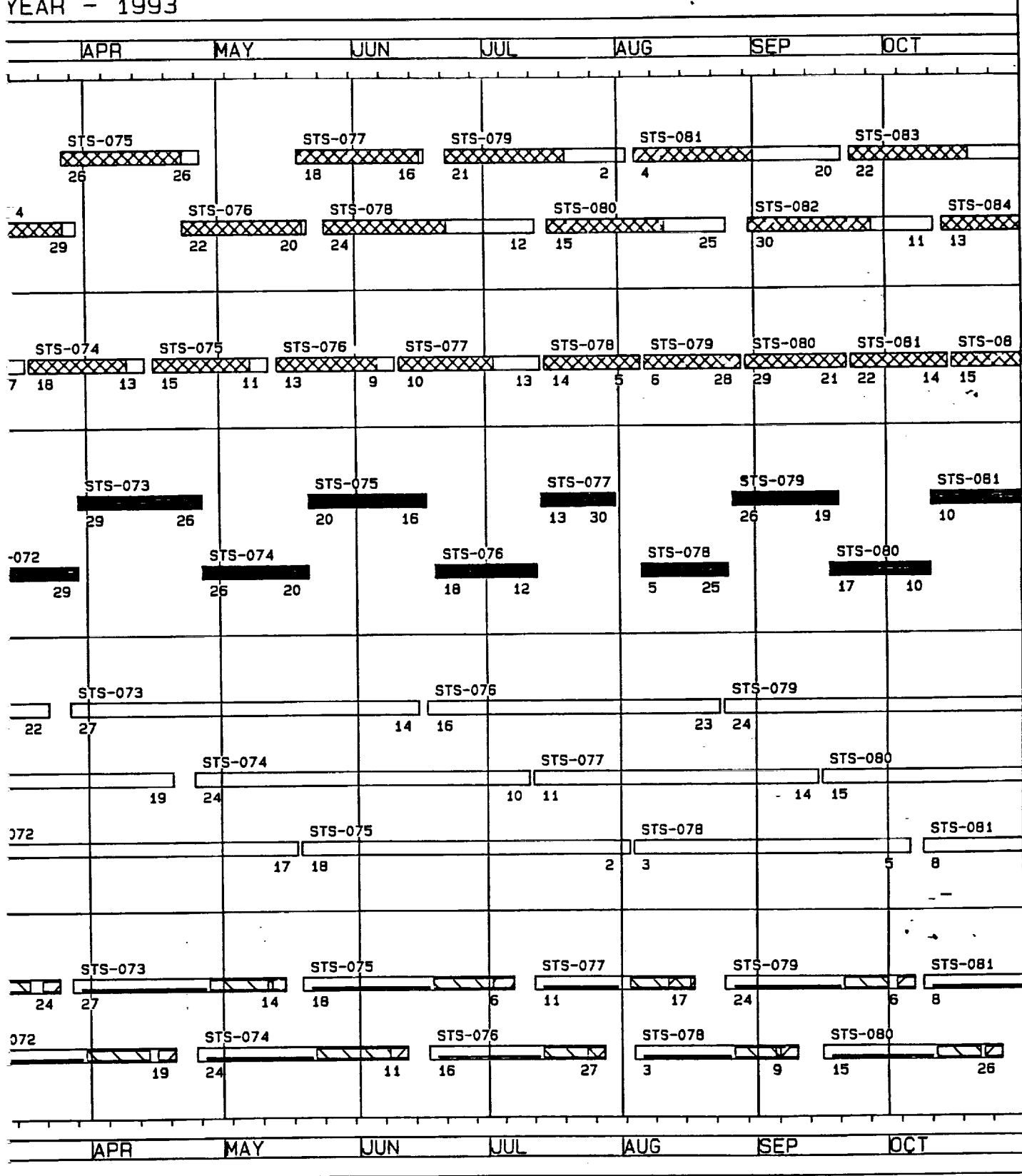
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ET/ SRB FACILITY UTILIZATION

YEAR - 1993

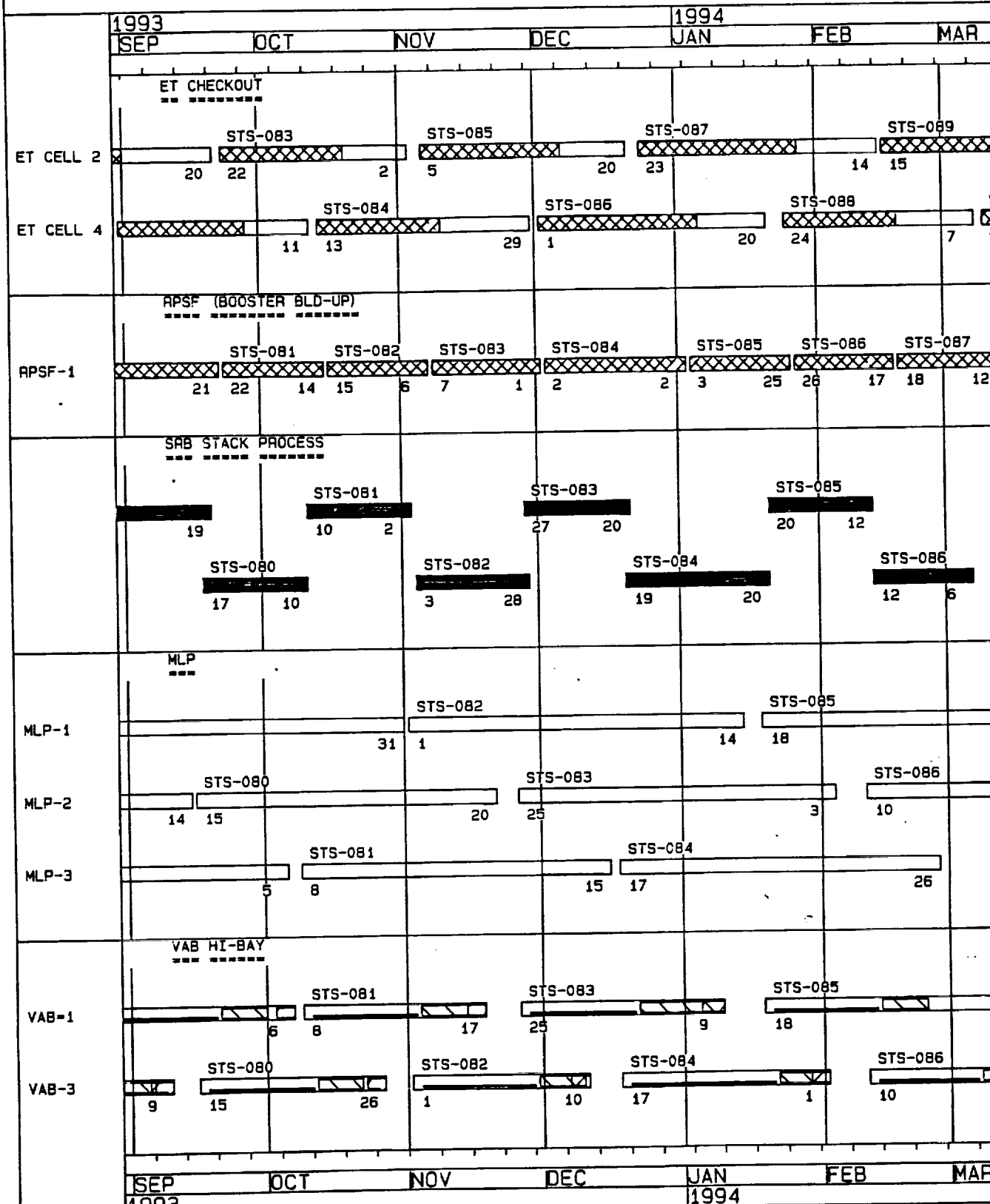


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Figure 2.1-2. FY 1993 ET/SRB Facility Utilization. 5-2 10-26 1.0

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 FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693
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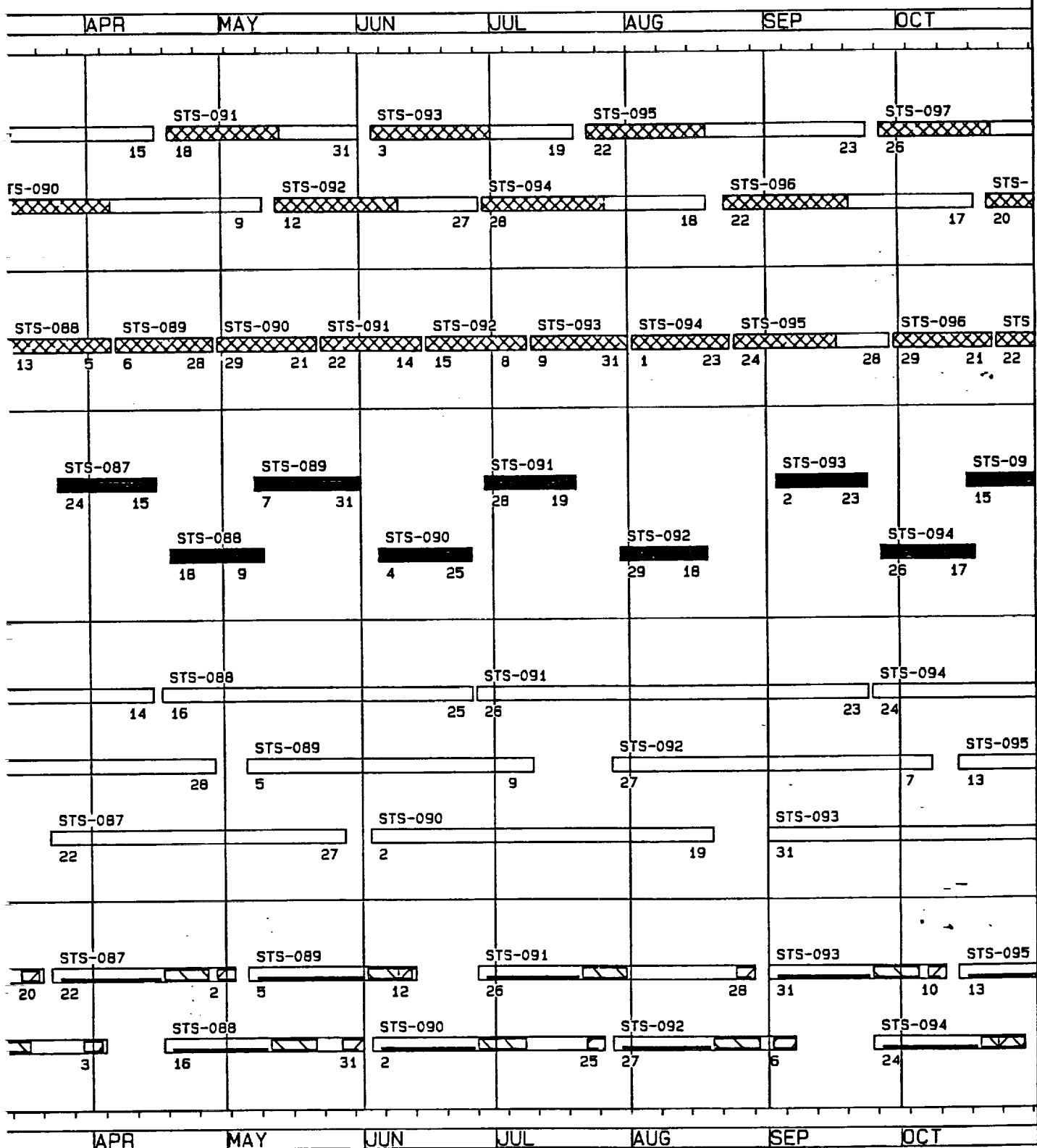
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ET/ SRB FACILITY UTILIZATION

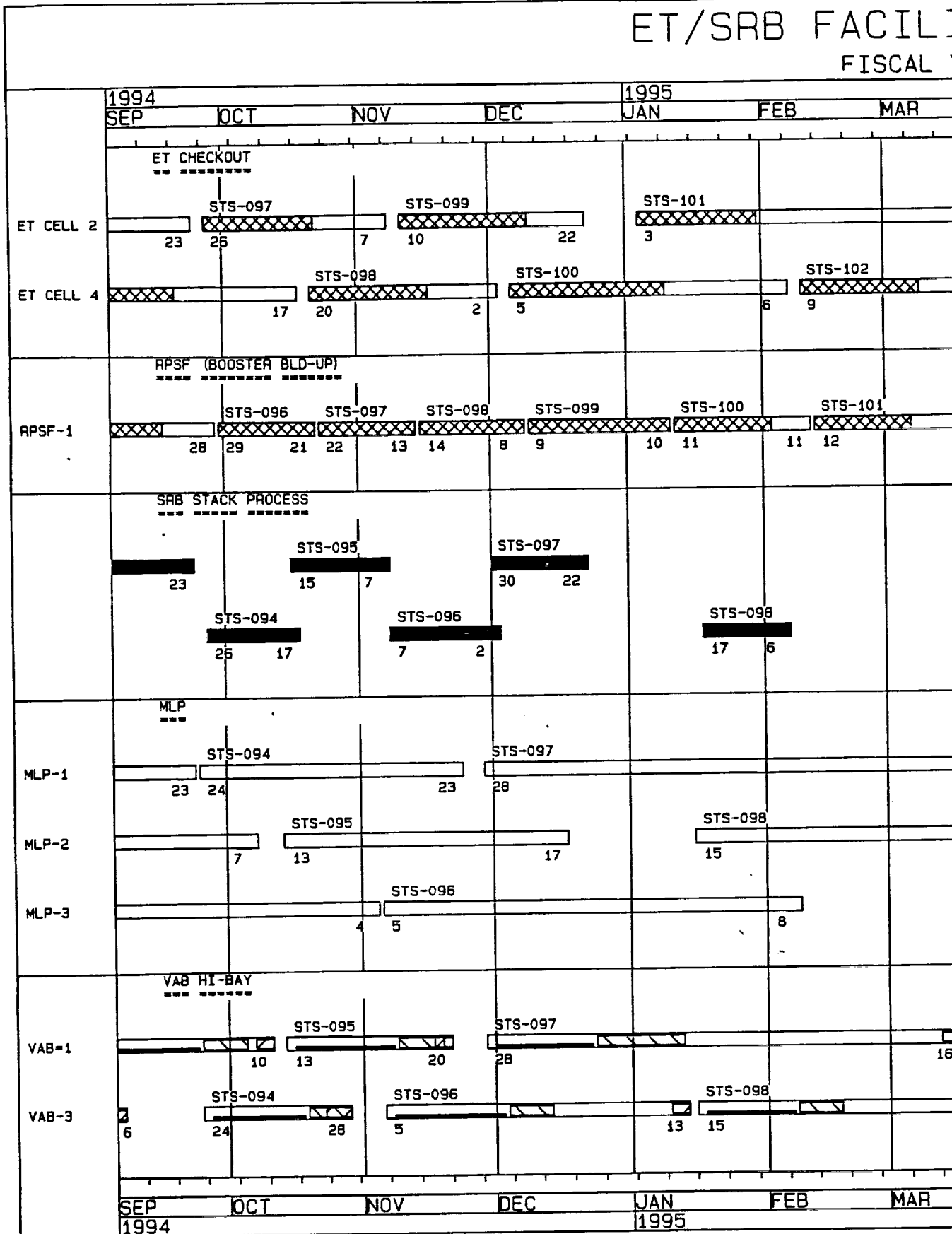
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 FOR PLANNING PURPOSES ONLY

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Figure 2.1-3. FY 1994 ET/SRB Facility Utilization. 5-2 10-26 1



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 FOR SPC PLANS

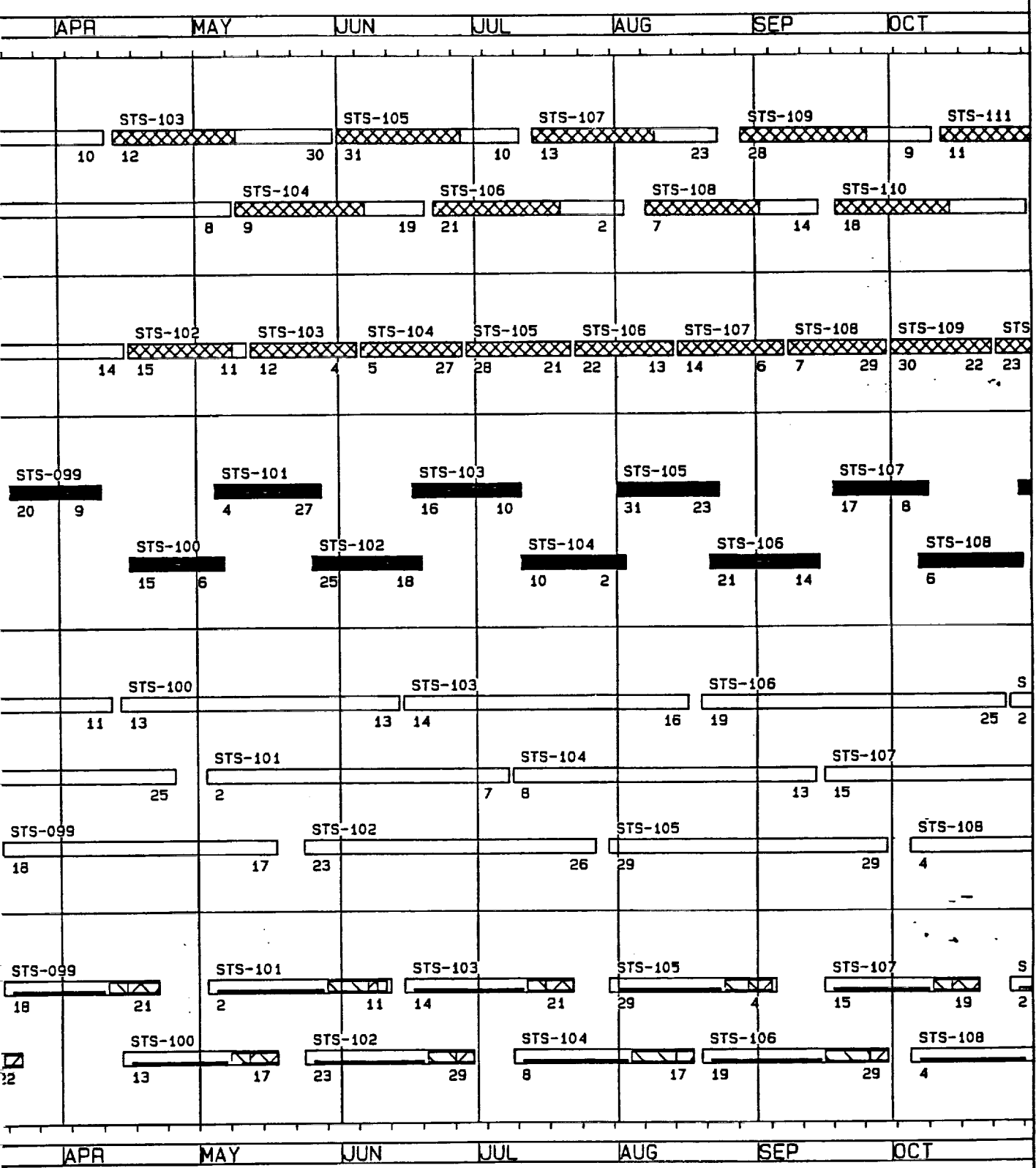
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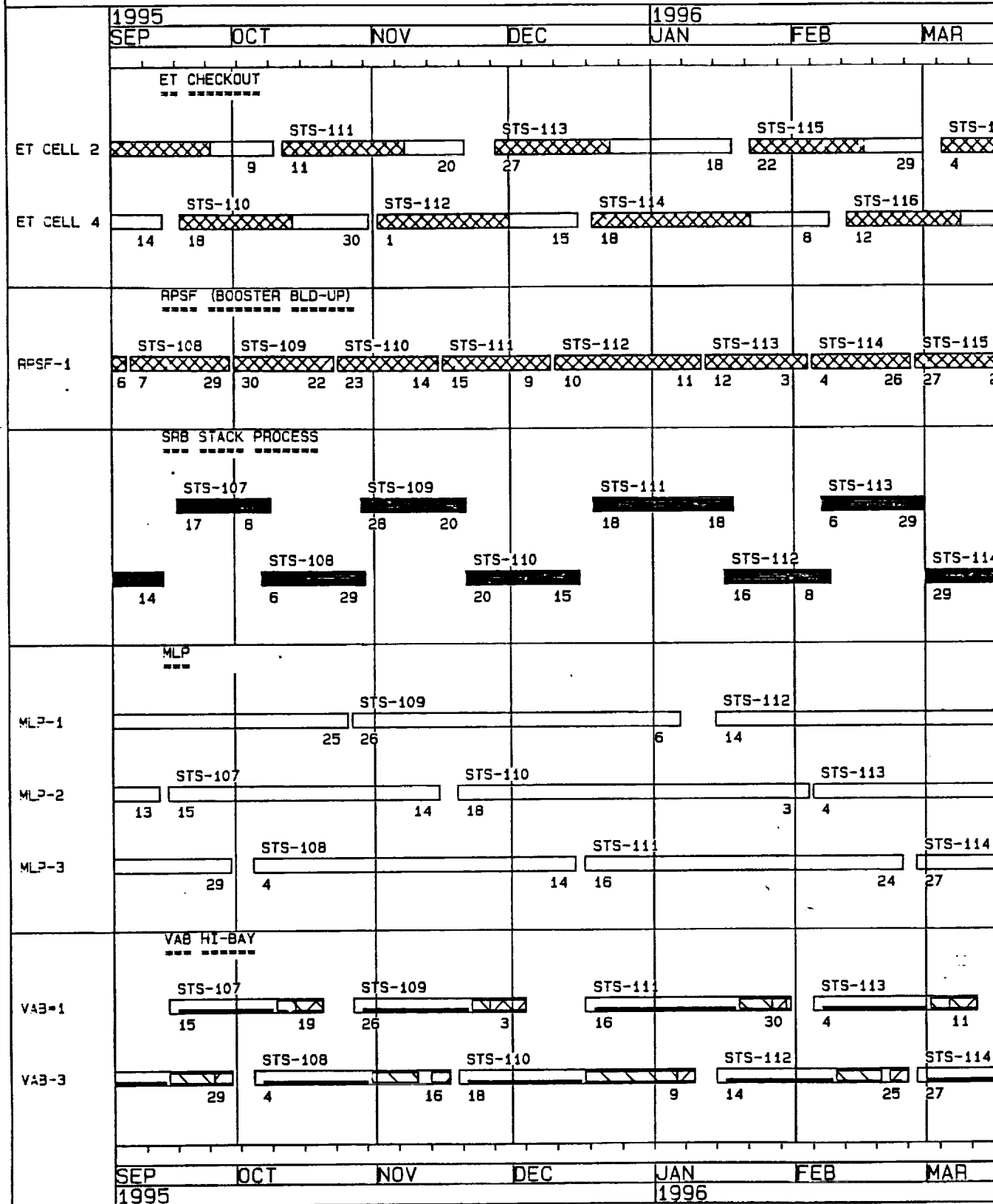


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Figure 2.1-4. FY 1995 ET/SRB Facility Utilization.

ET/SRB FACILITIES
FISCAL



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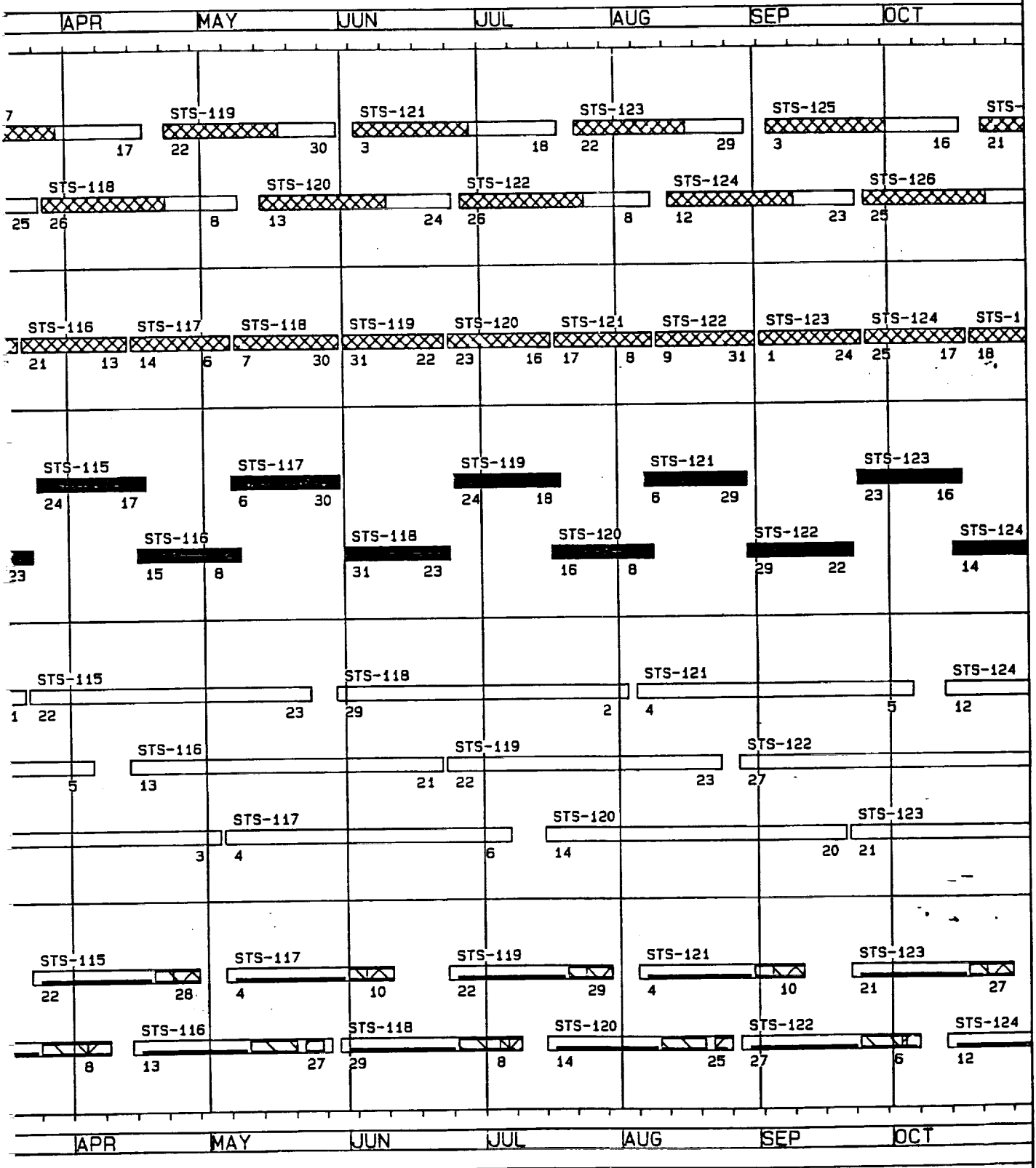
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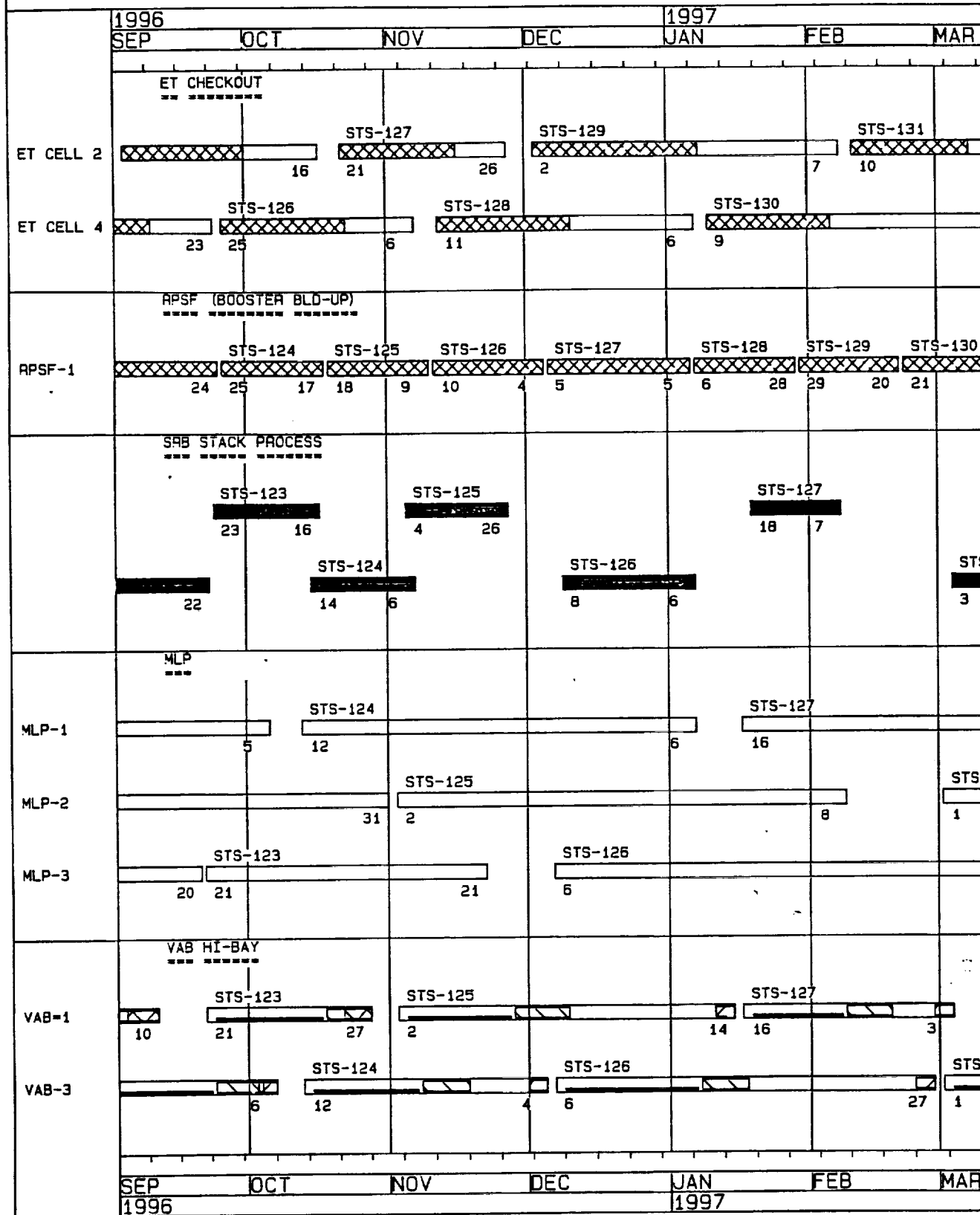


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Figure 2.1-5. FY 1996 ET/SRB Facility Utilization.

ET/SRB FACILITIES
FISCAL



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FROM 2-SEP-96 UNTIL 31-OCT-97

LSOC - KSC PROJECT SUPPORT

FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693

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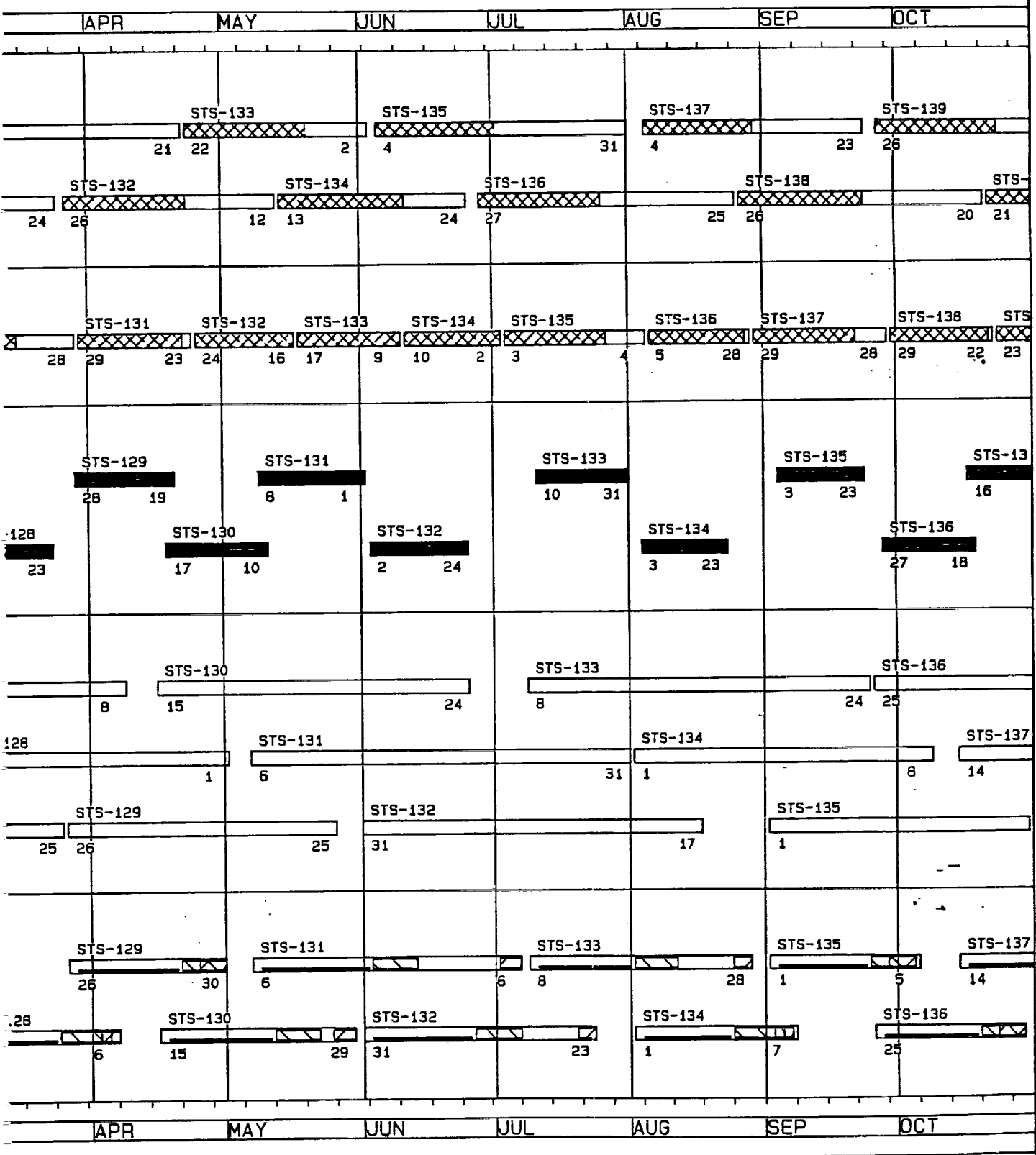
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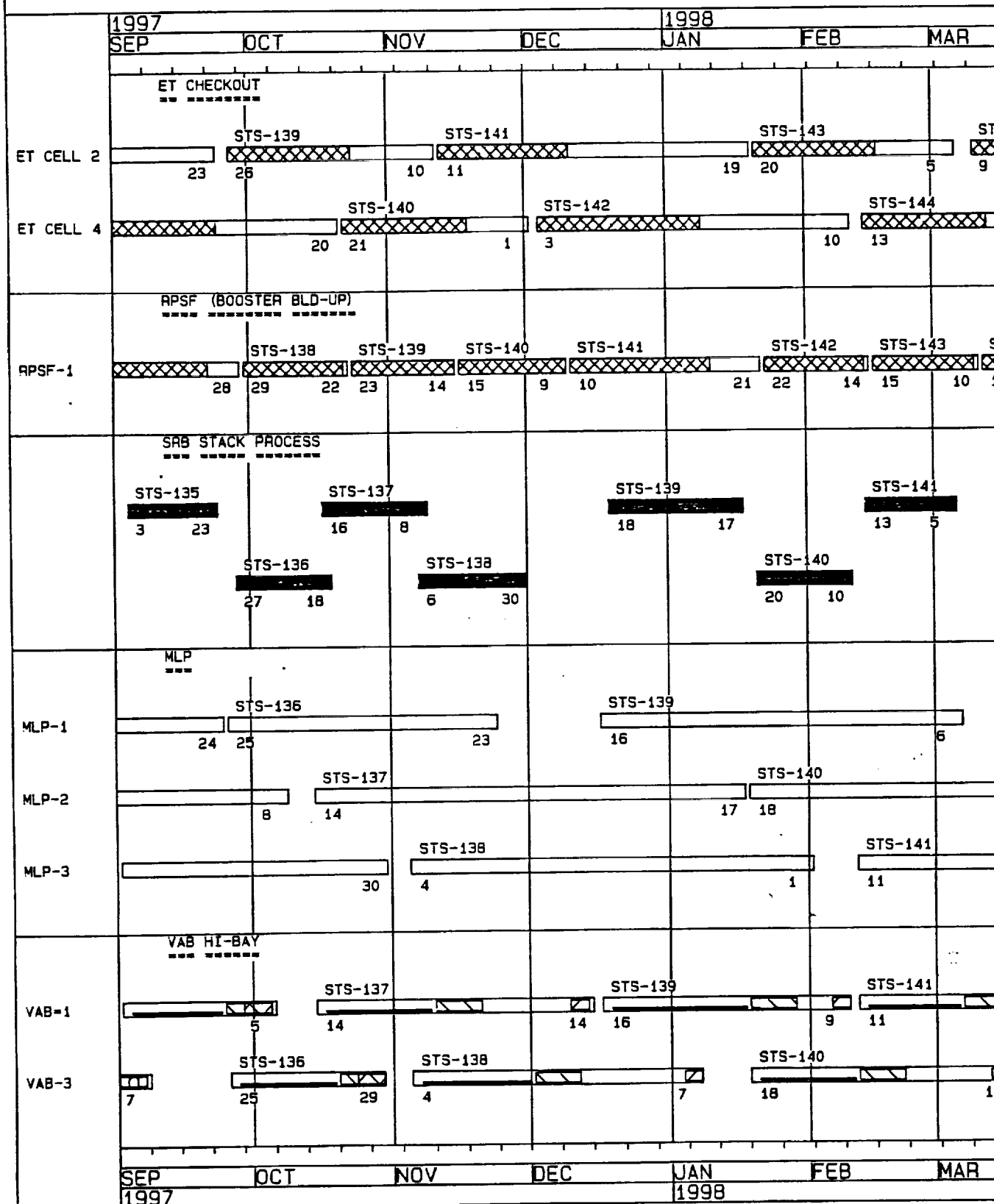


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Figure 2.1-6. FY 1997 ET/SRB Facility Utilization. 5-2 10-26 1.0

ET/SRB FACILITIES
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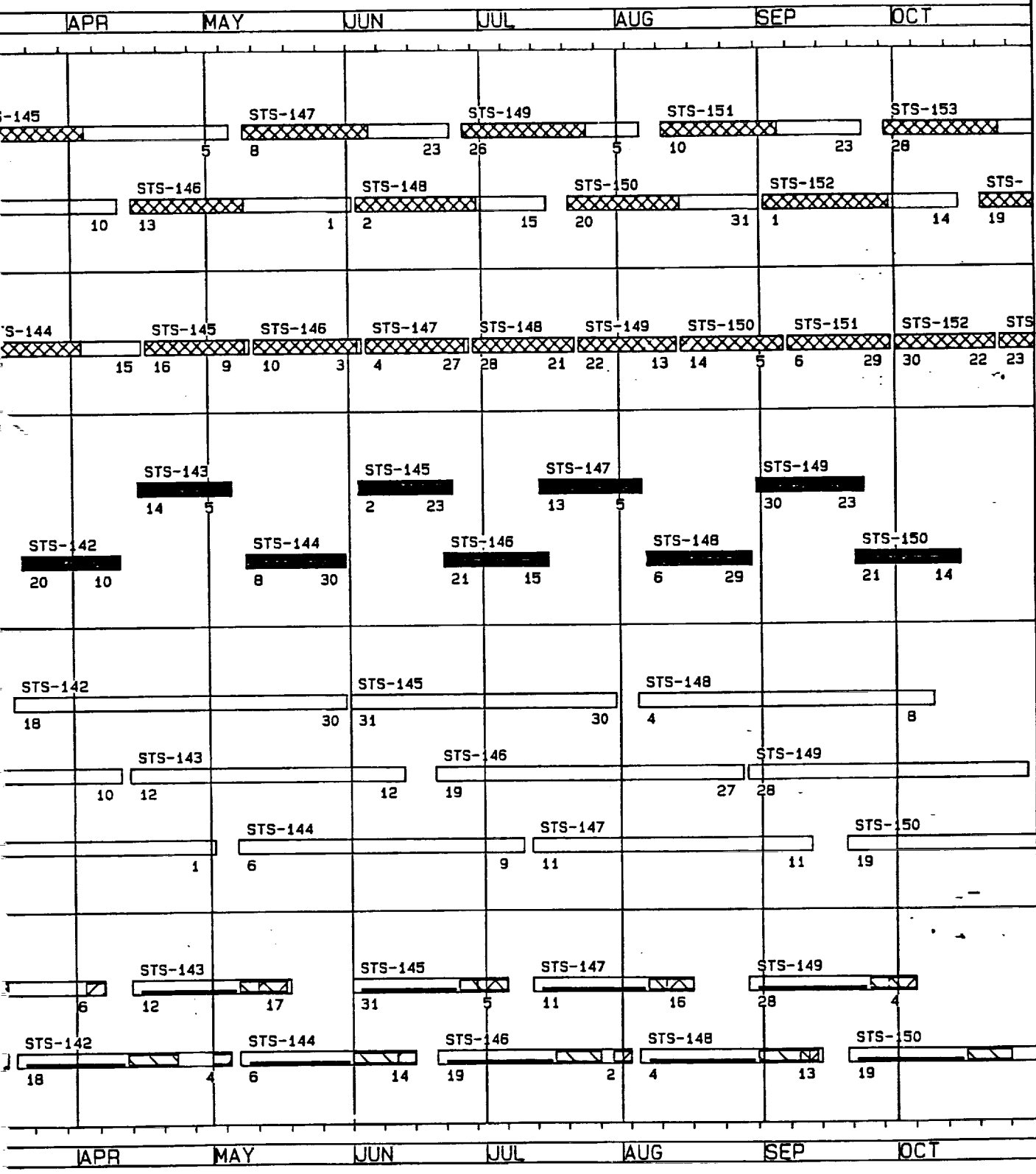
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YEAR - 1998

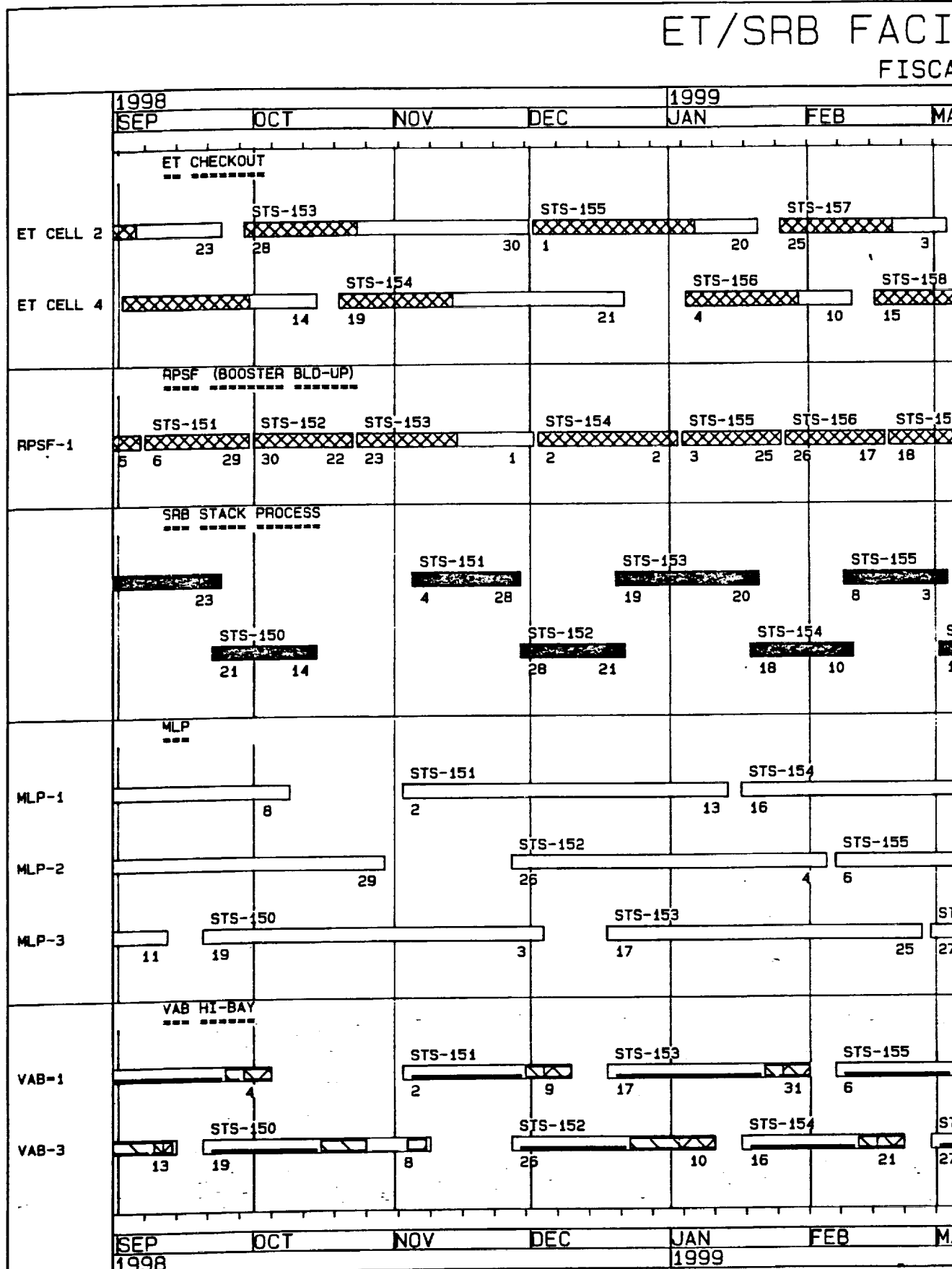


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Figure 2.1-7. FY 1998 ET/SRB Facility Utilization.

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 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693
 FILE: SRB1999 - ID: 121 DATED: 9:31 am

FROM 31-AUG-98 UNTIL 31-OCT-99

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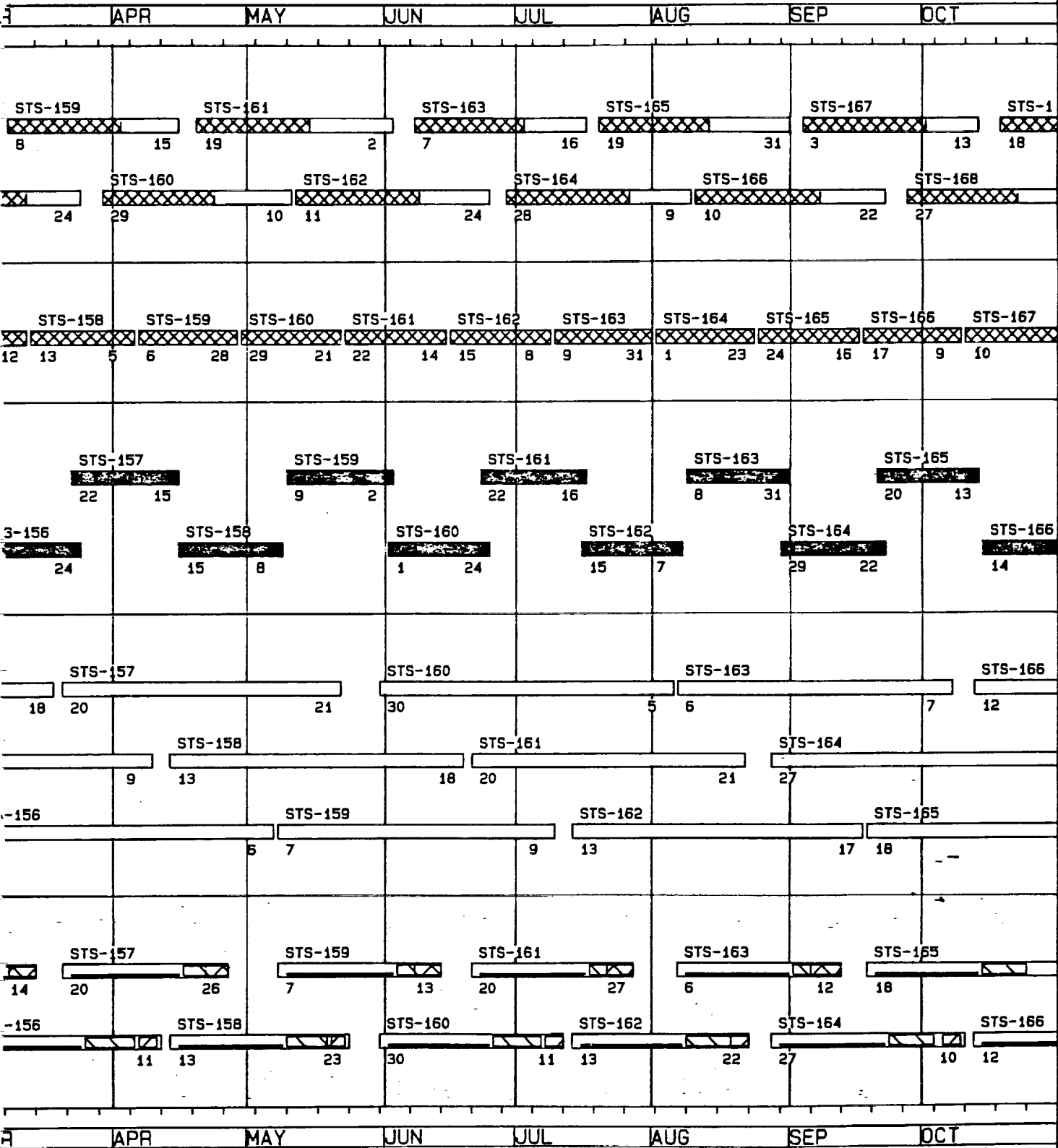
28-OCT-88

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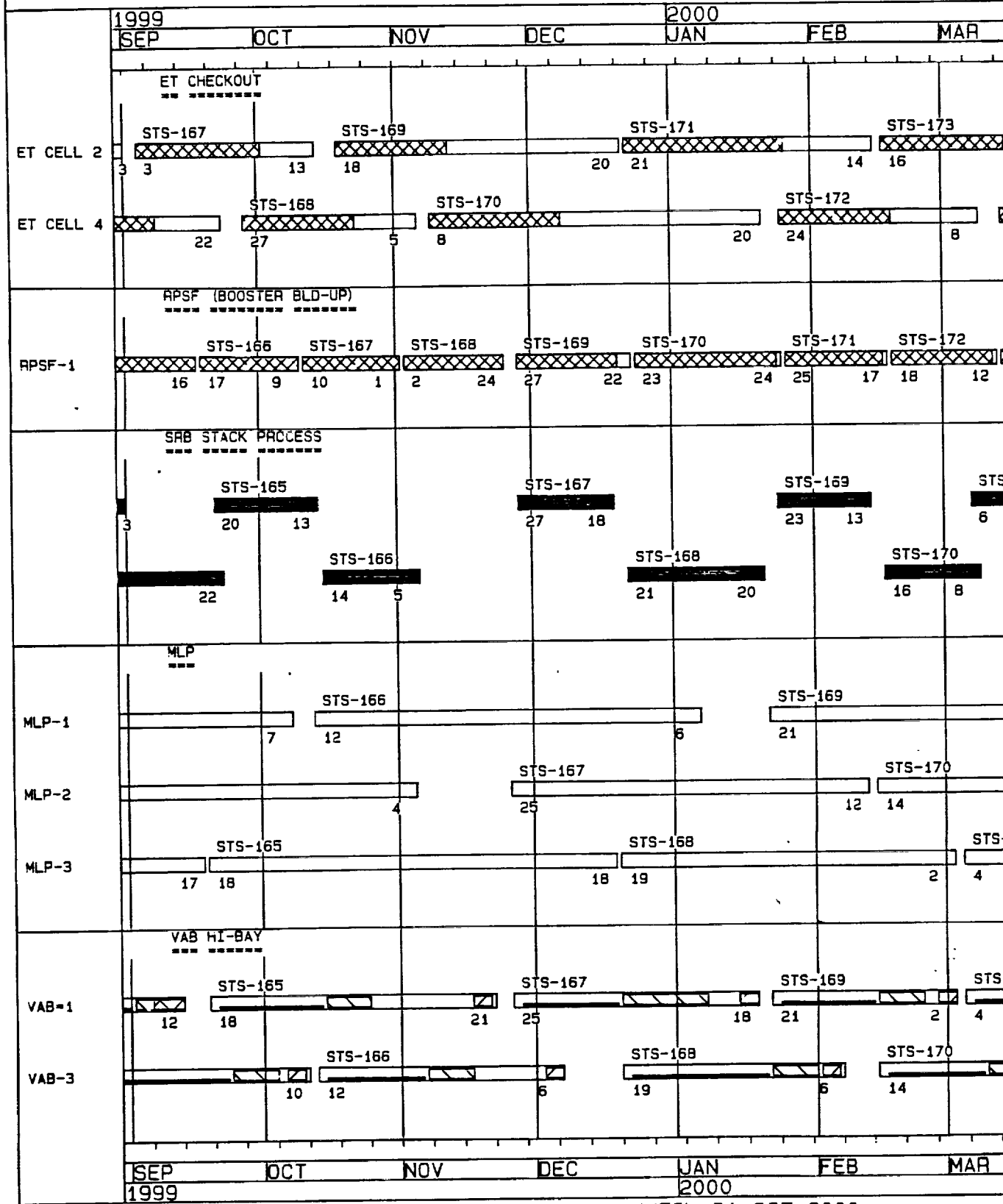
ILITY UTILIZATION

YEAR - 1999



NOT BASED ON PRELIMINARY STUDY - SRB BASELINE ASSIGNMENT MANIFEST PLANNING PURPOSES ONLY

Figure 2.1-8. FY 1999 ET/SRB Facility Utilization. 5-2 10-26 1



PROJECT: SRB000 FROM 30-AUG-99 UNTIL 31-OCT-2000
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693
 FILE: SRB100 - ID: 121 DATED: 8: 22 AM 30-AUG-88

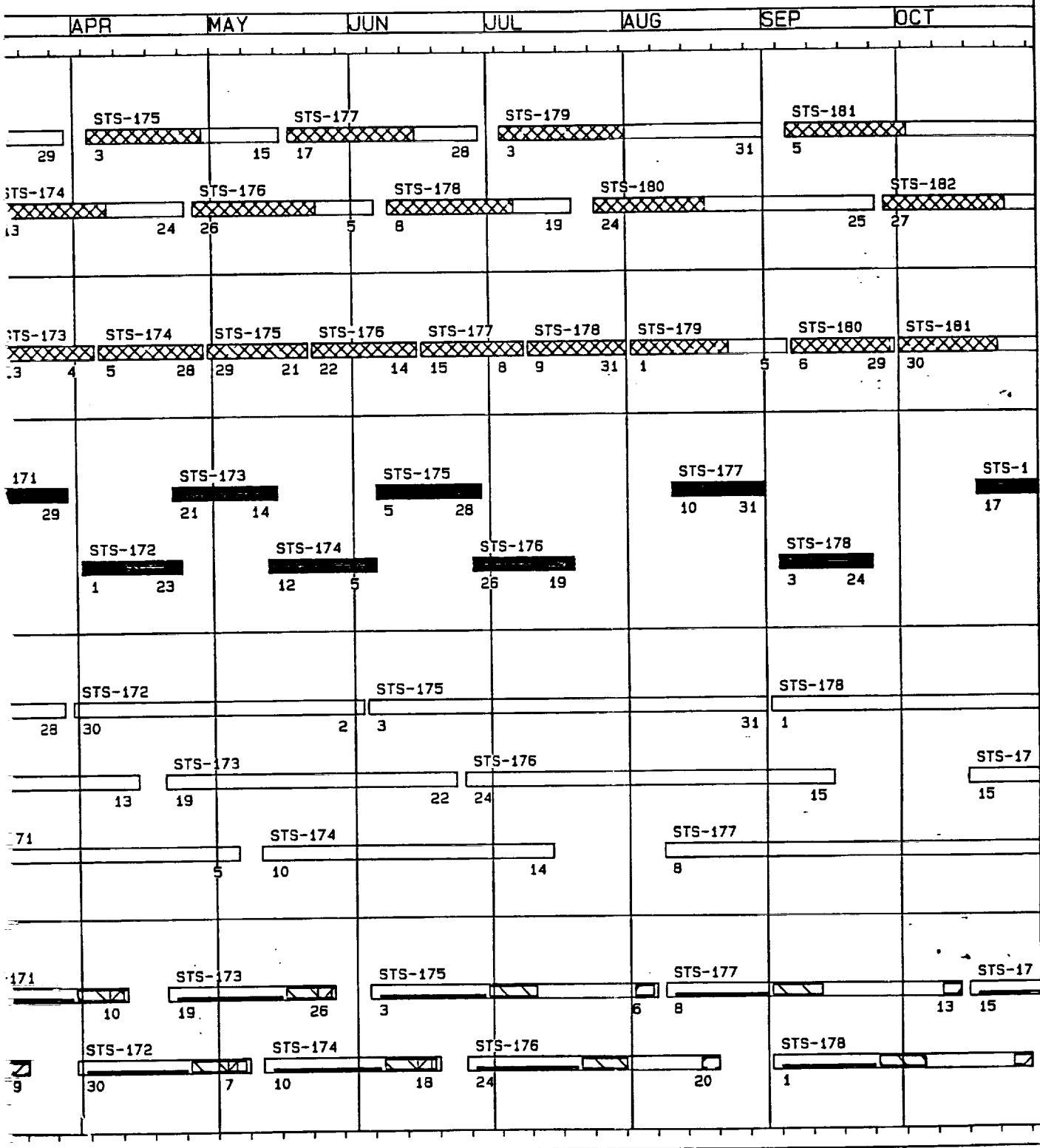
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TY UTILIZATION

YEAR - 2000

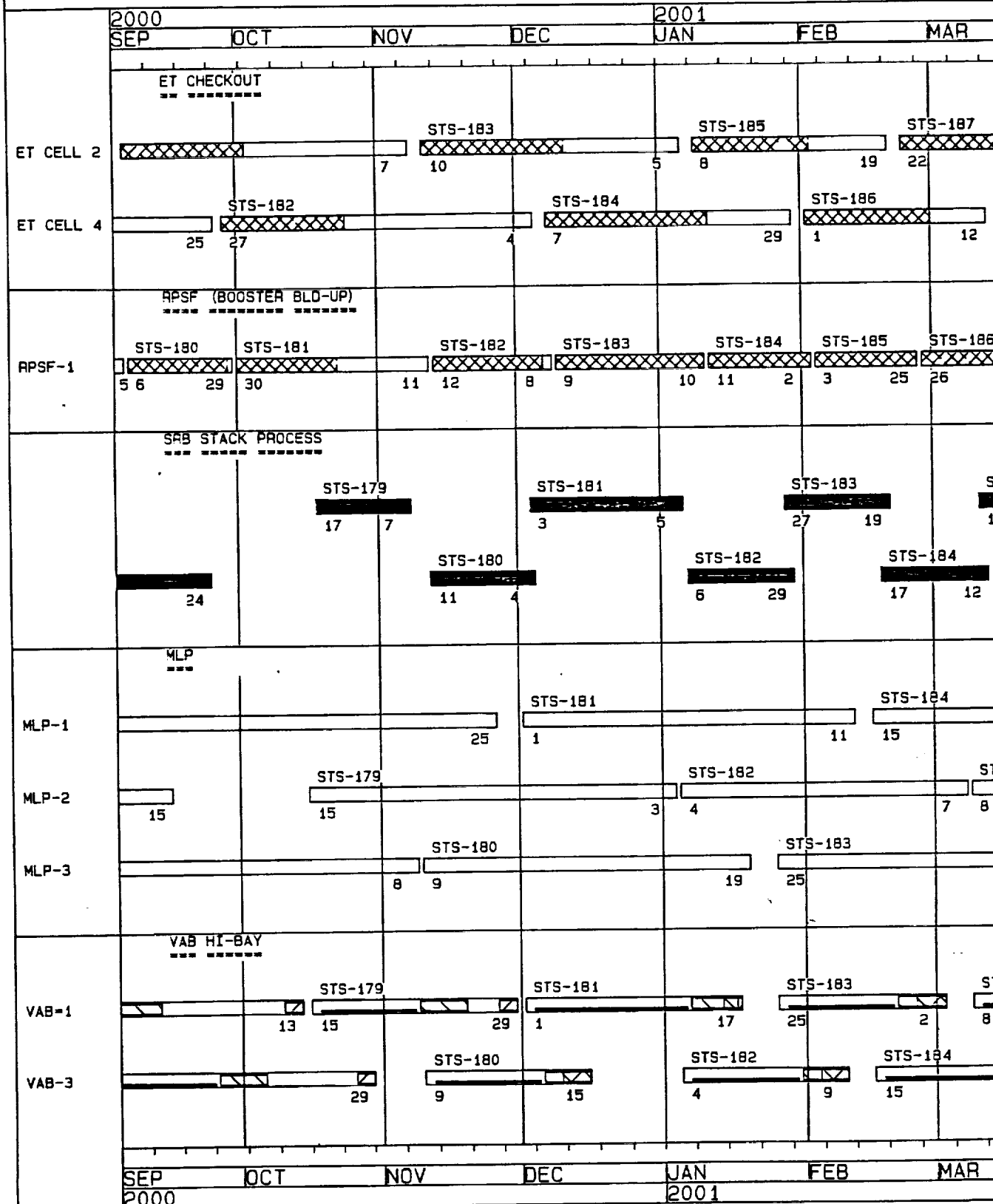


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tem 8:22 am 30-AUG-88

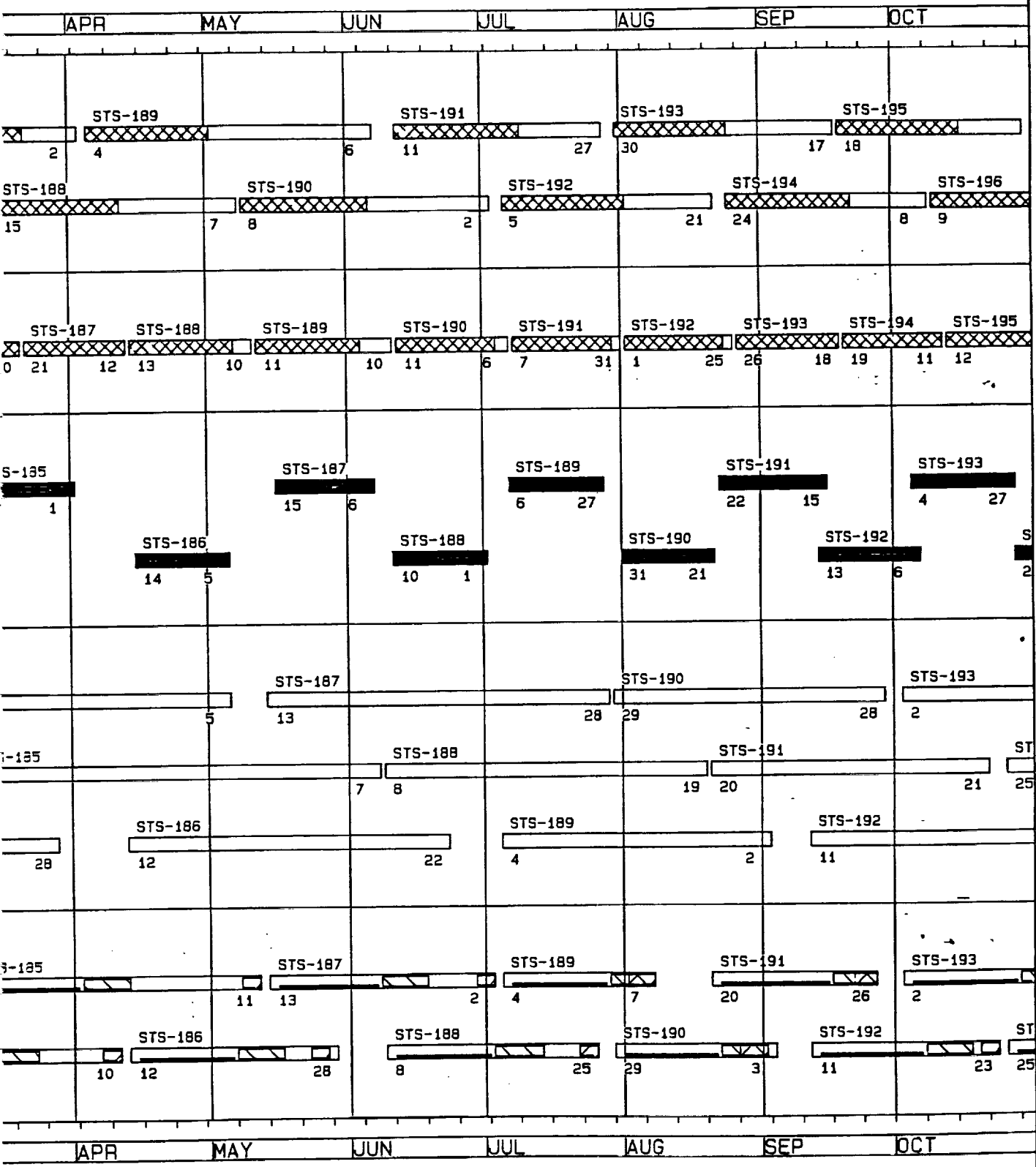
Figure 2.1-9. FY 2000 ET/SRB Facility Utilization.



PROJECT: SRB000 FROM 4-SEP-2000 UNTIL 31-OCT-2001
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693
 FILE: SRB101 - ID: 121 DATED: 8:30 am 30-AUG-88

FACILITY UTILIZATION

YEAR - 2001

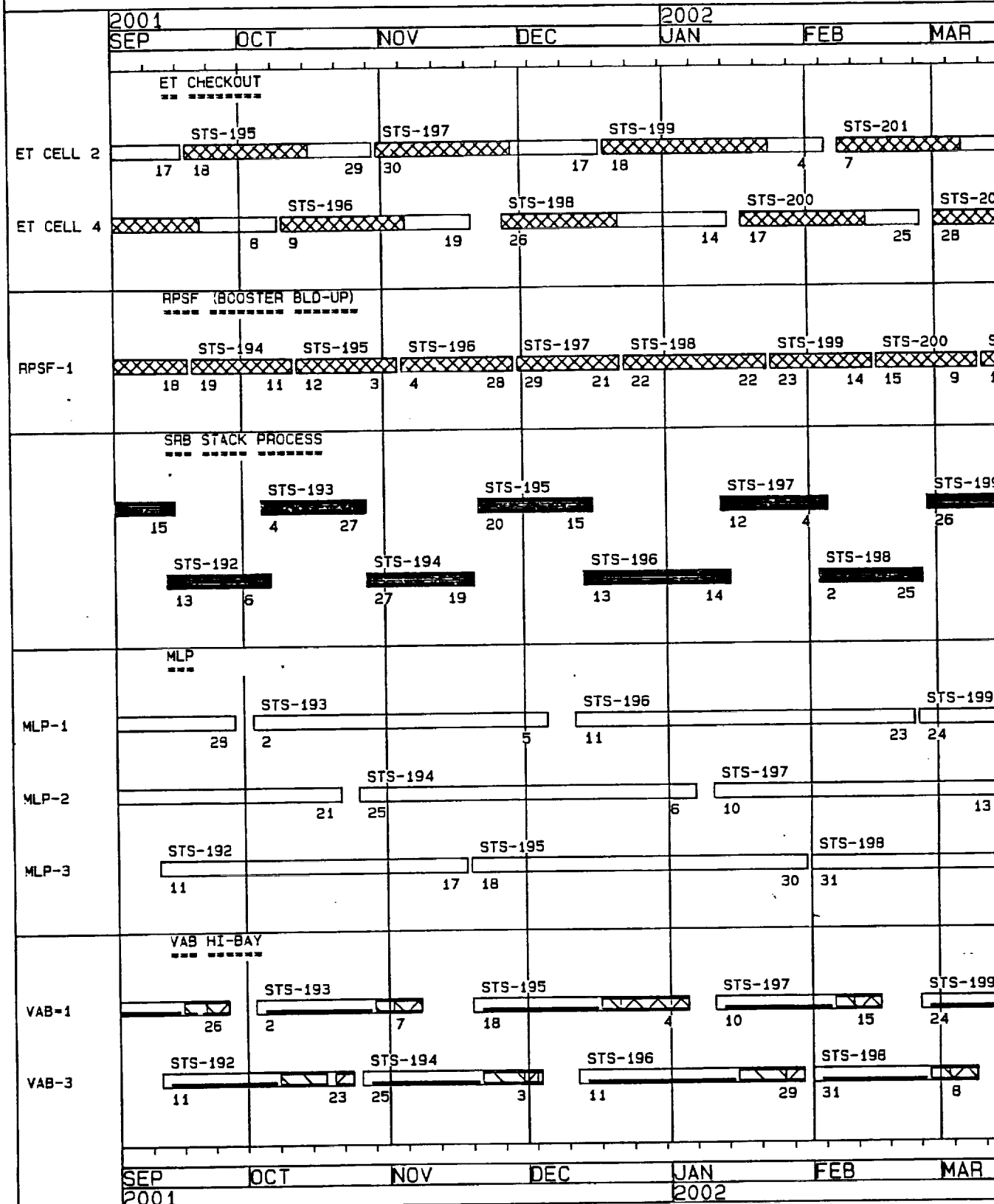


ASSESSMENT BASED ON PRELIMINARY
 PB STUDY - SRB BASELINE
 FLIGHT ASSIGNMENT MANIFEST
 SPC PLANNING PURPOSES ONLY

System 8:30 am 30-AUG-88

Figure 2.1-10. FY 2001 ET/SRB Facility Utilization. 5-2 10-26 1:00

ET/SRB FACILITY
FISCAL



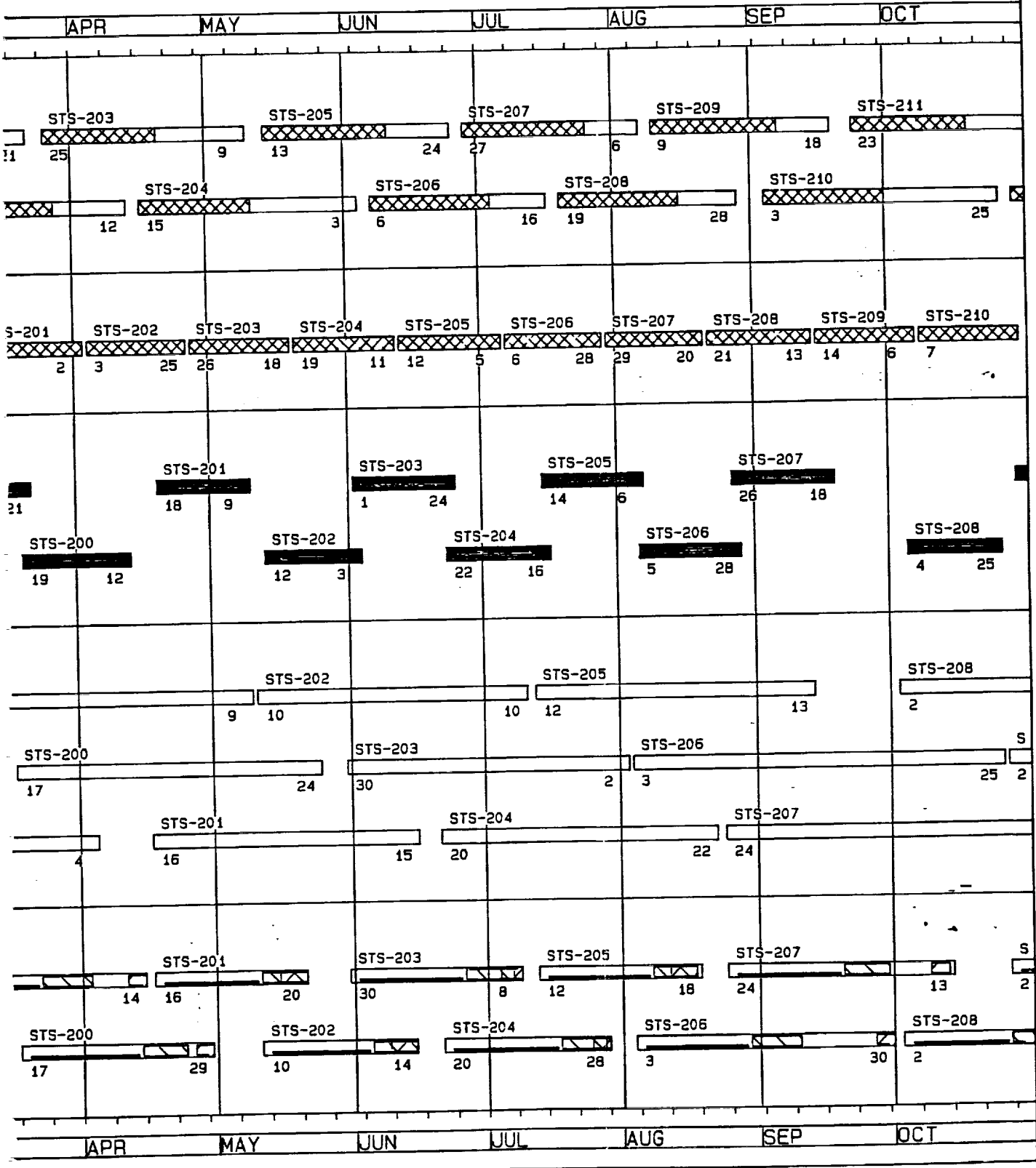
PROJECT: SRB000 FROM 3-SEP-2001 UNTIL 31-OCT-2002
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693
 FILE: SRB102 - ID: 121 DATED: 8:36 am 30-AUG-98

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FACILITY UTILIZATION

YEAR - 2002

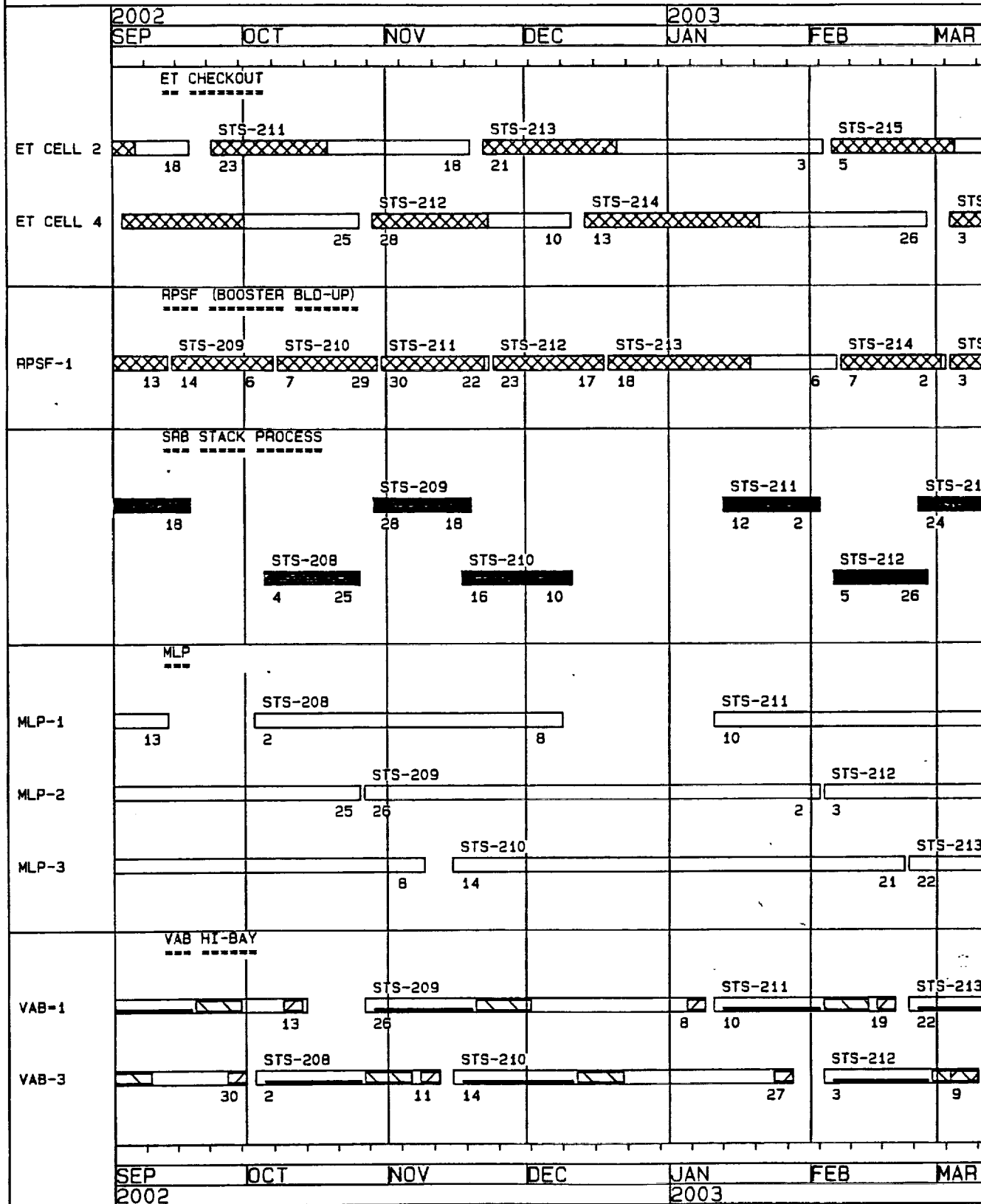


MENT BASED ON PRELIMINARY
B STUDY - SRB BASELINE
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PC PLANNING PURPOSES ONLY

stem 8: 36 am 30-AUG-88

Figure 2.1-11. FY 2002 ET/SRB Facility Utilization. 5-2 10-26 1:00p

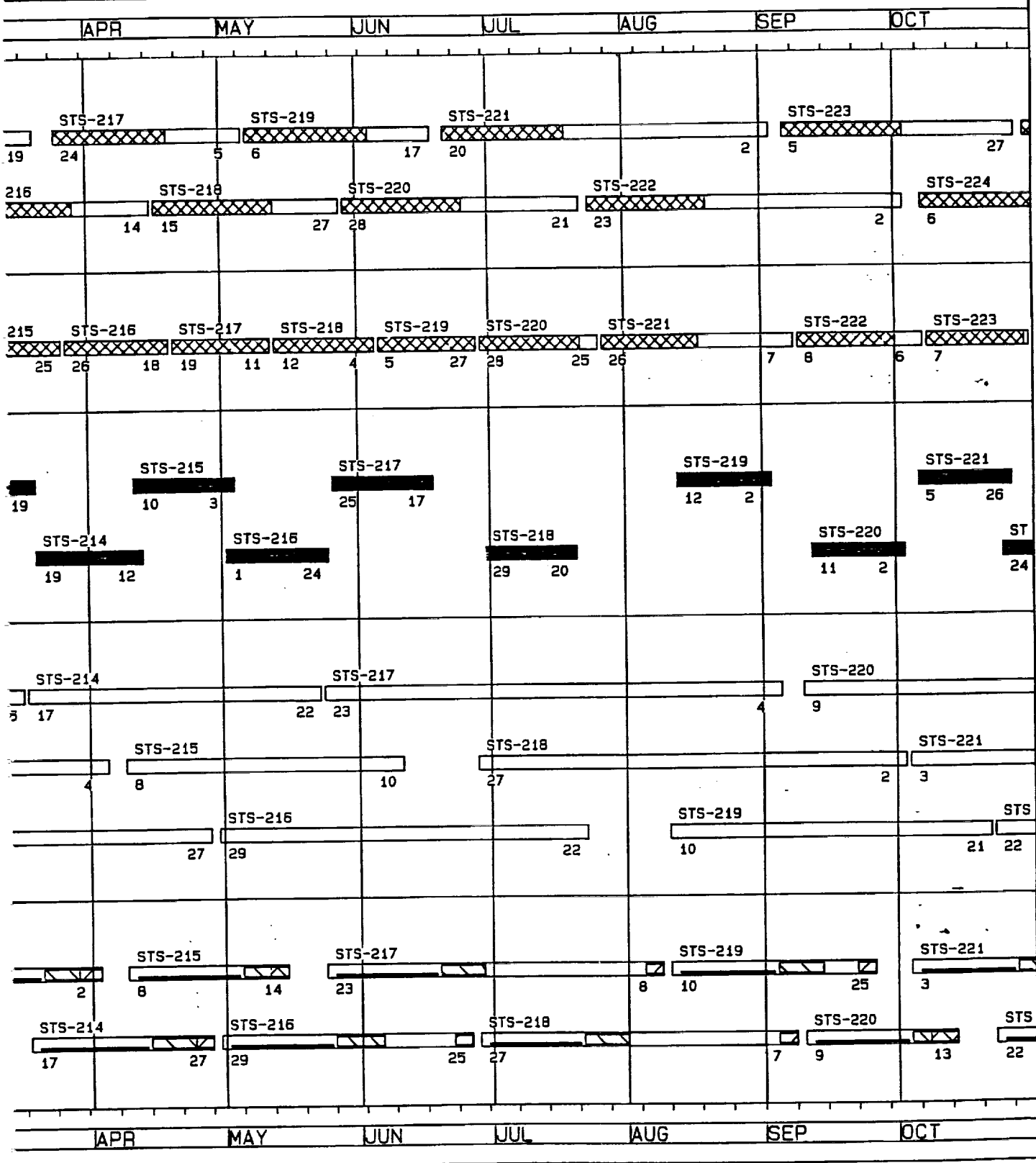
ET/SRB FACILITIES
FISCAL



PROJECT: SRB000 FROM 2-SEP-2002 UNTIL 31-OCT-2003
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693
 FILE: SRB103 - ID: 121 DATED: 8: 39 am 30-AUG-88
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ILITY UTILIZATION

YEAR - 2003

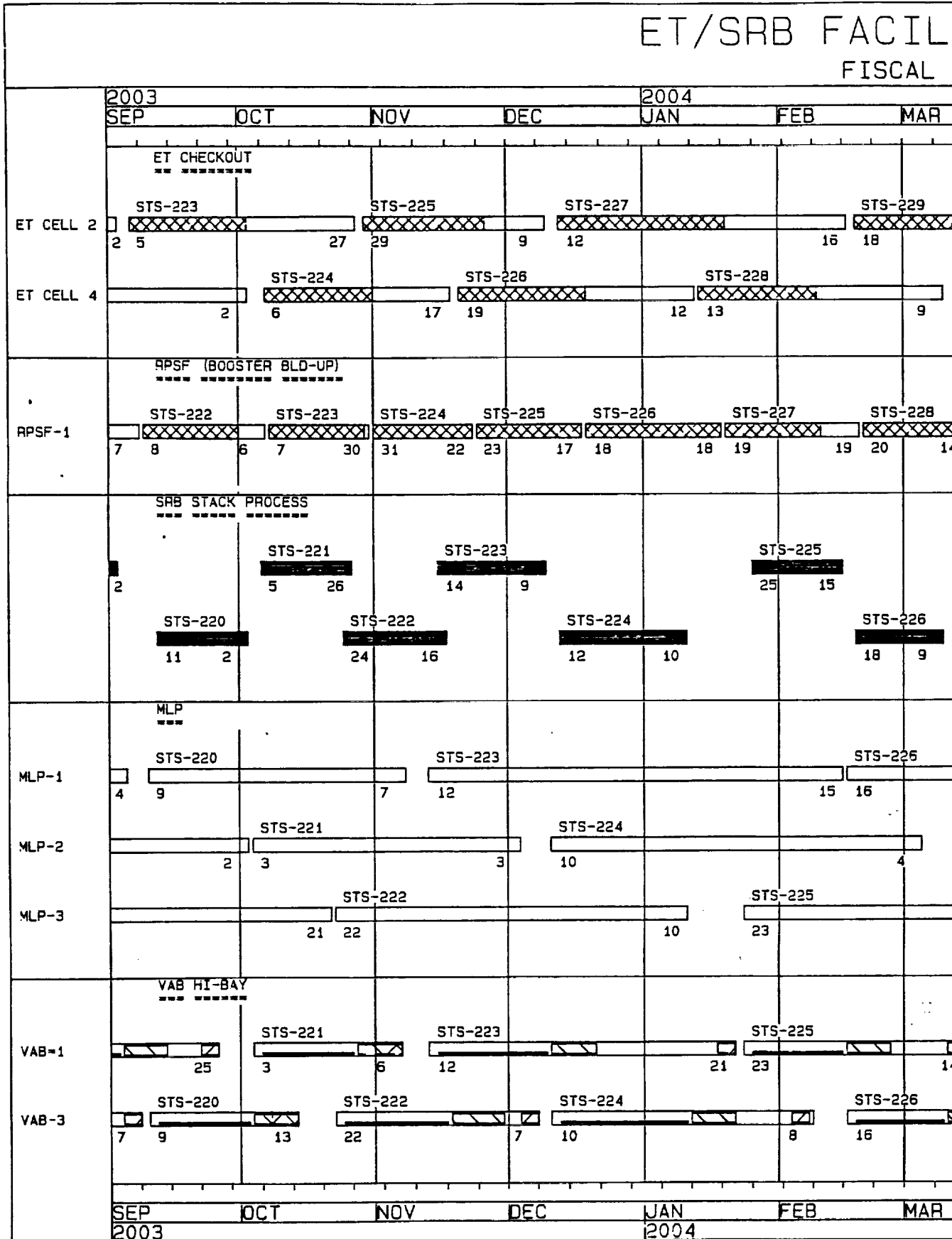


ASSUMPTIONS BASED ON PRELIMINARY
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 SPC PLANNING PURPOSES ONLY

System 8: 39 am 30-AUG-88

Figure 2.1-12. FY 2003 ET/SRB Facility Utilization. 5-2 10-26 1.0

ET/SRB FACIL
FISCAL



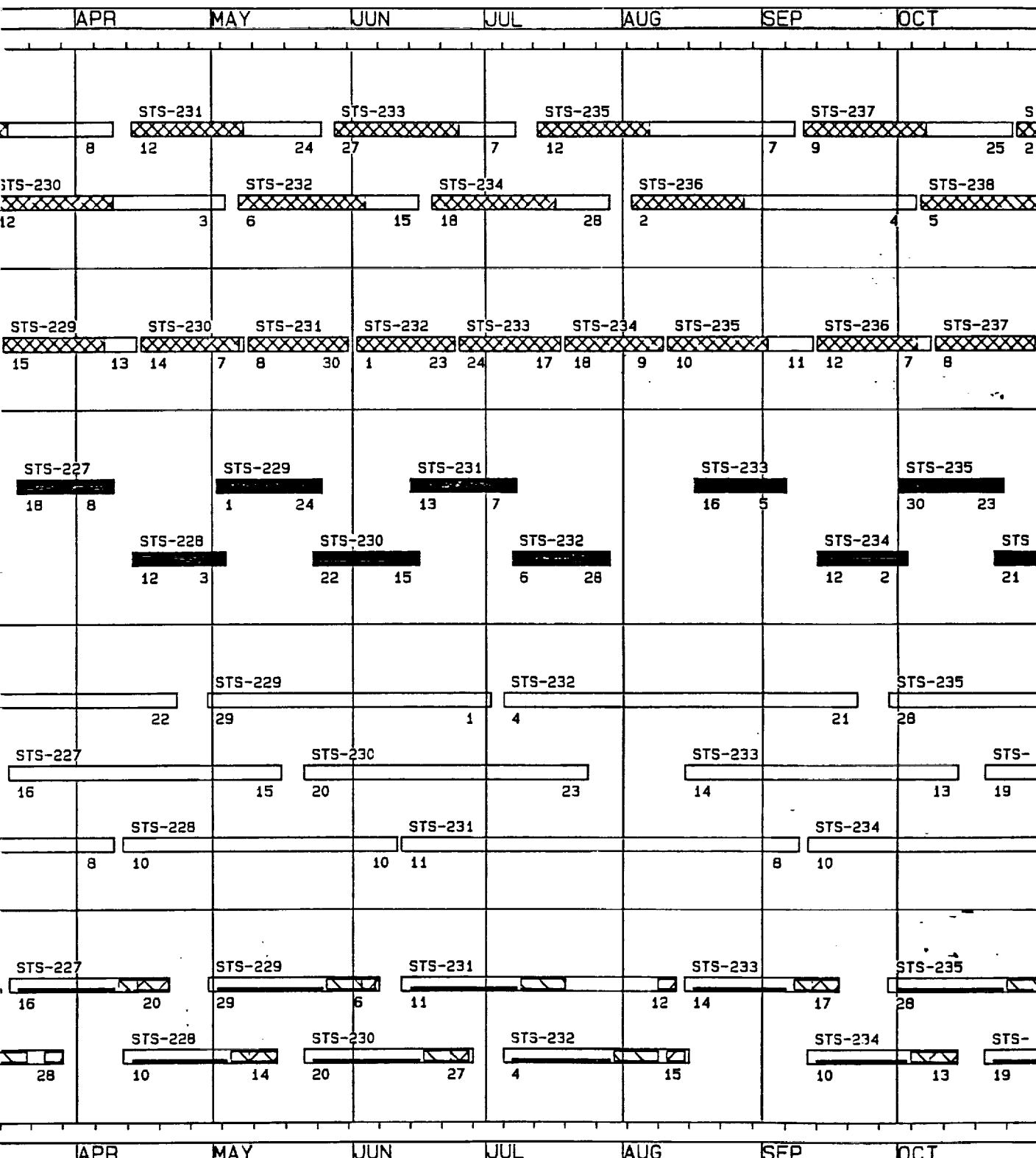
PROJECT: SRB000 FROM 1-SEP-2003 UNTIL 31-OCT-2004
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 857-6693
 FILE: SRB104 - ID: 121 DATED: 8: 46 am 30-AUG-88

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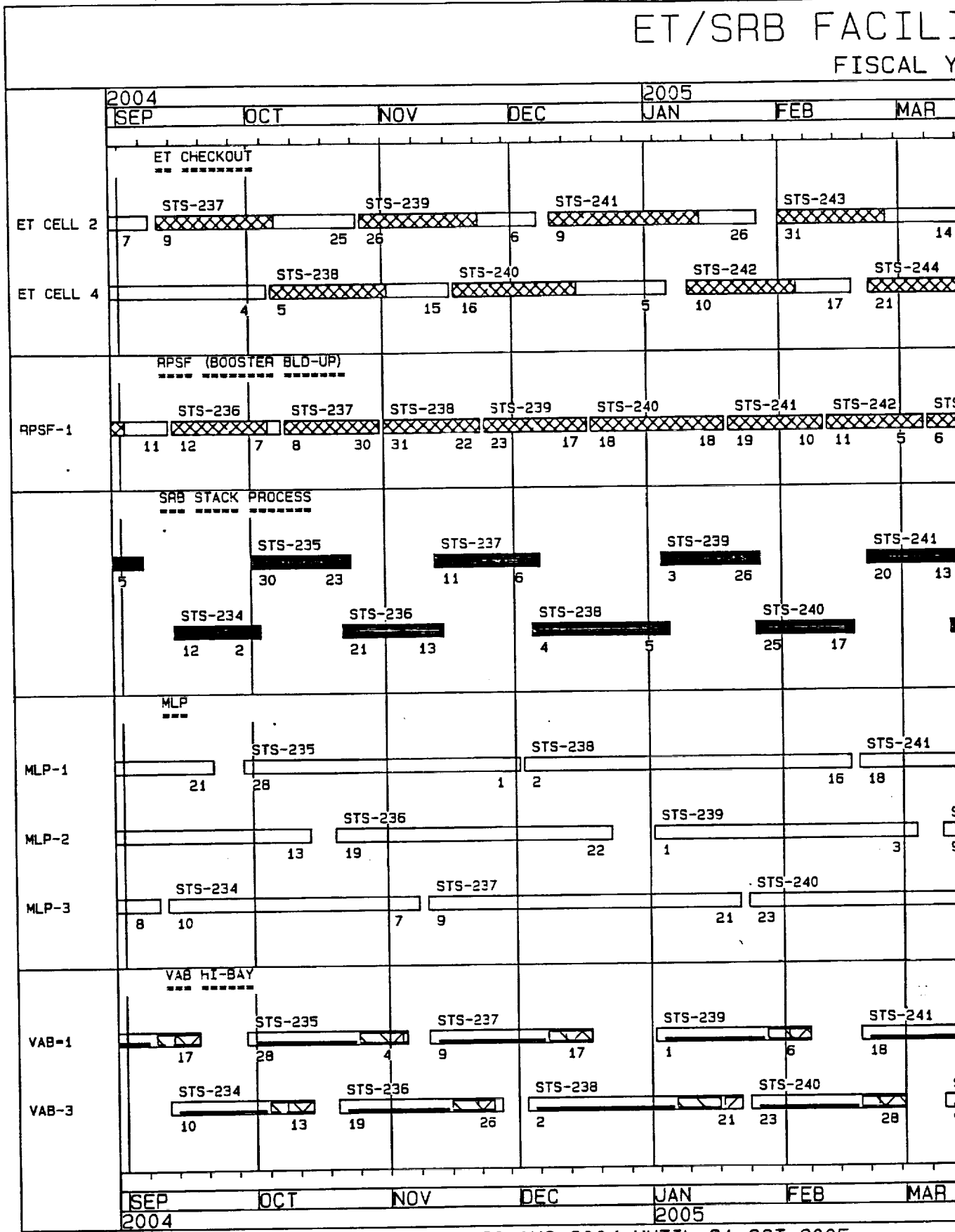
YEAR - 2004



MENT BASED ON PRELIMINARY
 B STUDY - SRB BASELINE
 GHT ASSIGNMENT MANIFEST
 PC PLANNING PURPOSES ONLY

stem 8: 46 am 30-AUG-88

Figure 2.1-13. FY 2004 ET/SRB Facility Utilization. 5-2 10-26 1:00p



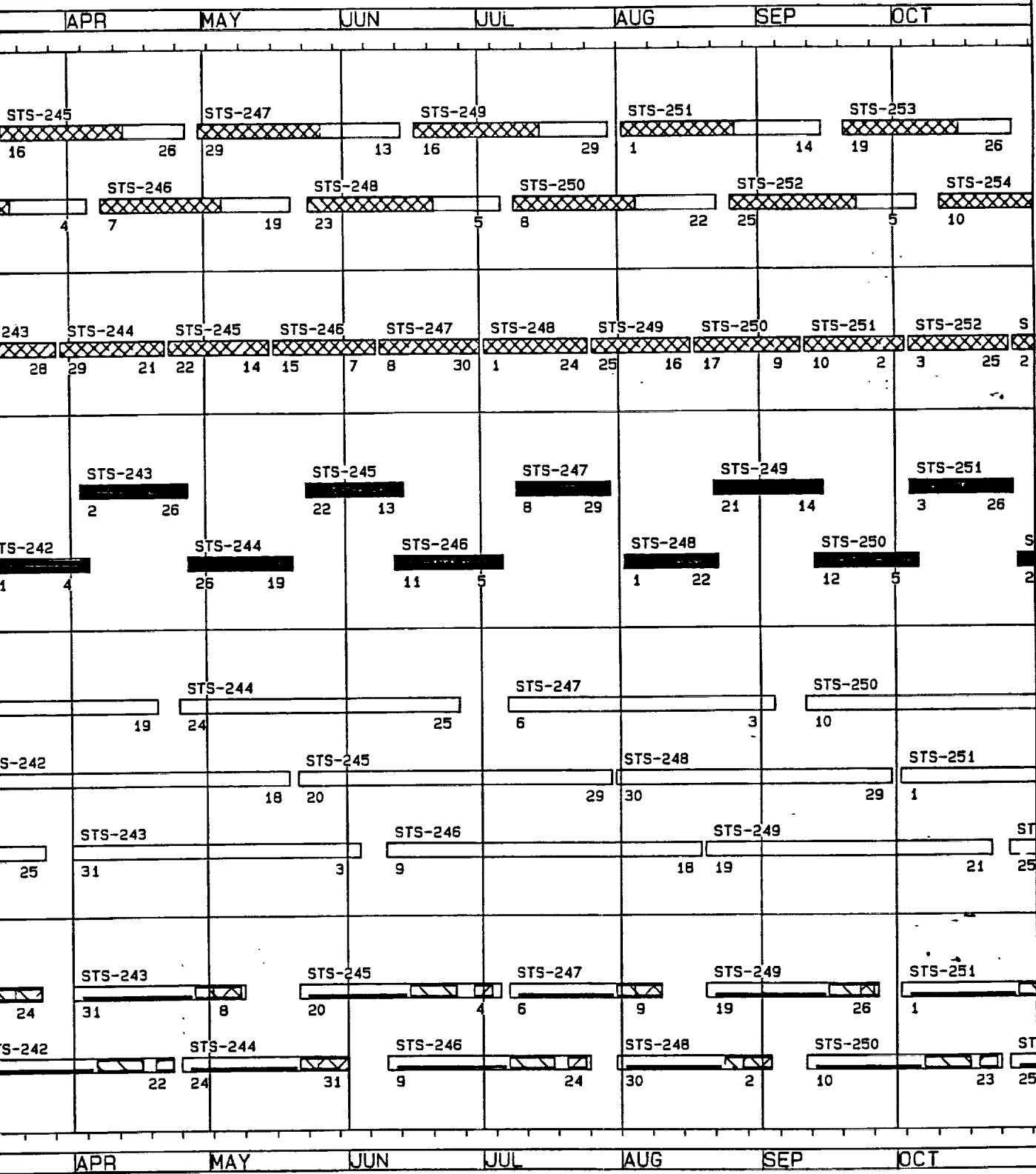
PROJECT: SRB000 FROM 30-AUG-2004 UNTIL 31-OCT-2005
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693
 FILE: SRB105 - ID: 121 DATED: 8. 53 am 30-AUG-99

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YEAR - 2005

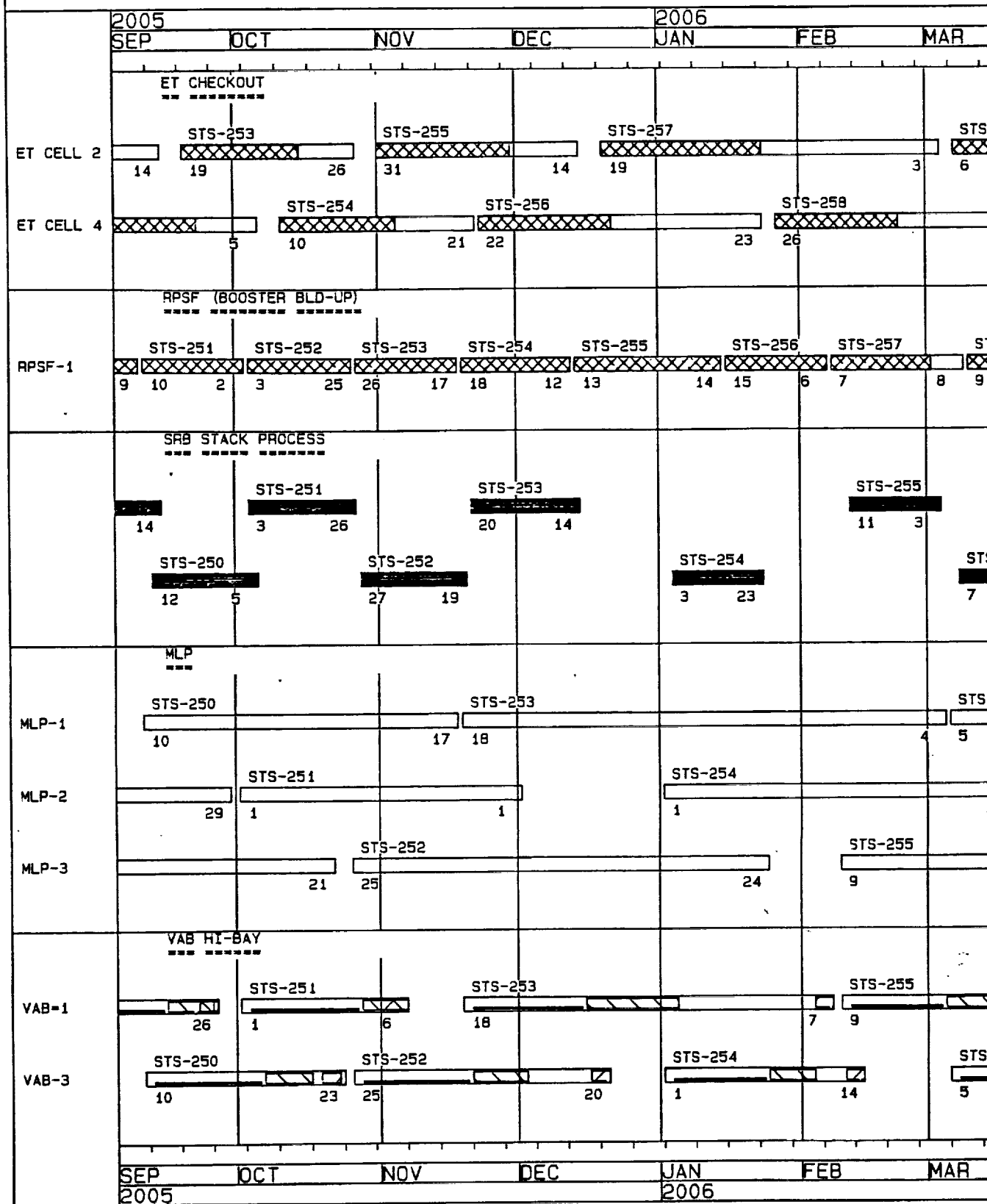


MENT BASED ON PRELIMINARY
 STUDY - SRB BASELINE
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stem 8:53 am 30-AUG-88

Figure 2.1-14. FY 2005 ET/SRB Facility Utilization.

ET/SRB FACIL
FISCAL



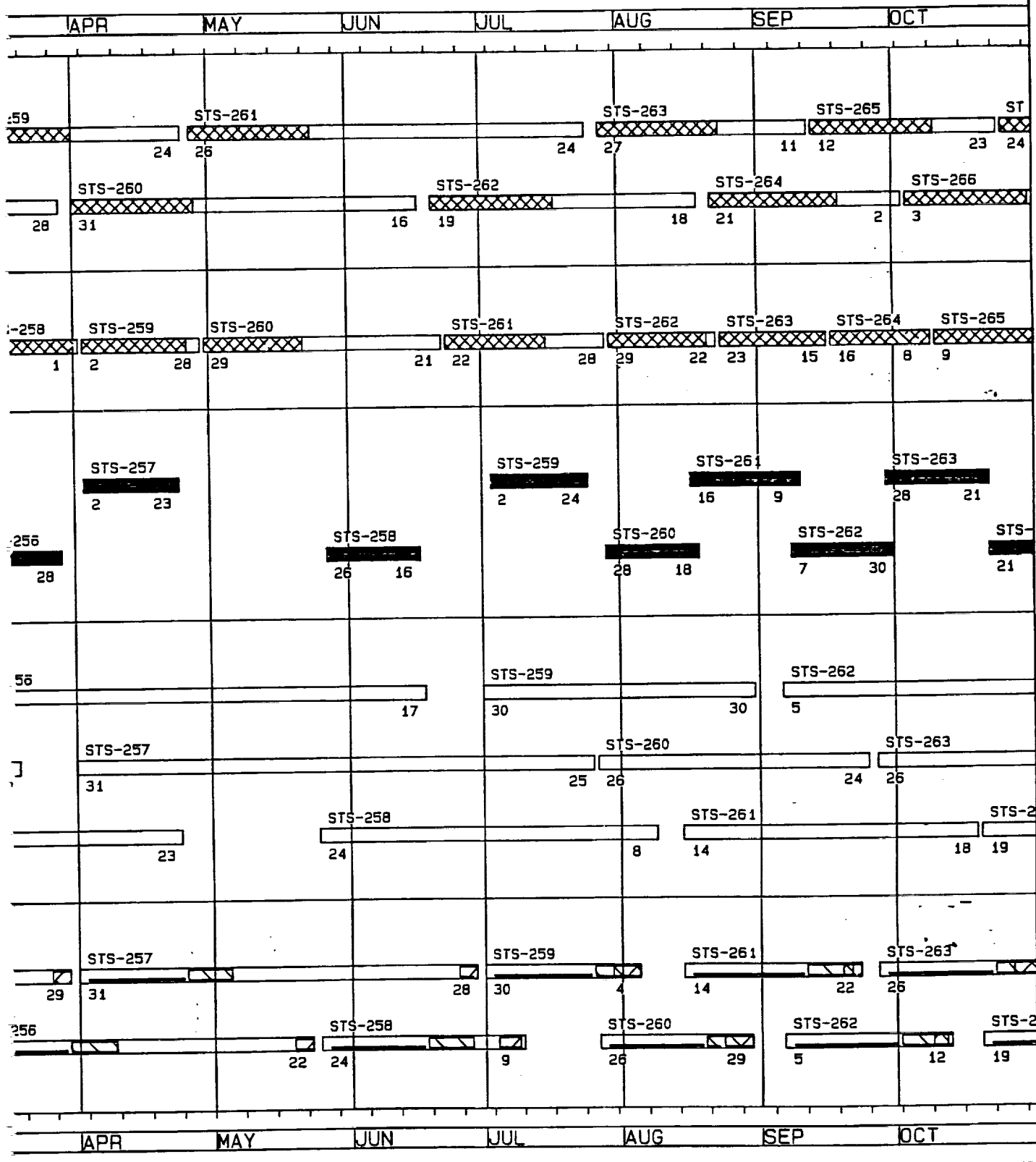
PROJECT: SRB000 FROM 5-SEP-2005 UNTIL 31-OCT-2006
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693
 FILE: SRB106 - ID: 121 DATED: 9:01 am 30-AUG-98

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FACILITY UTILIZATION

YEAR - 2006

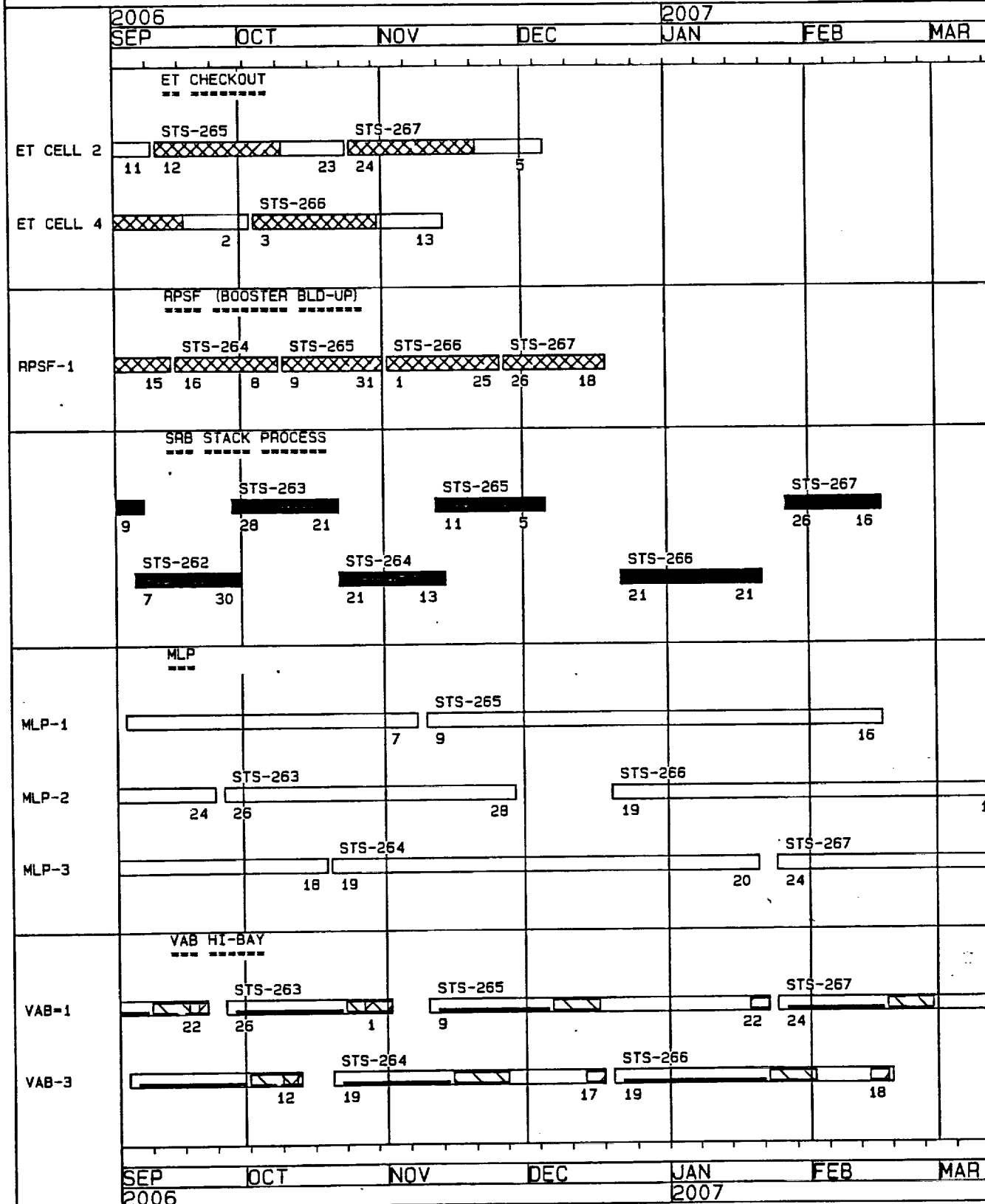


BASED ON PRELIMINARY
STUDY - SRB BASELINE
LIGHT ASSIGNMENT MANIFEST
SPC PLANNING PURPOSES ONLY

stem 9:01 am 30-AUG-88

Figure 2.1-15. FY 2006 ET/SRB Facility Utilization. 5-2 10-26 1:00

ET/SRB FACIL
FISCAL



PROJECT: SRB000 FROM 4-SEP-2006 UNTIL 31-OCT-2007
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 867-6693
 FILE: SRB107 - ID: 121 DATED: 9:08 am 30-AUG-88
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FACILITY UTILIZATION

YEAR - 2007

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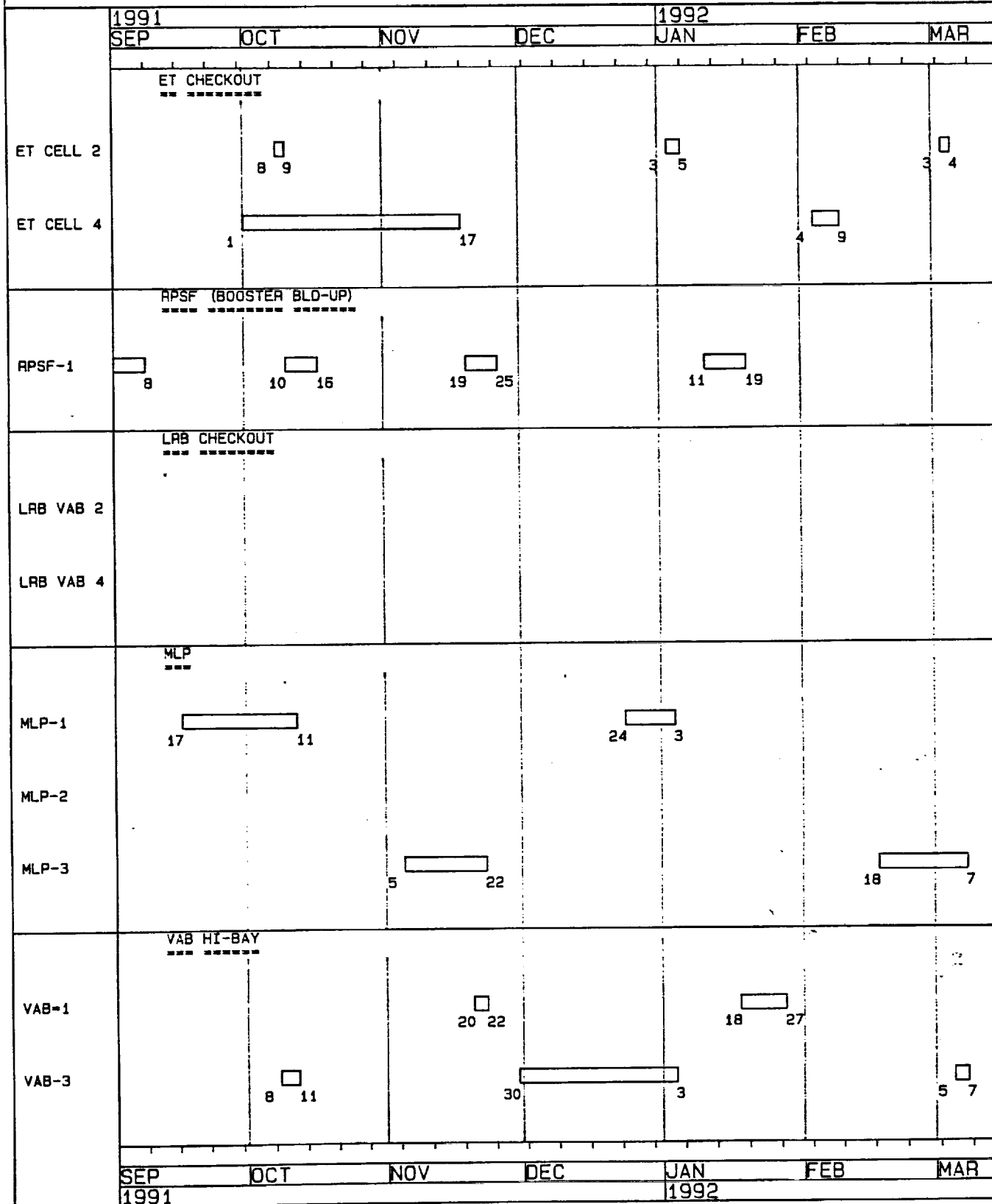
ASSESSMENT BASED ON PRELIMINARY
STUDY - SRB BASELINE
LIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

System 9: 08 am 30-AUG-88

Figure 2.1-16. FY 2007 ET/SRB Facility Utilization.

FOLDOUT FRAME

ET/SRB FACILITIES
FISCAL



PROJECT: SRB000 FROM 2-SEP-91 UNTIL 31-OCT-92
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB1992 - ID: 121 DATED: 7: 23 aa31-AUG-88

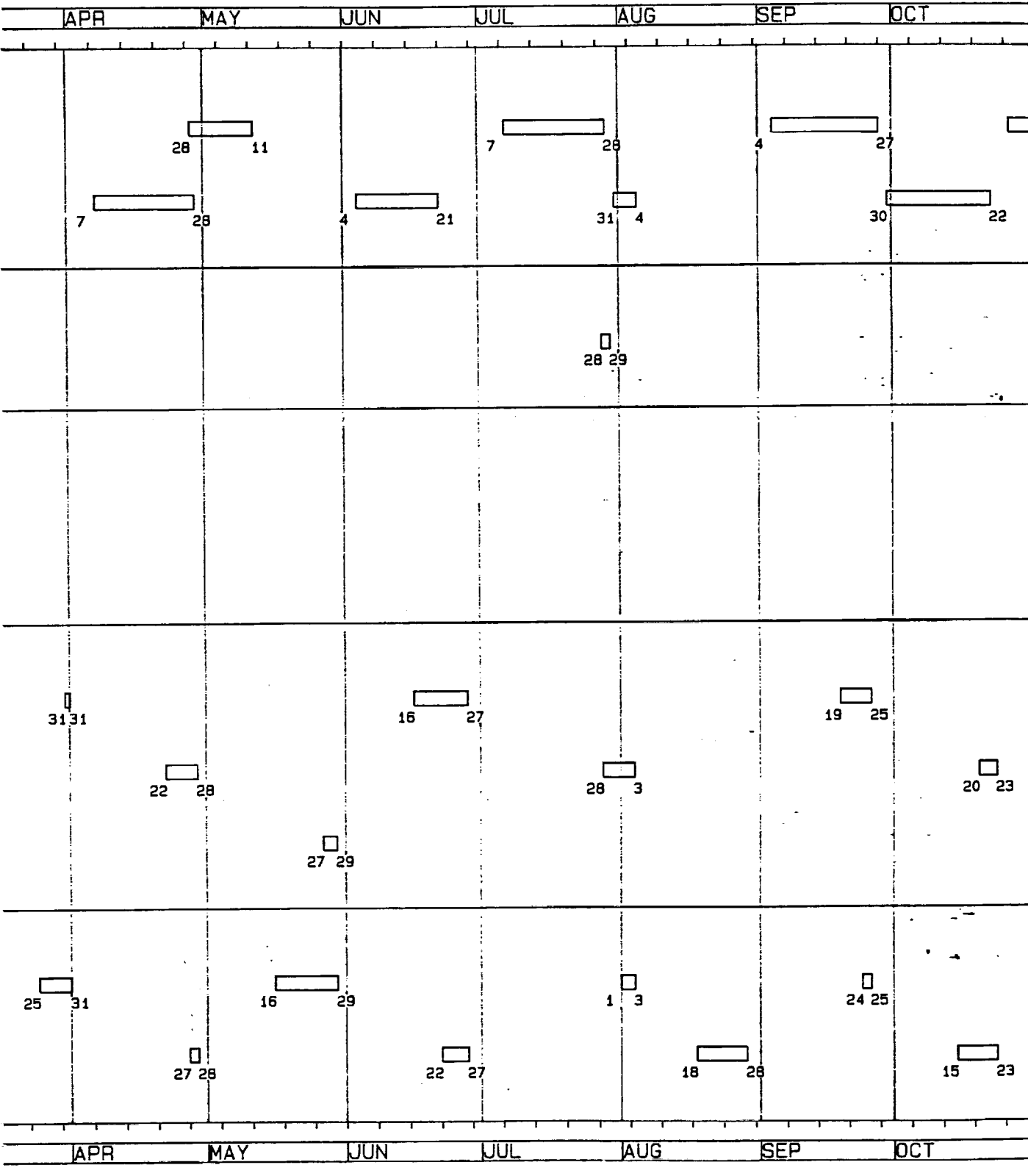
ASSESSMENT BASED ON PRELIMINARY
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 FOR SPC PLANNING PURPOSES ONLY

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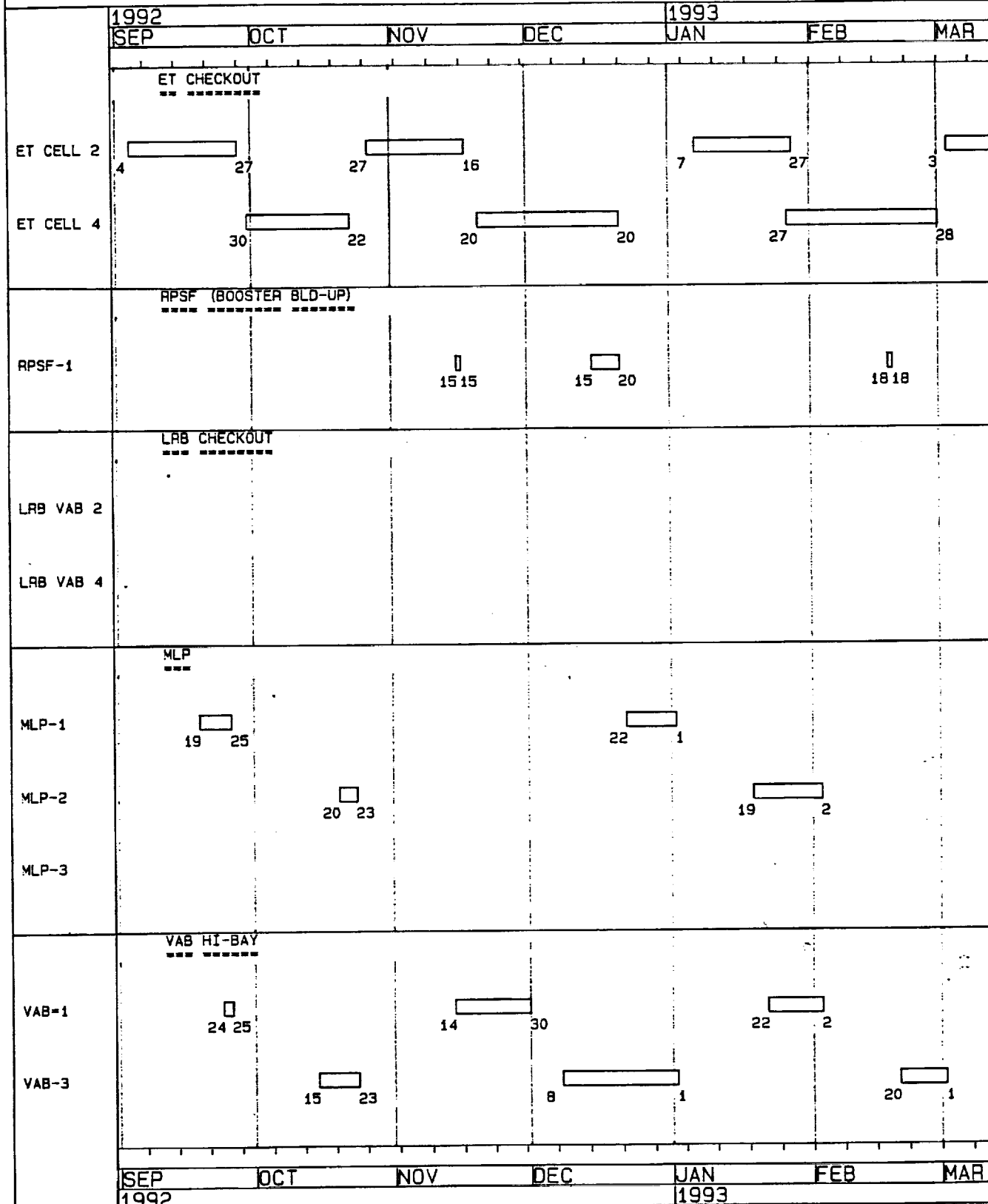
EAR - 1992



stem 7:23 am 31-AUG-88

Figure 2.2-1. FY1992 ET/SRB Facility Open Periods. | 5-2 10/26 1:00p

ET/SRB FACILITIES
FISCAL

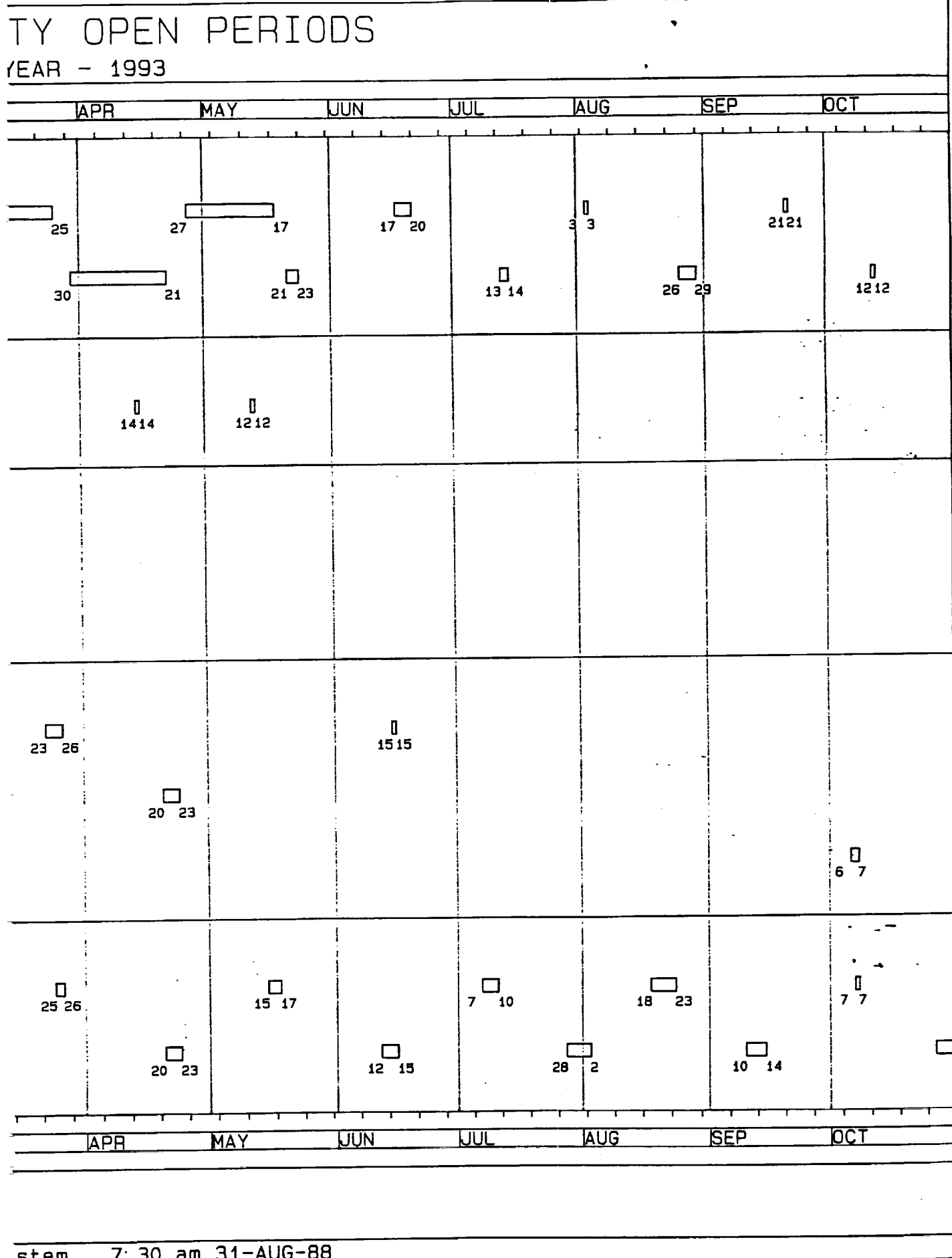


PROJECT: SRB000 FROM 31-AUG-92 UNTIL 31-OCT-93
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB1993 - ID: 121 DATED: 7:30 am 31-AUG-88

ASSESSMENT BASED ON PRELIMINARY
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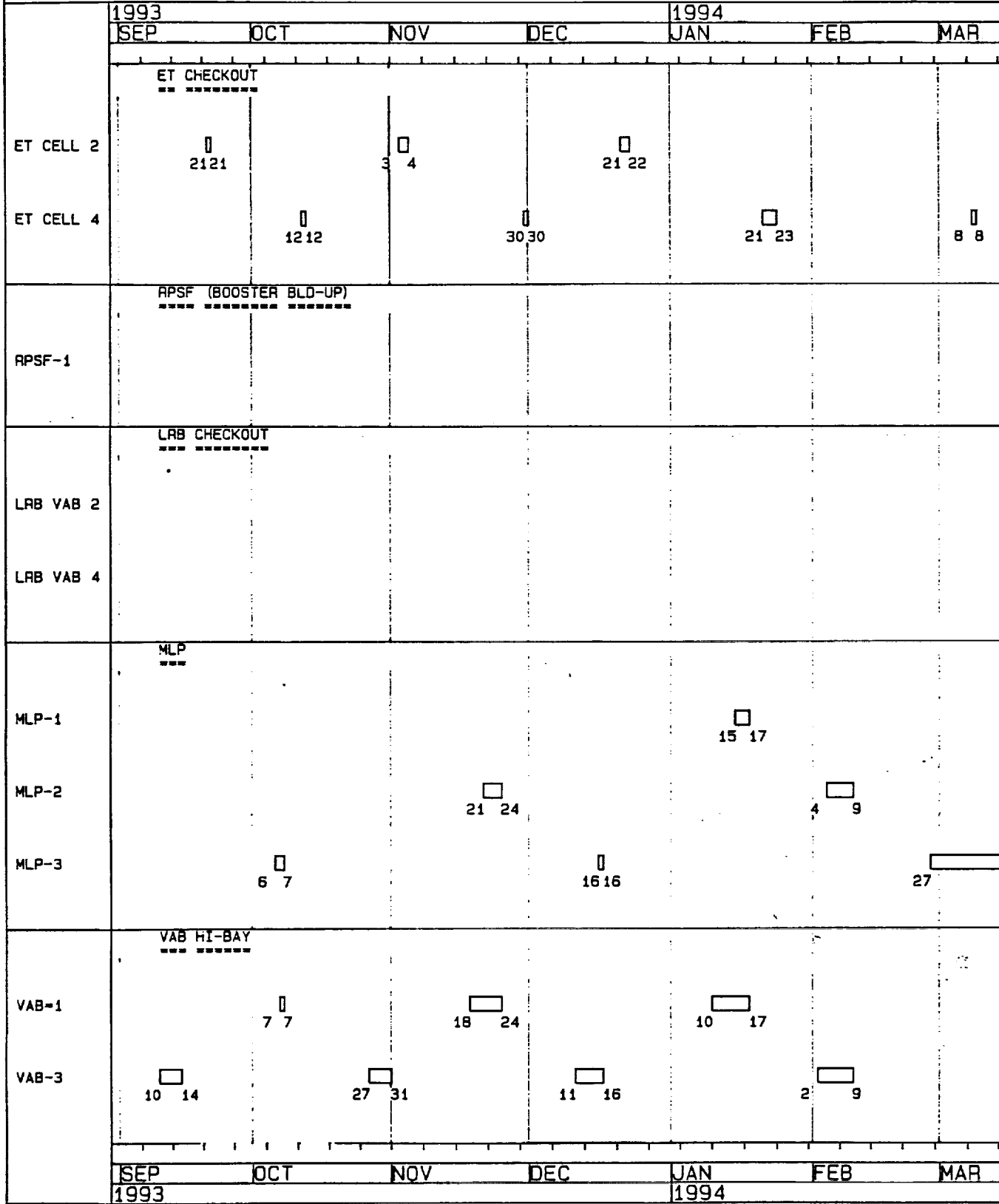
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stem 7:30 am 31-AUG-88

Figure 2.2-2. FY1993 ET/SRB Facility Open Periods. 5-2 10/26 1:00

ET/SRB FACILITY
FISCAL



PROJECT: SRB000 FROM 30-AUG-93 UNTIL 31-OCT-94
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB1994 - ID: 121 DATED: 7:32 am 31-AUG-88

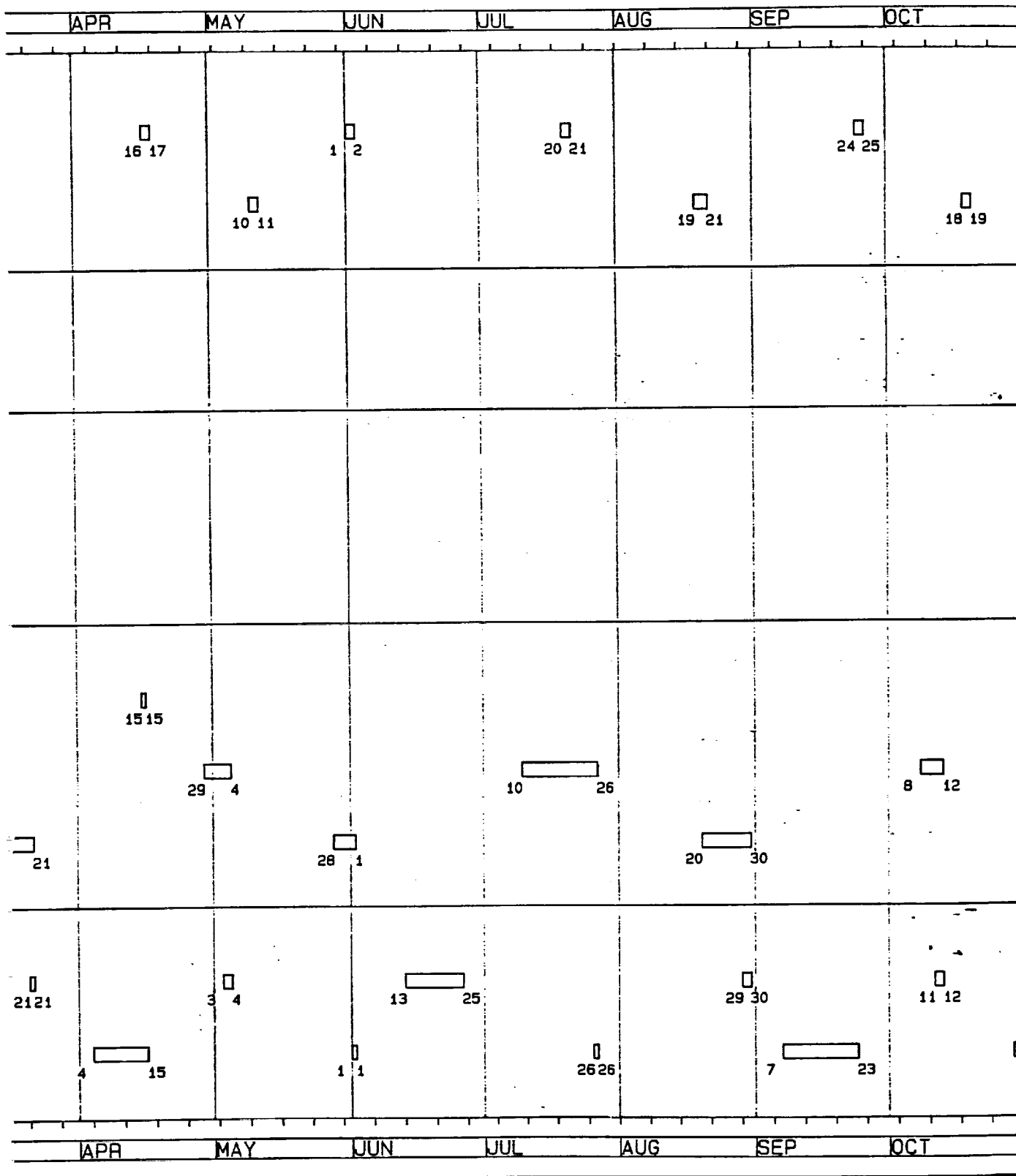
ASSESSMENT BASED ON PRELIMINARY
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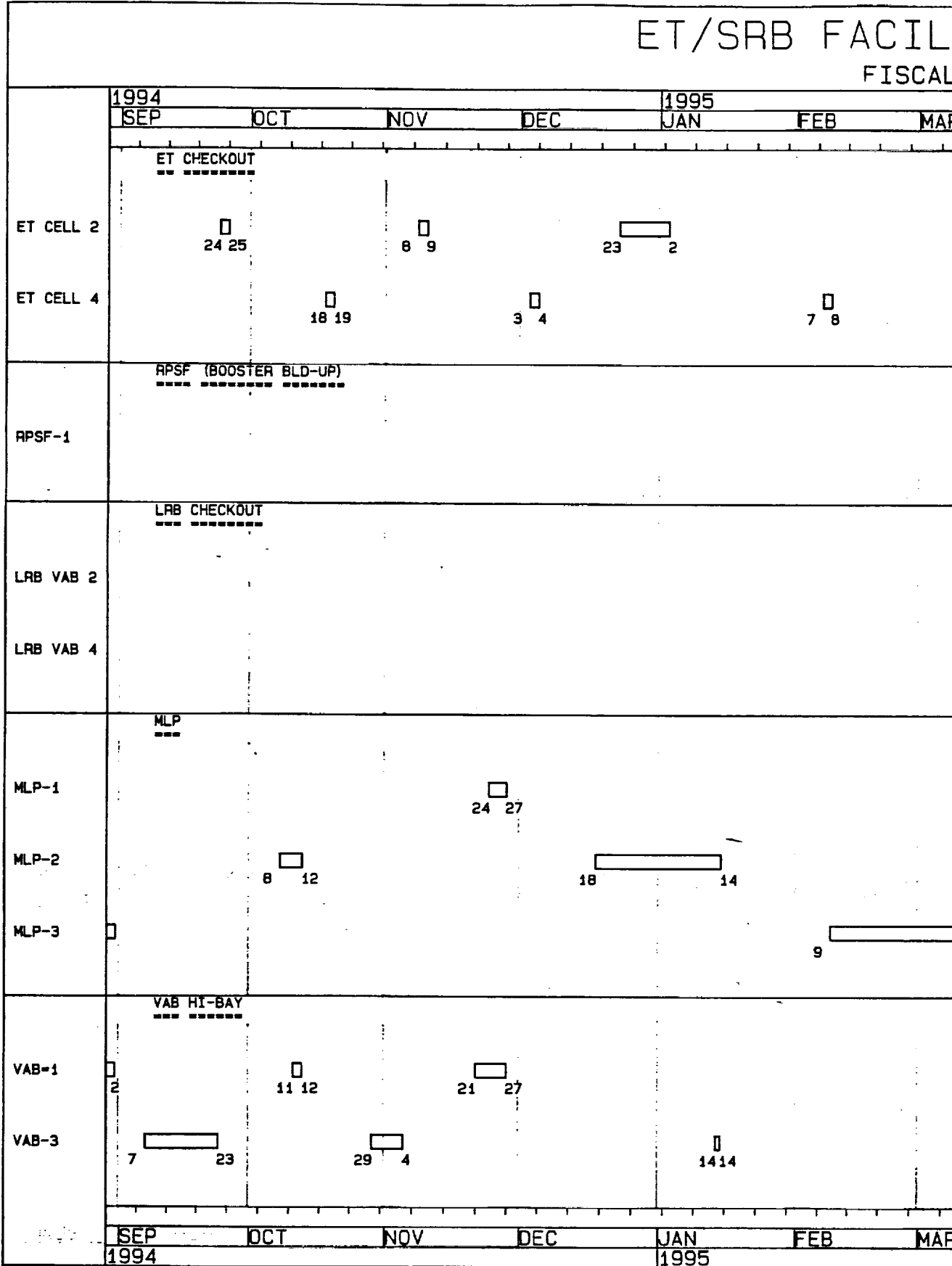
YEAR - 1994



tem 7: 32 am 31-AUG-88

Figure 2.2-3. FY1994 ET/SRB Facility Open Periods. 5-2 10/26 1:00p

ET/SRB FACIL
FISCAL



PROJECT: SRB000 FROM 29-AUG-94 UNTIL 31-OCT-95
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB1995 - ID: 121 DATED: 7: 38 am 31-AUG-88

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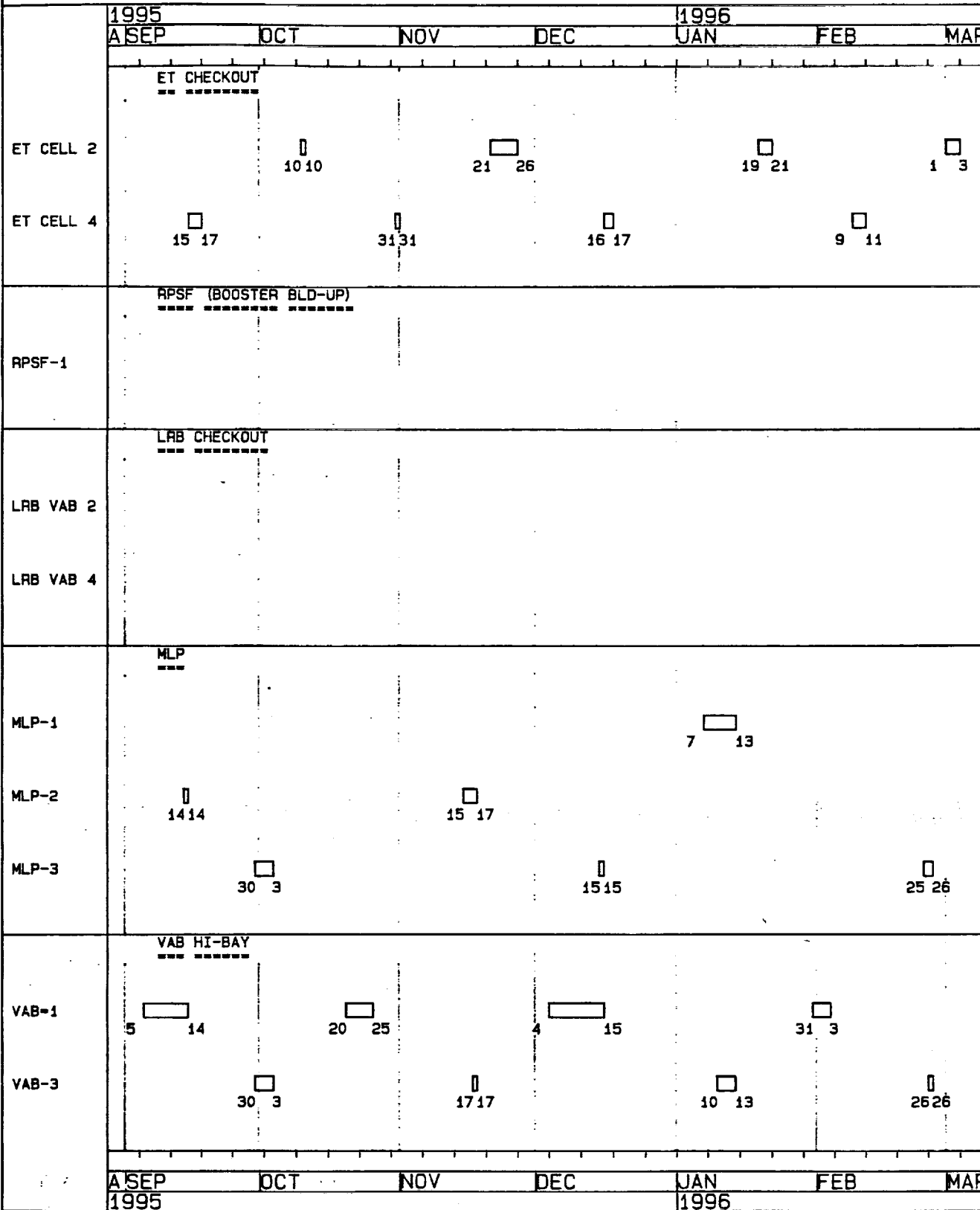
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System 7:38 am 31-AUG-88

Figure 2.2-4. FY1995 ET/SRB Facility Open Periods. 5-2 10/26 1:0

ET/SRB FACILITIES
FISCAL



PROJECT: SRB000 FROM 28-AUG-95 UNTIL 31-OCT-96
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB1996 - ID: 121 DATED: 7: 43 31-AUG-88

ASSESSMENT BASED ON PRELIMINARY
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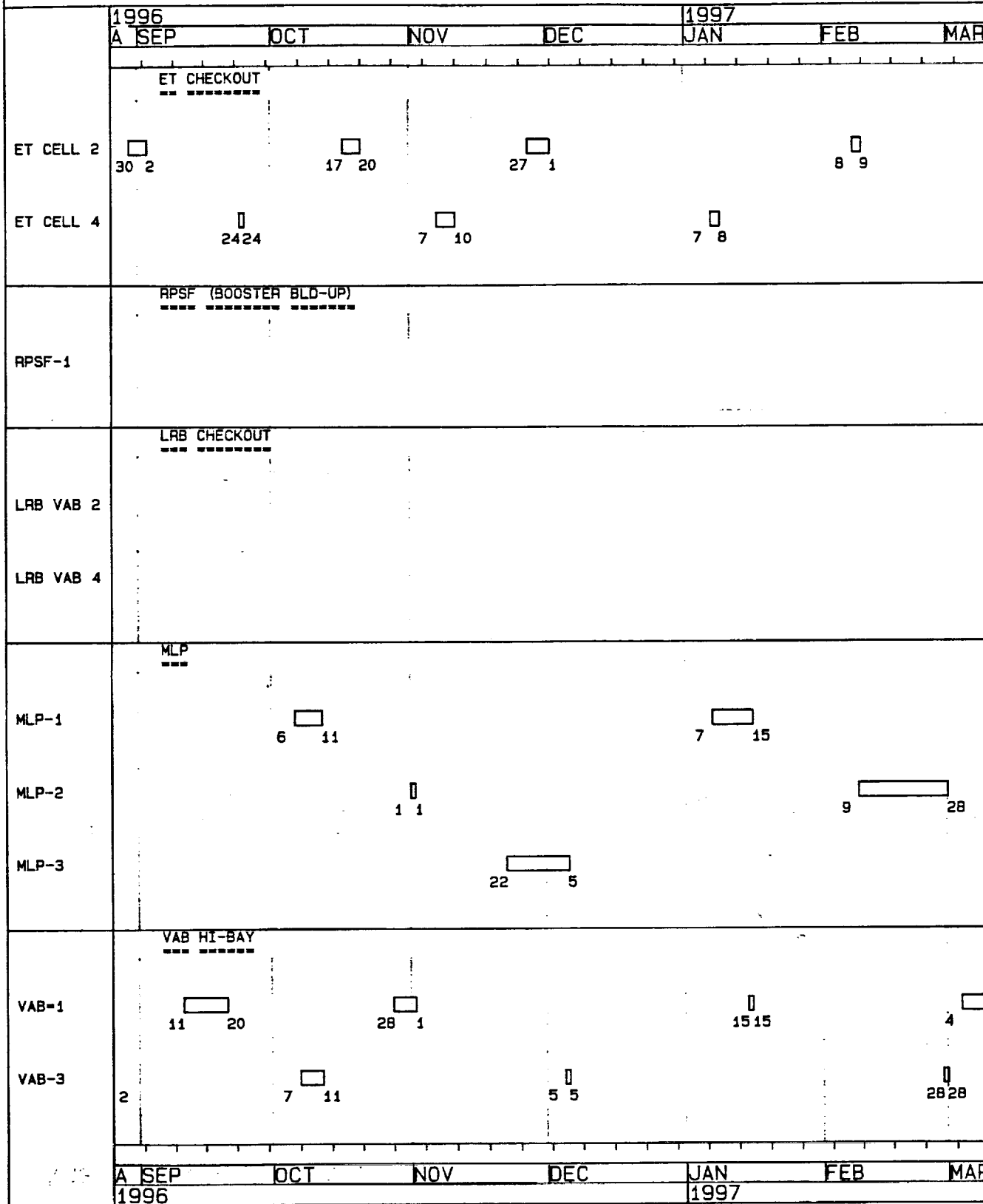
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stem 7:43 am 31-AUG-88

Figure 2.2-5. FY1996 ET/SRB Facility Open Periods. 5-2 10/26 1:00



PROJECT: SRB000 FROM 26-AUG-96 UNTIL 31-OCT-97
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB1997 - ID: 121 DATED: 7: 49 am 31-AUG-88

ASSESSMENT BASED ON PRELIMINARY
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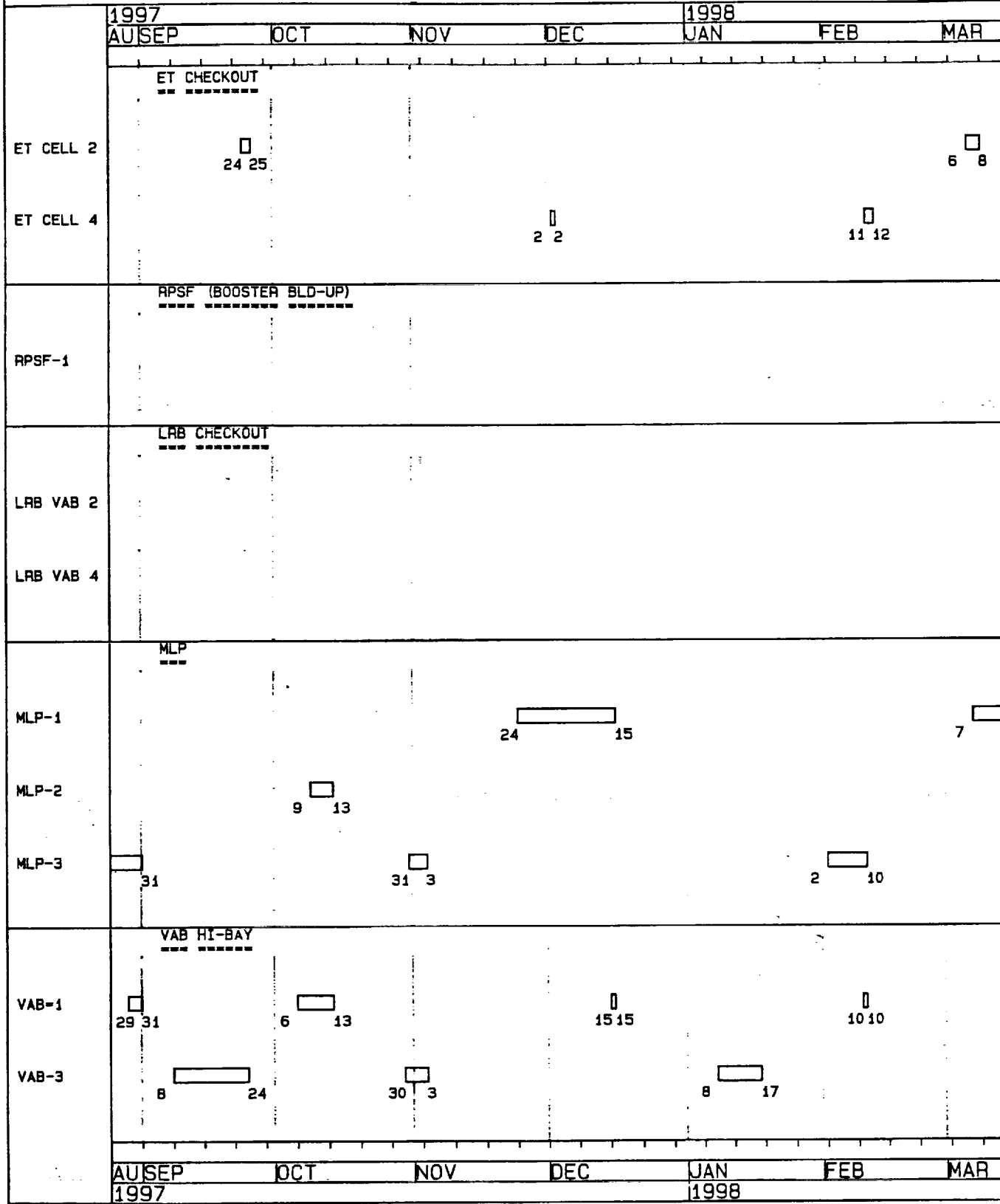
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Figure 2.2-6. FY1997 ET/SRB Facility Open Periods. 5-2 10/26 1:00

ET/SRB FACILITY
FISCAL YEAR



PROJECT: SRB000 FROM 25-AUG-97 UNTIL 31-OCT-98
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB1998 - ID: 121 DATED: 7:55 am 31-AUG-88

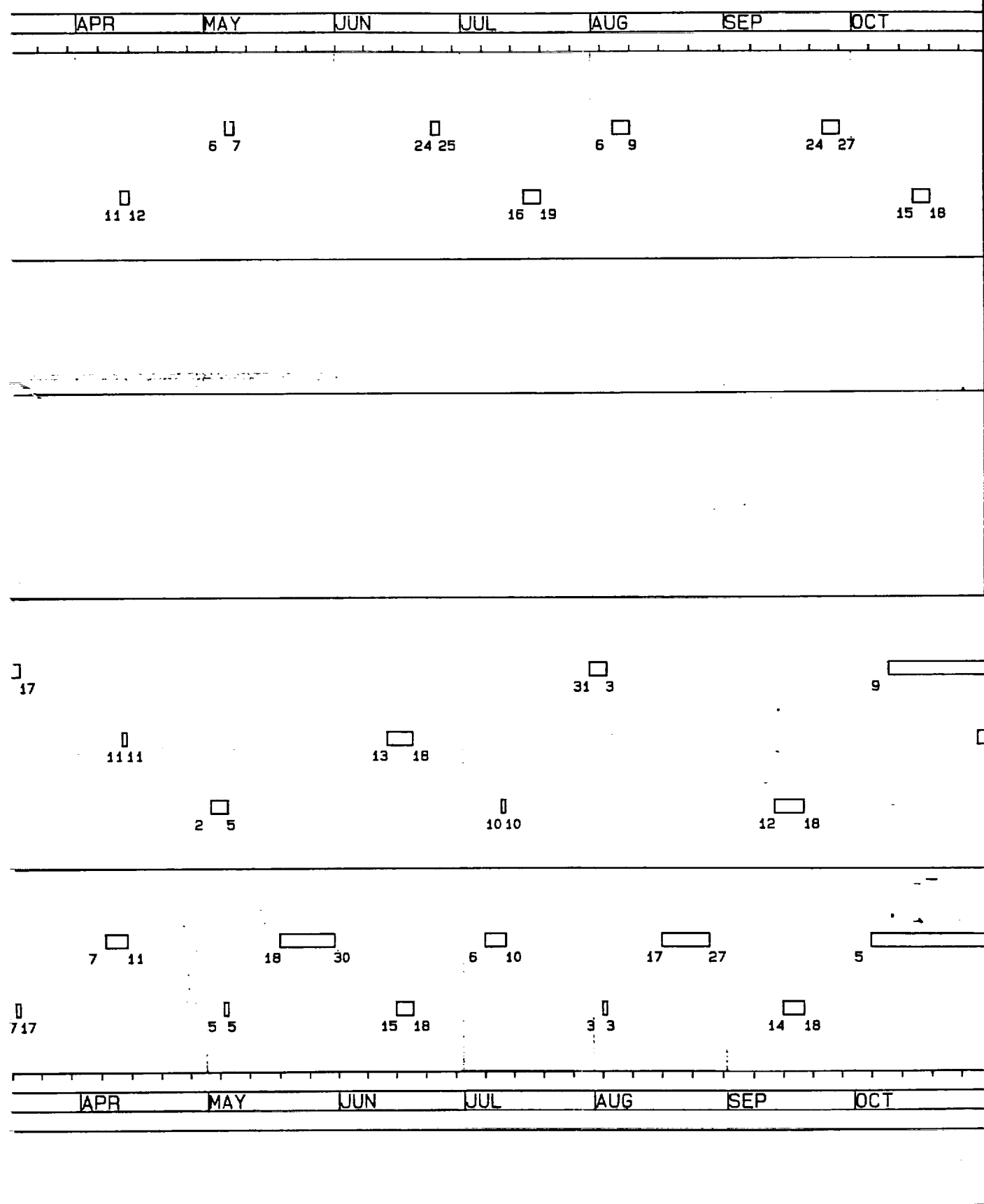
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YEAR - 1998

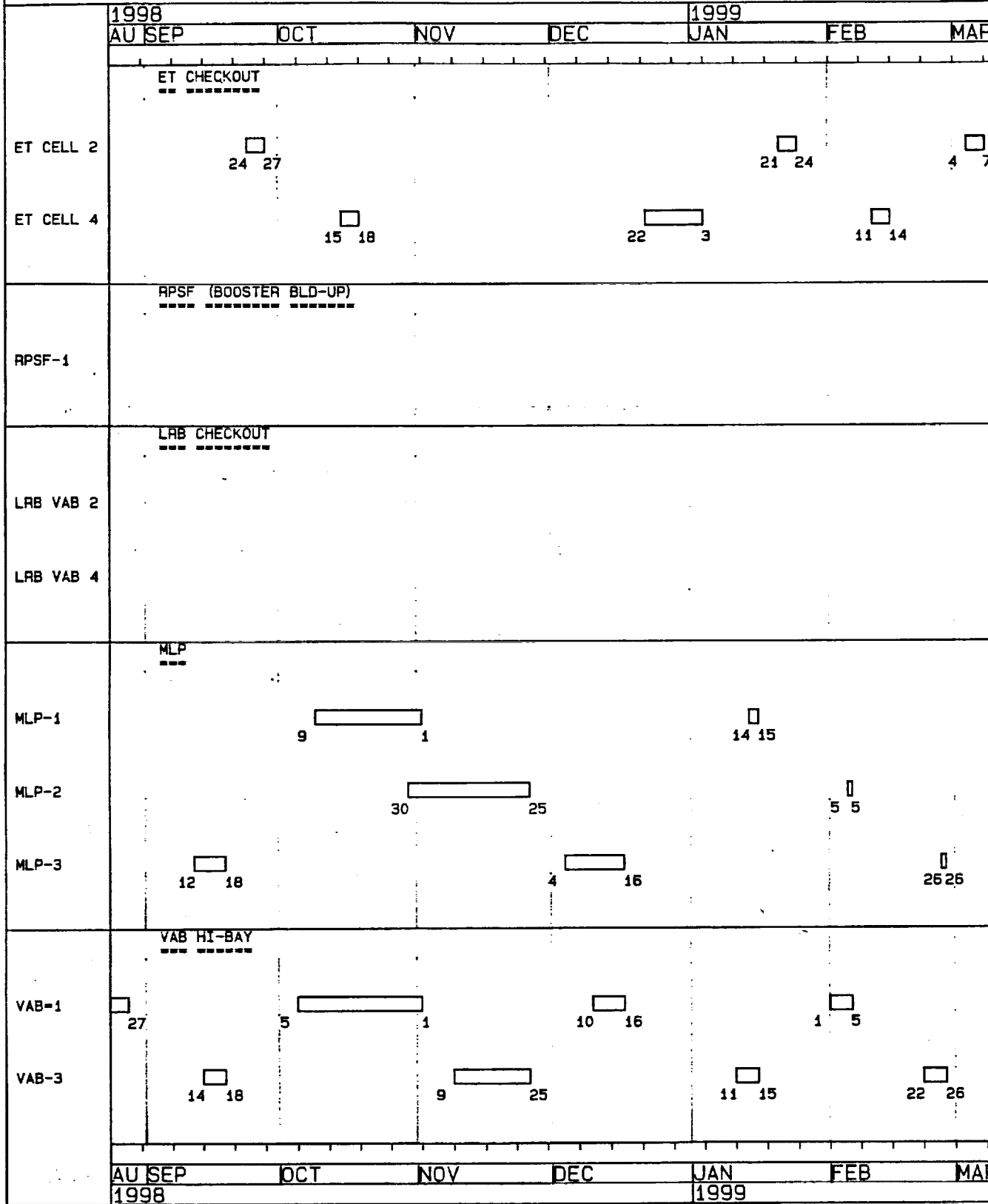


cem 7:55 am 31-AUG-88

Figure 2.2-7. FY1998 ET/SRB Facility Open Periods. 5-2 10/26 1:00p

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ET/SRB FACILITIES
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PROJECT: SRB000 FROM 24-AUG-98 UNTIL 31-OCT-99

LSOC - KSC PROJECT SUPPORT
FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
FILE: SRB1999 - ID: 121 DATED: 8:01 31-AUG-88

ASSESSMENT BASED ON PRELIMINARY
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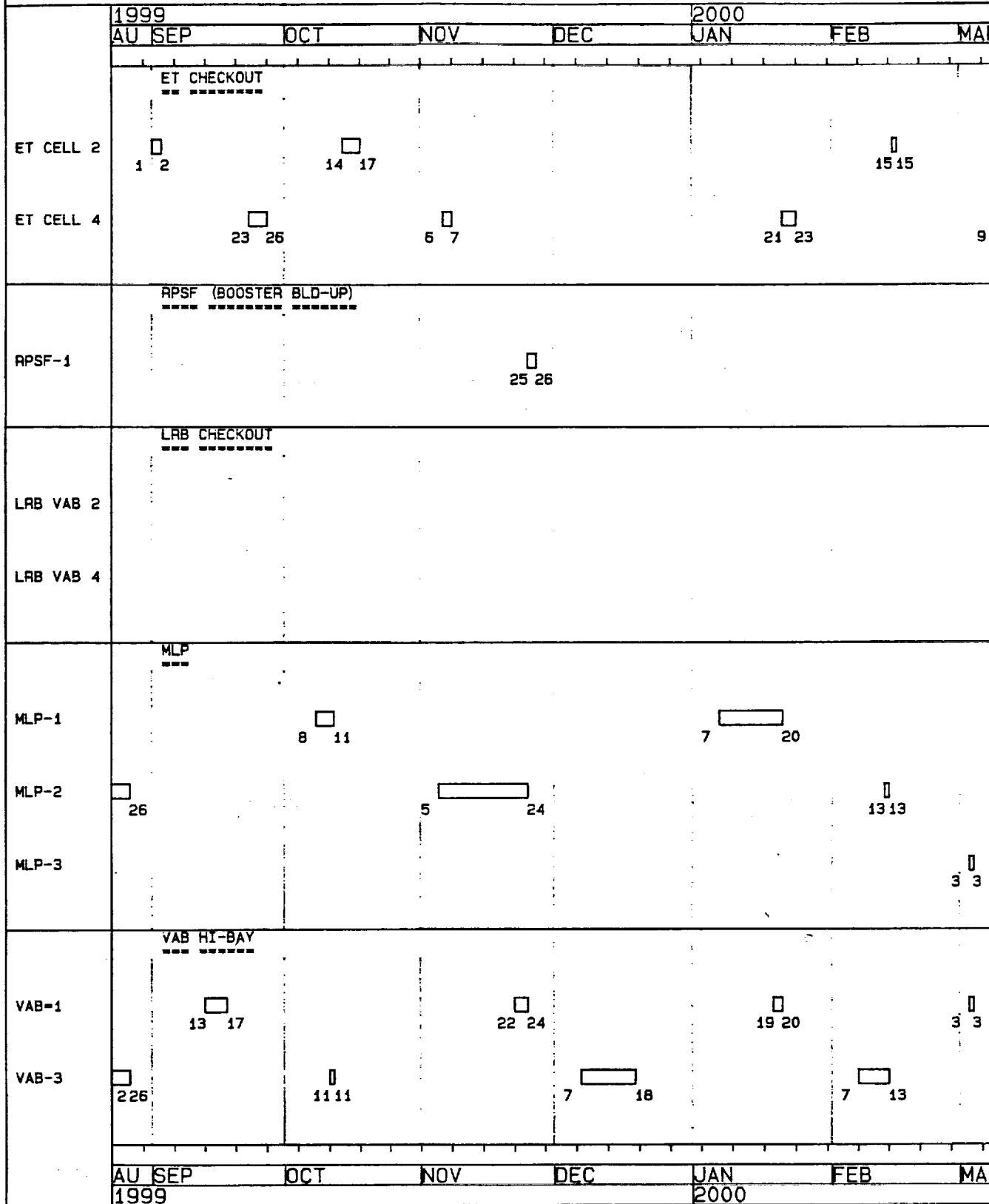
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stem 8: 01 am 31-AUG-88

Figure 2.2-8. FY1999 ET/SRB Facility Open Periods. 5-2 10/26 1:00

ET/SRB FACILITIES
FISCAL



PROJECT: SRB000 FROM 23-AUG-99 UNTIL 31-OCT-2000
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB2000 - ID: 121 DATED: 8.08 am31-AUG-99

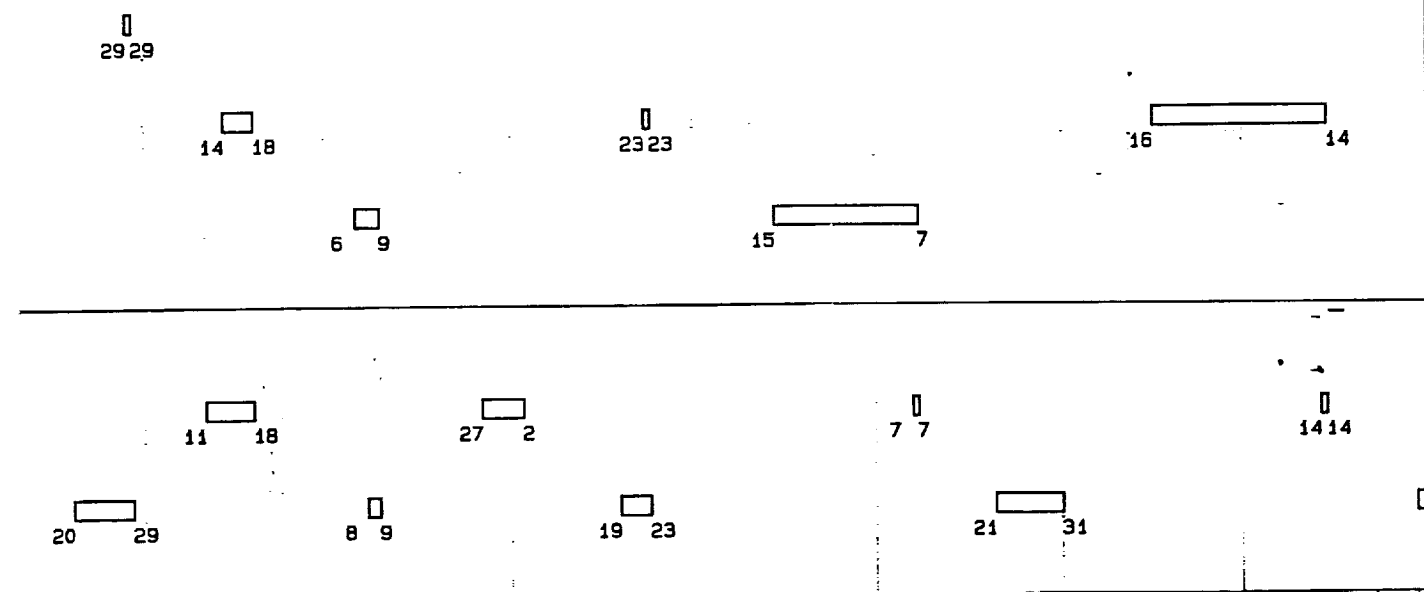
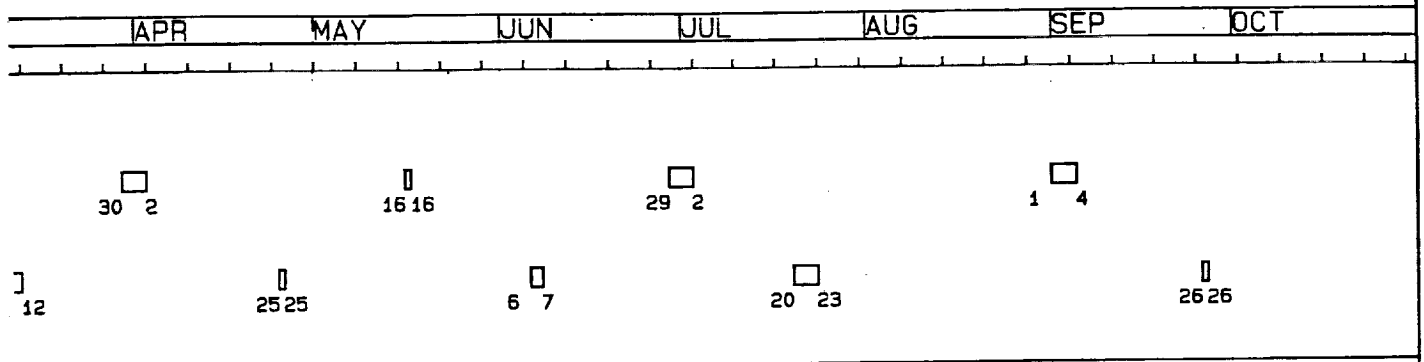
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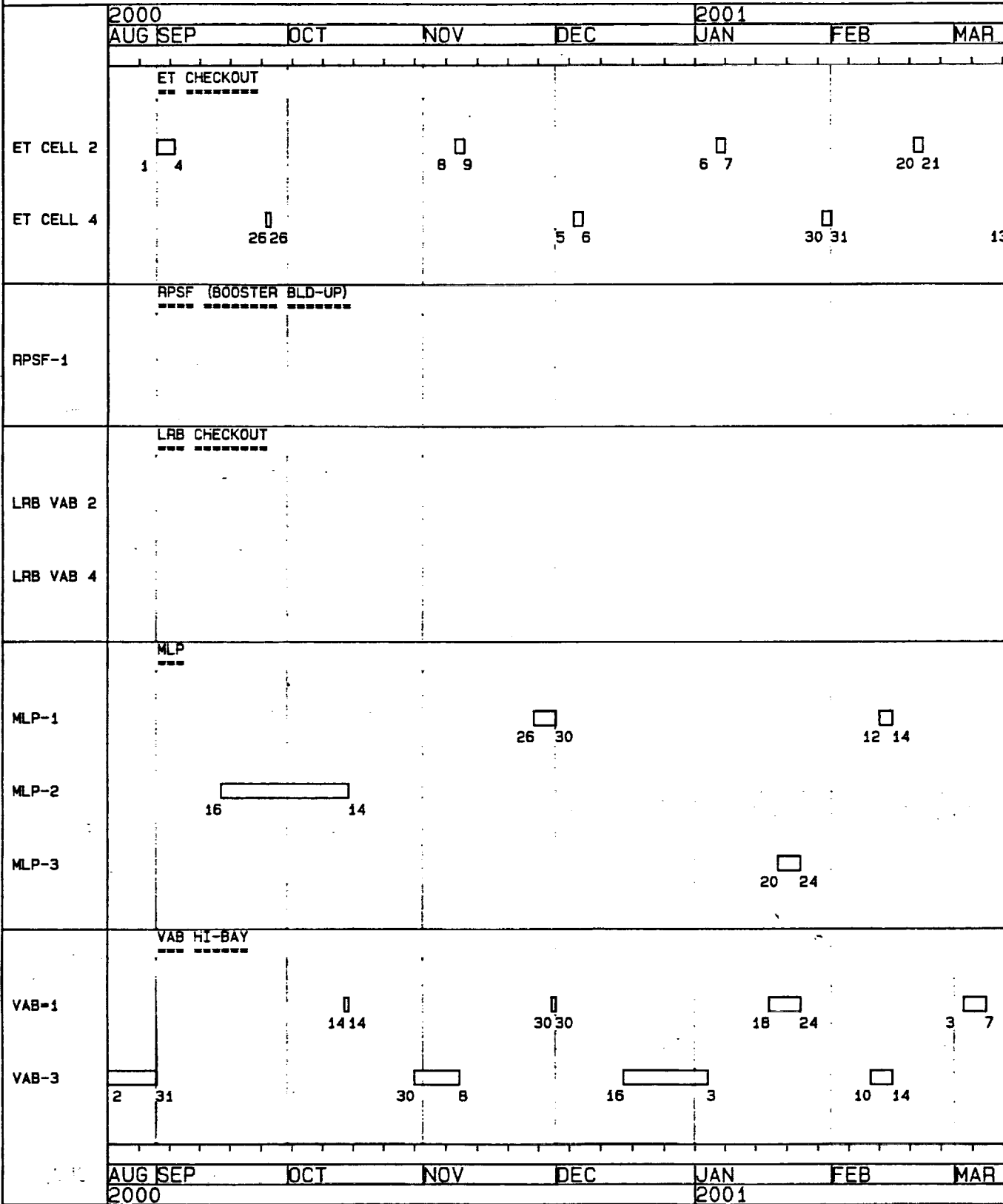
stem 8:08 am 31-AUG-88

Figure 2.2-9. FY2000 ET/SRB Facility Open Periods. 5-2 10/26 1:00

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PROJECT: SRB000 FROM 21-AUG-2000 UNTIL 31-OCT-2001

LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB2001 - ID: 121 DATED: 8:15 am 31-AUG-88

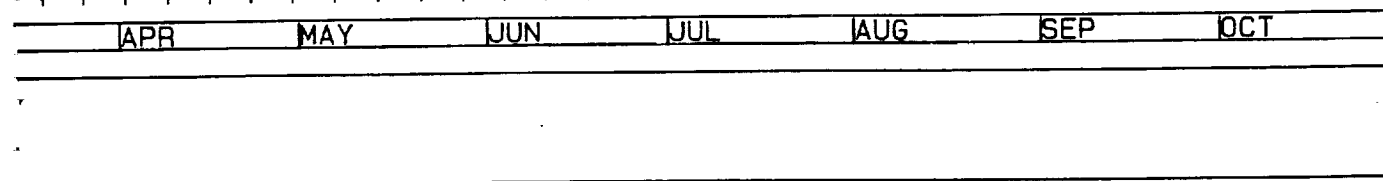
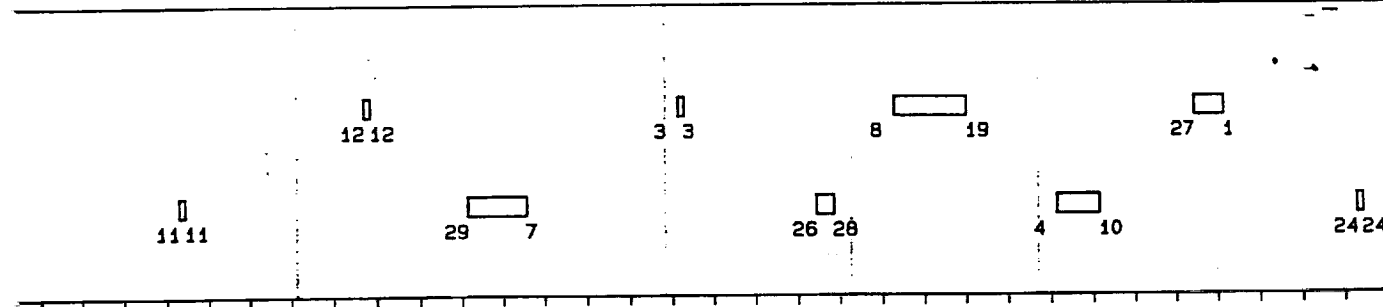
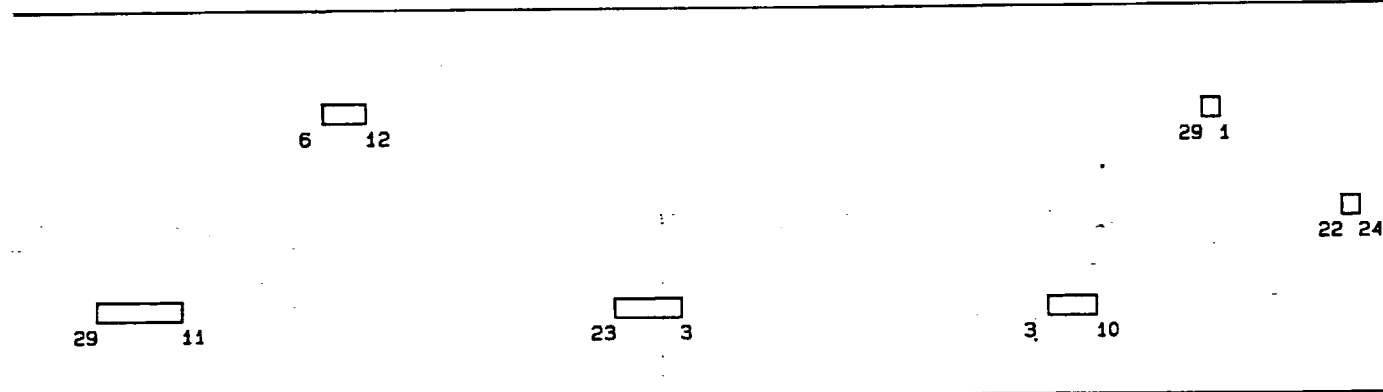
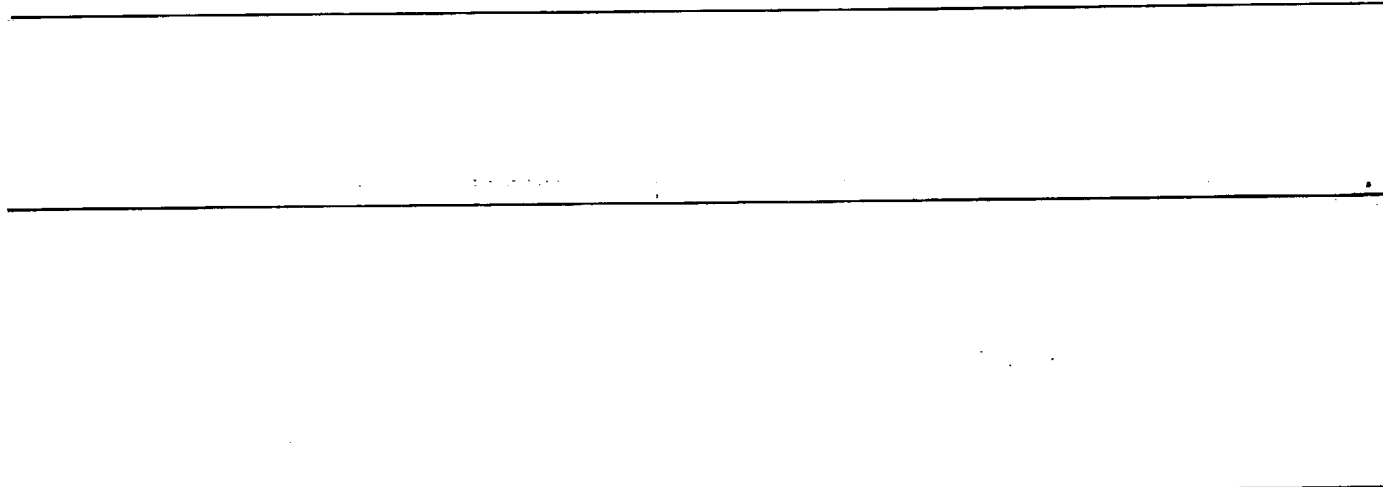
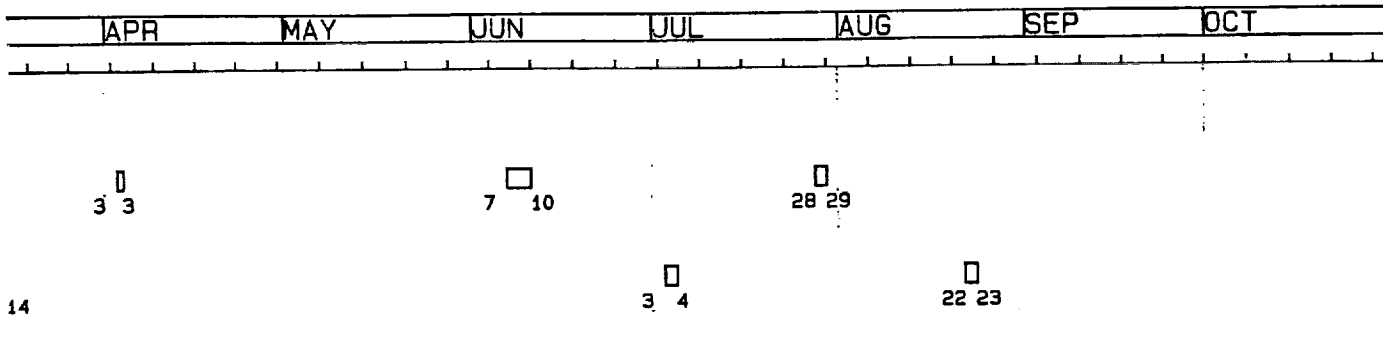
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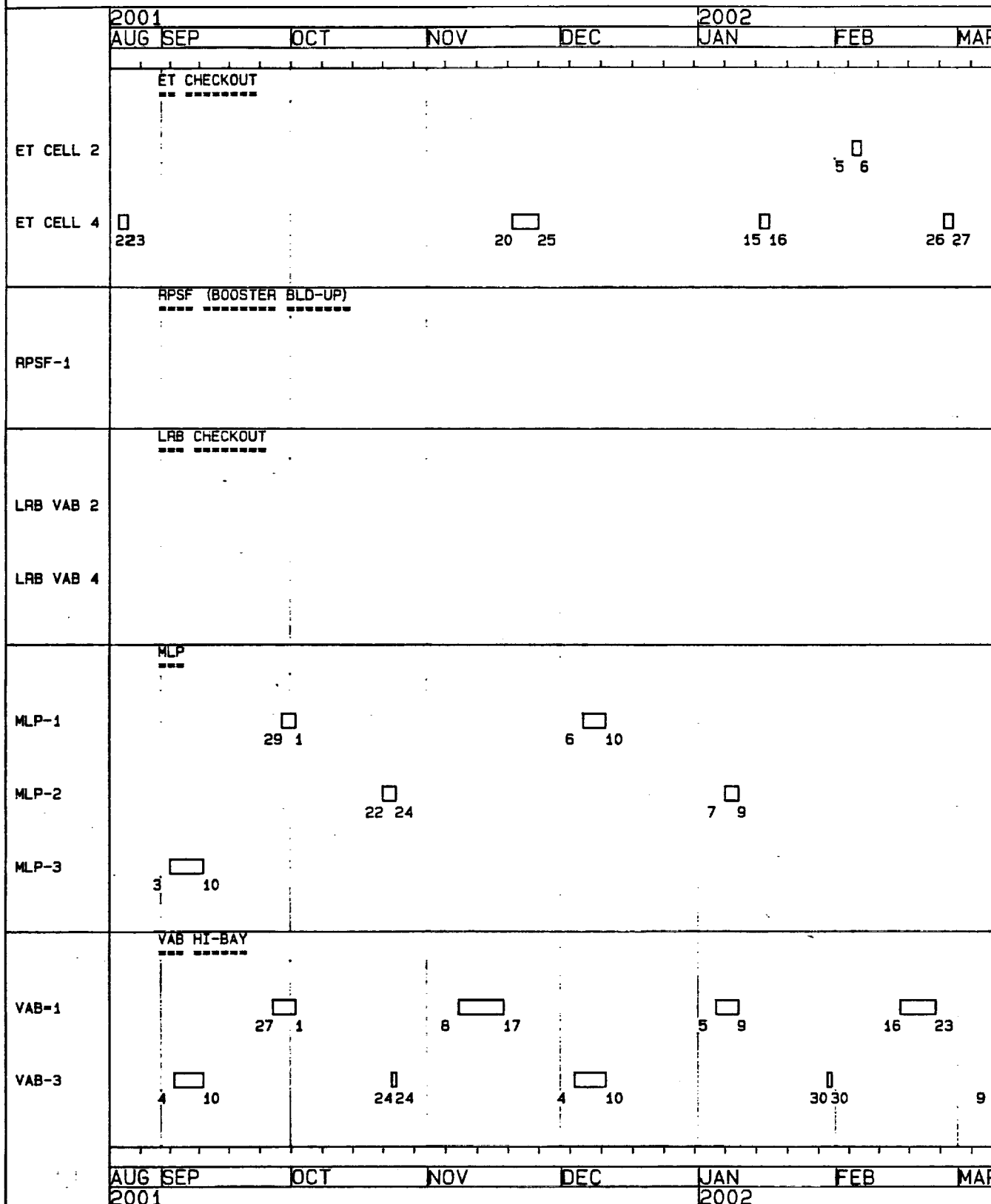
em 8:15 am 31-AUG-88

Figure 2.2-10. FY2001 ET/SRB Facility Open Periods. 5-2 10/26 1:00p

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ET/SRB FACILITIES

FISCAL YEAR



PROJECT: SRB000 FROM 20-AUG-2001 UNTIL 31-OCT-2002

LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB2002 - ID: 121 DATED: 8: 22 0831-AUG-88

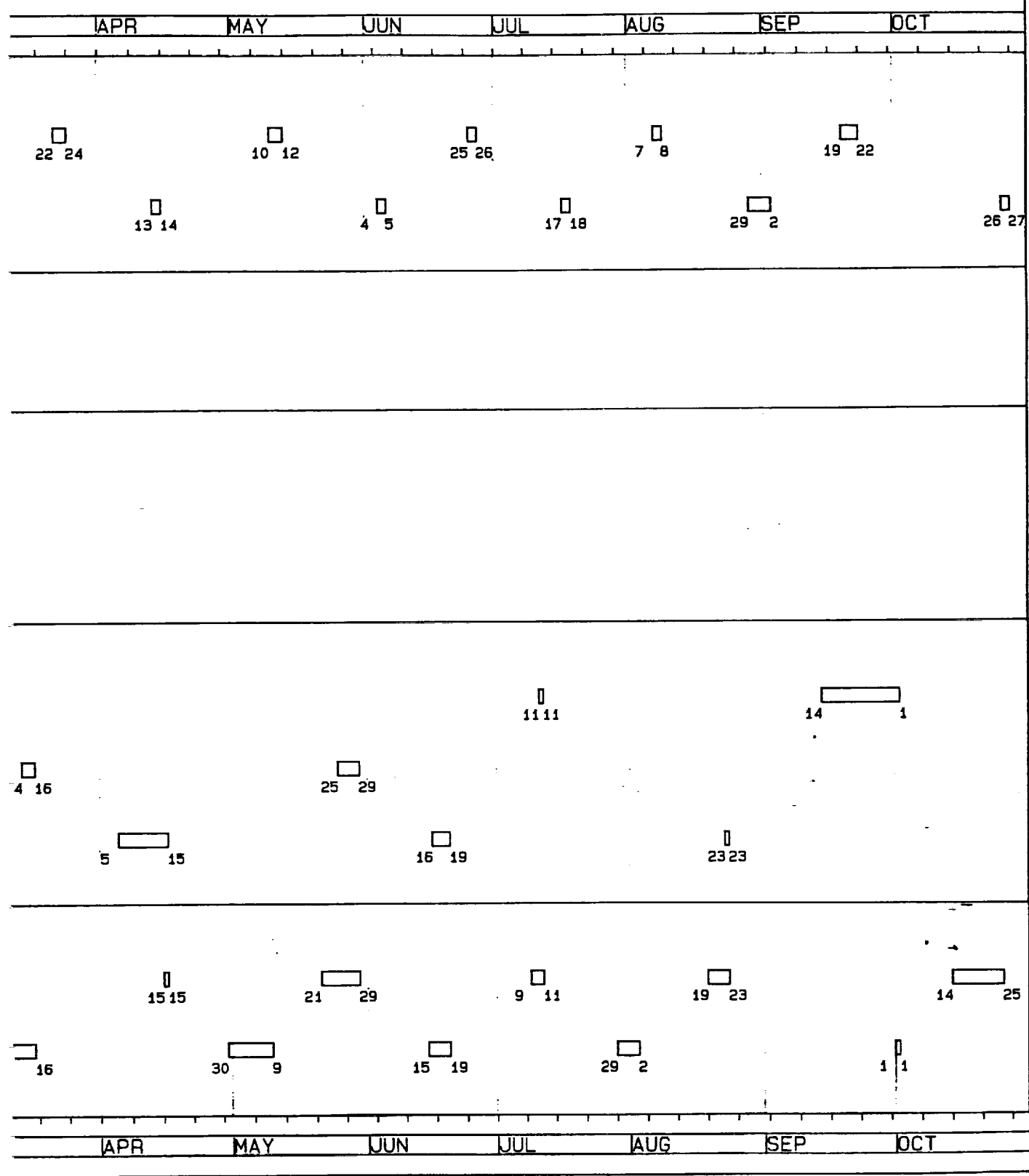
ASSESSMENT BASED ON PRELIMINARY
 LRB STUDY - SRB BASELINE
 FLIGHT ASSIGNMENT MANIFEST
 FOR SPC PLANNING PURPOSES ONLY

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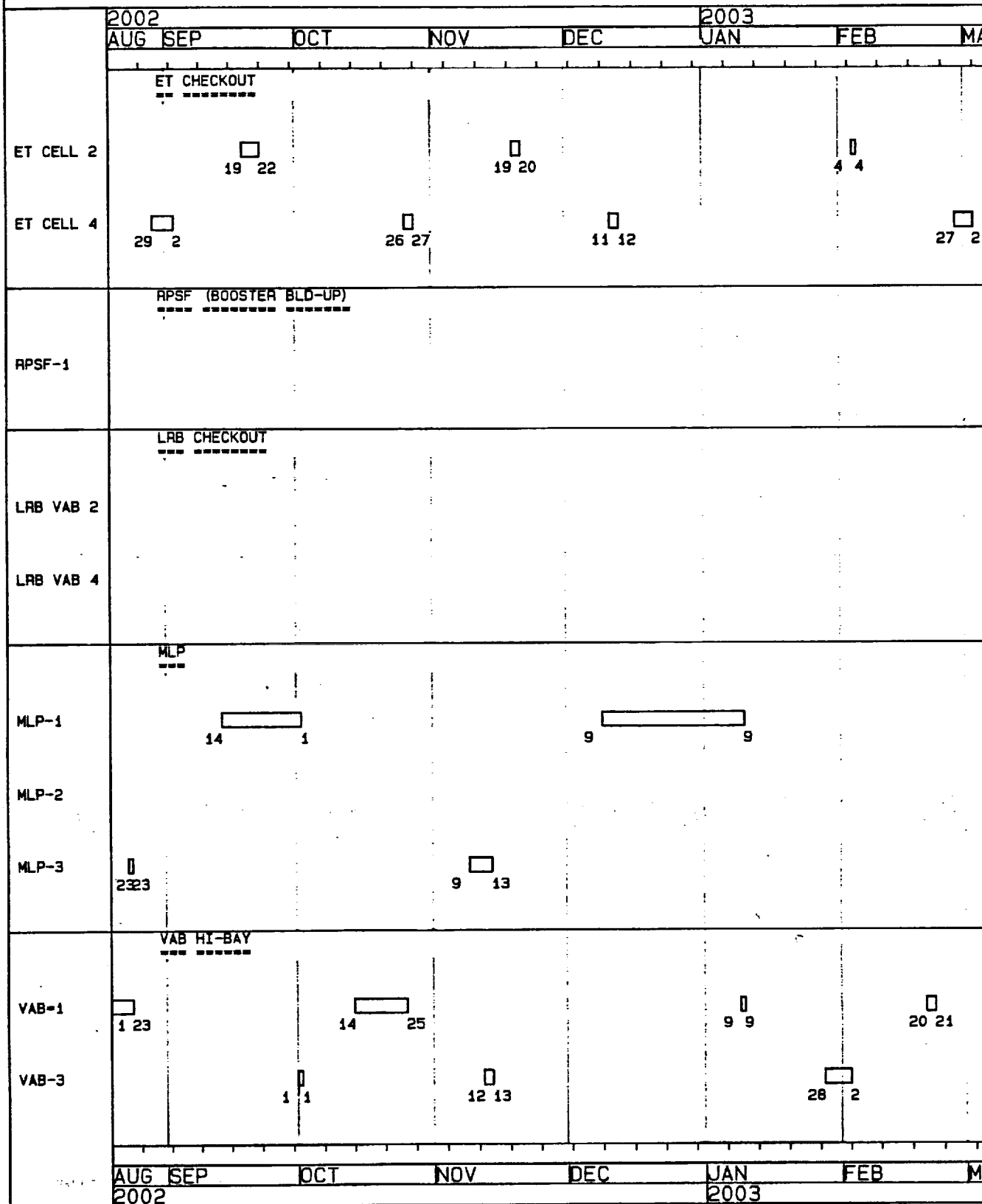
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tem 8: 22 am 31-AUG-88

Figure 2.2-11. FY2002 ET/SRB Facility Open Periods. 5-2 10/26 1:00p

ET/SRB FACILITIES
FISCAL



PROJECT: SRB000 FROM 19-AUG-2002 UNTIL 31-OCT-2003

LSOC - KSC PROJECT SUPPORT
FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6593
FILE: SRB2003 - ID: 121 DATED: 8: 32 31-AUG-88

ASSESSMENT BASED ON PRELIMINARY
LRB STUDY - SRB BASELINE
FLIGHT ASSIGNMENT MANIPULATION
FOR SPC PLANNING PURPOSES

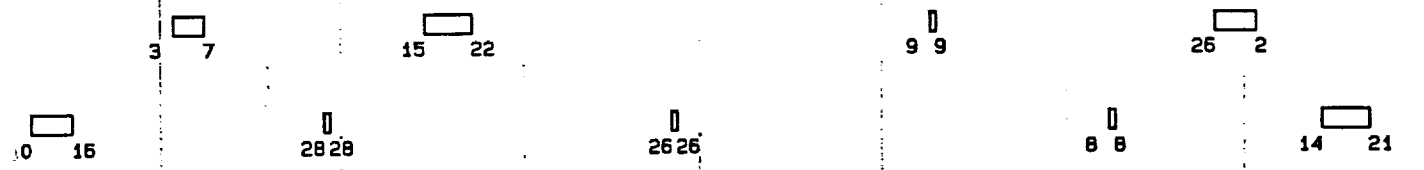
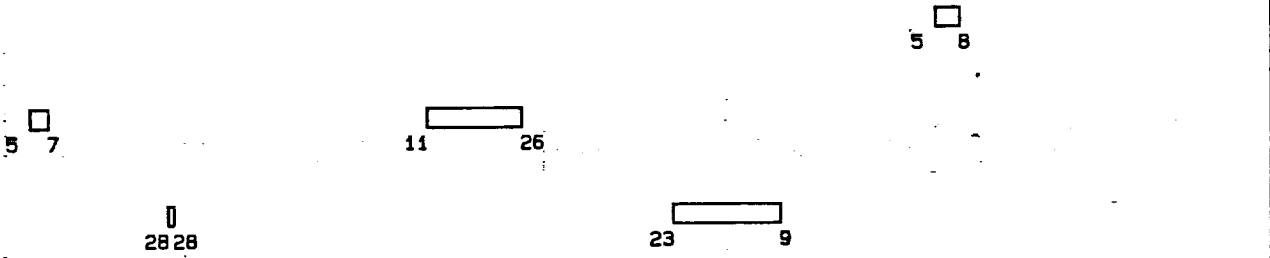
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YEAR - 2003

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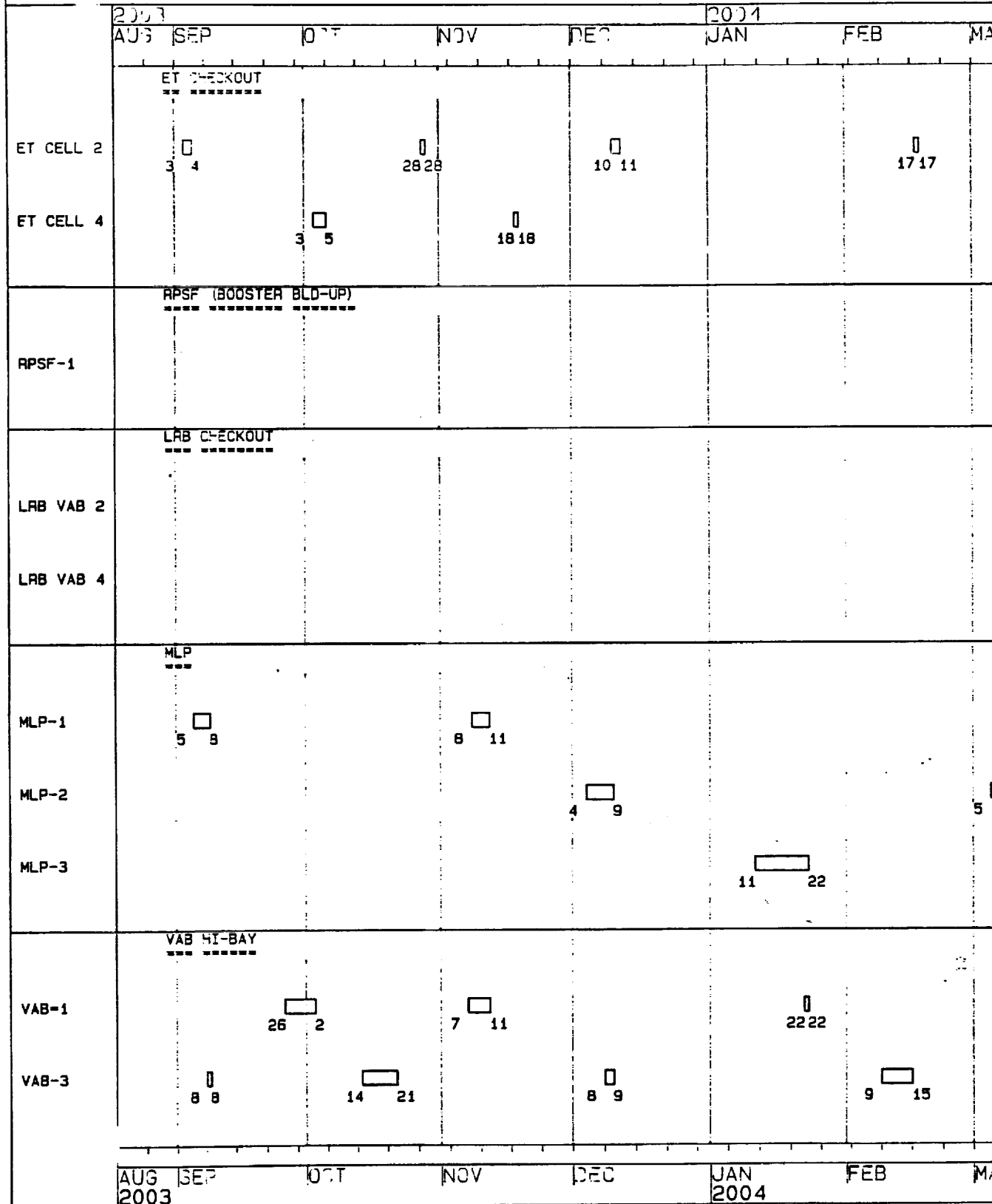
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Figure 2.2-12. FY2003 ET/SRB Facility Open Periods. (5-2 10/26 1:00)

ET/SRB FACILITIES
FISCAL



PROJECT: SRB000 FROM 18-AUG-2003 UNTIL 31-OCT-2004
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 967-6633
 FILE: SRB2004 - ID: 121 DATED: 8:38 3-31-AUG-88

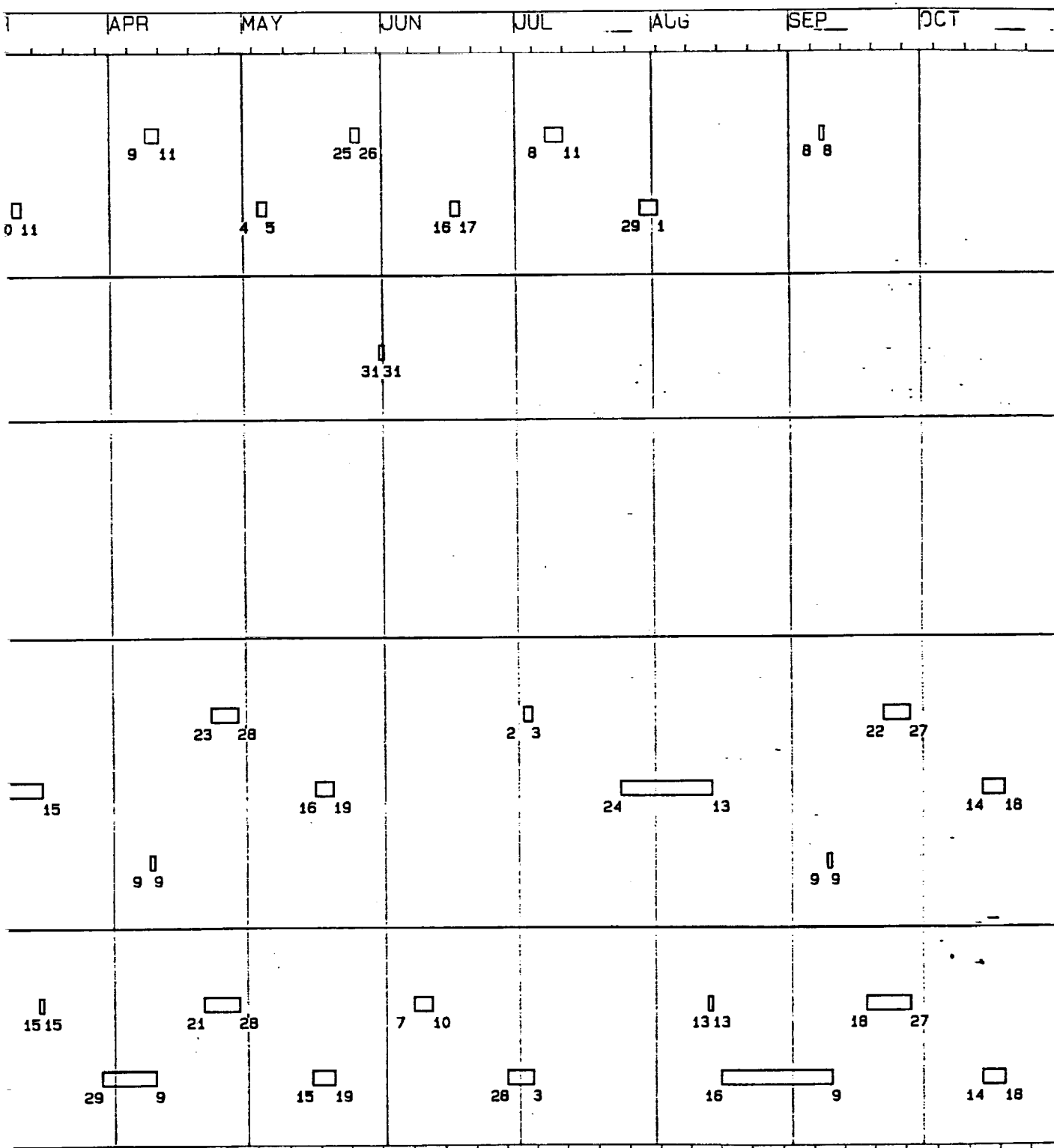
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FACILITY OPEN PERIODS

YEAR - 2004



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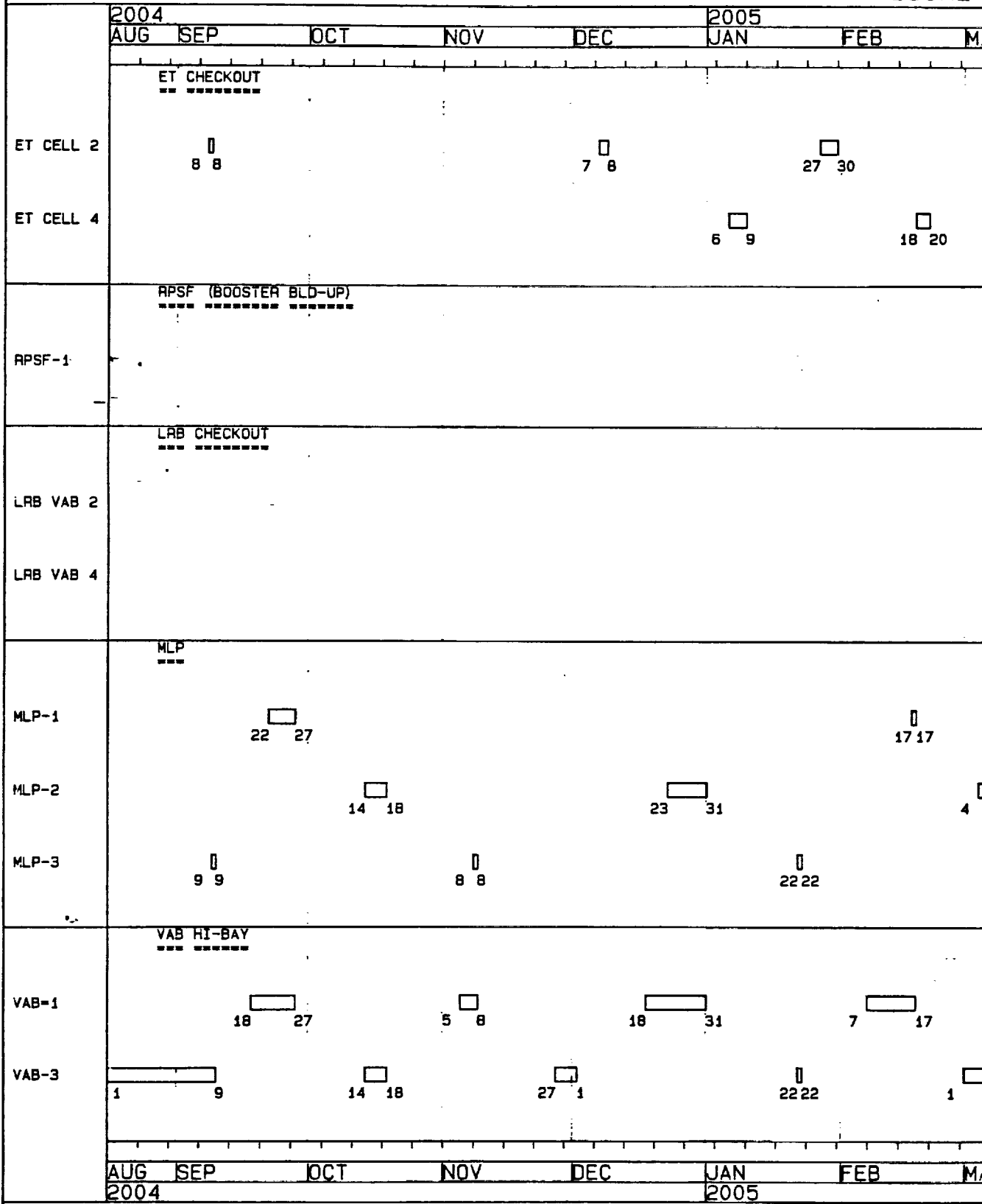
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Figure 2.2-13. FY2004 ET/SRB Facility Open Periods.

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ET/SRB FACILITIES
FISCAL



PROJECT: SRB000 FROM 16-AUG-2004 UNTIL 31-OCT-2005

LSOC - KSC PROJECT SUPPORT

FOR INFORMATION CONTACT: LSOC J. ZARTHAN 867-6693

FILE: SRB2005 - ID: 121 DATED: 8:45 am 31-AUG-88

ASSESSMENT BASED ON PRELIMINARY
LRB STUDY - SRB BASELINE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES

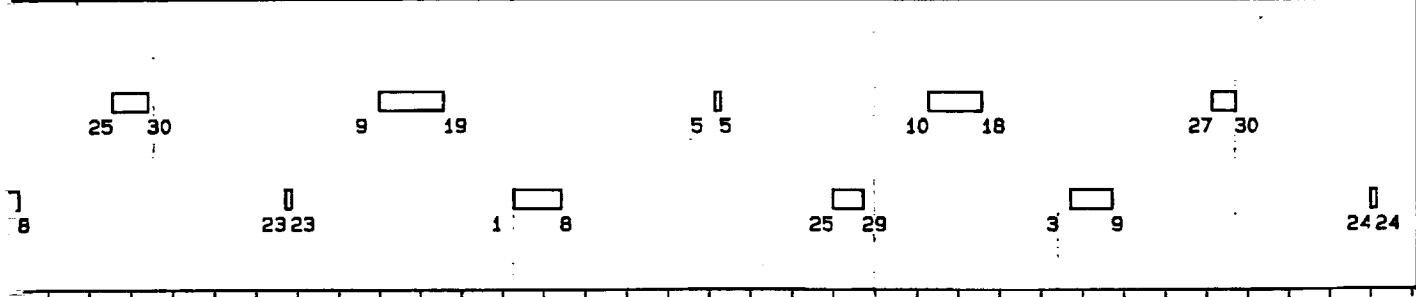
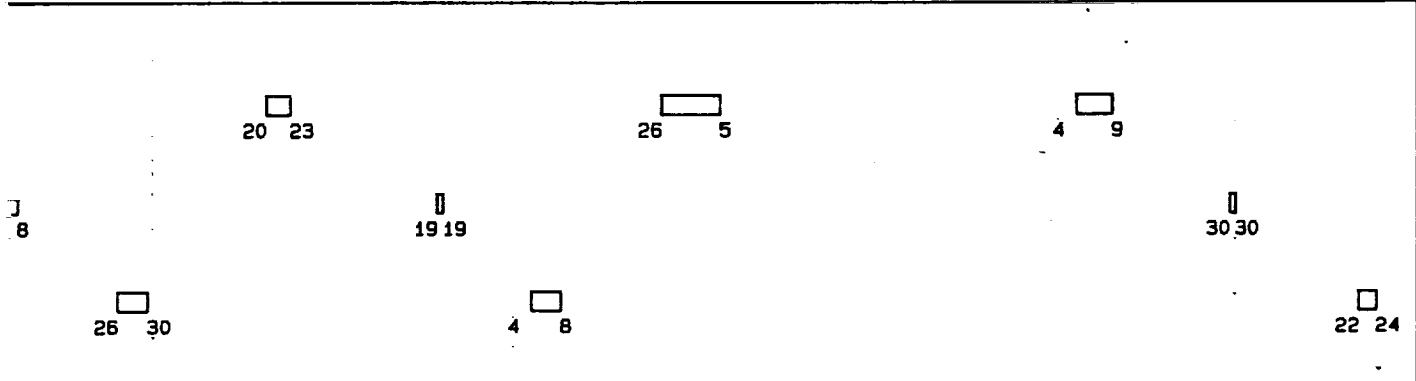
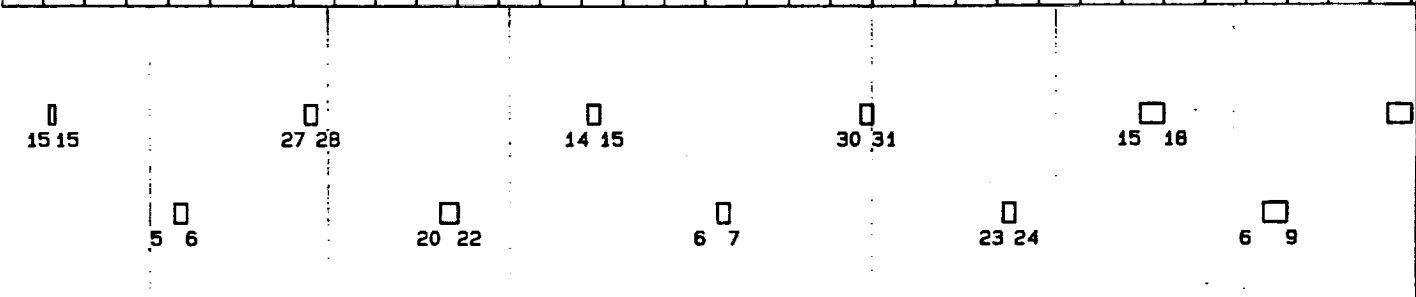
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YEAR - 2005

APR MAY JUN JUL AUG SEP OCT

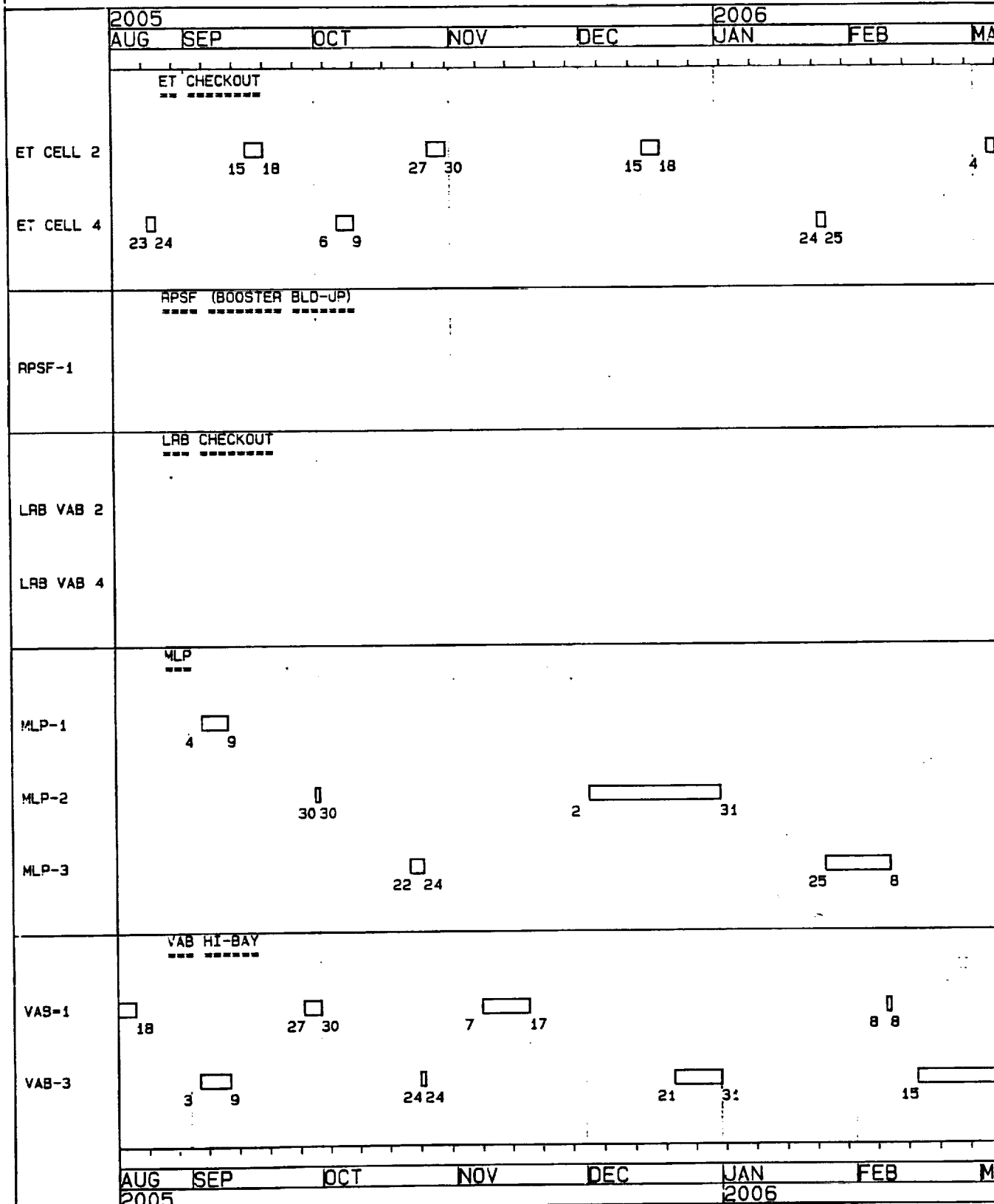


APR MAY JUN JUL AUG SEP OCT

7:45 am 31-AUG-88

Figure 2.2-14. FY2005 ET/SRB Facility Open Periods. 5-2 10/26 1:00p

ET/SRB FACILITIES
FISCAL YEAR



PROJECT: SRB000 FROM 15-AUG-2005 UNTIL 31-OCT-2006
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
 FILE: SRB2006 - ID: 121 DATED: 8:54 am 31-AUG-88

ASSESSMENT BASED ON PRELIMINARY
 LRB STUDY - SRB BASELINE
 FLIGHT ASSIGNMENT MANIFEST
 FOR SPC PLANNING PURPOSES

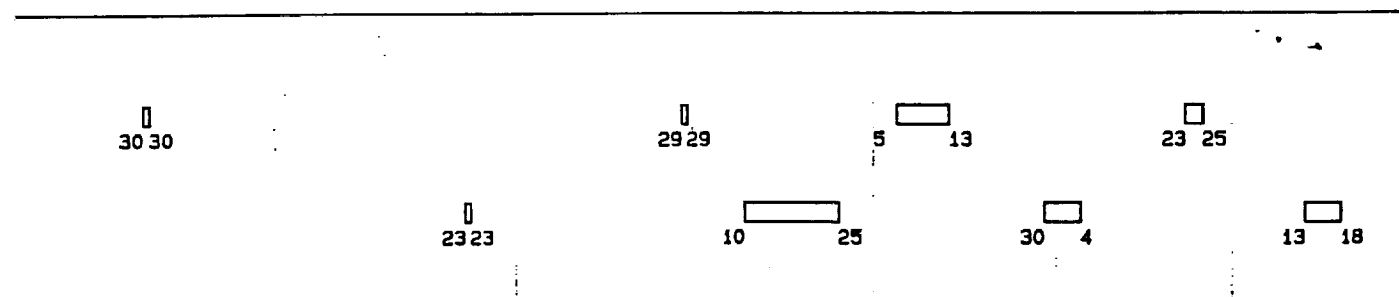
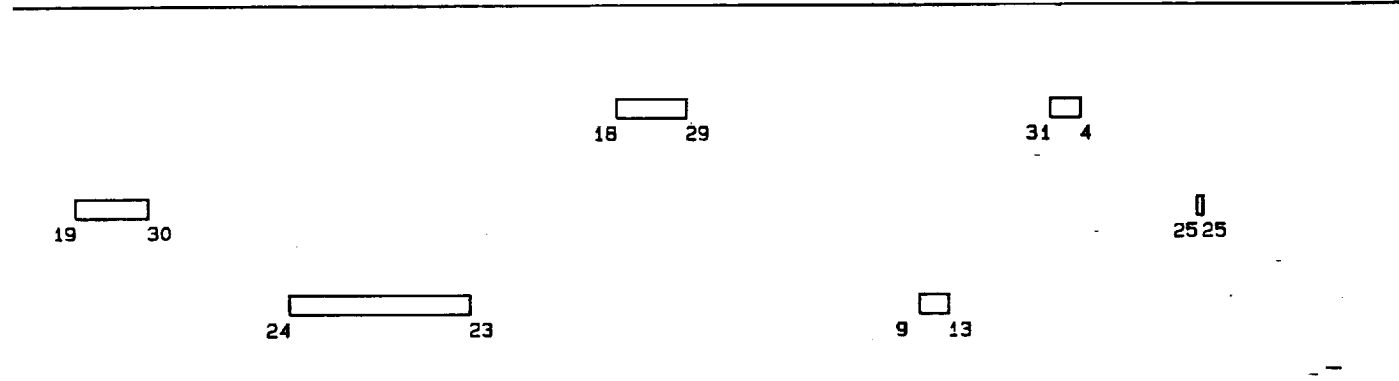
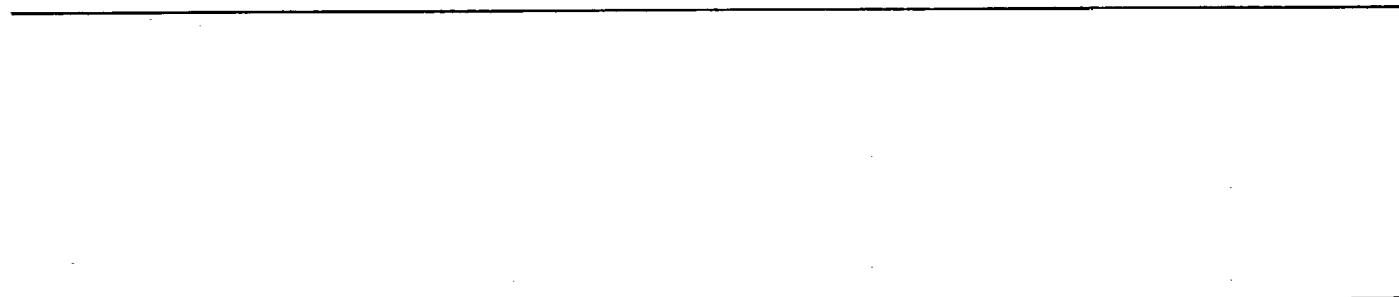
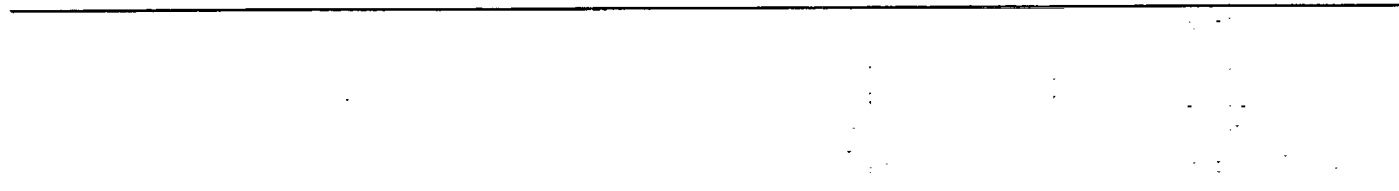
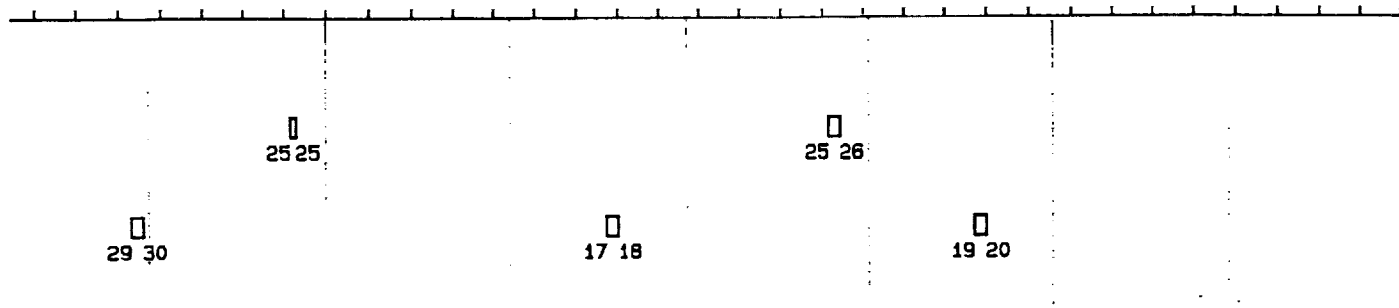
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FACILITY OPEN PERIODS

YEAR - 2006

APR MAY JUN JUL AUG SEP OCT



APR MAY JUN JUL AUG SEP OCT

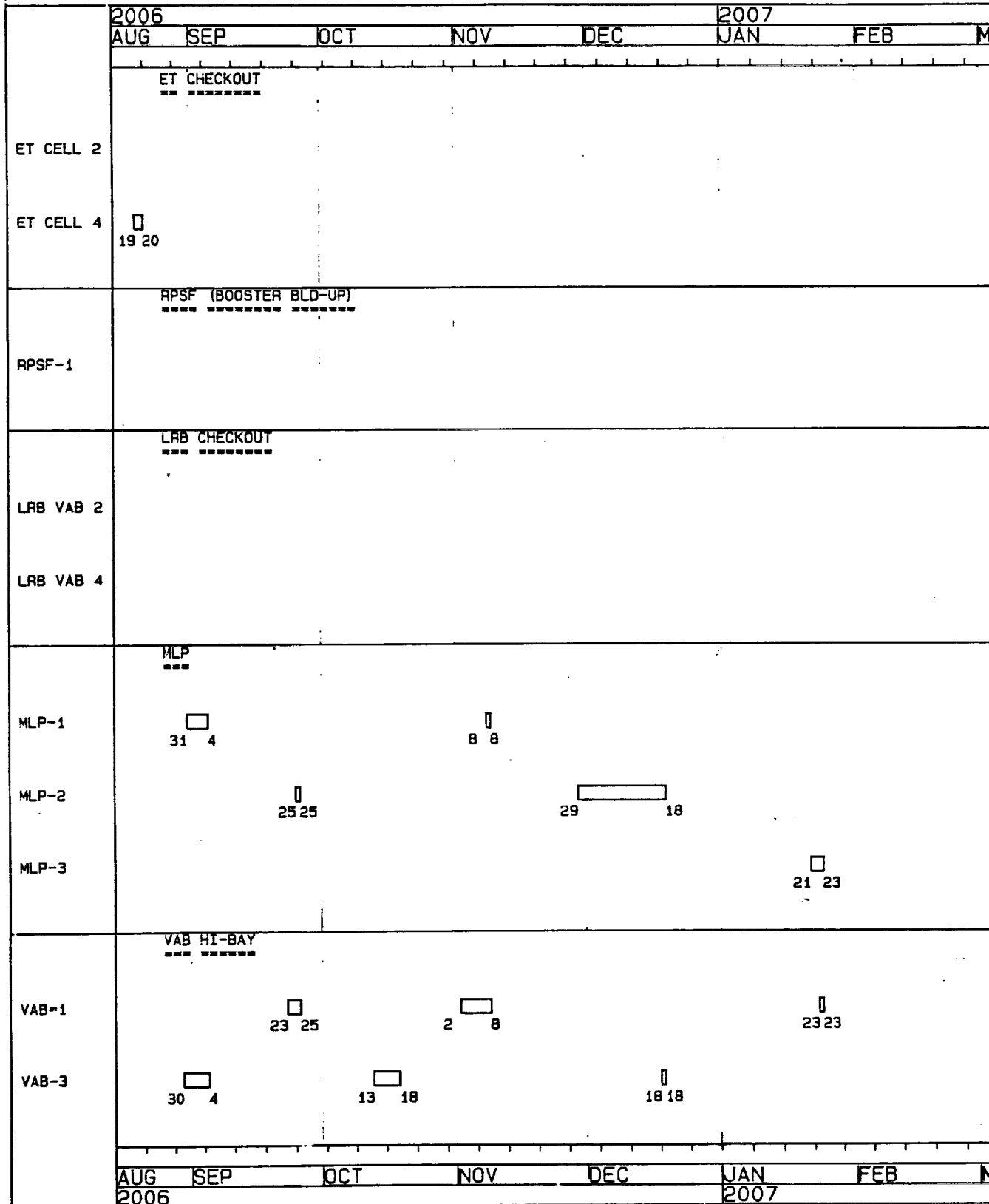
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tem 8: 54 am 31-AUG-88

Figure 2.2-15. FY2006 ET/SRB Facility Open Periods. 5-2 10/26 1:00p

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ET/SRB FACILITIES
FISCAL



PROJECT: SRB000 FROM 14-AUG-2006 UNTIL 31-OCT-2007

LSOC - KSC PROJECT SUPPORT
FOR INFORMATION CONTACT: LSOC J. ZARTMAN 867-6693
FILE: SRB2007 - ID: 121 DATED: 9:06 AM 31-AUG-88

ASSESSMENT BASED ON PRELIM
LRB STUDY - SRB BASELINE
FLIGHT ASSIGNMENT MANIPULATION
FOR SPC PLANNING PURPOSES

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FY OPEN PERIODS							
YEAR - 2007							
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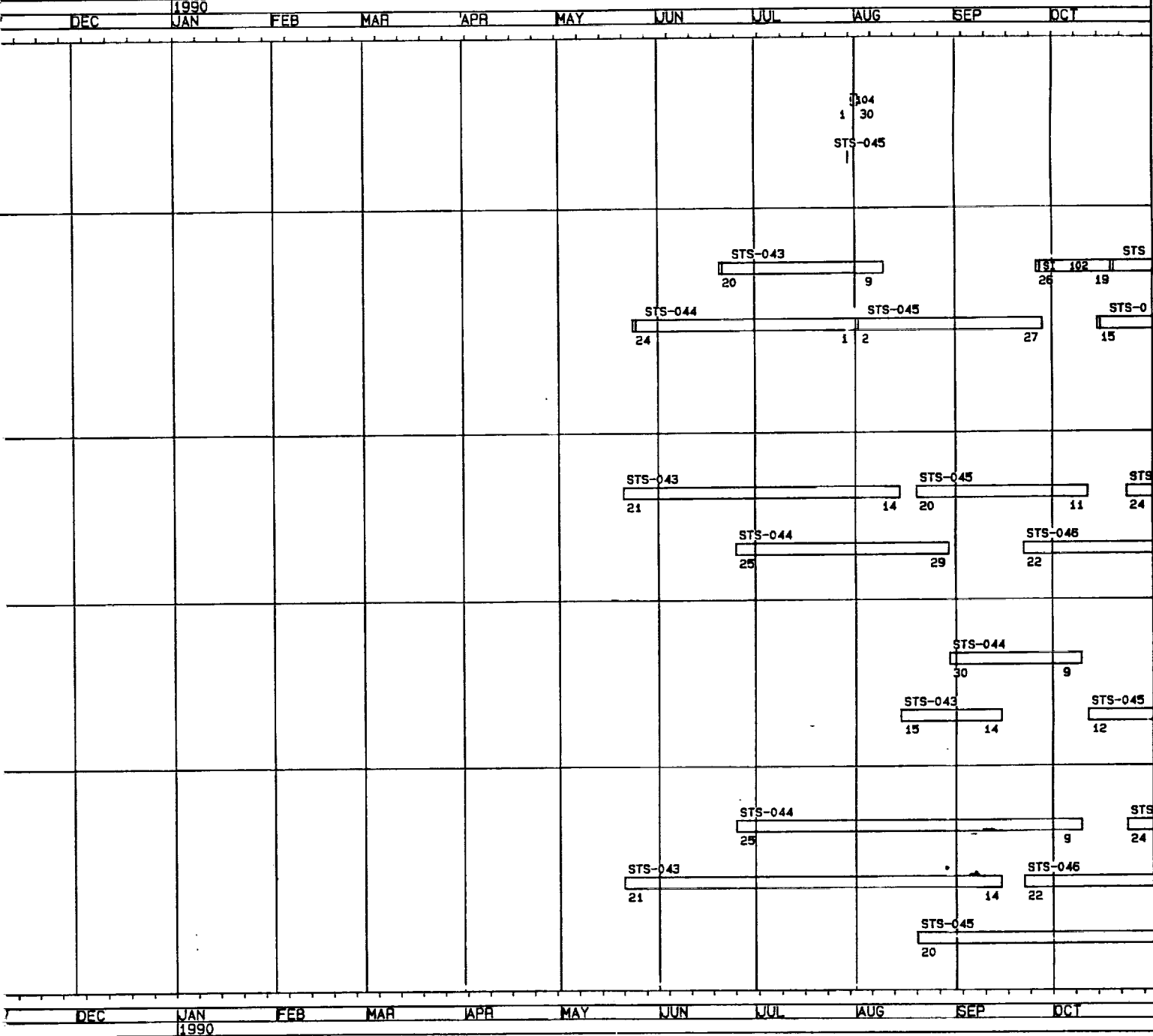
Figure 2.2-16. FY2007 ET/SRB Facility Open Periods. 5-2 10/26 1:00p

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	SEP	OCT	NOV
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OPF-2			
OPF-3			
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VAB-3			
PAD-A	PAD ----		
PAD-B			
NLP-1	NLP ----		
NLP-2			
NLP-3			
	SEP	OCT	NOV
	1989		
PROJECT: SRB000 - FROM			
LSOC - KSC PROJECT SUPPORT			
FOR INFORMATION CONTACT: SDC J. BOLAND 867-			
FILE: SRB1990 - III J21 DATED: 11: 48 pm 31			
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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 1990

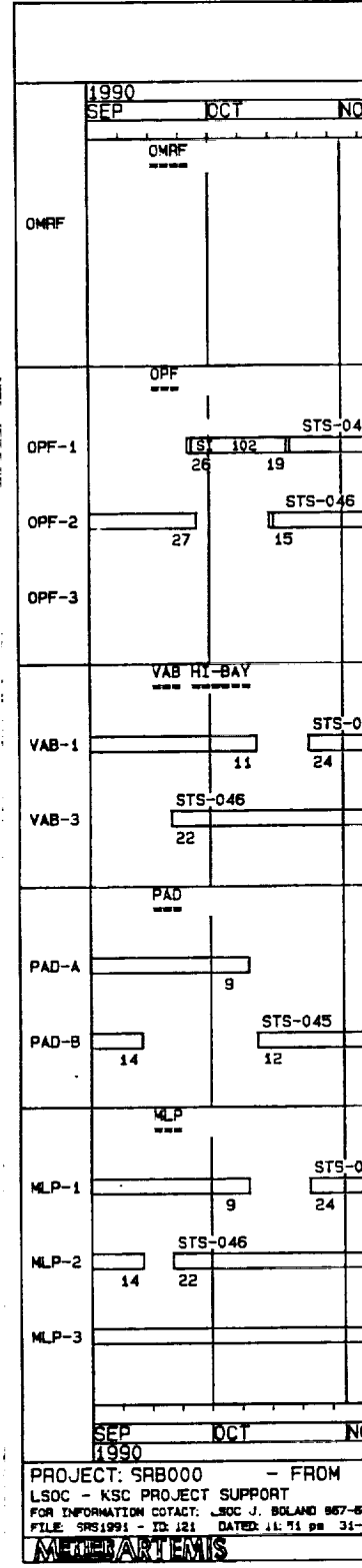


1990
-SEP-89 UNTIL 31-OCT-90

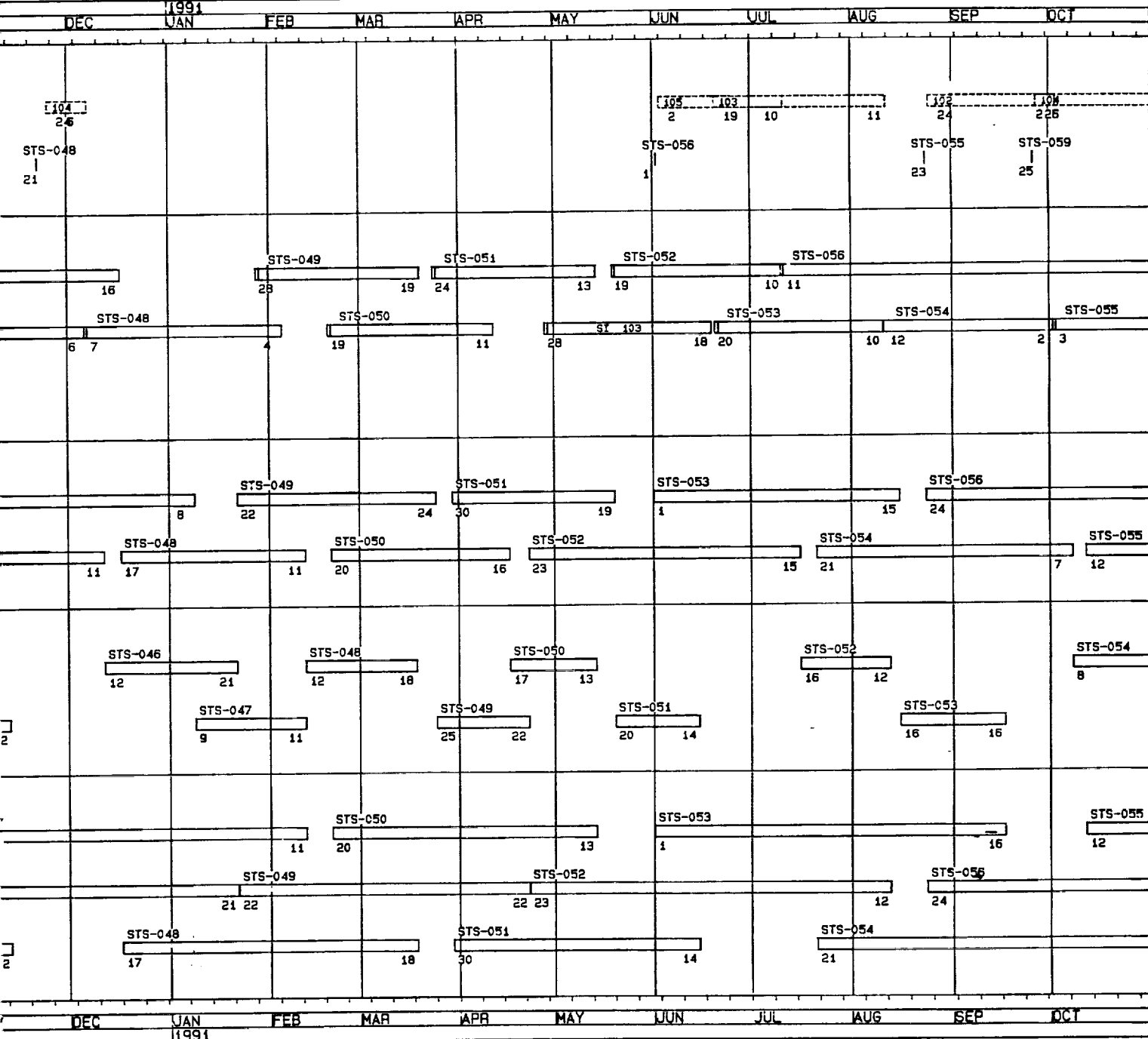
ASSESSMENT BASED ON PRELIMINARY
LBD STUDY - SRS BASELINE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

Figure 2.3-1 FY1990 Orbiter/SSV Facility Utilization

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ORBITER/SSV FACILITY UTILIZATION
FISCAL YEAR - 1991



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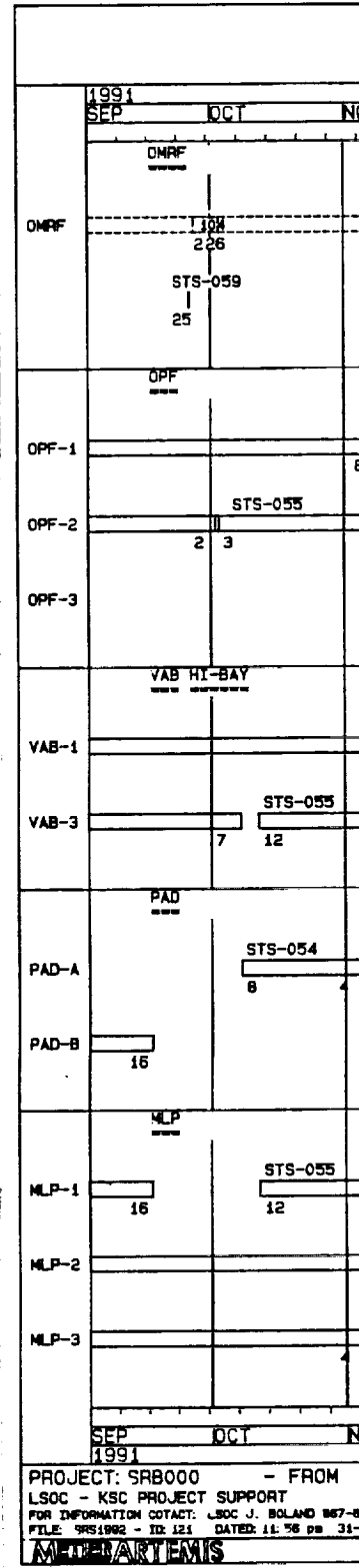
-SEP-90 UNTIL 31-OCT-91

ASSESSMENT BASED ON PRELIMINARY
LPS STUDY - SPS BASELINE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

Barchart Drawing System 11:51 pm 31-AUG-88 Page 2 of 18

Figure 2.3-2 FY1991 Orbiter/SSV Facility Utilization

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ORBITER/SSV FACILITY UTILIZATION
FISCAL YEAR - 1992

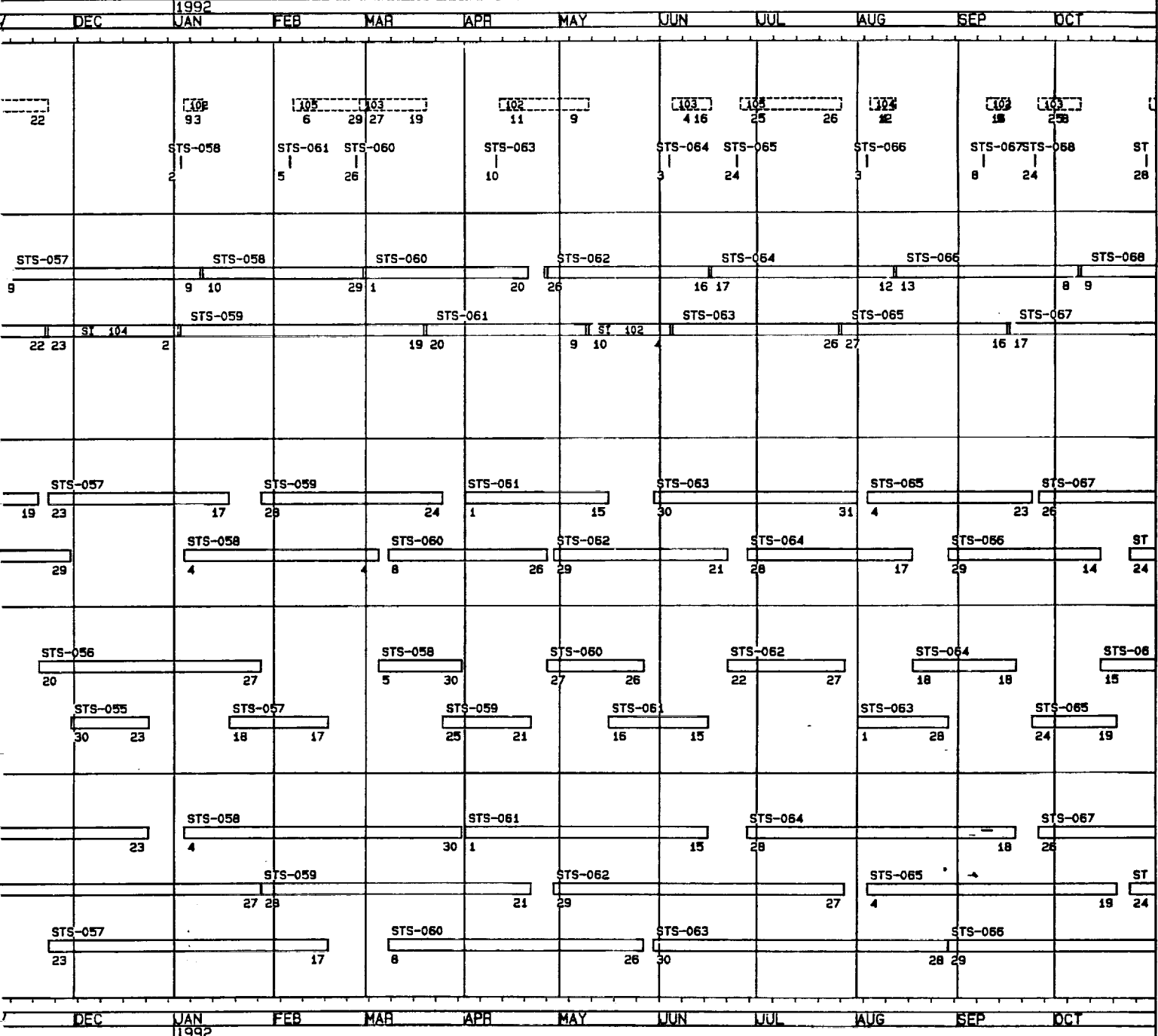
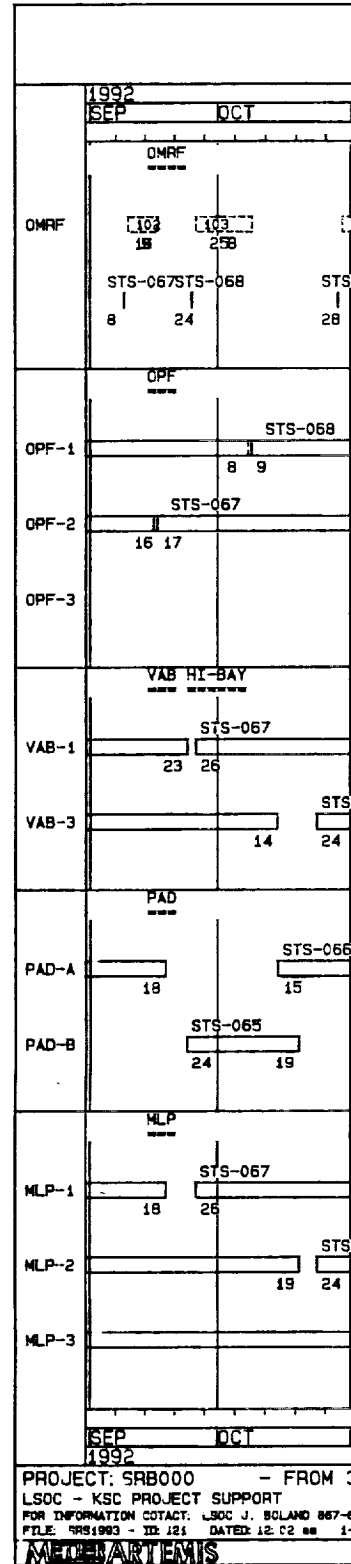


Figure 2.3-3 FY1992 Orbiter/SSV Facility Utilization

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ORBITER/SSV FACILITY UTILIZATION FISCAL YEAR - 1993

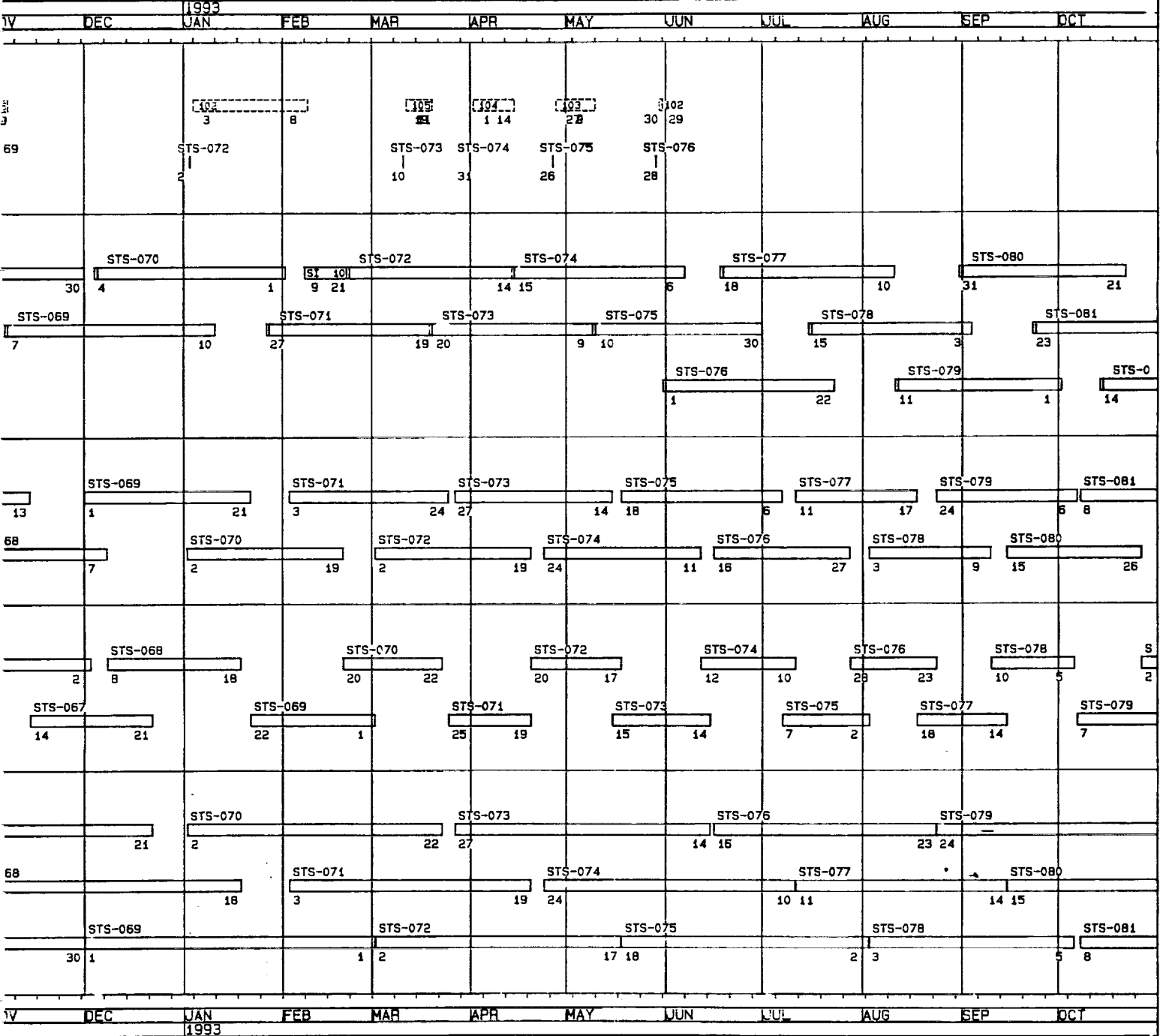
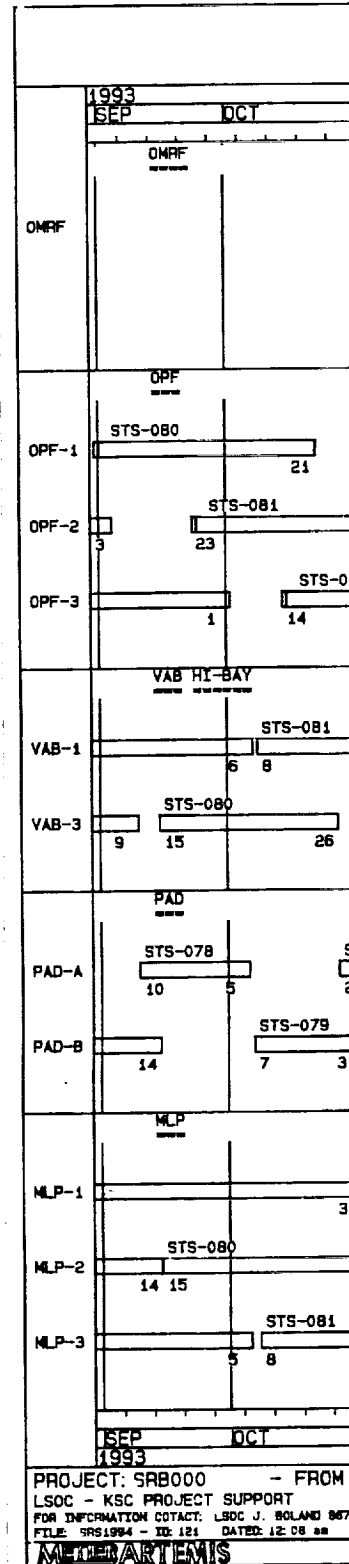


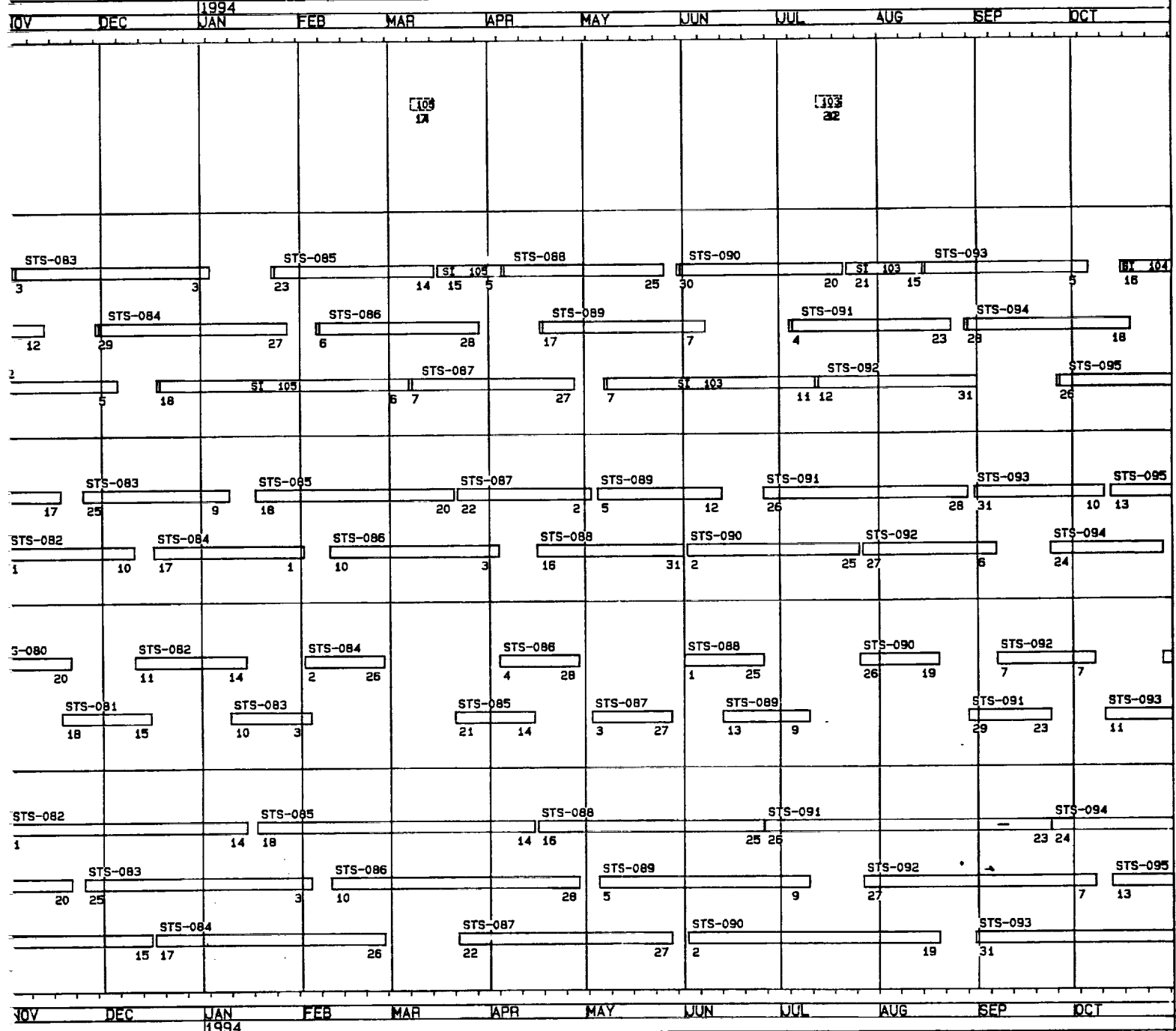
Figure 2.3-4 FY1993 Orbiter/SSV Facility Utilization

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ORBITER/SSV FACILITY UTILIZATION
FISCAL YEAR - 1994



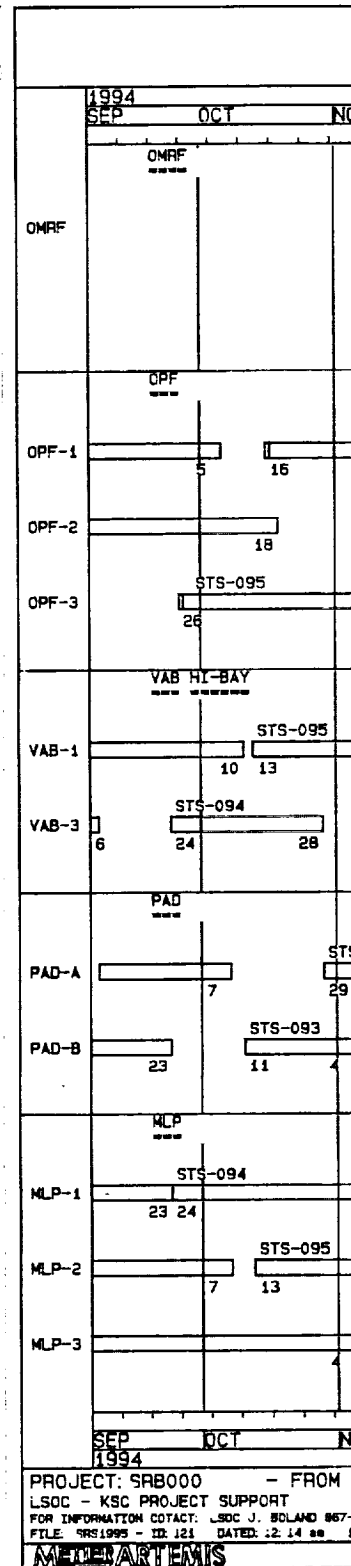
0-AUG-93 UNTIL 31-OCT-94

ASSESSMENT BASED ON PRELIMINARY
LMS STUDY - SRS BASELINE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

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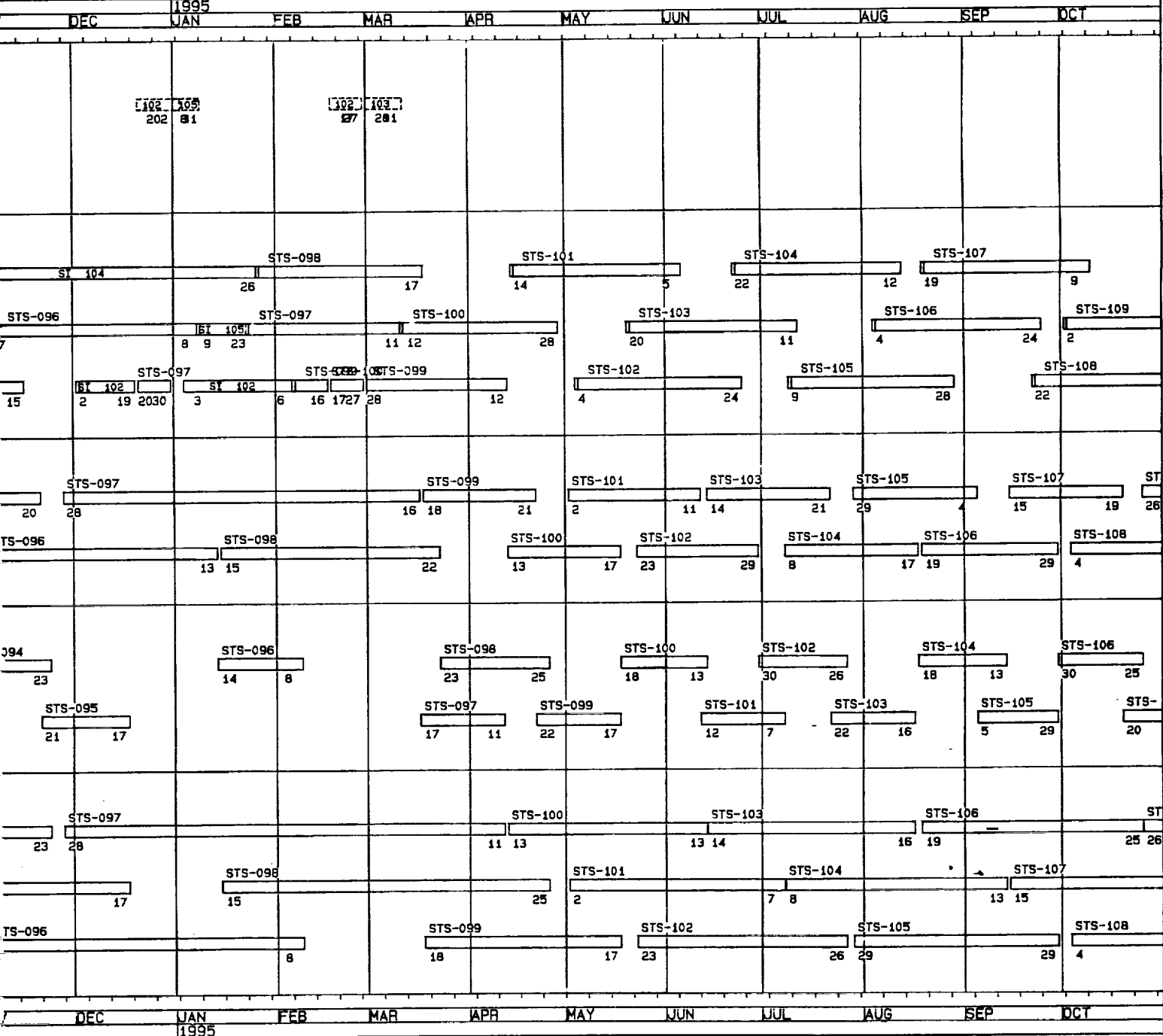
Figure 2.3-5 FY1994 Orbiter/SSV Facility Utilization

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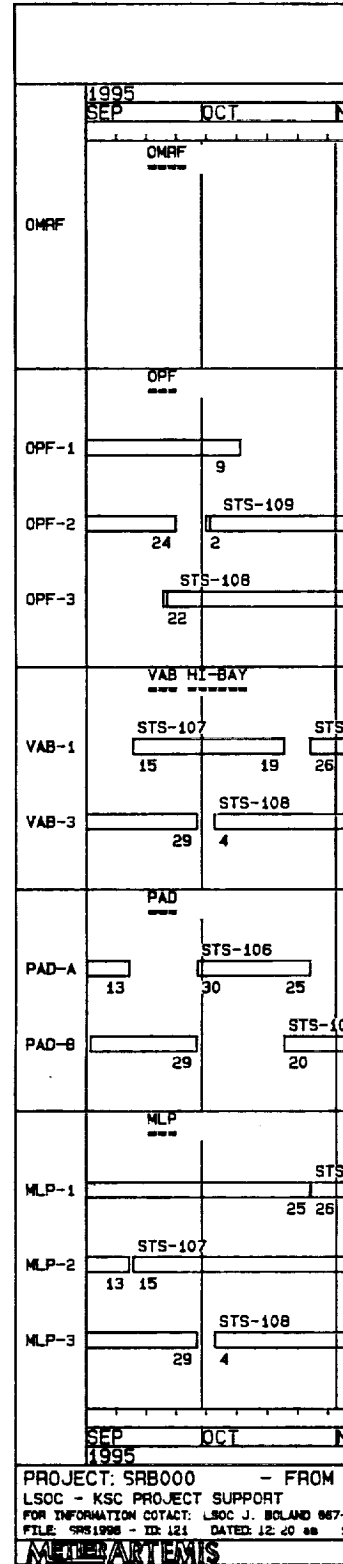
ORBITER/SSV FACILITY UTILIZATION
FISCAL YEAR - 1995



SEP-94 UNTIL 31-OCT-95
 ASSESSMENT BASED ON PRELIMINARY
 LRB STUDY - SRR BASELINE
 FLIGHT ASSIGNMENT MANIFEST
 FOR SPC PLANNING PURPOSES ONLY
 Barchart Drawing System 12:14 am 1-SEP-88 Page 6 of 18

Figure 2.3-6 FY1995 Orbiter/SSV Facility Utilization

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PROJECT: SRB000 - FROM
 LSOC - KSC PROJECT SUPPORT
 FOR INFORMATION CONTACT: LSOC J. BOLAND 887-
 FILE: SRB1995 - ID: 121 DATE: 12-20-95
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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 1996

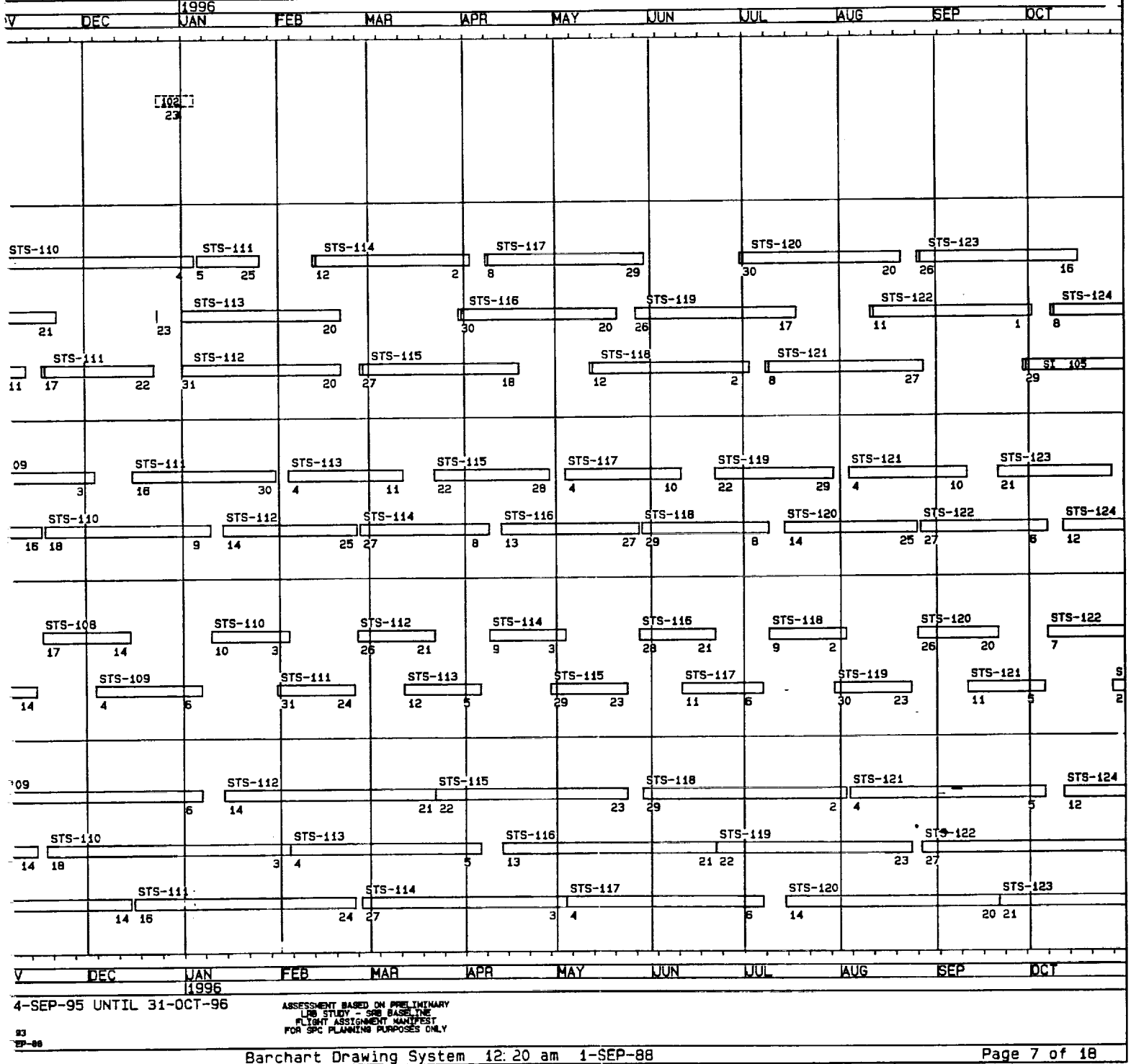
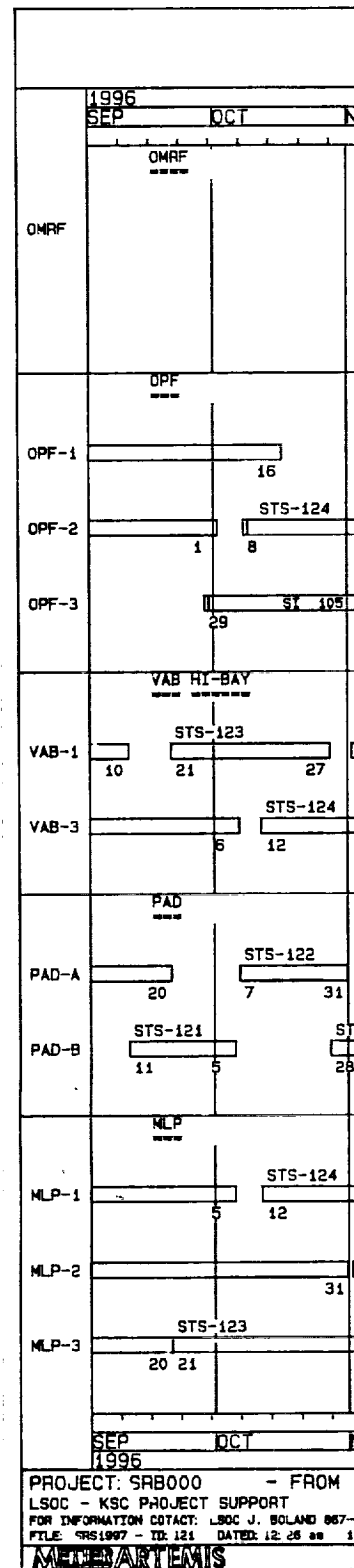


Figure 2.3-7 FY1996 Orbiter/SSV Facility Utilization

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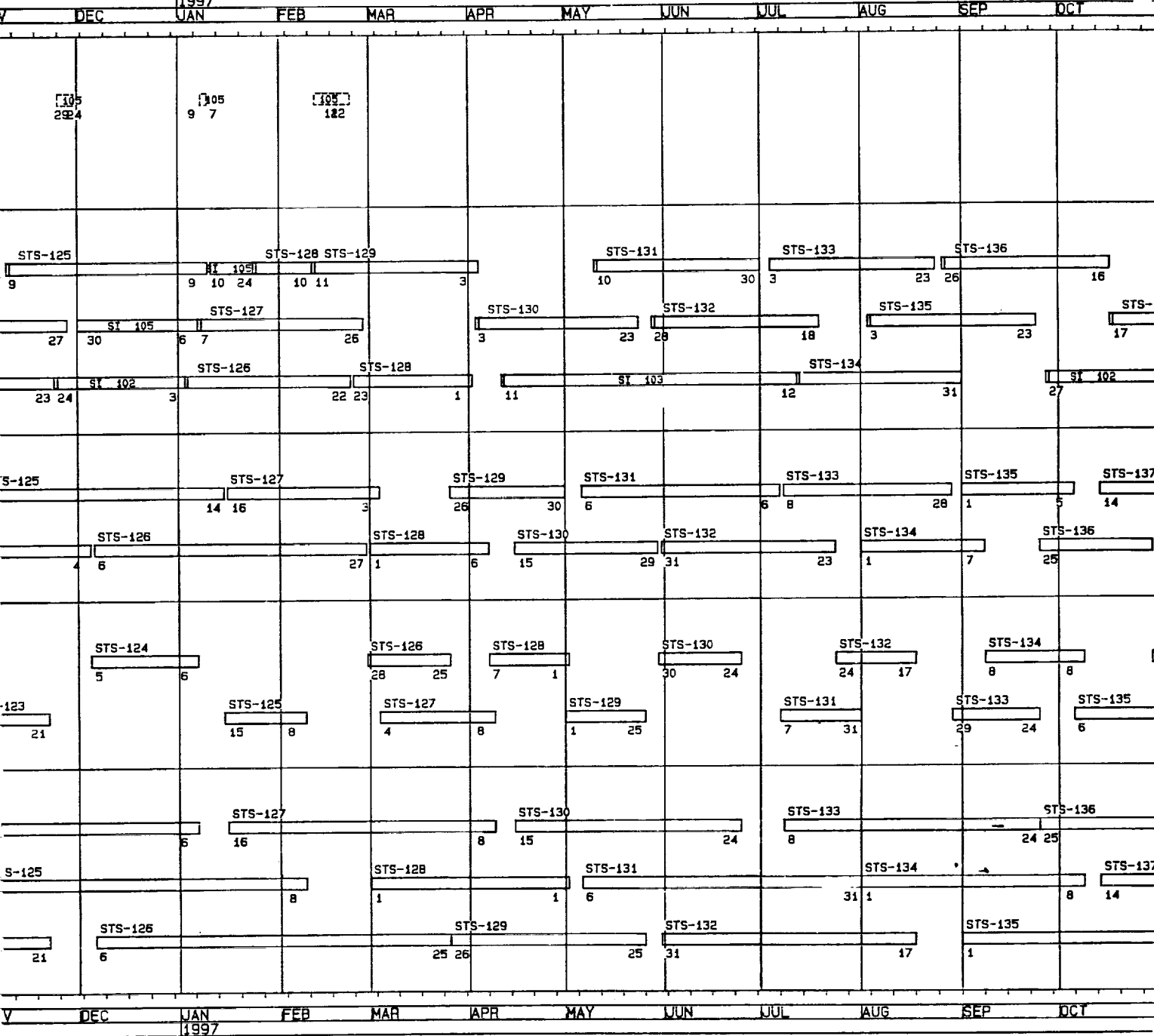


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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 1997

1997



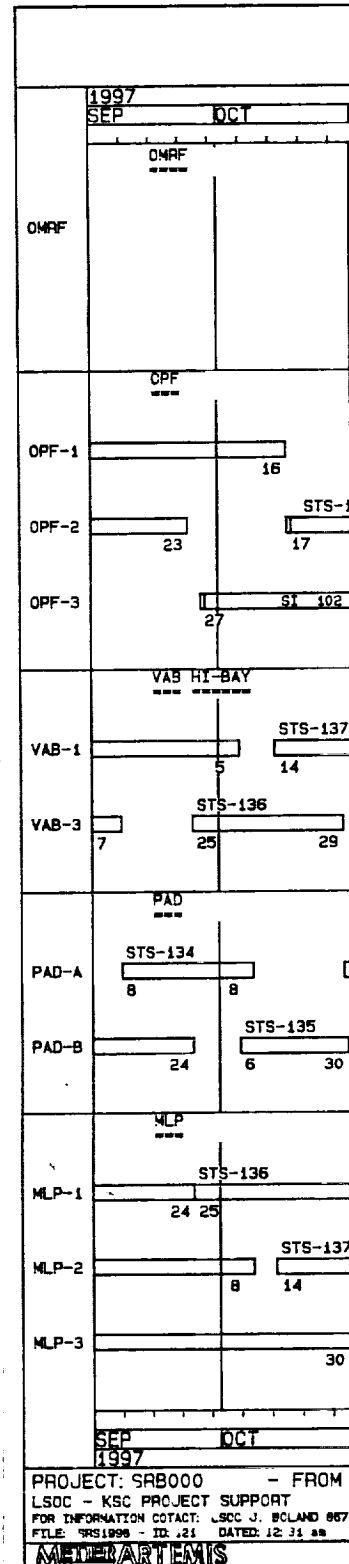
SEP-96 UNTIL 31-OCT-97

ASSESSMENT BASED ON PRELIMINARY
LUB STUDY - SRB BASELINE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

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Figure 2.3-8 FY1997 Orbiter/SSV Facility Utilization

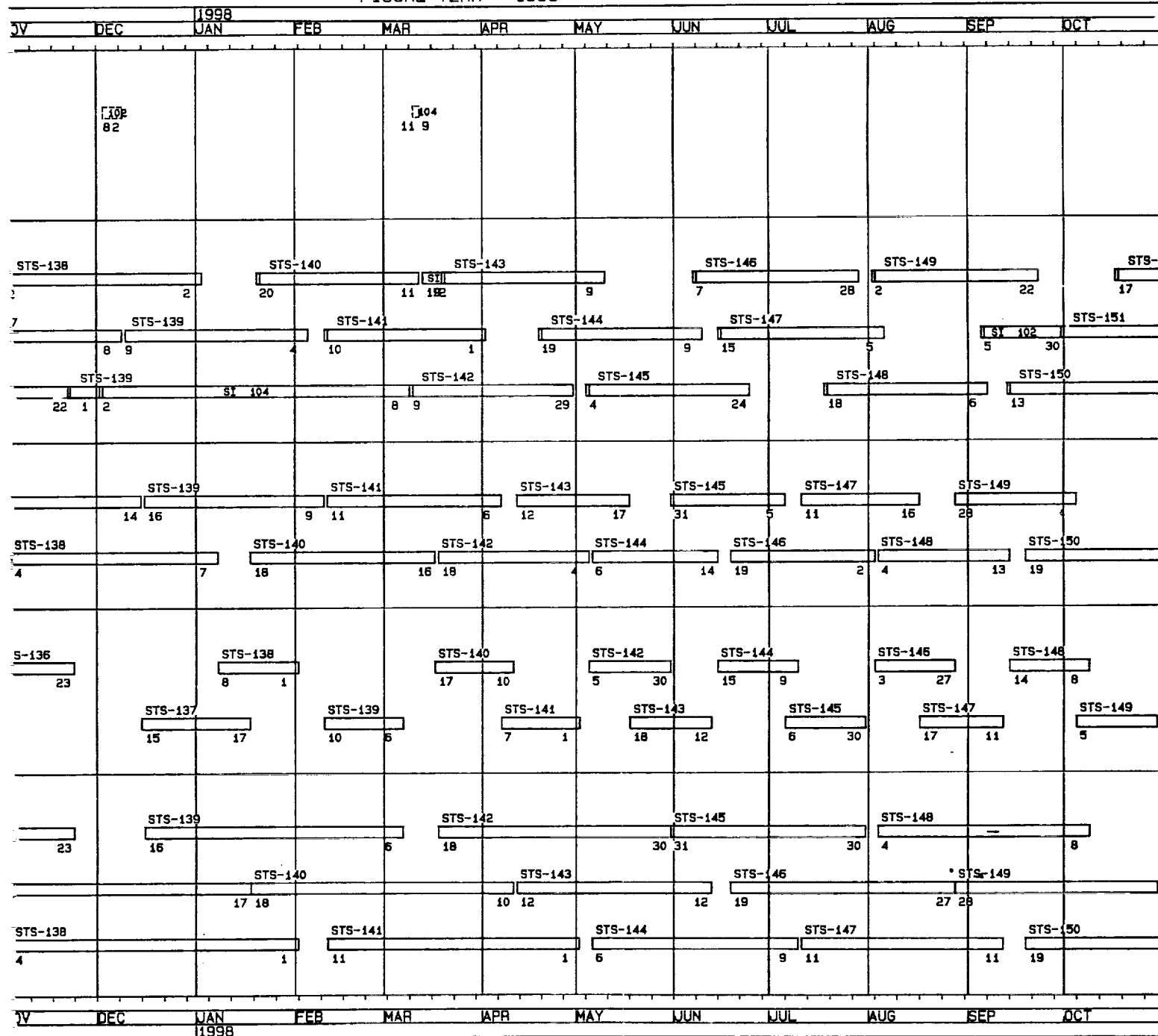
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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 1998



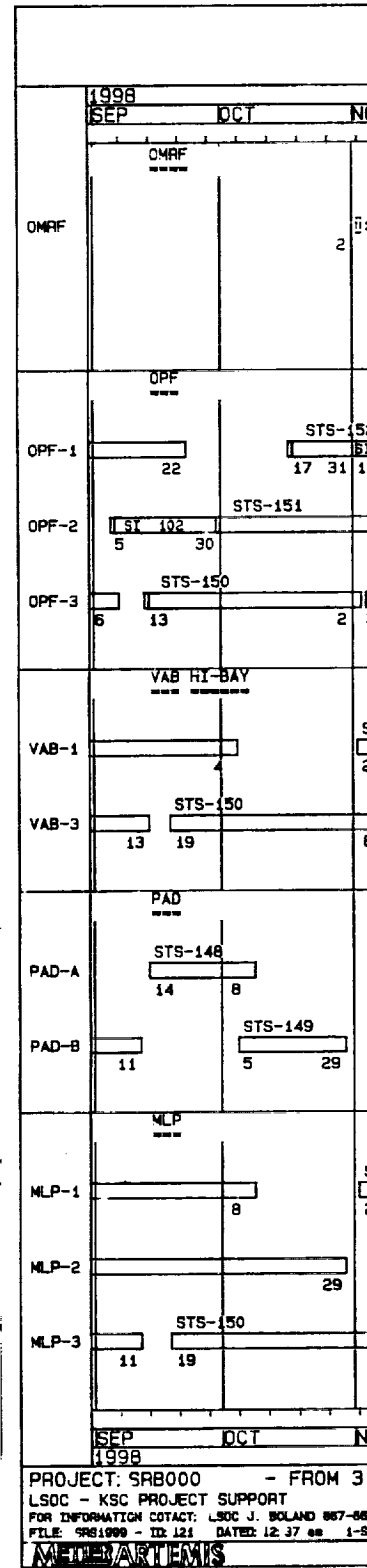
3-SEP-97 UNTIL 31-OCT-98

ASSESSMENT BASED ON PRELIMINARY
LIFE STUDY - SRS BASELINE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

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Figure 2.3-9 FY1998 Orbiter/SSV Facility Utilization

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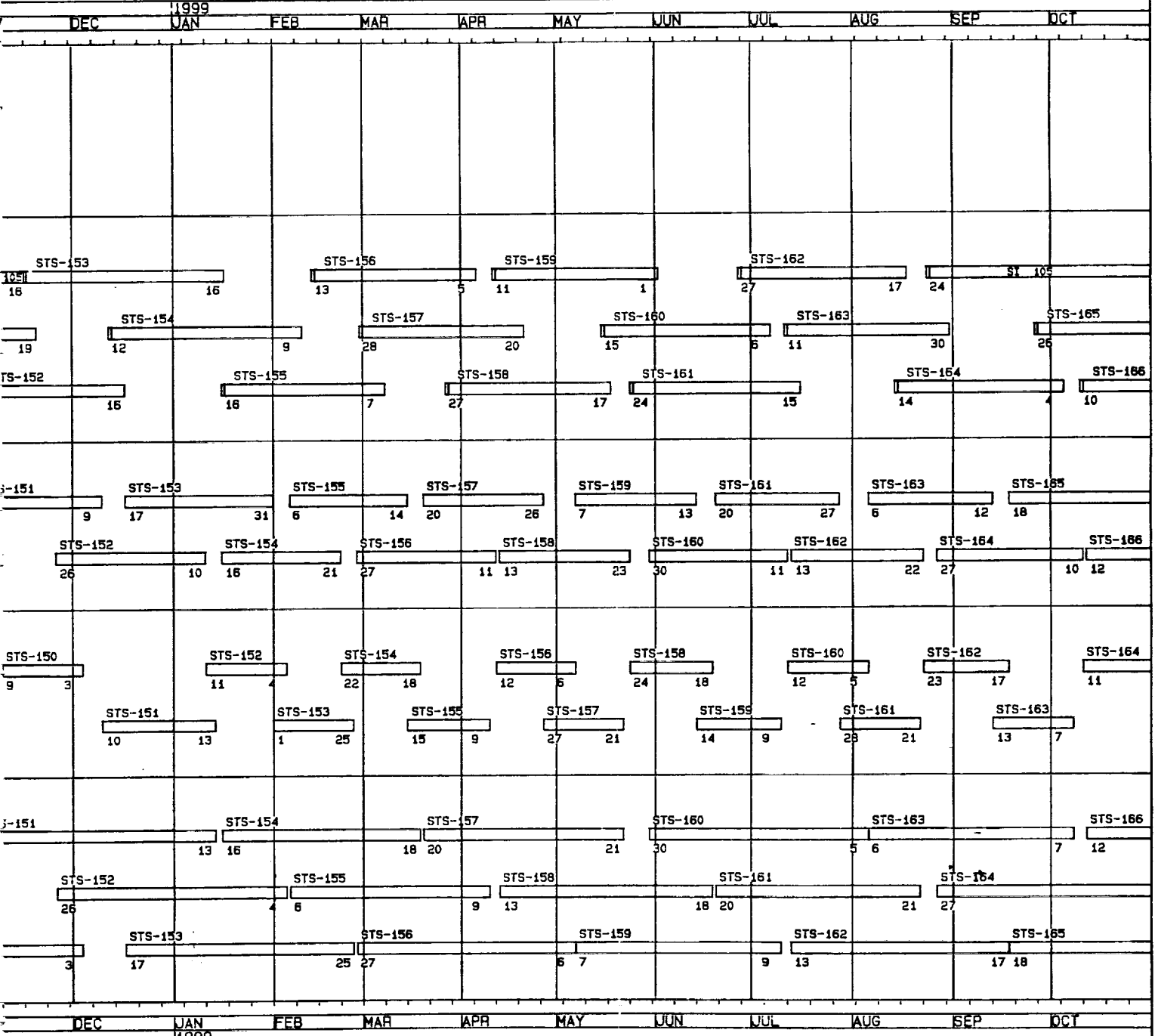


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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 1999



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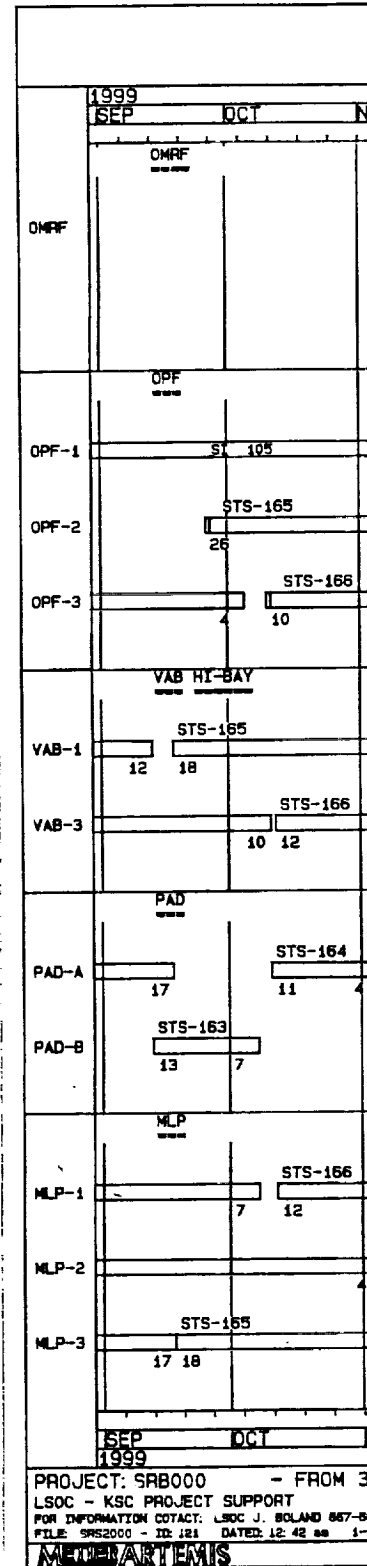
AUG-98 UNTIL 31-OCT-99

ASSESSMENT BASED ON PRELIMINARY
LRF STUDY - SRB BASELINE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

Barchart Drawing System 12:37 am 1-SEP-88 Page 10 of 18

Figure 2.3-10 FY1999 Orbiter/SSV Facility Utilization

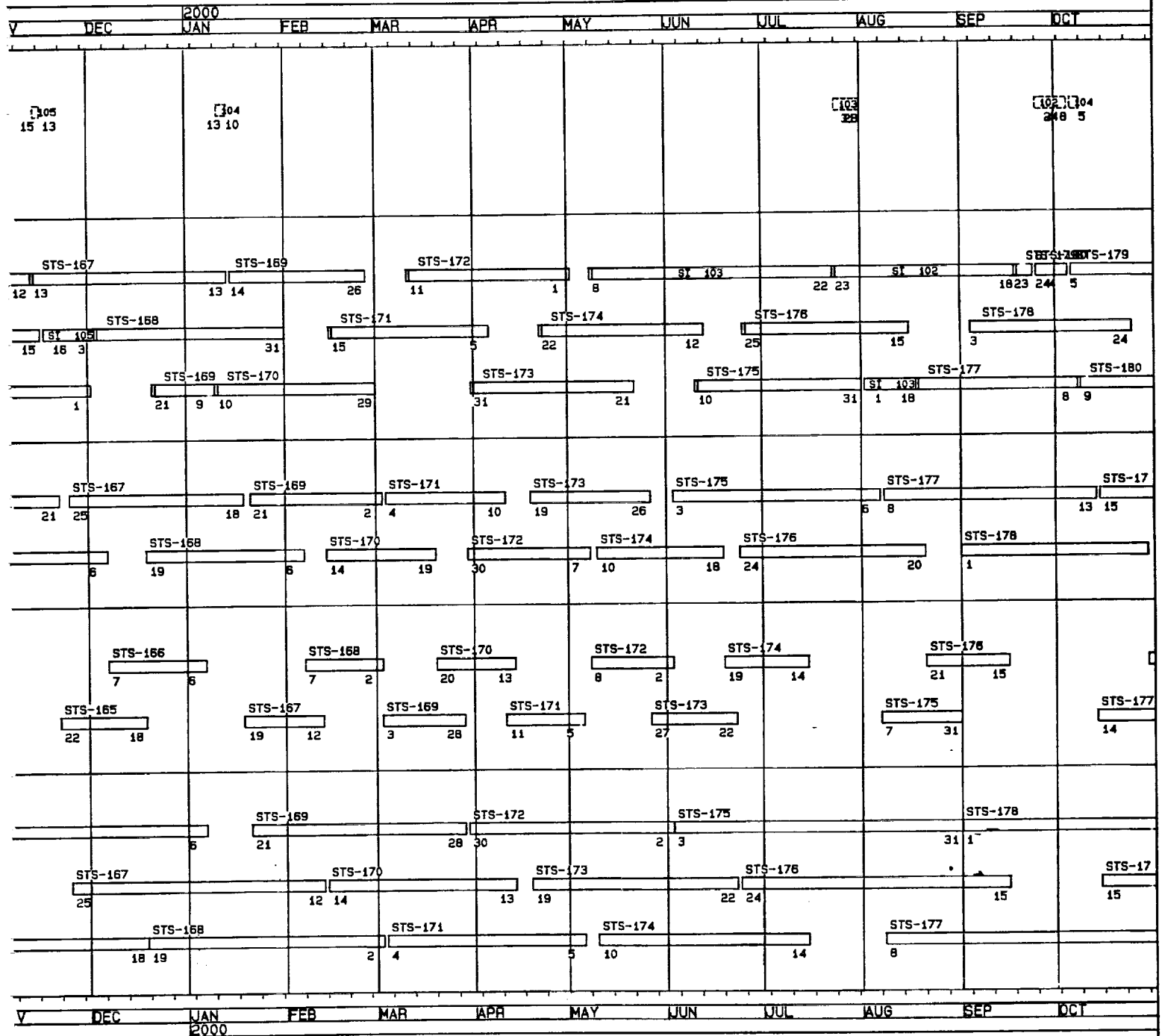
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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 2000



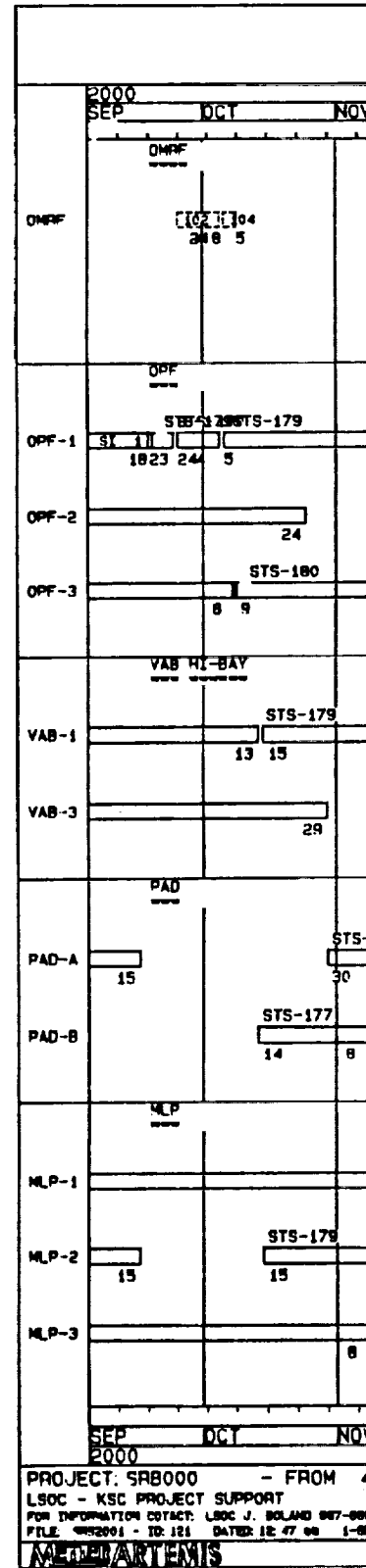
-AUG-99 UNTIL 31-OCT-2000

ASSESSMENT BASED ON PRELIMINARY
LRF STUDY - SRS BASELINE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

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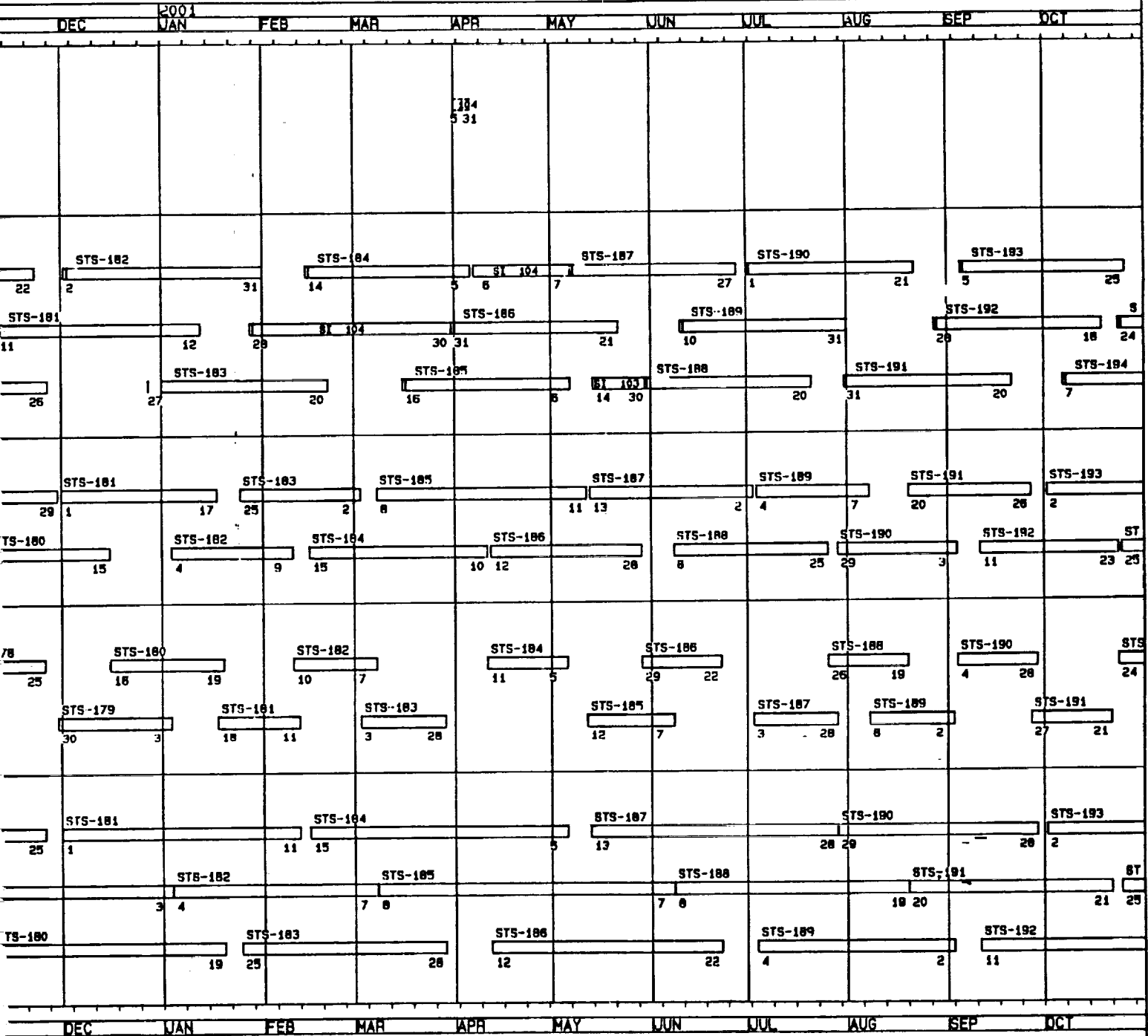
Figure 2.3-11 FY2000 Orbiter/SSV Facility Utilization

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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 2001

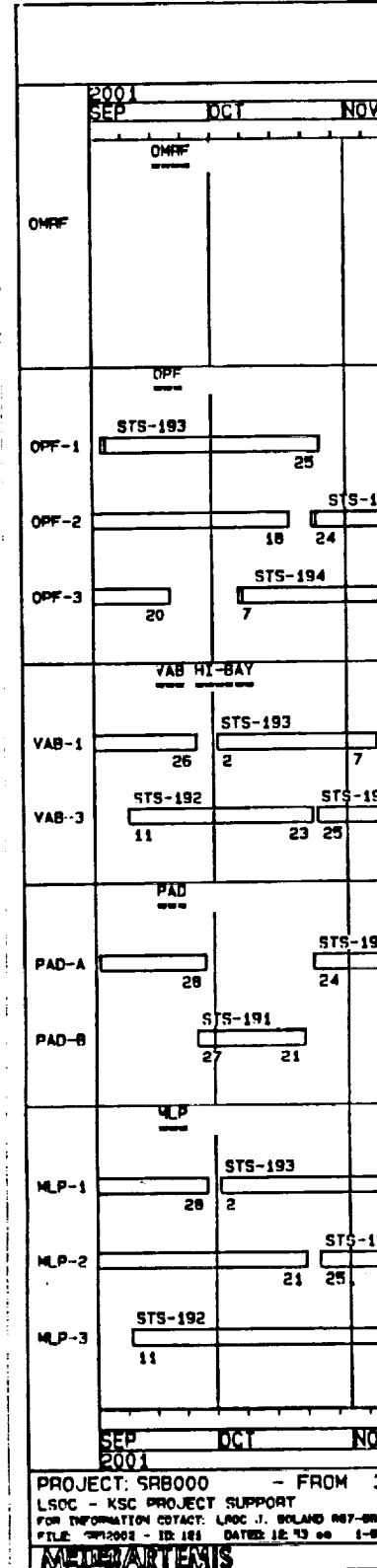


SEP-2000 UNTIL 31-OCT-2001

ASSESSMENT BASED ON PRELIMINARY
LIFE STUDY - USE BASED THE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

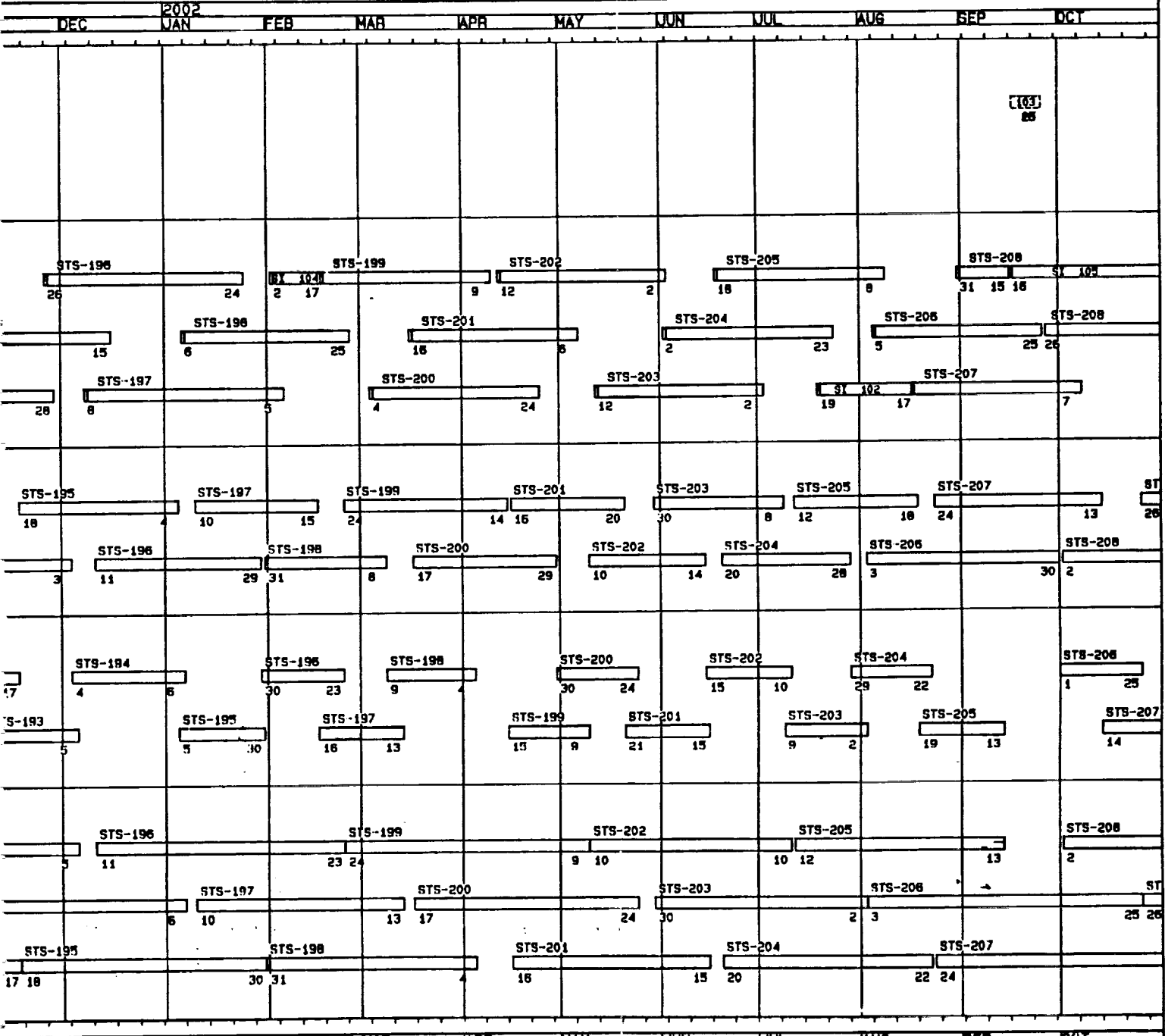
Figure 2.3-12 FY2001 Orbiter/SSV Facility Utilization

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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 2002



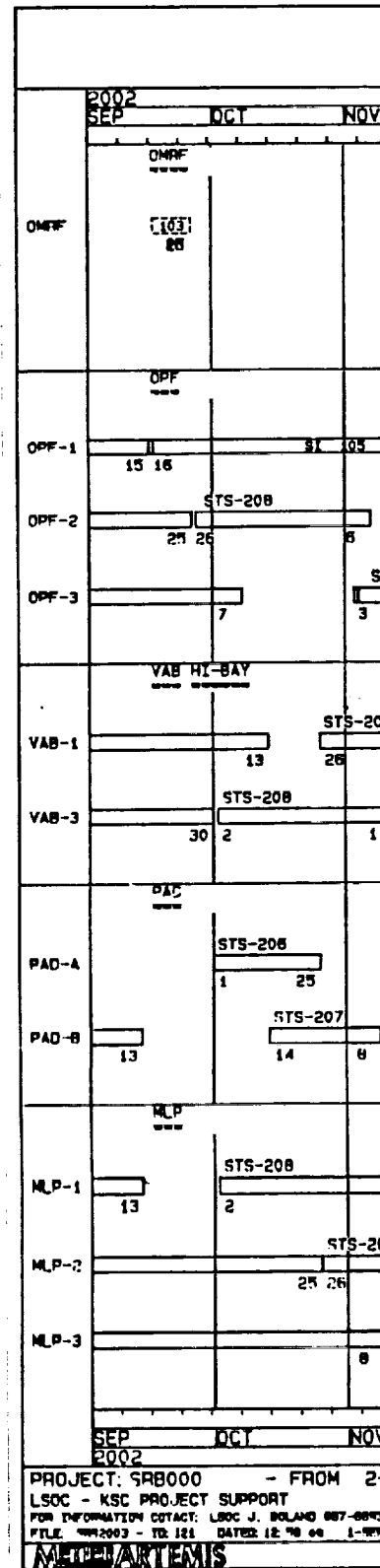
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SEP-2001 UNTIL 31-OCT-2002

AGREEMENT BASED ON PRELIMINARY
LMA STUDY - SEE BASELINE
FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

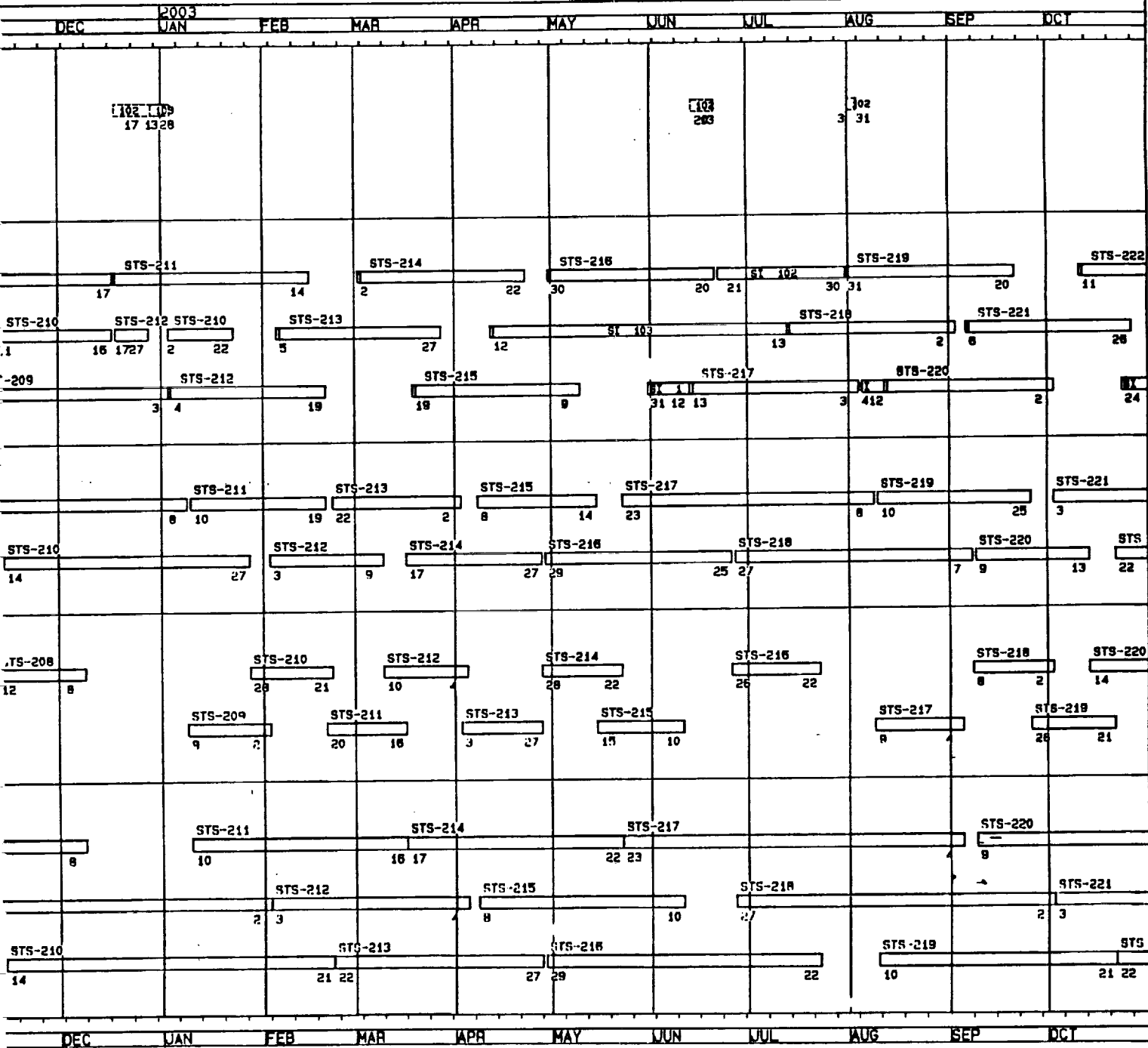
Figure 2.3-13 FY2002 Orbiter/SSV Facility Utilization

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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 2003

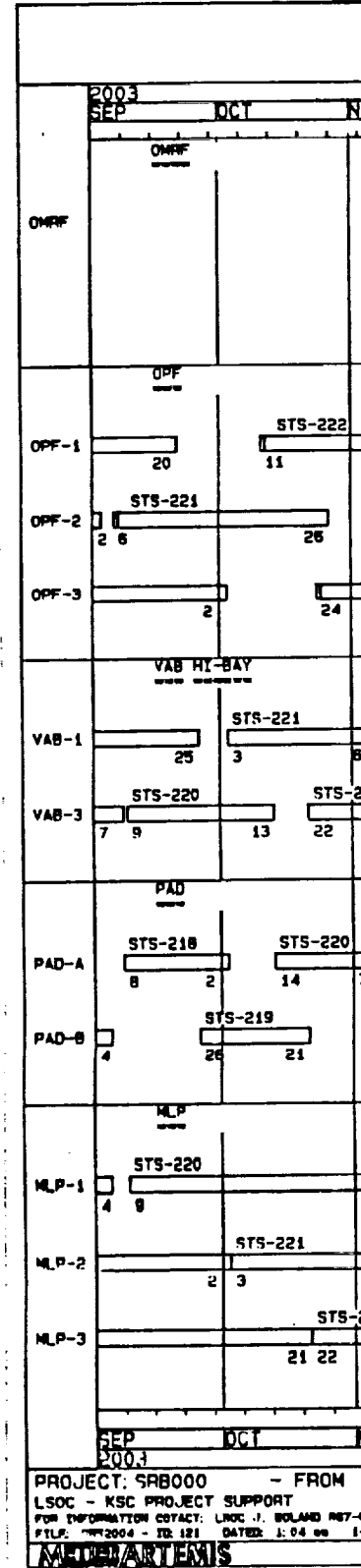


SEP-2002 UNTIL 31-OCT-2003

ASSIGNMENT BASED ON PRELIMINARY
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FLIGHT ASSIGNMENT MANIFEST
FOR SPC PLANNING PURPOSES ONLY

Figure 2.3-14 FY2003 Orbiter/SSV Facility Utilization

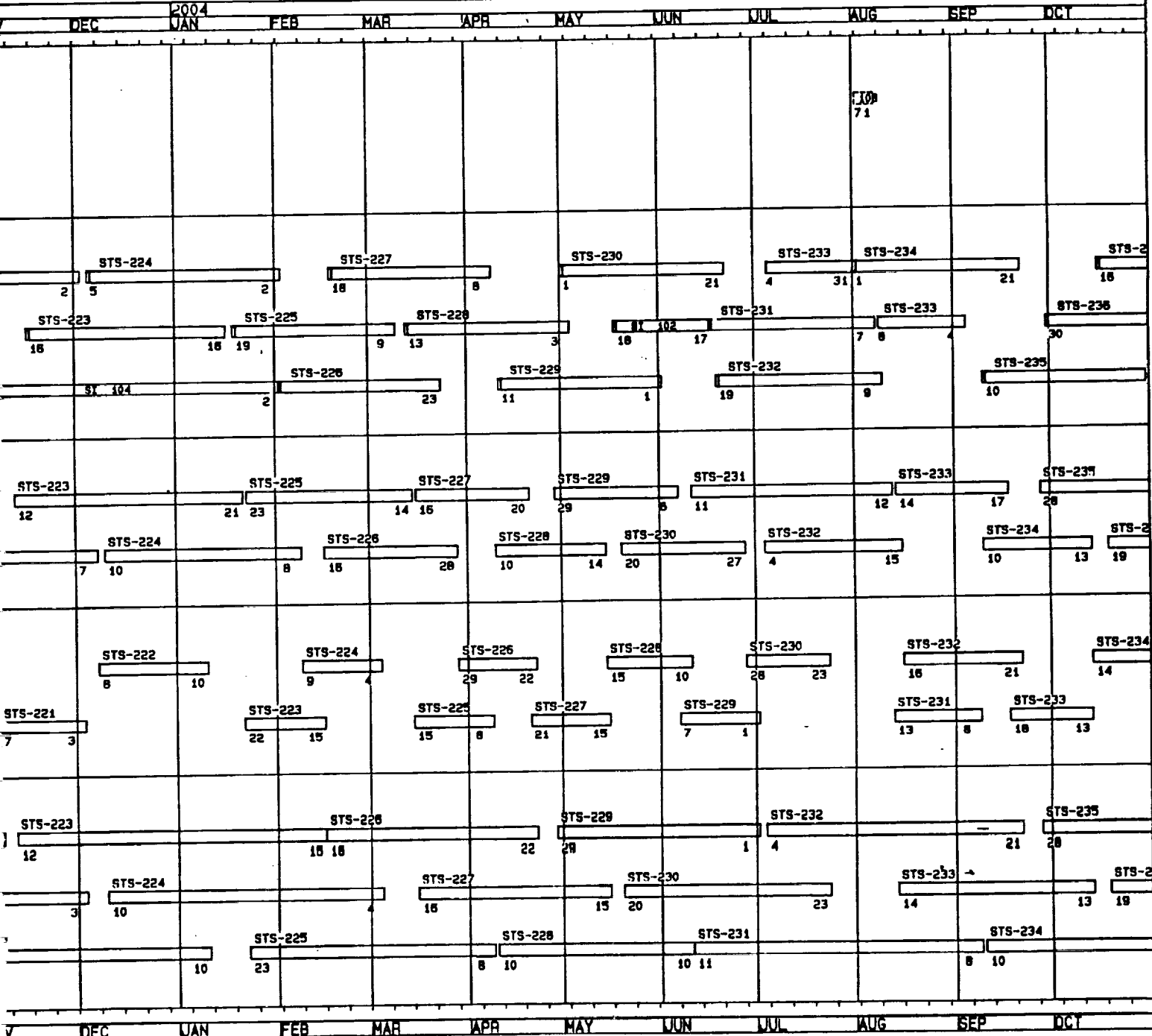
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ORBITER/SSV FACILITY UTILIZATION

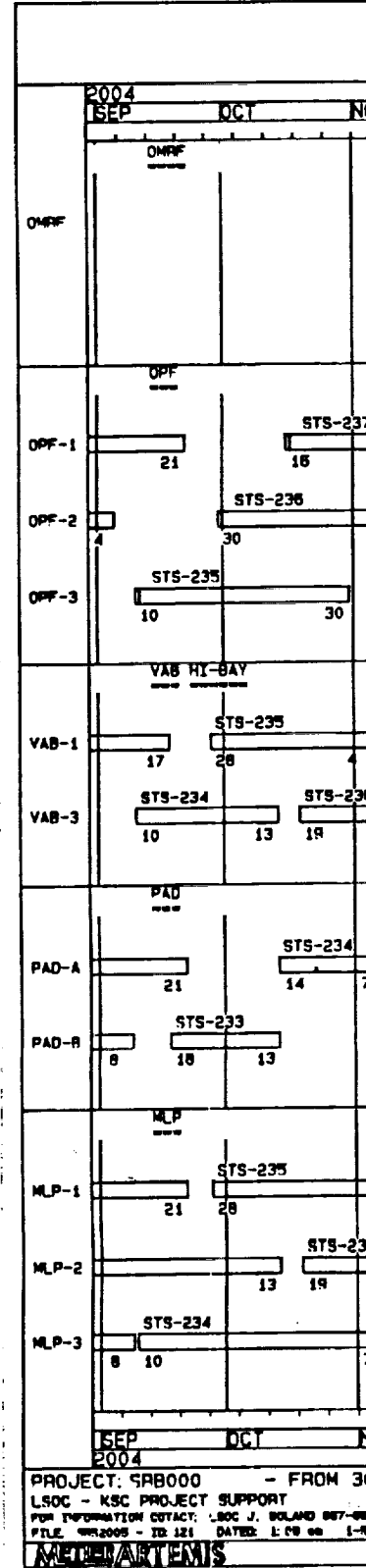
FISCAL YEAR - 2004



SEP-2003 UNTIL 31-OCT-2004
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 FLIGHT ASSIGNMENT MANIFEST
 FOR SPC PLANNING PURPOSES ONLY
 Barchart Drawing System 1:04 am 1-SEP-88 Page 15 of 18

Figure 2.3-15 FY2004 Orbiter/SSV Facility Utilization

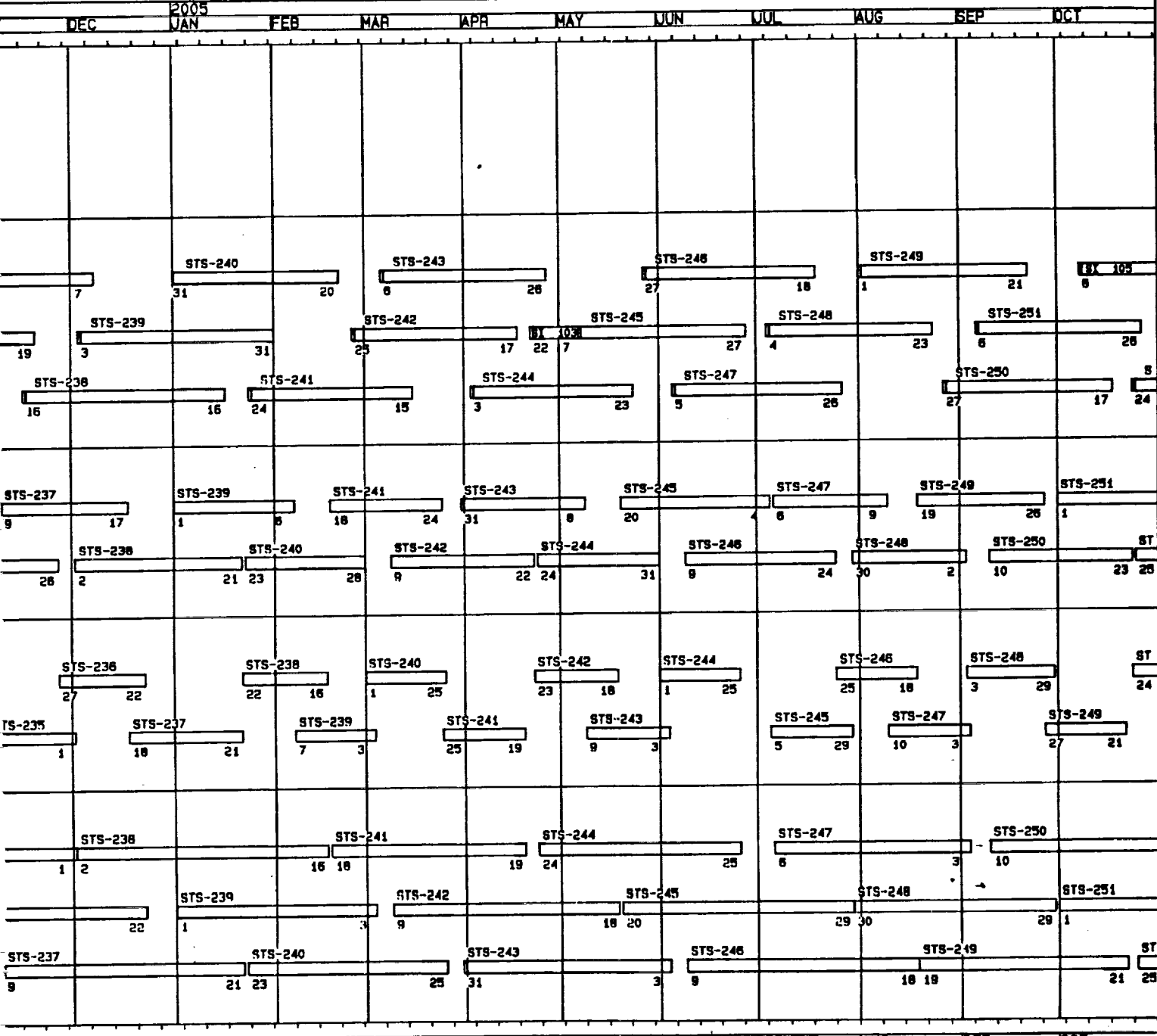
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ORBITER/SSV FACILITY UTILIZATION

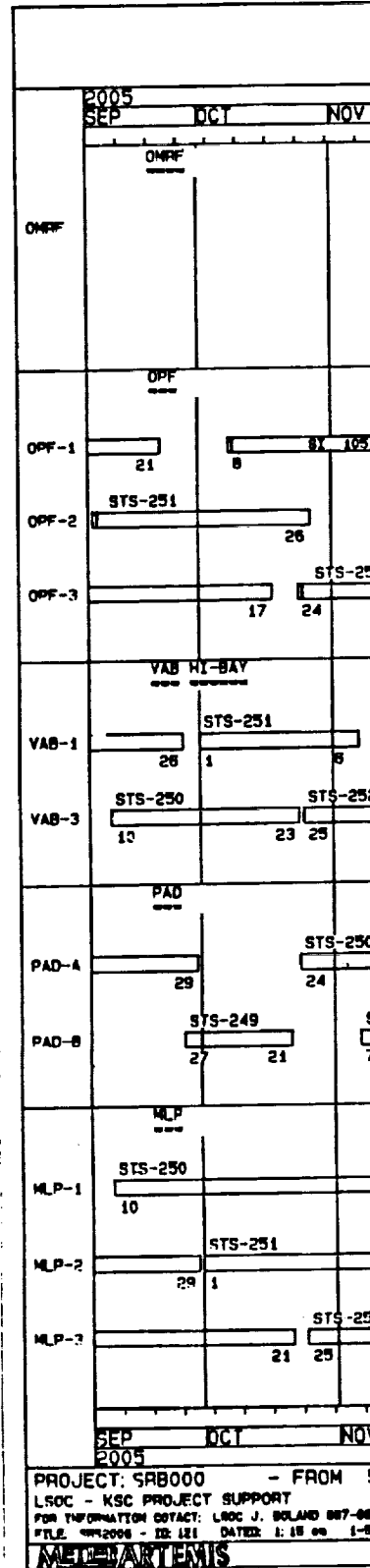
FISCAL YEAR - 2005



AUG-2004 UNTIL 31-OCT-2005
 2005
 ASSIGNMENT BASED ON PRELIMINARY
 LEO STUDY - THIS BASELINE
 FLIGHT ASSIGNMENT MANIFEST
 FOR SPC PLANNING PURPOSES ONLY
 Barchart Drawing System 1:09 am 1-SEP-88 Page 16 of 18

Figure 2.3-16 FY2005 Orbiter/SSV Facility Utilization

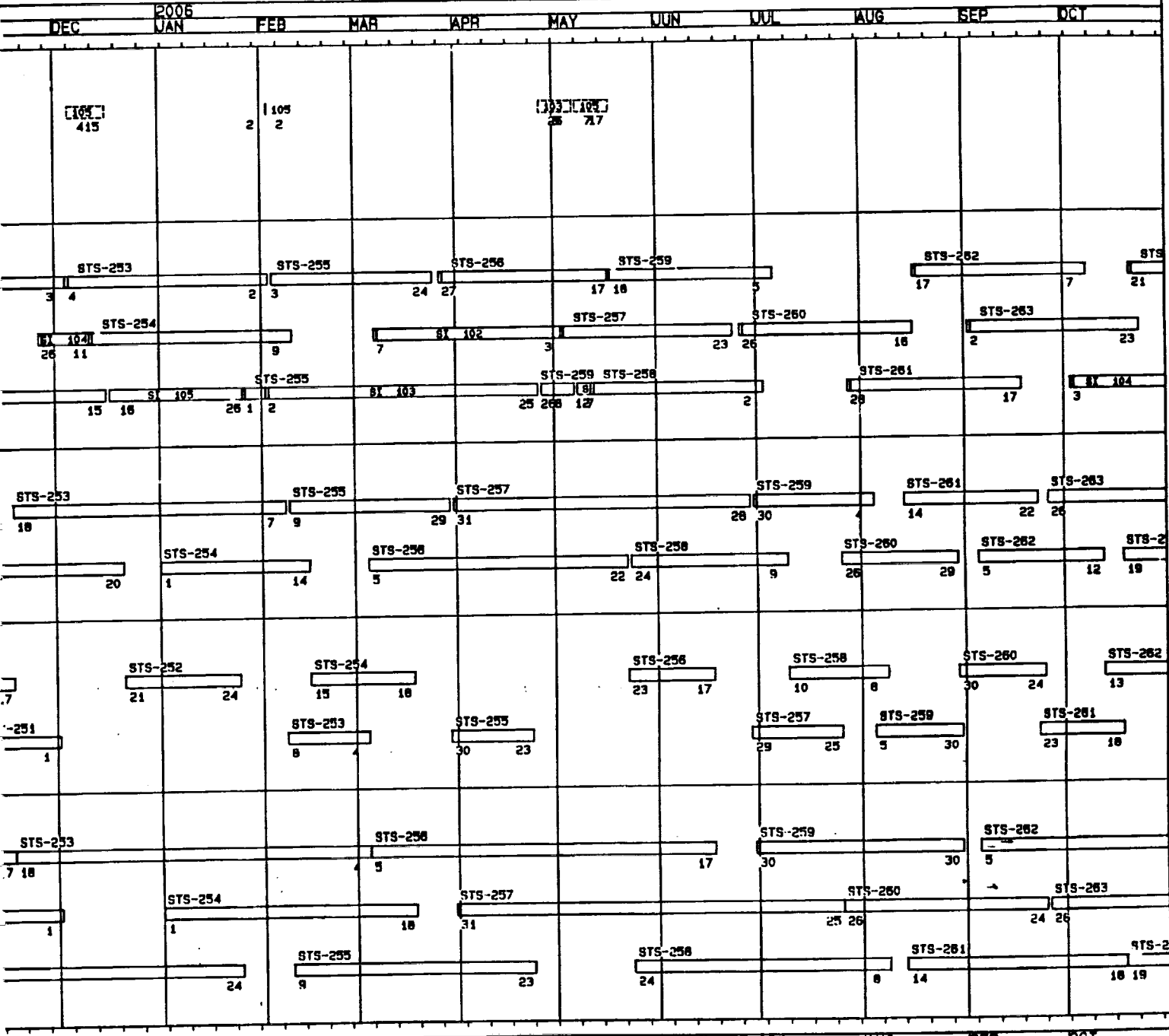
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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 2006



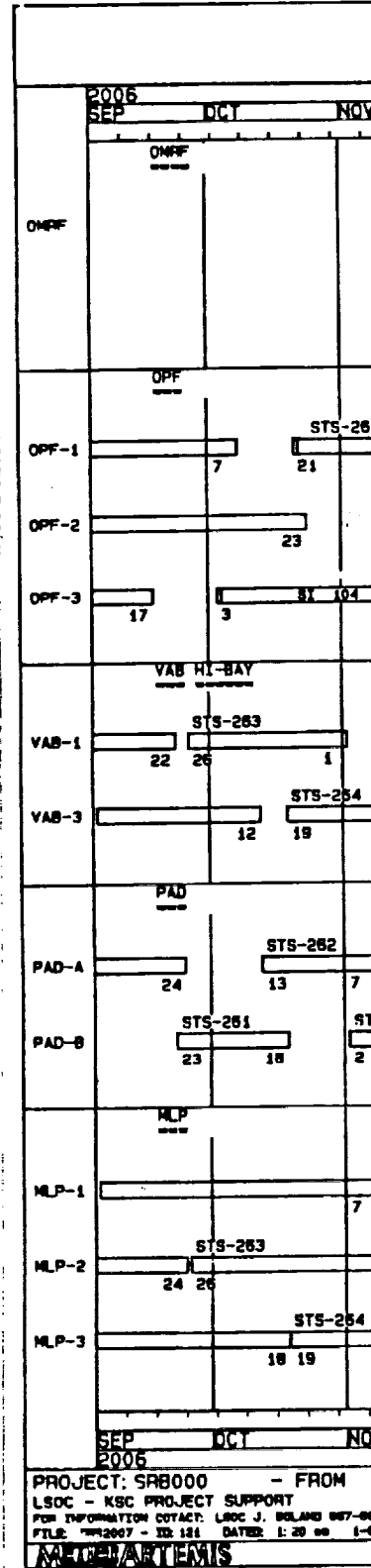
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SEP-2005 UNTIL 31-OCT-2006

ASSESSMENT BASED ON PWS TITANIUM
LINE STUDY - SEE NASA/TSC
FLIGHT ASSIGNMENT MANIFEST
FOR TSC PLANNING PURPOSES ONLY

Figure 2.3-17 FY2006 Orbiter/SSV Facility Utilization

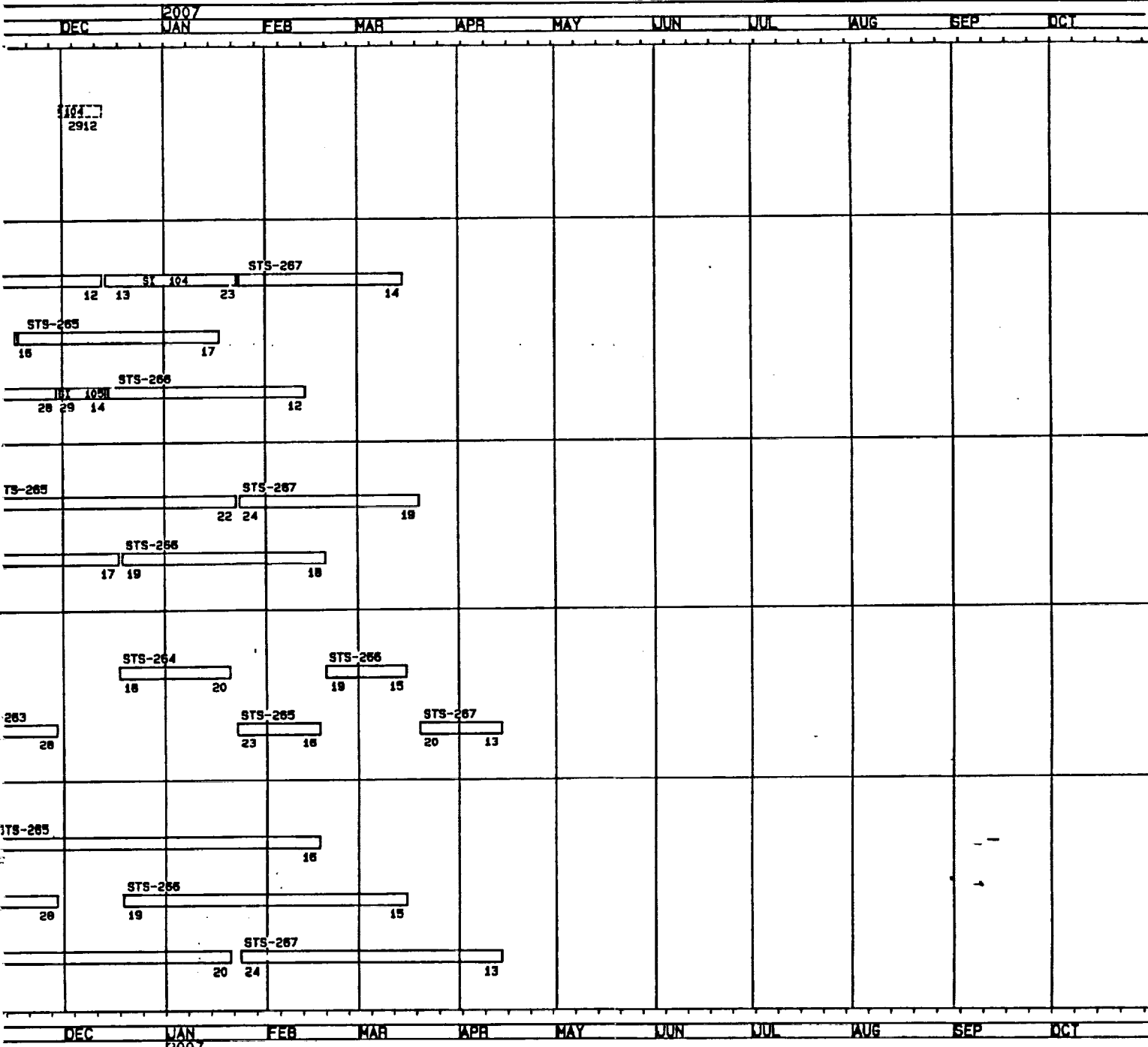
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ORBITER/SSV FACILITY UTILIZATION

FISCAL YEAR - 2007



SEP-2006 UNTIL 31-OCT-2007

AGREEMENT BASED ON PRELIMINARY
 LMS STUDY - SEE BARCHART
 FLIGHT ASSIGNMENT MATRIXX
 FOR SPC PLANNING PURPOSES ONLY

Barchart Drawing System 1:20 am 1-SEP-88 Page 18 of 18

Figure 2.3-18 FY2007 Orbiter/SSV Facility Utilization

**VOLUME V - SECTION 2
APPENDIX**

TABLE OF CONTENTS

- 2.1 ET/SRB BASELINE FACILITY UTILIZATION (FY 1992 THRU FY 2007)**
- 2.2 ET/SRB FACILITY OPEN PERIODS (FY 1992 THRU 2007)**
- 2.3 ORBITER/SSV FACILITY UTILIZATION (FY 1990 THRU FY 2007)**

VOLUME V

SECTION 3

LRB FACILITY REQUIREMENTS AND CONCEPTS FOR NEW FACILITIES

VOLUME 5 SECTION 3
LIST OF APPENDED SUPPORTING DATA AND FIGURES

3.1 **Flame Trench Modification**

The appendix section describes the present construction of the flame trench at Pad 34A and B and the geometry with respect to the Crawler Transporter tracks.

3.1.1 **Flame Trench Description**

The flame trench is 58 feet wide and 40 feet deep. It is lined with 6" refractory concrete brick on a 3 foot thick single pour monolithic steel reinforced walls and base. Figure 3.1.1 shows the detail design. To widen the trench would require removal of the brick and concrete in the area of the booster.

3.1.2 **Crawler Transporter Width**

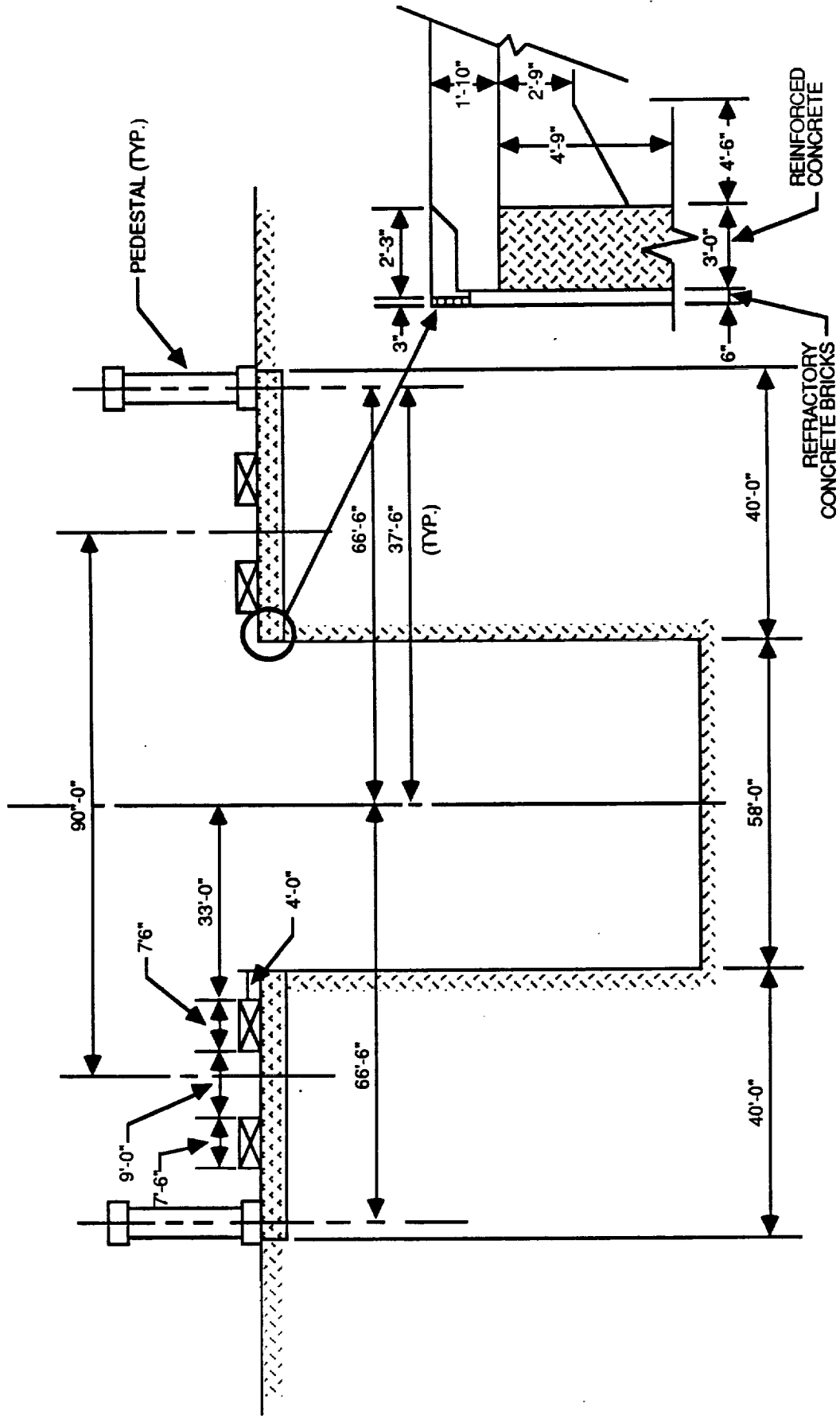
As seen in Figure 3.1.1 the inside width of the crawler transporter is 66 feet. The present clearance of the concrete wall and the transporter track is 6 inches. To maintain a 3 foot thick trench wall would require the wall to be under a crawler transporter track. If the trench wall thickness can be reduced to 6 inches at the top of the trench 5 feet can be gained. However, since the wall is a single pour a clear angled surface for installation of the refractory concrete brick will be time consuming.

3.4.1.3 **Conclusion**

The feasibility of modifying the flame trench is limited by the existing crawler and existing construction. Providing a new crawler with a wider track will impact the MLP pedestal (on the pad and in the VAB) and the crawlerway. Further detailed design analysis is required in a Phase-B study.

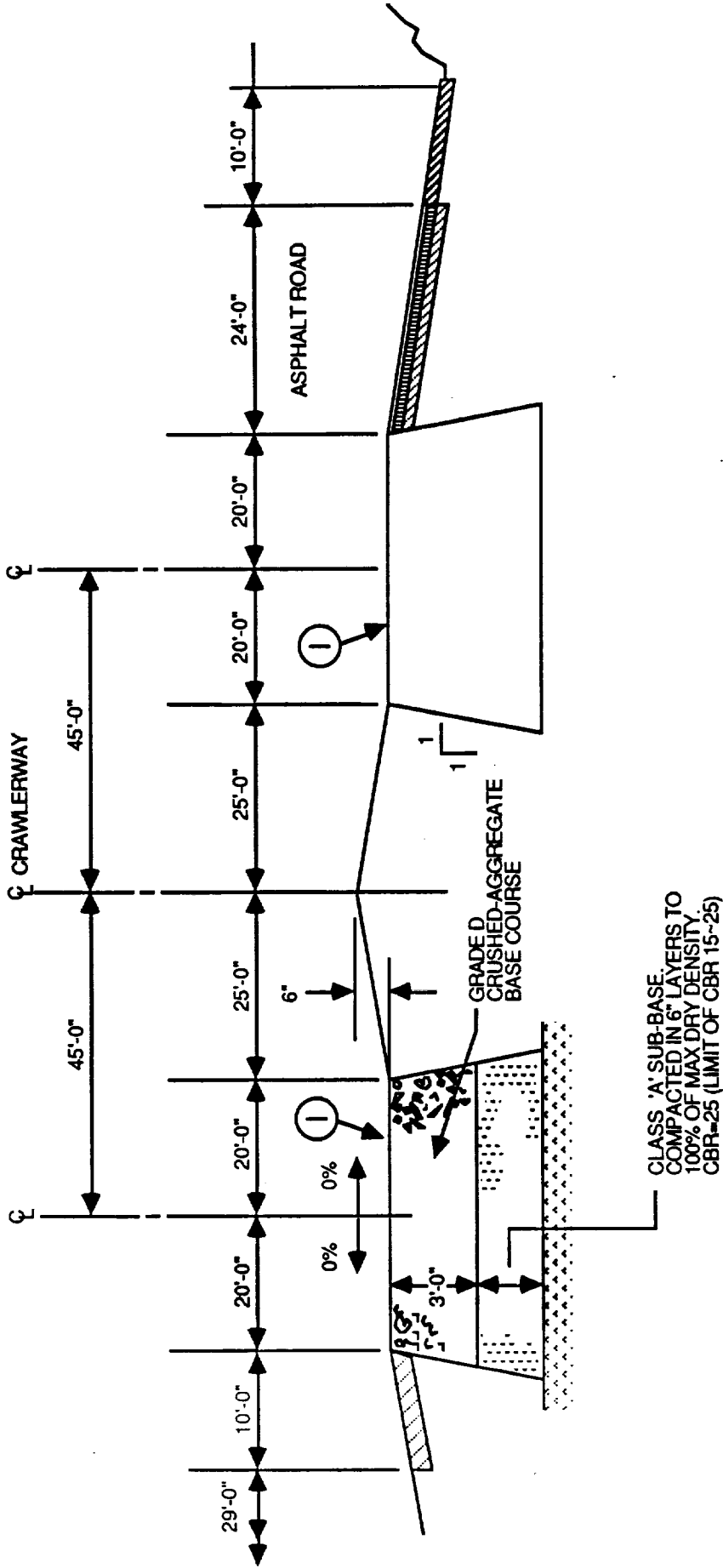
3.1.4 **Reference**

Core of Engineers Drawings 203-102



REF DWG: 203-102 SH 3080

Figure 3.1.1. Typical Flame Trench



NOTE: ① BITUMINOUS PRIME COAT

REF. DWG: CORPS OF ENGR DWG# 203-102

Figure 3.1.2. Typical Cross Section Of Crawlerway

VOLUME V

SECTION 4

LRB LAUNCH SUPPORT EQUIPMENT DEFINITION

(All supporting data for this Study Product
is included in Volume III.)

VOLUME V

SECTION 6

LRB MANPOWER

**VOLUME V SECTION 6
LRB MANPOWER APPENDICES
TABLE OF CONTENTS**

- 6.1 Liquid Rocket Booster Integration Study Dr. W. F. Huseonica**
- 6.2 WBS Data On STS Processing**
- 6.3 Morton Thiokol Technician Head Count**
- 6.4 SRB Technician Count By Location**
- 6.5 LRB Skill Mix Counts**
- 6.6 Manloading By Location Data**
- 6.7 NASA Support Team Headcount Data**

VOLUME V SECTION 6

LRB Manpower

6.1 LRB Integration Study - Dr. W. F. Huseonica

6.1.1 This study was developed using data for the year 1985 from the WBS/PWO reporting system. SRB manhours were used as a baseline and were modulated with SRB/LRB technical differences to arrive at LRB estimates. The ratios of support technician for the Orbiter were used rather than the SRB because of the multiple liquid engines and associated control mechanisms. These ratios were further modulated to reflect the differences in complexity between the LRB and the Orbiter.

LIQUID ROCKET BOOSTER INTEGRATION STUDY
DR. W.F. HUSEONICA, PAWS, INC.

LRB PROCESSING MANHOURS AND COST

SKILL MIX	RATIO	MANHOURS	LOADED RATE	COST	MHRS % OF TOTAL	COST % OF TOTAL
Technicians	1.00	20,056	\$17.72	\$355,392	11%	11%
Processing VAB Pad		11,744 3,632 4,680				
Engineering	0.89	17,850	\$20.55	\$366,814	10%	11%
Fac & Gnd Spt	1.14	22,864	\$17.20	\$393,258	13%	12%
Logistics	0.53	10,630	\$16.19	\$172,095	6%	5%
Quality	0.38	7,621	\$18.29	\$139,393	4%	4%
Safety	0.08	1,604	\$18.29	\$ 29,346	1%	1%
PP & C	0.22	4,412	\$17.88	\$ 78,892	2%	2%
Overhead	0.42	8,424	\$19.30	\$162,574	5%	5%
Grumman	0.71	14,240	\$19.75	\$281,235	8%	8%
SUBTOTAL		107,701		\$1,979,000		
Base Supprt EG & G	1.60	32,090	\$16.00	\$513,434	18%	15%
NASA - CS	1.92	38,508	\$22.00	\$847,165	22%	25%
TOTALS		178,298		\$3,339,599	100%	100%

COMMENTS AND ASSUMPTIONS:

1. MHRS and cost for processing LRBs from receipt thru launch
2. All skill mixes are ratioed to technicians
3. MHRS and cost are based on the LRB processing flow
4. EG&G base support assumes 20% supports cargo and 80% supports shuttle element processing
5. The NASA/KSC civil service values have the assumptions as the EG&G base support assumptions as the EG&G base support assumption in item #4
6. A non-recoverable LRB is assumed in the above table

Reviewed 6/17/88

S. Burns
A. Withers
K. Humphries
B. Husednica
G. Artley

1-1-70
LGV 1

LIQUID ROCKET BOOSTER INTEGRATION STUDY
DR. W.F. HUSEONICA, PAWS, INC.

LRB PROCESSING MANLOADING

<u>SKILL MIX</u>	<u>RATIO</u>	<u>MANHOURS</u>	<u>MANPOWER</u>
TECHNCIANS	1.00	20,056	47
ENGINEERING	0.89	17,850	42
FAC & GND SUPPT	1.14	22,864	54
LOGISTICS	0.53	10,630	25
QUALITY	0.38	7,621	18
SAFETY	0.08	1,604	4
PP&C	0.22	4,412	10
OVERHEAD	0.42	8,424	20
GRUMMAN	0.71	14,240	34

		SUBTOTAL	254

BASE SUPPT-EG&B	1.60	32,090	76
NASA/KSC-CS	1.92	38,508	91

		SUBTOTAL	167

		TOTAL	421

COMMENTS AND ASSUMPTIONS:

1. MANPOWER BASED ON A 53 DAY
GENERIC LRB FLOW
2. MANPOWER IS CALCULATED 8 HRS
A DAY TIMES 53 DAYS AND
DIVIDED INTO MANHOURS

LRB INTEGRATION STUDY
DR. WFH, PAWS, INC.

CURRENT SRB PROCESSING MHRS AND COST

SRB ACTIVITY/LOC	BASED ON WBS		95%	
	AVE MHRS	AVE COST	UCL MHRS	UCL COST
SRB PROCESSING	15,892	\$265,800	18,603	\$311,191
SRB STACKING	7,979	\$139,764	10,240	\$181,008
VAB INTEGRATION	3,636	\$62,657	5,095	\$88,728
PAD PROCESSING	15,943	\$299,000	18,575	\$343,842
SRB SHOPS/SE MAINT	2,885	\$46,350	3,378	\$54,264
SRB OPS SUPPORT	5,893	\$153,321	6,898	\$179,466
INTEG OPS SUPPORT	7,000	\$144,360	7,961	\$164,167
PSF - MAINT	2,479	\$47,914	2,818	\$54,488
VAB - MAINT	4,078	\$79,313	4,639	\$90,196
PAD/MLP - MAINT	243	\$4,979	276	\$5,661
SAFETY	4,729	\$100,800	5,377	\$114,630
OVERHEAD	3,679	\$79,500	4,183	\$90,407
SPC (LSOC) SUPPORT				
SRB PROCESSING	721	\$14,817	1,120	\$23,016
SRB STACKING	733	\$15,063	784	\$16,111
VAB INTEGRATION	123	\$2,528	254	\$5,220
PAD PROCESSING	3,765	\$72,043	5,704	\$109,146
OPS SUPPORT	251	\$4,591	814	\$14,888
GRUMMAN	2,760	\$54,507	3,997	\$78,936
SUBTOTAL	82,789	\$1,587,306	100,716	\$1,925,365
BASE SUPPORT - EG&G	32,090	\$513,434	32,090	\$513,434
NASA/KSC - CS	38,508	\$847,165	38,508	\$847,165
SUBTOTAL	70,598	\$1,360,599	70,598	\$1,360,599
SRB RETREIVAL/DISASS	6,800	\$138,800	7,539	\$153,164
SRB RETREIVAL VESSEL	5,672	\$118,207	6,450	\$134,425
HANGAR AF OPS	10,885	\$217,372	12,379	\$247,195
USBI - KSC OPS	74,436	\$1,423,758	88,043	\$1,678,048
SUBTOTAL	97,793	\$1,898,137	114,411	\$2,212,832
GRAND TOTAL	251,180	\$4,846,042	285,725	\$5,498,796
USBI - MSFC SUPPORT	130,263	\$2,491,577	154,075	\$2,936,584

COMMENTS AND ASSUMPTION:

1. MORTON THIOKOL PROCESSING MHRs AND COST BASED ON THE PAST 14 MISSIONS
2. SPC (LSOC) DATA BASED ON THE PAST THREE (3) MISSIONS
3. ALL SPC MHR AND COST DATA IS PWD AND AND WBS DATA
4. EG&G AND NASA/KSC CS MHR AND COST DATA ASSUMES 80% OF MHRs & COST SUPPORTS SHUTTLE ELEMENT PROCESSING AND 20% SUPPORTS CARGO OPS AT KSC
5. ALL LSOC SUPPORT IS ENGINEERING MRS EXCEPT 1/2 OF PAD PROCESSING AND THE OTHER HALF IS TECHS AND ALL OPS SUPPORT IS QUALITY PEOPLE
6. IT IS ASSUMED THE USBI-KSC OPS IS STAFF APPROX IS SAME AS MORTON THIOKOL AT 400 PEOPLE

Average
KSC
1

TABLE 3.1
SHUTTLE PROCESSING ORGANIZATION
STAFFING, RATIOS & LOADED RATES

DEPARTMENT	FUNCTION	HEAD COUNT	RATIO	LOADED RATES
-XX	TECHNICANS	1005	1.00	\$17.72
1X-XX	OVERHEAD	423	0.42	\$19.30
	PROGRAM MANAGEMENT	26	0.02	
	HUMAN RESOURCES	66	0.07	
	MISSION MANAGEMENT	68	0.07	
	BUSINESS MANAGEMENT	263	0.26	
17-XX	PROCESSING ENGINEERING	892	0.89	\$20.55
22-XX	PROCESS PLANNING & CONTROL	225	0.22	\$17.88
3X-XX	FACILITY & GROUND SUPPORT	1863	1.85	\$17.20
	GRUMMAN INTEG GND SUPPORT	713	0.71	
	FACILITY O & M	648	0.64	
	COMMUNICATIONS	302	0.30	
	SUPPORT ENGINEERING	152	0.15	
	TEST SUPPORT MGMT	36	0.04	
	ORGANIZATION MGMT	12	0.01	
-XX	LOGISTICS	528	0.53	\$15.19
5X-XX	SR & QA	462	0.46	\$18.29
	R & QA	365	0.38	
	SAFETY	77	0.08	
MX-XX	MORTON THIOKOL-SRB & ET PROC	387	0.39	\$17.18
	TOTAL SHUTTLE STAFFING	5785		

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CONCLUSIONS

0 OVERALL SUPPORT RATIOS TO TECHNICANS

- SHUTTLE - 4.37 : 1

SHUTTLE II - 1.00 : 1

NASP - 1.00 : 1

ELV - 1.60 : 1

0 SHUTTLE SCRUB/RECYCLE PER DAY

• TECHNICANS - 5,000 MHRB

SUPPORT - 21,850 MHRB

TOTAL MHRB - 26,850

TOTAL COST - \$483,300 (1986*)

0 SCHEDULED TO UNSCHEDULED MAINTENANCE

RATIO - 2.42 : 1

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VOLUME V SECTION 6

LRB MANPOWER

6.2 WBS Data On STS Processing

6.2.1 Work breakdown structure data for the year 1985 was chosen as a baseline for use in developing LRB data. This period was used because it represented the highest launch rate and busiest work activity of any year in STS history. Ten launches occurred during this era which is the closest approximation to 14 launches per year that could be found.

SRB PROCESSING MANHOURS AND COSTS
 WBS 1.1.2.1

6/17/00
 SUB

MTI ONLY

<u>MISSION</u>	<u>MHRS SRB PROCESS</u>	<u>LOADED COSTS SRB PROCESS</u>
BTB-17	17300	\$278700.00
BTB-19	19800	\$345100.00
BTB-20	12500	\$215500.00
BTB-23	13900	\$247400.00
BTB-24	9200	\$169300.00
BTB-25	14100	\$233500.00
BTB-26	16700	\$277500.00
BTB-27	16000	\$254500.00
BTB-28	19500	\$314000.00
BTB-30	15900	\$256600.00
BTB-31	12300	\$198200.00
BTB-32	10700	\$177900.00
BTB-33	28700	\$487200.00

<u>--</u>	<u>95% LCL</u>	<u>SAMPLE MEAN</u>	<u>95% UCL</u>	<u>STD DEV</u>	<u>STD ERR</u>
MHRS	13182	15892	18603	4986	1383
COSTS	220409	265800	311191	83499	23159

SRB STACKING OPERATIONS
WBS 1.1.2.2

<u>MISSION</u>	<u>MHRB SRB STACK</u>	<u>LOADED COSTS SRB STACK</u>
STB-14	5600	\$113000.00
STB-17	9200	\$154800.00
STB-19	8900	\$154900.00
STB-20	5500	\$102900.00
STB-23	6800	\$119200.00
STB-24	700	\$14100.00
STB-25	3600	\$48000.00
STB-26	13700	\$234200.00
STB-27	14200	\$255400.00
STB-28	5000	\$64000.00
STB-30	8200	\$141900.00
STB-31	5900	\$106300.00
STB-32	6900	\$124900.00
STB-33	16500	\$303100.00

<u>MHRB</u>	<u>95% LCL</u>	<u>SAMPLE MEAN</u>	<u>95% UCL</u>	<u>STD DEV</u>	<u>STD ERR</u>
MHRB	5717	7979	10240	4318	1154
COSTS	98521	139764	181008	78735	21043

SRB RETRIEVAL AND DISASSEMBLE OPERATIONS
WBS 1.1.2.3

<u>MISSION</u>	<u>MHRB SRB RET/DIS</u>	<u>LOADED COSTS SRB RET/DIS</u>			
STS-13	6900	\$124900.00			
STS-14	9100	\$173000.00			
STS-17	7500	\$151900.00			
STS-19	6600	\$135100.00			
STS-20	9000	\$183200.00			
STS-23	6200	\$130400.00			
STS-24	5700	\$116400.00			
STS-25	5300	\$101000.00			
STS-26	8400	\$167200.00			
STS-27	5300	\$106800.00			
STS-28	6200	\$140200.00			
STS-30	6100	\$133200.00			
STS-31	4800	\$105400.00			
STS-32	8100	\$174500.00			
	<u>95%</u>	<u>SAMPLE</u>	<u>95%</u>	<u>STD</u>	<u>STD</u>
	<u>LCL</u>	<u>MEAN</u>	<u>UCL</u>	<u>DEV</u>	<u>ERR</u>
<u>MHRB</u>	6061	6800	7539	1410	377
<u>COSTS</u>	124436	138800	153164	27421	7328

ET RECEIVING OPERATIONS
WBS 1.1.3.1

<u>MISSION</u>	<u>MHRS ET REC</u>	<u>LOADED COSTS ET REC</u>
ST8-14	600	\$7700.00
ST8-17	800	\$8700.00
ST8-19	100	\$1400.00
ST8-20	400	\$7000.00
ST8-23	600	\$11000.00
ST8-24	900	\$14500.00
ST8-25	600	\$9900.00
ST8-26	600	\$11100.00
ST8-27	900	\$14900.00
ST8-28	400	\$9200.00
ST8-30	1200	\$19300.00
ST8-31	500	\$9900.00
ST8-32	1100	\$18500.00
ST8-33	700	\$11800.00
ST8-34	700	\$12900.00
ST8-35	1000	\$16500.00

<u>WBS</u>	<u>95% LCL</u>	<u>SAMPLE MEAN</u>	<u>95% UCL</u>	<u>STD DEV</u>	<u>STD ERR</u>
MHRS	555	694	833	284	71
COSTS	10927	13164	15402	4567	1142

ET PROCESSING OPERATIONS
WBS 1.1.3.2

<u>MISSION</u>	<u>MHRS ET PROCESS</u>	<u>LOADED COSTS ET PROCESS</u>
BTB-14	4100	\$73500.00
BTB-17	5000	\$86500.00
BTB-19	4700	\$80000.00
BTB-20	7100	\$122400.00
BTB-23	9500	\$164500.00
BTB-24	9600	\$173600.00
BTB-25	8100	\$149700.00
BTB-26	5900	\$110800.00
BTB-27	11700	\$199000.00
BTB-28	5500	\$91500.00
BTB-30	7100	\$117600.00
BTB-31	9600	\$162600.00
BTB-32	8200	\$140100.00
BTB-33	12600	\$217200.00
BTB-34	4500	\$81600.00
BTB-35	6100	\$111600.00
BTB-36	6000	\$106700.00
BTB-38	5300	\$94500.00

<u>WBS</u>	<u>95% LCL</u>	<u>SAMPLE MEAN</u>	<u>95% UCL</u>	<u>STD DEV</u>	<u>STD ERR</u>
MHRS	6097	7256	8414	2507	591
COSTS	107140	126856	146571	42677	10059

INTEGRATED VEHICLE SERVICING - VAB
WBS 1.1.4.1

<u>MISSION</u>	<u>MHRS INTEG SERVICE</u>	<u>LOADED COSTS INTEG SERVICE</u>
STB-14	12700	\$221700.00
STB-17	1500	\$25900.00
STB-19	2800	\$20500.00
STB-20	2100	\$36700.00
STB-23	2000	\$33500.00
STB-24	3000	\$53200.00
STB-25	5100	\$88900.00
STB-26	2600	\$48000.00
STB-27	3300	\$56900.00
STB-28	4400	\$76300.00
STB-30	2100	\$37000.00
STB-31	2400	\$45500.00
STB-32	3700	\$72000.00
STB-33	3200	\$61100.00

<u>MISSION</u>	<u>95% LCL</u>	<u>SAMPLE MEAN</u>	<u>95% UCL</u>	<u>STD DEV</u>	<u>STD ERR</u>
MHRS	2177	3636	5095	2785	744
COSTS	36586	62657	88728	49770	13302

SRB/ET PROCESSING SUPPORT WBS DATA

<u>WBS</u>	<u>DESCRIPTION</u>	<u>95% LCL</u>	<u>SAMPLE MEAN</u>	<u>95% UCL</u>	<u>STD DEV</u>	<u>STD ERR</u>
1.1.2.4	SRB SHOP OPS MANHOURS COSTS (*)	1967 29618	2371 35707	2776 41796	744 11201	206 3107
1.1.2.5	SRB MODS MANHOURS COSTS (*)	12 284	14 343	17 401	4 108	1 30
1.1.2.6	SRB CONTIGENCY MANHOURS COSTS (*)	314 5907	379 7121	443 8336	119 2234	33 620
1.1.2.7	SRB SE MAINT MANHOURS COSTS (*)	101 2637	121 3179	142 3721	38 997	11 277
1.1.2.8	SRB MGMT/SUPP MANHOURS COSTS (*)	4888 127177	5893 153321	6898 179466	1849 48097	513 13339
1.3.3	ET SHOP OPS MANHOURS COSTS (*)	1256 20357	1456 23594	1655 26832	437 7078	102 1652
1.1.3.4	ET MODS MANHOURS COSTS (*)	868 13249	1006 15356	1144 17462	302 4607	70 1075
1.1.3.5	ET CONTINGENCY MANHOURS COSTS (*)	206 4022	239 4661	272 5301	72 1398	17 326
1.1.3.6	ET SE MAINT MANHOURS COSTS (*)	53 1385	61 1606	69 1826	18 482	4 112
1.1.3.7	ET MGMT/SUPP MANHOURS COSTS (*)	2430 63277	2817 73339	3203 83401	845 22002	197 5134
1.1.4.6	INTEG CONT OPS MANHOURS COSTS (*)	5418 113337	6280 131360	7142 149383	1884 39408	440 9195
1.1.4.8	LAUNCH OPS SUPP MANHOURS COSTS (*)	621 11216	720 13000	819 14784	216 3900	50 910

**FACILITY AND OVERHEAD WBS DATA
PART I**

<u>WBS</u>	<u>DESCRIPTION</u>	<u>95% LCL</u>	<u>SAMPLE MEAN</u>	<u>95% UCL</u>	<u>STD DEV</u>	<u>STD ERR</u>
PROCESS AND STORAGE FACILITY						
1.1.2.9	PBF OPS MANHOURS COSTS (*)	696 14581	807 16900	918 19219	242 5070	5 118
1.3.28.1	PBF MAINT MANHOURS COSTS (*)	99 2903	114 3364	130 3826	34 1009	1 23
1.3.28.4	PBF BE MODS MANHOURS COSTS (*)	1072 18415	1243 21343	1413 24271	373 6403	8 1494
1.3.28.5	PBF OPS SUPP MANHOURS COSTS (*)	271 5442	314 6307	357 7172	94 1892	2 44
VAB						
1.3.4.1	VAB FAC MAINT MANHOURS COSTS (*)	1344 24436	1557 28321	1771 32207	467 8496	109 1983
1.3.4.3	VAB RESERVED MANHOURS COSTS (*)	1781 34832	2064 40371	2348 45910	619 12111	145 2826
1.3.4.5	VAB OPS SUPP MANHOURS COSTS (*)	394 9164	457 10621	520 12079	137 3186	32 744
MLP						
1.3.6.1	MLP MAINT MANHOURS COSTS (*)	80 1473	93 1707	106 1941	28 512	7 120
1.3.6.2	MLP MODS MANHOURS COSTS (*)	123 2749	143 3186	162 3623	43 956	10 223
PAD A						
1.3.8.1	PAD A MAINT MANHOURS COSTS (*)	6 74	7 86	8 97	2 26	1 6

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**FACILITY AND OVERHEAD WBS DATA
PART II**

<u>WBS</u>	<u>DESCRIPTION</u>	<u>95% LCL</u>	<u>SAMPLE MEAN</u>	<u>95% UCL</u>	<u>STD DEV</u>	<u>STD ERR</u>
HANGAR AF						
1.3.13.1	HANGAR AF MAINT MANHOURS COSTS (*)	5565 108744	6450 126036	7335 143328	1935 37811	452 8822
1.3.13.2	HANGAR AF MODS MANHOURS COSTS (*)	191 4265	221 4943	252 5621	66 1483	16 346
1.3.13.3	HGR AF RESERVED MANHOURS COSTS (*)	3636 74540	4214 86393	4792 98246	1264 25918	295 6048
SRB RETREIVAL VESSELS						
1.3.14.1	VESSEL MAINT MANHOURS COSTS (*)	1837 39615	2129 45914	2421 52214	639 13774	149 3214
1.3.14.3	VEBSEL RESERVED MANHOURS COSTS (*)	3057 62374	3543 72293	4029 82211	1063 21688	248 5061
SAFETY						
1.6.1.1	SAFETY MANHOURS COSTS (*)	4080 86970	4729 100800	5377 114630	1419 30240	331 7056
OVERHEAD						
1.6.. & 1.7	MGMT SYS MANHOURS COSTS (*)	3174 68593	3679 79500	4183 90407	1104 23850	258 5365

VEHICLE TEST AND LAUNCH OPERATIONS - PAD
WBS 1.1.4.2

<u>MISSION</u>	<u>MHRS VEH TBT PAD</u>	<u>LOADED COSTS VEH TBT PAD</u>
STS-14	25400	\$453700.00
STS-17	14500	\$274600.00
STS-19	13300	\$334600.00
STS-20	8300	\$195200.00
STS-23	15500	\$289700.00
STS-24	19200	\$360800.00
STS-25	22800	\$416900.00
STS-26	14300	\$250500.00
STS-27	19600	\$343800.00
STS-28	16500	\$282900.00
STS-29	13100	\$237300.00
STS-31	12000	\$218300.00
STS-32	8500	\$155500.00
STS-33	20200	\$372200.00

<u>---</u>	<u>95% LCL</u>	<u>SAMPLE MEAN</u>	<u>95% UCL</u>	<u>STD DEV</u>	<u>STD ERR</u>
MHRS	13311	15943	18575	5025	1343
COSTS	254158	299000	343842	85604	22879

VOLUME V SECTION 6

LRB MANPOWER

6.3 Morton Thiokol Technical Head Count

6.3.1 In order to develop the LRB/SRB comparisons it was necessary to establish the number of MTI technicians and their support ratios. They are as follows:

Retrieval Techs	24
Disassembly Tech	38
SRB Techs RPSF	48
VAB	34
PAD	18
External Tank (processing)	26
Integration	33

TOTAL TECHS	221
Support MTI	318

TOTAL MTI	539

VOLUME V SECTION 6

LRB MANPOWER

6.4 SRB Technician Count By Location

6.4.1 In order to establish a direct correlation between the LRB and SRB technician work force, the manhours at each location was divided by the number of days spent in the facility times 8 hours. This data was used for determining the LRB technician head count. A similar exercise was performed for the SRB as well and is included as a part of the database in this appendix.

SRB STAFFING

TECHNICIANS

SRB Processing
SRB Skirts 17 days

Inspection/SEG off load

17 days - (11 day overlap with SRB skirts)

Booster Stacking
ET Mate & C/O
SYS INT C/O

21 days
11 days
5 days

RPSF 5 days / 3 shifts

15,892 mh = 690 mh/day = 86 techs RPSF

23 days 8 hours

7,979 mh = 379.95 mh/day = 47 techs VAB

21 days 8

15,943 mh = 886.7 mh/day = 111 techs PAD

18 days 8

VOLUME V SECTION 6

LRB MANPOWER

6.5 LRB Skill Mix Counts

6.5.1 Each of the tasks in the ARTEMIS CPM charts was examined to determine what technician skill was examined to determine what technician skill would be required. Basic skill types of mechanical, electrical, engine and TPS were established. Totals were compiled and the skill mix comparison charts evolved from the data.

LRB MECHANICAL TECHNICIAN MANHOURS

<u>OMI</u>	<u>HOURS</u>	<u>LOCATION</u>	<u>CUMULATIVE HOURS</u>
048C	64	VAB	64
054C	48	VAB	112
050C	64	VAB	176
051C	80	VAB	256
150D	56	VAB	312
055D	336	VAB	648
250E	16	VAB	664
066D	16	VAB	680
056D	48	VAB	728
067D	32	VAB	760
155E	336	VAB	1096
059D	128	VAB	1224
164E	16	VAB	1240
166E	16	VAB	1256
156E	48	VAB	1304
167E	32	VAB	1336
159E	128	VAB	1464
061F	1056	VAB	2520
069F	48	VAB	2568
073F	256	VAB	2824
078F	80	VAB	2904
01A	84	HPF	2988
06A	64	HPF	3025
02A	80	HPF	3132
05A	72	HPF	3204
08A	64	HPF	3268
012B	112	HPF	3380
013B	32	HPF	3412
015B	32	HPF	3444
016B	32	HPF	3476
044B	640	HPF	4116
046B	288	HPF	4404
023B	256	HPF	4660
022B	144	HPF	4804
040B	320	HPF	5124
021B	96	HPF	5220
034B	384	HPF	5604
035B	144	HPF	5748
032B	64	HPF	5812
033B	128	HPF	5940
031B	192	HPF	6132
038B	1536	HPF	7668
036B	288	HPF	7956
037B	576	HPF	8532
301B	80	HPF	8612
047B	160	HPF	8772
053B	80	HPF	8852
070G	64	PAD	8916
071G	64	PAD	8980
072G	1344	PAD	10324
079T	160	PAD	10484
074G	192	PAD	10676

		SUBTOTAL	10676

LRB MECHANICAL TECHNICIAN MANHOURS (CONTINUED)

<u>OMI</u>	<u>HOURS</u>	<u>LOCATION</u>	<u>CUMULATIVE HOURS</u>
			10676
080T	80	PAD	10756
075G	288	PAD	11044
076G	64	PAD	11108
084H	132	PAD	11240
083H	16	PAD	11256
082H	16	PAD	11272
085H	168	PAD	11440
086H	144	PAD	11584
090H	192	PAD	11776
089H	32	PAD	11808
091H	48	PAD	11856
094H	96	PAD	11952
095H	240	PAD	12192
096H	32	PAD	12224
097H	48	PAD	12272
098I	360	PAD	12632
104H	96	PAD	12728
101H	96	PAD	12824
099H	160	PAD	12984
106H	192	PAD	13176
111H	96	PAD	13272
108H	32	PAD	13304
107H	32	PAD	13336
109H	128	PAD	13464
190I	640	PAD	14104

		TOTAL CUMULATIVE HOURS	14104

LRB
ELECTRICAL TECHNICIAN MANHOURS

<u>OMI</u>	<u>HOURS</u>	<u>LOCATION</u>	<u>CUMULATIVE HOURS</u>
01A	84	HPF	84
07A	64	HPF	148
04A	64	HPF	212
019B	64	HPF	276
014B	32	HPF	308
017B	64	HPF	372
018B	64	HPF	436
020B	192	HPF	628
046B	288	HPF	916
024B	192	HPF	1108
026B	288	HPF	1396
027B	64	HPF	1460
029B	320	HPF	1780
030B	128	HPF	1908
025B	384	HPF	2292
115B	64	HPF	2356
042B	256	HPF	2612
043B	384	HPF	2996
114B	160	HPF	3156
047B	160	HPF	3316
053B	80	HPF	3396
151C	80	VAB	3476
049C	64	VAB	3540
057D	64	VAB	3604
065D	16	VAB	3620
058D	32	VAB	3652
064D	16	VAB	3668
060D	64	VAB	3732
157E	64	VAB	3796
165E	16	VAB	3812
158E	32	VAB	3844
160E	64	VAB	3908
061F	1056	VAB	4964
062F	48	VAB	5012
063F	96	VAB	5108
077F	640	VAB	5748
078F	80	VAB	5828
080T	80	PAD	5908
081H	48	PAD	5956
088H	48	PAD	6004
093H	32	PAD	6036
087H	192	PAD	6228
092H	96	PAD	6324
098I	360	PAD	6684
103H	64	PAD	6748
105H	48	PAD	6796
100H	288	PAD	7084
110H	32	PAD	7116
112H	96	PAD	7212
190I	640	PAD	7852

TOTAL CUMULATIVE HOURS			7852

LRB ENGINE TECHNICIAN MANHOURS

<u>OMI</u>	<u>HOURS</u>	<u>LOCATION</u>	<u>CUMULATIVE HOURS</u>
039B	192	HPF	192
041B	224	HPF	416
047B	160	HPF	576
300B	16	HPF	592
102H	256	PAD	848
360H	384	PAD	1232
190I	640	PAD	1872

		TOTAL CUMULATIVE HOURS	1872

LRB
TPS TECHNICIAN MANHOURS

<u>OMI</u>	<u>HOURS</u>	<u>LOCATION</u>	<u>CUMULATIVE HOURS</u>
045B	1280	HPF	1280
350H	1152	HPF	2432

		TOTAL CUMULATIVE HOURS	2432

LRB
SKILL MIX BY PERCENTAGE

<u>SKILL</u>	<u>TOTAL HOURS</u>	<u>PERCENTAGE</u>
MECHANICAL	14104	53.7%
ELECTRICAL	7852	29.9%
ENGINE TECH	1872	7.1%
TPS TECH	2432	9.3%
	-----	-----
TOTAL	26260	100.0%

VOLUME V SECTION 6

LRB MANPOWER

6.6 Manpower Loading By Location Data

6.6.1 These data were determined by examining each of the tasks in the ARTEMIS baseline CPM chart and allocating them by location. This allowed the establishment of manpower allocation by location. The numbers of the OMI/tasks are used for identification.

VAB MH LRB

<u>OMI</u>	<u>SHIRTS</u>	<u>HOURS</u>	<u>TECHS</u>	<u>TYPE</u>	<u>TASK HOURS</u>	<u>TOTALS</u>
048C	4	32	2	M	64	64
054C	3	24	6	M	48	112
151C	5	40	2	E	80	192
050C	4	32	2	M	64	256
049C	4	32	2	E	64	320
051C	5	40	2	M	80	400
150D	1	8	7	M	56	456
055D	3	24	14	M	336	792
250E	1	8	2	M	16	808
057D	2	16	4	E	64	872
065D	1	8	2	E	16	888
058D	2	16	2	E	32	920
064D	1	8	2	E	16	936
066D	1	8	2	M	16	952
056D	1	8	6	M	48	1000
067D	2	16	2	M	32	1032
155E	3	24	14	M	336	1368
060D	2	16	4	E	64	1432
059D	4	32	4	M	128	1560
157E	2	16	4	E	64	1624
165E	1	8	2	E	16	1640
158E	2	16	2	E	32	1672
164E	1	8	2	M	16	1688
166E	1	8	2	M	16	1704
156E	1	8	6	M	48	1752
167E	2	16	2	M	32	1784
160E	2	16	4	E	64	1848
159E	4	32	4	M	128	1976
061F	33	264	8	M/E	2112	4088
069F	3	24	2	M	48	4136
062F	1	8	6	E	48	4184
063F	3	24	4	E	96	4280
073F	3	24	14	M	256	4536
077F	4	32	20	E	640	5176
078F	1	8	20	M/E	160	5336

MANHOURS LRB
PAD

<u>OMI</u>	<u>SHIFTS</u>	<u>HOURS</u>	<u>TECHS</u>	<u>TYPE</u>	<u>TASK HOURS</u>	<u>TOTAL</u>
070G	2	16	4	M	64	64
071G	2	16	4	M	64	128
072G	7	84	16	M	1344	1472
079T	1	8	20	M	160	1632
074G	12	96	2	M	192	1824
080T	1	8	20	M/E	160	1632
075G	18	144	2	M	288	2272
081H	1	8	6	E	48	2320
076G	1	8	8	M	64	2384
084H	4	32	4	M	132	2516
350H	18	144	8	TPS	1152	3668
083H	1	8	2	M	16	3684
082H	1	8	2	M	16	3700
085H	7	56	3	M	168	3868
088H	1	8	6	E	48	3916
086H	3	24	6	M	144	4060
090H	4	32	6	M	192	4252
089H	1	8	4	M	32	4284
093H	1	8	4	E	32	4316
087H	6	48	4	E	192	4508
091H	1	8	6	M	48	4556
094H	3	24	4	M	96	4652
092H	2	16	6	E	96	4784
095H	5	40	6	M	240	4988
096H	1	8	4	M	32	5020
097H	1	8	6	M	48	5068
098I	3	24	30	M&E	720	5788
102H	4	32	8	R	256	6044
104H	3	24	4	M	96	6140
101H	4	32	3	M	96	6236
099H	5	40	4	M	160	6396
103H	2	16	4	E	64	6460
105H	3	24	2	E	48	6508
106H	4	32	6	M	192	6700
100H	6	48	6	E	288	6988
360H	6	48	8	R	384	7372
111H	3	24	4	M	96	7468
108H	2	16	2	M	32	7500
107H	1	8	4	M	32	7532
110H	2	16	2	E	32	7564
109H	2	16	8	M	128	7692
112H	3	24	4	E	96	7788
190I	8	64	30	MER	1920	9708

MANHOURS

HPF FOR LRB

01A	3 shifts	(24 hrs X	7 persons)	M/E	168	6162
06A	4 shifts	(32 hrs X	2 persons)	M	64	6226
07A	4 shifts	(32 hrs X	2 persons)	E	64	6290
02A	5 shifts	(40 hrs X	2 persons)	M	80	6370
05A	3 shifts	(24 hrs X	3 persons)	M	72	6442
04A	4 shifts	(32 hrs X	2 persons)	E	64	6506
08A	4 shifts	(32 hrs X	2 persons)	M	64	6570
012B	2 shifts	(16 hrs X	7 persons)	M	112	6682
019B	2 shifts	(16 hrs X	4 persons)	E	64	6746
014B	1 shift	(8 hrs X	4 persons)	E	32	6778
017B	2 shifts	(16 hrs X	4 persons)	E	64	6842
013B	1 shift	(8 hrs X	4 persons)	M	32	6874
018B	2 shifts	(16 hrs X	4 persons)	E	64	6938
015B	1 shift	(8 hrs X	4 persons)	M	32	6970
016B	1 shift	(8 hrs X	4 persons)	M	32	7002
020B	2 shifts	(16 hrs X	12 persons)	E	192	7194
044B	10 shifts	(80 hrs X	8 persons)	M	640	7834
045B	10 shifts	(80 hrs X	16 persons)	T	1280	9114
046B	6 shifts	(48 hrs X	12 persons)	M/E	576	9690
023B	4 shifts	(32 hrs X	8 persons)	M	256	9946
022B	3 shifts	(24 hrs X	6 persons)	M	144	10090
024B	3 shifts	(24 hrs X	8 persons)	E	192	10282
026B	3 shifts	(24 hrs X	12 persons)	E	288	10570
040B	4 shifts	(32 hrs X	10 persons)	M	320	10890
027B	2 shifts	(16 hrs X	4 persons)	E	64	10954
021B	2 shifts	(16 hrs X	6 persons)	M	96	11050
034B	4 shifts	(32 hrs X	12 persons)	M	384	5994
035B	3 shifts	(24 hrs X	6 persons)	M	144	5610
032B	1 shifts	(8 hrs X	8 persons)	M	64	5466
033B	2 shifts	(16 hrs X	8 persons)	M	128	5402
029B	5 shifts	(40 hrs X	8 persons)	E	320	5274
030B	2 shifts	(16 hrs X	8 persons)	E	128	4954
025B	4 shifts	(32 hrs X	12 persons)	E	384	4826
031B	3 shifts	(24 hrs X	8 persons)	M	192	4442
038B	12 shifts	(96 hrs X	16 persons)	M	1536	4250
039B	4 shifts	(32 hrs X	6 persons)	R	192	2714
036B	3 shifts	(24 hrs X	12 persons)	M	288	2522
037B	6 shifts	(48 hrs X	12 persons)	M	576	2234
115B	2 shifts	(16 hrs X	4 persons)	E	64	1658
041B	2 shifts	(16 hrs X	4 persons)	R	224	1594
042B	2 shifts	(16 hrs X	16 persons)	E	256	1370
043B	3 shifts	(24 hrs X	16 persons)	E	384	1114
114B	2 shifts	(16 hrs X	10 persons)	E	160	730
301B	2 shifts	(16 hrs X	5 persons)	M	80	720
047B	2 shifts	(16 hrs X	30 persons)	M/E/R	480	640
053B	1 shift	(8 hrs X	20 persons)	M/E	160	
300B	1 shift	(8 hrs X	2 persons)	R	16	

VOLUME V SECTION 6

6.7 NASA SUPPORT TEAM HEAD COUNT DATA

6.7.1 NASA Operations Interface Team

NASA Operations and O&M contractors operational support to all areas of activation functions:

20	TE &/or	SPC	Ops Engineering types
60	TV &/or	SPC	Yount/Lamberth types
20	TL &/or	SPC	Webb types
20	TP &/or	SPC	Carpenter types
10	SI &/or	SPC	Bobic types

140 Total personnel

* Finance and contracts not included in any team

5 Person required for an LRB project office

145 total team count

NOTE:

- Ops and System Engineering OMD's
- Ops and System Engineering Software
- Ops and System Engineering Certification
- Ops and System Engineering ORI
- Ops and System Engineering Pathfinder
- Ops and System Engineering ORD Turnover/Acceptance
- Ops and System Engineering Training]
- Ops and System Engineering Certification

6.7.1.1 Schedule of Manpower Utilization (by %)

<u>1990</u>	<u>91</u>	<u> </u>	<u>92</u>	<u> </u>	<u>93</u>	<u> </u>	<u>94</u>	<u> </u>	<u>95</u>	<u> </u>	<u>96</u>	<u> </u>	<u>97</u>	<u> </u>	<u>98</u>	<u> </u>	<u>99</u>	<u> </u>	<u>2000</u>	
	25%		100%		100%		100%		100%		80%		40%		30%		30%		10%	

Work control, scheduling, outages/permits, security -- covered in activation support

6.7.2 NASA Engineering Interface Team

NASA &/or Contractor To Support Activation Management Team

A. DE/TM-TV-TE Engineering &/or Contractors

4 X 5 TV = 20 - Provide Engineering direction/documents from

2 X 5 TE = 10 - Level II & III

1 X 10 DE = 10 - Provide change and approval loop

1 X 5 RTQ = 5 - Provide Site (field Engineers)

1 X 5 RTQ = 5 - Review & Approval Interim OMI's & TPS Loop

1 X 5 SI = 10 - Walk downs, test surveillance system acceptance.

60

B. TM Operations &/or Contractor

5 X 1 = Site - All above and schedule

4 X 5 = Site - Plus work control

Functional Interface - Schedule approvals

2 X 5 TE = 10 - Site control for staging

1 X 2 TP = 2 - Outage loop

3 X 5 TL = 15 - Permit loop

1 X 4 TL = 4 - Security loop

2 X 5 RT/RQ = 10 - Area control

1 X 5 RS = 5

15 SI = 15

61

C. NASA and KSC Project Planning Office

1 LRB/EB	- Change Control
1 Engineering/GSE	- ICD Approvals
1 Ground Systems	Test data and approvals from/to
1 Finance	Level II & I \$
1 Scheduling	Schedule level III

D. RQ/Safety and Contractors Environmental

30 people Impact Assessment

Schedule

1990		91		92		93		94		95		96		97		98		99		20
50%		100%		100%		100%		100%		100%		80%		50%		45%		40%		
35%																				

6.7.3 Activation Management Team

Responsible for coordination of design construction and activation of facilities. Interface between the LRB activation and the operational SRB program. Migrate to LRB team as core group for operational phase.

Manning Schedule

1991		92		93		94		95		96		97		98		99		2000
130		151		268		368		298		78		105		127		65		62

VOLUME V

SECTION 7

COST ESTIMATES INCLUDING TRANSITION

VOLUME V APPENDIX 7
COST ESTIMATES

TABLE OF CONTENTS

7.1	ET/LRB Horizontal Processing Facility (Section A)
7.2	VAB (Section B)
7.3	LRB Mobile Launch Platform #4 (Section C)
7.4	LRB Mobile Launch Platform #5 (Section D)
7.5	MLP Parksite #2 (Section E)
7.6	LC-39 PAD A or B (Section F)
7.7	LCC/LPS (Section G)
7.8	Launch Equipment Test Facility (Section H)
7.9	High Voltage Power Distribution (Section I)

VOLUME V APPENDIX 7

COST ESTIMATES

This appendix contains the detailed engineering estimates for the launch site non-recurring costs for each station set impacted by LRB STS integration.

It is the intent of this section to display the derivation of costs for the bottoms-up pricing approach. In general, detailed estimates have been prepared for the facility requirements, Launch Support Equipment (LSE) and Ground Support Equipment (GSE) for each station set. The derivation of station set costs associated with design, TTV, initial spares and activation management is consistent with the cost estimating approach described in Volume III, Sections 7.1.3, 7.1.4, 7.1.5 and 7.1.6 respectively. LRB MLP #4 and #5 are the only station set detailed estimates which display this technique for all cost elements.

The station set non-recurring cost estimates have been summarized and presented in matrix format, for each LRB configuration, in Volume III, Section 7 of this report.

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

T. NO. _____ PCN _____ DATE PREPARED 10/29/89 SHEET 1A OF 12A

PROJECT LRB INTEGRATION STUDY
 LOCATION ET/LRB HPF - FACILITY CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	SITE PREPARATION	237,800	SF	5 ⁰⁰	1,189,000
2.	STRUCTURE			25 ⁰⁰	5,945,000
3.	ARCHITECTURAL			10 ⁰⁰	2,378,000
4.	MECHANICAL			25 ⁰⁰	5,945,000
5.	ELECTRICAL			15 ⁰⁰	3,567,000
6.	2-30 TON CRANE				1,600,000
7.	20 TON CRANE				650,000
8.	2-5 TON HOISTS				60,000
9.	12" REINFORCED CONCRETE APRON (165,000 SF)	20,200	SY	32 ⁰⁰	647,000
10.	12" REINFORCED CONCRETE TOWWAY (60,000 SF)	7300	SY	32 ⁰⁰	234,000
11.	OUTFITTING (20% OF BUILDING COST @ \$19,024,000)				3,805,000
					<u>26,020,000</u>
	SUB OVERHEAD	15	%		3,903,000
	SUB PROFIT	10	%		2,993,000
	PRIME MARK-UP	10	%		3,291,000
	BOND	1	%		362,000
	ESCALATION (2 YEARS)	10.25	%		3,748,000
	CONTINGENCY	15	%		<u>6,048,000</u>
	TOTAL FACILITY				46,365,000

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

D. NO.

PCN.

DATE PREPARED

10-10-88

SHEET 34 OF 124

PROJECT

LRB INTEGRATION STUDY

LOCATION

ET AND LRB GROUND SUPPORT EQUIPMENT (GSE), LC-39, KSC

CODE

ARCHITECT/ENGINEER

ESTIMATOR

R. H. WASSUM

DRAWING NO.

CHECKED BY

APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	ACCESS EQUIPMENT:				
1.	ELEVATOR WORK PLATFORMS ET	4	EA	120,000	480,000
2.	ELEVATOR WORK PLATFORMS LRB	4	EA	85,000	340,000
3.	INTERTANK ACCESS DOOR PROTECTOR	2	EA	2,800	5,600
4.	INTERTANK ACCESS TOOL KIT	2	EA	5,000	10,000
5.	TOW TRACTOR	2	EA	65,000	130,000
6.	PORTABLE LIGHTS	16	EA	4,000	64,000
	SUBTOTAL				1,029,600
	ECS EQUIPMENT:				
7.	ECS FLEX. DUCT SET	2	EA	2,000	4,000
8.	ECS FLEX DUCT ADAPTER SET	2	EA	9,500	19,000
9.	CIRCULATING MODULE	2	EA	25,000	50,000
10.	GROUND COOL LOOP SELECT PANEL	2	EA	40,000	80,000
	SUBTOTAL				153,000
	BATTERY SHOP (FLIGHT BATTERIES):				
11.	CHARGING PANEL	2	EA	75,000	150,000
12.	BATTERY TEST PANEL	2	EA	65,000	130,000
13.	BATTERY TOOL SETS	2	EA	10,000	20,000
	SUBTOTAL				300,000

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO. _____ RCN _____ DATE PREPARED 10-10-88 SHEET 4A OF 12A

PROJECT LRB INTEGRATION STUDY

LOCATION ET AND LRB GROUND SUPPORT EQUIPMENT (GSE), LC-39, KSC CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR R. H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	TVC SYSTEM:				
14.	ELECTRICAL POWER PANEL	4	EA	60,000	\$ 240,000
15.	TVC TEST PANEL	4	EA	85,000	340,000
	SUBTOTAL				580,000
	PNEUMATIC SYSTEM EQUIPMENT:				
16.	LRB AFT COMPARTMENT PURGE PANEL	2	EA	85,000	170,000
17.	PNEUMATIC PRESSURE UNIT	2	EA	60,000	120,000
18.	PNEUMATIC REGULATOR PANEL	2	EA	85,000	170,000
19.	PRIMARY He REDUCTION AND BOTTLE FILL	2	EA	10,000	20,000
20.	LRB VENT VALVE ACTUATOR PANEL	2	EA	85,000	170,000
21.	LRB VENT ACTUATION AND PURGE PANEL	2	EA	90,000	180,000
22.	G ₂ INTERTANK PURGE PANEL	2	EA	80,000	160,000
23.	LOX TANK PRESSURE AND G ₂ PURGE PANEL	4	EA	60,000	240,000
24.	RPI TANK PRESSURE AND G ₂ PURGE PANEL	4	EA	60,000	240,000
	SUBTOTAL				1,470,000

ORIGINAL PAGE IS OF POOR QUALITY.

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 10-10-88 SHEET 5A OF 12A

PROJECT LRB INTEGRATION STUDY
 LOCATION ET AND LRB GROUND SUPPORT EQUIPMENT (GSE), LC-39, KSC CODE _____
 ARCHITECT/ENGINEER _____ ESTIMATOR E. H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	POWER EQUIPMENT:				
25.	DC POWER SUPPLY ET & LRB	2	EA	200,000	400,000
26.	ELECTRICAL BONDING TEST UNIT	2	EA	2,000	4,000
27.	DC POWER CABLE SET (6EA - 4 SETS)	24	EA	1,000	24,000
28.	DC POWER RACK	4	EA	60,000	240,000
29.	BUS MONITOR UNIT	2	EA	3,000	6,000
30.	HEATER CONFIDENCE TEST SET	2	EA	4,000	8,000
					682,000
	PYRO EQUIPMENT:				
31.	PYRO SUBSTITUTION UNIT	6	EA	12,000	72,000
32.	STRAY VOLTAGE CHECK-OUT UNIT	2	EA	20,000	40,000
33.	SAFEARM SIMULATOR	2	EA	30,000	60,000
34.	LOW ENERGY PYRO SIMULATOR	2	EA	30,000	60,000
35.	PYRO SYSTEM CHECKOUT UNIT	2	EA	30,000	60,000
	FLCA PYRO TEST SET	4	EA	40,000	160,000
	SUBTOTAL				452,000

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO. _____

PCH _____

DATE PREPARED
10-2-88

SHEET 8A OF 12A

PROJECT
LRB INTEGRATION STUDY

LOCATION
LRB GET PROCESSING FACILITY CONTROL ROOM, LCL-39, KSC

CODE _____

ARCHITECT/ENGINEER _____

ESTIMATOR
R. H. WASSUM

DRAWING NO. _____

CHECKED BY _____

APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	LAUNCH PROCESSING SYSTEM				
	COMPUTER CONSOLES/CPU	6	EA	400,000	2,400,000
2.	HARDWARE INTERFACE MODULES (HIM)	2	EA	90,000	180,000
3.	FRONT END PROCESSOR (FEP)	2	EA	80,000	160,000
4.	VOICE AND DATA RECORDER SYSTEM	1	EA	30,000	30,000
5.	UNINTERRUPTIBLE POWER SUPPLY (UPS)	1	EA	70,000	70,000
6.	CONTROL CABLES	200	EA	1000	200,000
7.	LONG RUN CABLES	46	EA	1000	46,000
8.	TERMINAL DISTRIBUTORS	5	EA	30,000	150,000
9.	FIRE CONTROL SYSTEM	1	EA	150,000	150,000
10.	PORTABLE TEST EQUIPMENT FOR AVIONICS/ENGINE	1	SET	150,000	150,000
11.	OLSA RACK	1	EA	100,000	100,000
12.	STRIP CHART RECORDERS (SCRS)	1	EA	60,000	60,000
13.	PROCESSED DATA RECORDER/CP5.4	1	EA	75,000	75,000
	SUB-TOTAL				\$3,771,000

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

Q. NO. _____ PCN _____ DATE PREPARED 10-4-88 SHEET 9A OF 12A

PROJECT LRB INTEGRATION STUDY

LOCATION LRB & ET HORIZONTAL PROCESSING FACILITY ENGINE SHOP, G. S. E., LC-39, KSC CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR R. H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	HYSTER LIFT TRUCK (H70-0764)				\$900,000.
2.	ENGINE HORIZONTAL INSTALLER (H70-0568)				665,000
3.	ENGINE HANDLER (H90-0901)				460,000
4.	ENGINE HANDLER, SLING (H70-0902)				16,000
5.	INTERFACE SUPPORT PANEL (H70-0911)				75,000
6.	ROTATING SLING (H70-0903)				400,000
7.	ENGINE VERTICAL INSTALLER (H70-0774)				1,250,000
8.	PROOF LOAD FIXTURE SET (H70-0911)				600,000
9.	ENGINE MOVER SET (H70-0890)				310,000
10.	ENGINE ALIGNMENT SET (A70-0645)				925,000
11.	ENGINE COMPONENT HANDLER SET (H70-0905)				630,000
12.	ENGINE LRU INSTALL/REMOVAL SET (H70-0528)				1,150,000
12.	ENGINE HANDLER MOVER				7,500
14.	ENGINE DOLLY (VERTICAL)	4	EA	25,000	100,000
15.	ENVIRONMENTAL PROTECTION SET (S70-0902)	8	EA	2,500	20,000

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO. PCN DATE PREPARED SHEET 10A OF 12A
10-4-88

PROJECT LRB INTEGRATION STUDY

LOCATION LRB & ET HORIZONTAL PROCESSING FACILITY ENGINE SHOP, G.S.E. LC-39, KSC CODE

ARCHITECT/ENGINEER ESTIMATOR
P. H. WASSUM

DRAWING NO. CHECKED BY APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
16.	INTERNAL INSPECTION EQUIPMENT (C70-0907)				\$ 200,000
17.	TEST ADAPTER SET (C70-0914)	2	EA	75,000	150,000
18.	FLOW TESTER (C70-0903/ C70-0904/C70-0908)	2	EA	150,000	300,000
19.	REGULATOR PANEL (C70-0743-X)	2	EA	32,000	64,000
20.	ENGINE FLUSH AND DRYING UNIT				500,000
21.	THERMAL PROTECTION SYSTEM WELDER	2	EA	75,000	150,000
22.	ENGINE COMMAND AND DATA SIMULATOR				400,000
23.	LRB ENGINE ACCESS PLATFORM, VERTICAL				600,000
24.	LRB ENGINE ACCESS PLATFORM, HORIZONTAL				550,000
25.	LRB ENGINE ACCESS PLATFORMS, VERTICAL	4	EA	150,000	600,000
26.	MANLIFT FOR ENGINE CHAMBER ENTRY	4	EA	75,000	300,000
27.	PRIMARY GASEOUS HELIUM REGULATOR PANEL (S70-0695-1)				250,000
28.	PRIMARY GASEOUS NITROGEN REGULATOR PANEL (S70-0695-2)				250,000
29.	MASS SPECTROMETER STATION				200,000

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO. PCN DATE PREPARED: 10/29/80 SHEET 12A OF 12A

PROJECT: **LRB INTEGRATION STUDY**

LOCATION: **ET / LRB HPF (LO2 / LH2 AND LO2 / RP1 GDSG PRES)** CODE

ARCHITECT/ENGINEER ESTIMATOR: S. BURNH

DRAWING NO. CHECKED BY APPROVED BY

EM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	SITE PREPARATION	262,800	SF	5 ⁰⁰	1,314,000
2.	STRUCTURE			25 ⁰⁰	6,570,000
3.	ARCHITECTURAL			10 ⁰⁰	2,628,000
4.	MECHANICAL			25 ⁰⁰	6,570,000
5.	ELECTRICAL			15 ⁰⁰	3,942,000
6.	2-30 TON CRANE				1,600,000
7.	20 TON CRANE				650,000
8.	2-5 TON HOISTS				60,000
9.	12" REINFORCED CONCRETE APRON (190,000 SF)	23,200	SY	32 ⁰⁰	743,000
10.	12" REINFORCED CONCRETE TOWNLAY (60,000 SF)	7,300	SY	32 ⁰⁰	234,000
11.	OUTFITTING (20% OF BUILDING COST @ \$21,024,000)				4,205,000
					<u>28,516,000</u>
	SUB OVERHEAD	15 %			4,278,000
	SUB PROFIT	10 %			3,280,000
	PRIME MARK-UP	10 %			3,607,000
	BOND	1 %			397,000
	ESCALATION (2 YEARS)	10.25 %			4,108,000
	CONTINGENCY	15 %			<u>6,638,000</u>
					50,514,000

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GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 10-1-88 SHEET 2B OF 10B

PROJECT **LRB INTEGRATION STUDY**

LOCATION **VAB, HIGH BAY 4, LC-39, KSC** CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR **R.H. WASSUM**

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	ELECTRICAL (SAME AS ON ESTIMATE PCN 75899 AS ESCALATED. LABOR 25,000HH MATERIAL \$265,810)	1	EA	890,810	890,810
2.	STRUCTURAL STEEL - DEMOLITION	512	TON	2000	1,024,000
3.	PLATFORM STRUCTURAL STEEL-EXTENSIBLE	1000	TON	3039	3,039,000
4.	SUPPORTING STRUCTURAL STEEL	700	TON	3039	2,127,300
5.	PEDESTAL TYPE IV (88,000LB)	1	EA	172,500	172,500
6.	PEDESTAL TYPE V (54,000LB)	2	EA	105,000	210,000
7.	PEDESTAL TYPE VI (41,000LB)	3	EA	81,250	243,750
8.	EXTERNAL DRIVE MECH. FOR PLATFORMS	6	EA	40,000	240,000
9.	Aux. PLATFORMS, STRUCTURAL AL. (12 EA. @ 2000LB)	12	EA	24,000	288,000
10.	1 TON JIB CRANES	6	EA	4,000	24,000
11.	5 TON JIB CRANES	6	EA	12,000	72,000
12.	ECS STATIONS	6	EA	283,200	1,699,200
13.	DRAFTER WHITE ROOM 67'x100'	1	EA	600,000	600,000
14.	ELECTRICAL CABLES	60	EA	1,000	60,000
					<u>10,690,500</u>

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<input type="checkbox"/> GROUND SUPPORT EQUIPMENT		KSC PRELIMINARY COST ESTIMATE WORK SHEET			<input type="checkbox"/> CONSTRUCTION	
I. NO.		PCN		DATE PREPARED		
				10-2-88		
PROJECT						
LRB INTEGRATION STUDY						
LOCATION					CODE	
GSE, HIGH BAY 4, VAB, KSC						
ARCHITECT/ENGINEER			ESTIMATOR			
			R. H. WASSUM			
DRAWING NO.		CHECKED BY		APPROVED BY		
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT	
1.	LRB FILEL & OXIDIZER VENT VALVE ACTUATION PANEL (SIMILAR TO 572-0680-01)	2	EA	175,000	350,000	
2.	STAINLESS STEEL TUBING	1	LOT	40,000	40,000	
3.	NEW 9099 ELECTRICAL INTERFACE	1	EA	150,000	150,000	
4.	TERMINAL DISTRIBUTORS	5	EA	15,000	75,000	
5.	PYRO TEST DISTRIBUTOR	1	EA	45,000	45,000	
6.	LPS SIGNAL ADAPTER	1	EA	80,000	80,000	
7.	MODIFY EXISTING DC POWER PANEL	1	EA	8,000	8,000	
8.	MODIFY EXISTING HIM	1	EA	12,000	12,000	
9.	MODIFY EXISTING TERMINAL DISTR.	2	EA	10,000	20,000	
10.	MODIFY EXISTING PANEL (SAME AS ITEM 1)	1	EA	80,000	80,000	
					860,000	
	SUB OVERHEAD	15%			129,000	
	SUB PROFIT	10%			98,900	
	PRIME MARKUP	10%			108,790	
	BOND	1%			11,967	
	ESCALATION (LYR)	5%			60,433	
	CONTINGENCY	15%			190,363	
	SPECIAL CONDITIONS				145,945	
					1,605,317	
	TOTAL GSE			SAY	\$ 1,610,000	

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

7. NO. _____ PCN _____ DATE PREPARED 10-5-88 SHEET 48 OF 108

PROJECT LRB INTEGRATION STUDY

LOCATION FACILITY MODIFICATION, VAB, HIGH BAY 4, LC-39, KSC

CODE _____

ARCHITECT/ENGINEER _____

ESTIMATOR R.H. WASSUM

DRAWING NO. _____

CHECKED BY _____

APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>DELTA COSTS FOR LO₂/RPI PRESS (GDCC) AND LO₂/LH₂ CONFIGURATIONS:</u>				
<u>1.</u>	<u>EXTENSIBLE PLATFORMS</u>				<u>\$</u>
	<u>A-36 STEEL</u>	<u>200</u>	<u>TONS</u>	<u>3039</u>	<u>607,900</u>
<u>2.</u>	<u>SUPPORTING STRUCTURE</u>				
	<u>A-36 STEEL</u>	<u>140</u>	<u>TONS</u>	<u>3039</u>	<u>425,460</u>
<u>3.</u>	<u>EXTERNAL DRIVE MECH. FOR PLATFORMS</u>	<u>2</u>	<u>EA</u>	<u>40,000</u>	<u>80,000</u>
<u>4.</u>	<u>1-TON JIB CRANE</u>	<u>2</u>	<u>EA</u>	<u>4,000</u>	<u>8,000</u>
<u>5.</u>	<u>5-TON JIB CRANE</u>	<u>2</u>	<u>EA</u>	<u>12,000</u>	<u>24,000</u>
<u>6.</u>	<u>ELECTRICAL</u>	<u>1</u>	<u>LOT</u>	<u>209,000</u>	<u>209,000</u>
					<u>1,345,260</u>
	<u>SUB OVERHEAD</u>	<u>15</u>	<u>%</u>		<u>201,789</u>
	<u>SUB PROFIT</u>	<u>10</u>	<u>%</u>		<u>154,705</u>
	<u>PRIME MARKUP</u>	<u>10</u>	<u>%</u>		<u>170,175</u>
	<u>BOND</u>	<u>1</u>	<u>%</u>		<u>18,719</u>
	<u>ESCALATION (1YR.)</u>	<u>5</u>	<u>%</u>		<u>94,532</u>
	<u>CONTINGENCY</u>	<u>15</u>	<u>%</u>		<u>297,777</u>
	<u>SPECIAL CONDITIONS</u>	<u>10</u>	<u>%</u>		<u>228,296</u>
					<u>2,511,254</u>
	<u>TOTAL ESTIMATE</u>				<u>\$2,511,254</u>

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

O. NO. _____ PCN _____ DATE PREPARED 10-1-88 SHEET 6B OF 10B

PROJECT LRB INTEGRATION STUDY

LOCATION VAB, HIGH BAY 3, LC-39, KSC CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR R.H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	ELECTRICAL (SAME AS ON ESTIMATE PCN 25899 AS ESCALATED. LABOR 25000 MH - MATERIAL \$265,810)	1	EA	890,810	890,810
2.	MODIFY EXISTING EXTENSIBLE PLATFORMS, STEEL	18	EA	30,000	540,000
3.	AUX. ALUMINUM PLATFORMS (SRB-AB @ 1000 LB)	16	EA	20,000	320,000
4.	AUX. AL PLATFORMS (LRB @ 2000 LB)	2	EA	20,000	40,000
5.	MODIFY EXISTING AUX. ALUMINUM PLATFORM	14	EA	15,000	210,000
6.	MODIFY SUPERSTRUCTURE	1	LOT	100,000	100,000
7.	ECS STATIONS	6	EA	283,200	1,699,200
8.	ELECTRICAL CABLES	40	EA	1,000	40,000
	SUB-TOTAL				3,840,010

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

W 3. PCN DATE PREPARED 10-2-88 SHEET 23 OF 103

PROJECT LRB INTEGRATION STUDY
 LOCATION GSE, HIGH BAY 3, VAB, KSC CODE

ARCHITECT/ENGINEER ESTIMATOR

DRAWING NO. CHECKED BY APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	LRB FUEL & OXIDIZER VENT VALVE ACTUATION PANEL (SIMILAR TO 572-0680-01)	2	EA	17,500	350,000
2.	STAINLESS STEEL TUBING	1	LOT	20,000	20,000
3.	MODIFICATIONS TO 9099 ELECTRICAL INTERFACE	1	EA	50,000	50,000
4.	MODIFICATION TO LRB FUEL & OXIDIZER PANEL	1	EA	8,000	8,000
5.	MOD TO TERMINAL DISTRIBUTORS	4	EA	10,000	40,000
6.	MOD TO PATCH DISTRIBUTOR PANEL	1	EA	12,000	12,000
7.	MOD TO PYRO TEST DISTR	1	EA	15,000	15,000
8.	MOD TO LPS SIGNAL ADAPTER	1	EA	10,000	10,000
9.	MOD TO HIM	1	EA	5,000	5,000
	SUB-TOTAL				\$582,000

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KSC PRELIMINARY COST ESTIMATE WORK SHEET

GROUND SUPPORT EQUIPMENT
 CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 10-3-88 SHEET 9B OF 10B

PROJECT LRB INTEGRATION STUDY
 LOCATION VAB CRAWLERWAY, LC-39, KSC CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR R. H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	WEIGHT REINFORCED CONCRETE CROSS-OVERS FOR CRAWLERWAY:				
	CONCRETE	569.9	CY	200.	113,980.
	#8 REINFORCING BAR	41.0	TONS	520.	21,320
	#6 REINFORCING BAR	69.0	TONS	520.	35,880
	DEWATERING	8	LOTS	16,000	128,000
2	RELOCATE OFF MODULAR HOUSING	1	EA	400,000	400,000
3.	DEMOLITION:				
	RAILROAD (250 LF)	250	LF	20	5,000
	ASPHALT PARKING AREA	-	-	-	-
	#8,00 SF	900'	SF	4	3,600
	FENCE (8' HIGH - 160 LF)	1	LOT	600	600
	12" POTABLE WATER LINE	160	LF	40	6,400
	8" SANITARY SEWER LINE	160	LF	5	800
	15KV DUCT BANK	160	LF	30	4,800
	PREVIOUS FILL OVER	-	-	-	-
	CRAWLERWAY	41,482	CY	5	207,410
	COMM DUCT BANK	600	LF	30	18,000
	COMM MANHOLE	2	EA	2000	4,000
	POWER MANHOLE	1	EA	2000	2,000
	FIREX, 8"	200	LF	40	8,000
4.	8' GATE X 145 LF	1	EA	20,000	20,000
5.	PAVED DRIVEWAY	5,263	SF	57	310,517
	PASE DRIVE	31,572	CY	35	1,105,020
7.	RAILROAD ENDING	1	EA	5000	5000
8.	12" POTABLE WATER LINE	180	LF	40	7,200
9.	8" SANITARY SEWER LINE	300	LF	40	12,000

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GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

Q. NO. PCN DATE PREPARED 10-3-88 SHEET 10B OF 10B

PROJECT L R B INTEGRATION STUDY

LOCATION VAB CRAWLERWAY LC-39, KSC CODE

ARCHITECT/ENGINEER ESTIMATOR R. H. WASSUM

DRAWING NO. CHECKED BY APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
10.	15 KV DUCT BANK	200	LF	60	\$ 12,000
11.	COMM. DUCT BANK	800	LF	60	48,000
12.	POWER MANHOLE	1	EA	5,000	5,000
13.	FIREX LINE 8"	220	LF	60	13,200
14.	RELOCATE 14" C.W. LINES	320	LF	112.5	16,000
15.	RELOCATE 4" C.W. LINES	320	LF	30	9,600
16.	RELOCATE 2" LINES ⁵⁵⁷ G ₁ & G ₂	320	LF	25	8,000
					3,532,737
	SUB OVERHEAD	15	%		379,911
	SUB PROFIT	10	%		291,265
	PRIME MARKUP	10	%		320,391
	BOND	1	%		35,243
	ESCALATION (1 YR.)	5	%		177,977
	CONTINGENCY	15	%		560,629
					\$4,298,153
	TOTAL			SAY	\$4,300,000

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GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 7-16-88 SHEET 26 OF 156

PROJECT LRB INTEGRATION STUDY

LOCATION LRB MLP #4 - ALL LO2 / RP-1 CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR J. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>FACILITY REQUIREMENTS</u>				
	<u>SUMMARY -</u>				
	<u>STRUCTURAL</u>				<u>16,260,000</u>
	<u>ARCHITECTURAL</u>				<u>1,172,000</u>
	<u>ELECTRICAL</u>				<u>5,250,000</u>
	<u>MECHANICAL</u>				<u>5,715,000</u>
	<u>SUB-TOTAL</u>				<u>28,397,000</u>
	<u>SUB OVERHEAD</u>	<u>15%</u>			<u>x 1.15</u>
	<u>SUB PROFIT</u>	<u>10%</u>			<u>x 1.10</u>
	<u>PRIME O/H & PROFIT</u>	<u>10%</u>			<u>x 1.10</u>
	<u>BOND</u>	<u>1%</u>			<u>x 1.01</u>
	<u>ESCALATION</u>	<u>13%</u>			<u>x 1.13</u>
	<u>CONTINGENCY</u>	<u>15%</u>			<u>x 1.15</u>
	<u>TOTAL</u>				<u>51,863,000</u>
	<u>(TO SHEET 1)</u>				

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO.	PCN	DATE PREPARED 9-13-55	SHEET <u>36</u> OF <u>156</u>
PROJECT LRB INTEGRATION STUDY			
LOCATION LRB MLP # 4 - ALL LO2 / RP-1			CODE
ARCHITECT/ENGINEER		ESTIMATOR S. BURNS	
DRAWING NO.	CHECKED BY	APPROVED BY	

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	LAUNCH SUPPORT EQUIPMENT SUMMARY				
	FABRICATION -				15,400,000
	ESCALATION	13%			x 1.13
	CONTINGENCY	15%			x 1.15
	SUB-TOTAL				20,013,000
	DAVIS-BACON -				1,570,000
	SUB OVERHEAD	15%			x 1.15
	SUB PROFIT	10%			x 1.10
	PRIME O/H & PROFIT	10%			x 1.10
	BOND	1%			x 1.01
	ESCALATION	13%			x 1.13
	CONTINGENCY	15%			x 1.15
	SUB-TOTAL				2,868,000
	TOTAL				22,881,000
	(TC TAB-1)				

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GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 9-16-99 SHEET 46 OF 156

PROJECT LRB INTEGRATION STUDY

LOCATION LRB MLP # 4 - ALL LO2 / RP-1 CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURLIS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>GROUND SUPPORT EQUIPMENT SUMMARY</u>				
	<u>FABRICATION -</u>				<u>21,737,000</u>
	<u>ESCALATION</u>	<u>13%</u>			<u>x 1.13</u>
	<u>CONTINGENCY</u>	<u>15%</u>			<u>x 1.15</u>
	<u>SUB-TOTAL</u>				<u>28,313,000</u>
	<u>DAVIS-BACON -</u>				<u>3,796,000</u>
	<u>SUB OVERHEAD</u>	<u>15%</u>			<u>x 1.15</u>
	<u>SUB PROFIT</u>	<u>10%</u>			<u>x 1.10</u>
	<u>PRIME O/H & PROFIT</u>	<u>10%</u>			<u>x 1.10</u>
	<u>BOND</u>	<u>1%</u>			<u>x 1.01</u>
	<u>ESCALATION</u>	<u>13%</u>			<u>x 1.13</u>
	<u>CONTINGENCY</u>	<u>15%</u>			<u>x 1.15</u>
	<u>SUB-TOTAL</u>				<u>6,734,000</u>
	<u>TOTAL</u>				<u>35,247,000</u>
	<u>(100,000 - 1)</u>				

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<input type="checkbox"/> GROUND SUPPORT EQUIPMENT	KSC PRELIMINARY COST ESTIMATE WORK SHEET	<input type="checkbox"/> CONSTRUCTION
NO.	PCH	DATE PREPARED 9-16-98
PROJECT LRB INTEGRATION STUDY		SHEET 56 OF 156
LOCATION LRB MLP # 4 - ALL LOG / RP-1		CODE
ARCHITECT/ENGINEER		ESTIMATOR S. BURNS
DRAWING NO.	CHECKED BY	APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	FACILITY REQUIREMENTS				
	STRUCTURAL -				
	SUPERSTRUCTURE	4200	TONS	3300	13,860,000
	FALSEWORK	1000	TONS	2400	2,400,000
	--SUB-TOTAL (TO SHEET 2)				16,260,000
	ARCHITECTURAL -				
	PAINT	185000	SF	3 ⁰⁰	550,000
	FLOORING	20000	SF	11 ⁰⁰	220,000
	INSULATION	20000	SF	9 ⁰⁰	180,000
	DOORS / HATCHES	60	EA	3700	222,000
	SUB-TOTAL (TO SHEET 2)				1,172,000
	ELECTRICAL -				
	AC POWER	1	LOT	3600 ^K	3,600,000
	SUB STATIONS	2	EA	600 ^K	1,200,000
	LIGHTING	1	LOT	240 ^K	240,000
	FIRE DETECTION	1	LOT	160 ^K	160,000
	PAGING / ARI	1	LOT	50 ^K	50,000
	--TOTAL--				5,250,000

GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 9-16-99 SHEET 76 OF 156

PROJECT: LRS INTEGRATION STUDY

LOCATION: LRS MLP # 4 - ALL LO2 / RP-1 CODE: _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	LAUNCH SUPPORT EQUIPMENT (LSE)				
	FABRICATION CONTRACTS -				
	TAIL SERVICE MAST	2	EA	3850 ^K	7,700,000
	HOLD DOWN MECH.	8	EA	100 ^K	800,000
	LIFT-OFF UMBILICAL (LO2)	2	EA	3100 ^K	6,200,000
	RP-1 UMBILICAL	2	EA	350 ^K	700,000
	SUB-TOTAL (TO SHEET 3)				15,400,000
	DAVIS-BACON -				
	ENGINE SERVICE PLATFORM (ESP)				
	SUPERSTRUCTURE	3	EA	151 ^K	453,000
	ACCESS PLM4	3	SET	63 ^K	189,000
	HOISTS	12	EA	54 ^K	648,000
	ESP SUB-TOTAL				1,290,000
	TS11 METALL	2	EA	40 ^K	80,000
	HO11 METALL	2	EA	50 ^K	100,000
	HO21 METALL	2	EA	50 ^K	100,000
	HO31 METALL	2	EA	50 ^K	100,000
	SUB-TOTAL (TO SHEET 3)				1,570,000

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO.	PCN	DATE PREPARED 9-16-95	SHEET <u>96</u> OF <u>156</u>
PROJECT LRB INTEGRATION STUDY			
LOCATION LRB MLP # 4 - ALL LO2 / RP-1			CODE
ARCHITECT/ENGINEER		ESTIMATOR J. BURNS	
DRAWING NO.	CHECKED BY	APPROVED BY	

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	A/E SERVICES				
	FACILITY REQUIREMENTS -				
	PER \$51,863,000				
	x .01%				
	<u>519,000</u>				<u>519,000</u>
	DESIGN \$51,863,000				
	x .08%				
	<u>4,150,000</u>				<u>4,150,000</u>
	SIES \$51,863,000				
	x .10%				
	<u>5,187,000</u>				<u>5,187,000</u>
	JOB TOTAL				<u>9,856,000</u>
	LAUNCH SUPPORT				
	PER \$51,863,000				
	x .01%				
	<u>229,000</u>				<u>229,000</u>

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO.	PCN	DATE PREPARED 7-16-88	SHEET <u>126</u> OF <u>156</u>
PROJECT LRB INTEGRATION STUDY			
LOCATION LRB MLP # 4 - ALL LOG / RP-1			CODE
ARCHITECT/ENGINEER		ESTIMATOR S. BURNS	
DRAWING NO.	CHECKED BY	APPROVED BY	

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	A/E SERVICES (CON'T.)				
	DESIGN	\$ 22,881,000			
		x .08%			
		1,831,000			1,831,000
	SIES	\$ 22,881,000			
		x .10%			
		2,288,000			2,288,000
	SUB-TOTAL				4,343,000
	GROUND SUPPORT EQUIPMENT -				
	PER	\$ 35,247,000			
		x .01%			
		353,000			353,000
	DESIGN	\$ 35,247,000			
		x .01%			
		3,520,000			3,520,000

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO.	PCN	DATE PREPARED <i>7-1-55</i>	SHEET <i>136</i> OF <i>156</i>
PROJECT <i>LRB INTEGRATION STUDY</i>			
LOCATION <i>LRB MLP # 41 - ALL LOG / RP-1</i>			CODE
ARCHITECT/ENGINEER		ESTIMATOR <i>S. BURNS</i>	
DRAWING NO.	CHECKED BY	APPROVED BY	

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<i>INITIAL SPARES -</i>				
	<i>9% OF LSE AND GSE FABRICATION COSTS</i>				
	<i>LSE \$20,013,000</i>				
	<i>x .09%</i>				
	<i>1,802,000</i>				<i>1,802,000</i>
	<i>GSE \$28,313,000</i>				
	<i>x .09%</i>				
	<i>2,549,000</i>				<i>2,549,000</i>
	<i>TOTAL</i>				<i>4,351,000</i>
	<i>(TO SHEET 1)</i>				



GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. PCN DATE PREPARED *9-19-85* SHEET *2 D* OF *8 D*

PROJECT *LRB INTEGRATION STUDY*

LOCATION *LRB MLP # 5 - ALL LOG / RP-1* CODE

ARCHITECT/ENGINEER ESTIMATOR *S. BURNS*

DRAWING NO. CHECKED BY APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<i>LAUNCH SUPPORT EQUIPMENT SUMMARY</i>				
	<i>FABRICATION -</i>				<i>7,700,000</i>
	<i>ESCALATION</i>	<i>13%</i>			<i>x 1.13</i>
	<i>CONTINGENCY</i>	<i>15%</i>			<i>x 1.15</i>
	<i>SUB-TOTAL</i>				<i>10,007,000</i>
	<i>DAVIS-BACON -</i>				<i>1,650,000</i>
	<i>SUB OVERHEAD</i>	<i>15%</i>			<i>x 1.15</i>
	<i>SUB PROFIT</i>	<i>10%</i>			<i>x 1.10</i>
	<i>PRIME O/H & PROFIT</i>	<i>10%</i>			<i>x 1.10</i>
	<i>BOND</i>	<i>1%</i>			<i>x 1.01</i>
	<i>ESCALATION</i>	<i>13%</i>			<i>x 1.13</i>
	<i>CONTINGENCY</i>	<i>15%</i>			<i>x 1.15</i>
	<i>SUB-TOTAL</i>				<i>3,014,000</i>
	<i>TOTAL</i>				<i>13,671,000</i>
	<i>(- SHEET</i>				

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

W O. PCN DATE PREPARED 9.19.00 SHEET 3 D OF 3 D

PROJECT LRB INTEGRATION STUDY

LOCATION LRB MLP # 5 - ALL LOS / RP-1 CODE

ARCHITECT/ENGINEER ESTIMATOR S. BURNS

DRAWING NO. CHECKED BY APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	GROUND SUPPORT EQUIPMENT SUMMARY				
	FABRICATION -				5,716,000
	ESCALATION	13%			x 1.13
	CONTINGENCY	15%			x 1.15
	SUB-TOTAL				11,327,000
	DAVIS-BACON				5,853,000
	SUB OVERHEAD	15%			x 1.15
	SUB PROFIT	10%			x 1.10
	PRIME O/H & PROFIT	10%			x 1.10
	BOND	1%			x 1.01
	ESCALATION	13%			x 1.13
	CONTINGENCY	15%			x 1.15
	SUB-TOTAL				
	TOTAL				22,017,000

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 9-19-55 SHEET 4D OF 8D

PROJECT LRB INTEGRATION STUDY

LOCATION LRB MLP # 5 - ALL LO₂ / RP-1 CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>LAUNCH SUPPORT EQUIPMENT</u>				
	<u>FABRICATION -</u>				
	<u>HOLD DOWN MECH.</u>	<u>8</u>	<u>EA</u>	<u>100^K</u>	<u>800,000</u>
	<u>LIFT-OFF UMBILICAL (LO₂)</u>	<u>2</u>	<u>EA</u>	<u>3100^K</u>	<u>6,200,000</u>
	<u>RP-1 UMBILICAL</u>	<u>2</u>	<u>EA</u>	<u>350^K</u>	<u>700,000</u>
	<u>SUB-TOTAL (TO SHEET 2)</u>				<u>7,700,000</u>
	<u>DAVIS-BACON -</u>				
	<u>ENGINE SERVICE PLATFORM</u>	<u>3</u>	<u>EA</u>	<u>430^K</u>	<u>1,290,000</u>
	<u>TSM REMOVE / INSTALL</u>	<u>2</u>	<u>EA</u>	<u>80^K</u>	<u>160,000</u>
	<u>HDM INSTALL</u>	<u>8</u>	<u>EA</u>	<u>5^K</u>	<u>40,000</u>
	<u>LO₂ UMB. INSTALL</u>	<u>2</u>	<u>EA</u>	<u>40^K</u>	<u>80,000</u>
	<u>RP-1 UMB. INSTALL</u>	<u>2</u>	<u>EA</u>	<u>40^K</u>	<u>80,000</u>
	<u>SUB-TOTAL (TO SHEET 2)</u>				<u>1,650,000</u>

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 9-19-58 SHEET 5 D OF 8 D

PROJECT LRB INTEGRATION STUDY

LOCATION LRB MLP # 5 - ALL LO2 / RP-1 CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>GROUND SUPPORT EQUIPMENT</u>				
	<u>FABRICATION -</u>				
	<u>LRB MECHANICAL</u>	<u>1</u>	<u>LOT</u>		<u>5,379,000</u>
	<u>LRB ELECTRICAL</u>	<u>1</u>	<u>LOT</u>		<u>3,337,000</u>
	<u>SUB-TOTAL</u>				<u>8,716,000</u>
	<u>(TO SHEET 3)</u>				
	<u>DAVIS-BACON -</u>				
	<u>ORB/ET MECHANICAL</u>	<u>1</u>	<u>LOT</u>		<u>2,102,000</u>
	<u>ORB/ET ELECTRICAL</u>	<u>1</u>	<u>LOT</u>		<u>2,012,000</u>
	<u>LRB MECHANICAL</u>	<u>1</u>	<u>LOT</u>		<u>1,361,000</u>
	<u>LRB ELECTRICAL</u>	<u>1</u>	<u>LOT</u>		<u>378,000</u>
	<u>SUB-TOTAL</u>				<u>5,853,000</u>
	<u>(TO SHEET 3)</u>				

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO.	PCN	DATE PREPARED 9-19-65	SHEET <u>7 D</u> OF <u>8 D</u>
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PROJECT: LRB INTEGRATION STUDY

LOCATION: LRB MLP # 5. ALL LO2 / RP-1 CODE

ARCHITECT/ENGINEER ESTIMATOR
S. BURNS

DRAWING NO. CHECKED BY APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>A/E SERVICES (CON'T.)</u>				
	<u>LSE SUB-TOTAL</u>				<u>2,084,000</u>
	<u>GROUND SUPPORT EQUIPMENT -</u>				
	<u>DESIGN \$ 22,017,000</u>				
	<u> x .06 %</u>				
	<u> 1,321,000</u>				<u>1,321,000</u>
	<u>SIES \$ 22,017,000</u>				
	<u> x .10 %</u>				
	<u> 2,202,000</u>				<u>2,202,000</u>
	<u>GSE SUB-TOTAL</u>				<u>3,523,000</u>
	<u>TOTAL</u>				<u>13,906,000</u>
	<u>(TO SHEET 1)</u>				

GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCH _____ DATE PREPARED: 9-19-93 SHEET 8D OF 9D

PROJECT: LRB INTEGRATION STUDY

LOCATION: LRB MLP # 5 - ALL LOG / RP-1 CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR: S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	INITIAL SPARES -				
	9% OF LSE AND GSE FABRICATION COSTS				
	LSE \$ 10,007,000				
	x .09%				
	901,000				901,000
	GSE \$ 11,327,000				
	x .09%				
	1,020,000				1,020,000
	TOTAL (TO SHEET 1)				1,921,000

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GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCH _____ DATE PREPARED 10-31-88 SHEET 1E OF 2E

PROJECT LRB INTEGRATION STUDY

LOCATION MCP PARK SITE #2 CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	ACCESS TOWERS -				
	EARTH WORK	1500	CY	16 ⁰⁰	24,000
	FOUNDATIONS	200	CY	95 ⁰⁰	19,000
	STRUCTURAL STEEL	50	TONS	3300	165,000
	MISC. STEEL	15	TONS	4100	61,500
	GRATING	2500	SF	17 ⁰⁰	42,500
	HAND RAIL / KICK PL.	1000	LF	45 ⁰⁰	45,000
2.	PEDESTALS -				
	TYPE IV (1)	44	TONS	2050	90,200
	TYPE V (2)	54	TONS	2050	110,700
	TYPE VI (3)	61.5	TONS	2050	126,075
3.	MECHANICAL -				
	PIPE & SUPPORTS -				
	H2O (CHILLED				
	POTABLE, FIREX)	1	LOT	51 ^K	51,000
	SANITARY	1	LOT	31 ^K	31,000
	PNEUMATICS	1	LOT	25 ^K	25,000
	INTERFACE	1	LOT	20 ^K	20,000
	EQUIPMENT -				
	HYAC	1	LOT	124 ^K	124,000
	CHILLED H2O	1	LOT	4 ^K	4,500
	FIREX	1	LOT	-	-
	SANITARY	1	LOT	7 ^K	7,000
	PNEUMATICS	1	LOT	12 ^K	12,000

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GROUND SUPPORT EQUIPMENT KSC PRELIMINARY COST ESTIMATE WORK SHEET CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 10-31-88 SHEET 2E OF 2E

PROJECT LRB INTEGRATION STUDY

LOCATION MLP PARKSITE #2 CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
4.	ELECTRICAL —				
	SWITCHGEAR	1	EA	105 ^K	105,000
	MCC	1	EA	75 ^K	75,000
	TRANSFORMER	1	EA	17 ^K	17,000
	LIGHT FIXTURES	50	EA	600	30,000
	CONDUIT	1	LOT	42 ^K	42,000
	CABLE / CONNECTORS	1	LOT	6 ^K	6,000
	WIRE / CONNECTIONS	1	LOT	14 ^K	14,000
	COMM. DUCT BANK	450	LF	60 ⁰⁰	27,000
	COMM. CABLE	500	LF	25 ⁰⁰	12,500
	COMM. MANHOLE	1	EA	4 ^K	4,000
	SUB-TOTAL				1,297,475
	SUB-CONTRACT O/H	15	%		x 1.15
	SUB-CONTRACT PROFIT	10	%		x 1.10
	PRIME MARK-UP	10	%		x 1.10
	BOND	1	%		x 1.01
	ESCALATION (6 MONTHS)	2.5	%		x 1.025
	CONTINGENCY	15	%		x 1.15
	TOTAL				2,150,000
	* BASED ON MLP PARKSITE #3				
	C-100 ESTIMATE				



GROUND SUPPORT EQUIPMENT KSC PRELIMINARY COST ESTIMATE WORK SHEET CONSTRUCTION

NO. _____ PCH _____ DATE PREPARED **9-23-88** SHEET **1F** OF **15F**

PROJECT **LRB INTEGRATION STUDY**

LOCATION **LOX SYSTEM TANK, PADS AORB, LC-39, KSC** CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR **R.H. WASSUM**

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1	18" STEEL PILING w/ CONCRETE, 300F LG ^{3/4" THK}	96	EA	9,600	921,600
2	PILE CAPS 10'x10'x3'THK	16	EA	1,200	19,200
3	CUT OFFS	96	EA	20	1,920
4	PRERUGGING	96	EA	10	960
5	TESTING, PILE	1	EA	30,000	30,000
6	MOBILIZATION AND DEMOLITION	1	EA	50,000	50,000
	PILING SUBTOTAL				1,023,680
7	TANK	1	EA	1,800,000	1,800,000
8	SUPER INSULATION	1	EA	600,000	600,000
9	CONCRETE PAD FOR TANK	315	CY	100	31,500
10	CONCRETE FORMWORK	1	LOT	10,000	10,000
					3,465,180
	FROM SHEET 2F				10,576,000
	SUB TOTAL				14,041,180
	SUB OVERHEAD	15	%		2,106,177
	SUB PROFIT	10	%		1,404,118
	PRIME MARKUP	10	%		1,404,118
	BOND	1	%		140,412
	ESCALATION (1YR.)	5	%		702,059
	CONTINGENCY	15	%		2,106,177
	SPECIAL CONDITIONS	25	%		3,510,295
					27,775,551
	TOTAL COST FOR ONE (1) PAD		EA		\$29,800,000

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

W.O. _____ PCN _____ DATE PREPARED 9-23-88 SHEET 2F OF 15F

PROJECT LRB INTEGRATION STUDY
 LOCATION LOX SYSTEM, PADS A OR B, LC-39, KSC CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR R. H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1	1000 GPM LOX PUMPS	2	EA	150,000	300,000
2	5000 GPM LOX PUMPS	2	EA	260,000	520,000
3	10" VJ LINE	2000	LF	3400	6,800,000
4	10" VALVES, LOX	6	EA	80,000	480,000
5	10" DRAIN VALVES LOX	4	EA	60,000	240,000
6	3" MAIN FILL VALVE	1	EA	12,000	12,000
7	3" TANKER FILL VALVES	5	EA	12,000	60,000
8	INSTRUMENTATION	1	LOT	880,000	880,000
9	INSTRUMENTATION TUBING	1	LOT	400,000	400,000
10	LOX TANK PRESSURE				
	10" VAPORIZER	1	EA	28,800	29,000
11	10" VAPORIZER VALVES	1	EA	80,000	80,000
12	LOX INTERFACE				
	TOWER	1	EA	250,000	250,000
13	VJ LINE SUPPORTS	90	EA	1500	135,000
14	10" VENT VALVES	2	EA	80,000	160,000
15	AC/DC POWER SYSTEM	1	EA	120,000	120,000
16	LIGHTING SYSTEM	1	EA	60,000	60,000
17	FIRE DETECTION SYSTEM	1	EA	20,000	20,000
18	LIGHTNING PROTECTION SYSTEM	1	EA	10,000	10,000
19	TANK VENT STACK	1		20,000	
	SUB-TOTAL				10,576,000

ORIGINAL PAGE IS OF POOR QUALITY

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

D. NO. _____ PCN _____ DATE PREPARED 11-5-88 SHEET 4F OF 15F

PROJECT LRB INTEGRATION STUDY

LOCATION LH₂ SYSTEM, LC-39-A ORB, KSC CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR R. H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	TANK FOUNDATION (REF. LOX ESTIMATE)	1		1,023,680	1,023,680
2.	TANK - 900,000 GAL. (REF. LOX ESTIMATE)	1	EA	2,441,500	2,441,500
3.	LH ₂ VAPORIZER	1	EA	29,000	29,000
4.	FLARE STACK (230')	1	EA	800,000	800,000
5.	LH ₂ VALVES - 10"	10	EA	150,000	1,500,000
6.	LH ₂ VALVES - 6"	7	EA	60,000	420,000
7.	10" VJ PIPE	200	LF	3,400	680,000
8.	6" VJ PIPE	200	LF	2,040	408,000
9.	PIPE SUPPORTS	22	EA	1,500	33,000
10.	TANKER MANIFOLD VALVES (S PORT)	6	EA	30,000	180,000
11.	VENT PIPE - 6" S.ST. INSULATED	1400	LF	1,020	1,428,000
12.	PNEUMATICS & INSTRUMENTATION	1	LOT	1,625,000	1,625,000
13.	AC/DC POWER	1	EA	120,000	120,000
14.	LIGHTING SYSTEM	1	EA	160,000	160,000
15.	FIRE DETECTION	1	EA	20,000	20,000
16.	HGDS	1	EA	870,000	870,000
17.	DELUGE SYSTEM	1	EA	450,000	450,000

SUB-TOTAL

12,182,170

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KSC PRELIMINARY COST ESTIMATE WORK SHEET

GROUND SUPPORT EQUIPMENT CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED **9-27-88** SHEET **6F** OF **15F**

PROJECT **LRB INTEGRATION STUDY**

LOCATION **RP-1 SERVICING SYSTEM, PADS AOR B, LC-39, KSC** CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR **R. H. WASSUM**

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1	2000 GPM RP-1 PUMP	2	EA	200,000	400,000
2	1000 GPM RP-1 PUMP	1	EA	50,000	50,000
3	30 GPM RP-1 DRAIN PUMP	1	EA	10,000	10,000
4	RP-1 STORAGE TANK	3	EA	291,500	874,500
5	8" SCHEDULE 40 FILL & DRAIN LINE 3/16 S ST	1600	LF	100	160,000
6	6" SCHEDULE 40 VENT PIPE 3/16 S ST	1750	LF	60	105,000
7	8" WELD FITTINGS 3/16 S ST	20	EA	700	14,000
8	6" WELD FITTINGS 3/16 S ST	25	EA	400	10,000
9	VENT STACK	1	EA	30,000	30,000
10	CATALYTIC COMBUSTION CHAMBER	1	EA	90,000	90,000
11	8" VALVES	12	EA	9,500	114,000
12	6" VALVES	4	EA	6,000	24,000
13	PNEUMATIC SYSTEM	1	EA	120,000	120,000
14	CONTROL CONSOLE	1	EA	60,000	60,000
15	RP-1 SERVICE TOWER	1	EA	250,000	250,000
16	8" FLEXIBLE HOSE	1	EA	8,000	8,000
17	6" FLEXIBLE HOSE	1	EA	6,000	6,000
18	PIPE SUPPORTS	100	EA	100	10,000
19	MAINTENANCE WELLS & COOLESP	6	EA	17,000	102,000
20	FILTRATION SEPARATOR	1	EA	100	100
21	PIPE SUPPORTS	10	EA	1,000	10,000
22	AC/DC POWER SYSTEM	1	EA	100,000	100,000
	SUBTOTAL				\$ 3,076,700

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GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED _____ SHEET 7F OF 15F

PROJECT: **LRB INTEGRATION STUDY**
 LOCATION: **FLAME DEFLECTORS, PADS A OR B, LC-39, KSC** CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR: **R. H. WASSUM**

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
MAIN DEFLECTOR:					
1	STRUCTURAL STEEL	1347.5	TON	\$3039	\$4,095,053
2	FONDUL Fyre REFRACTOR	347.6	TON	900	312,840
3	METAL MESH REINFORCING	49000	SF	2	98,000
SIDE DEFLECTORS (2EA):					
4	STRUCTURAL STEEL	275.0	TON	3039	835,725
5	FONDUL FIRE REFRACTOR	82.5	TON	900	74,250
6	METAL MESH REINFORCING	3000	SF	2	6,000
TRUCKS AND TRACK:					
7	MAIN DEFLECTOR	1	EA		900,000
8	SIDE DEFLECTORS	2	EA	300,000	600,000
					\$ 6,921,868
SUB OVERHEAD		15	%		1,038,280
SUB PROFIT		10	%		796,015
PRIME MARKUP		10	%		875,616
BOND		1	%		96,317
ESCALATION (1YR)		5	%		486,405
CONTINGENCY		15	%		1,459,215
SPECIAL CONDITIONS		25	%		2,796,838
					13,984,140
TOTAL				SAY	\$14,000,000

7.6

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO.

PCN

DATE PREPARED

9-29-88

SHEET

8F

OF

15F

PROJECT

LRB INTEGRATION STUDY

LOCATION

ETH₂ VENT UMBILICAL & INTERTANK ACCESS ARM, PADS A OR B, LC-39, KSC

CODE

ARCHITECT/ENGINEER

ESTIMATOR

R. H. WASSUM

DRAWING NO.

CHECKED BY

APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1	ARCH./STRUCTURAL				\$401,046*
2	MECHANISMS				250,166*
3	MECHANICAL				177,155*
4	ELECTRICAL				18,452*
					846,819
	SUB OVERHEAD	15	%		127,023
	SUB PROFIT	10	%		97,384
	PRIME MARKUP	10	%		107,123
	BOND	1	%		11,783
	ESCALATION (1YR.)	5	%		59,507
	CONTINGENCY	15	%		187,446
	SPECIAL CONDITIONS	25	%		359,271
					1,796,356
	TOTAL			SAY	1,800,000

* DERIVED FROM ESTIMATE OF 1977, C-100, PCN 76535

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO. _____ PCH _____ DATE PREPARED _____ SHEET 10F OF 15F

PROJECT: LRB INTEGRATION STUDY

LOCATION: GOX VENT ARM (FABRICATION), LC-39, PAD AREA CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR: R. H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	GOX VENT ARM - FORWARD ARM SEGMENT EQUIP. & ASSEMBLY	1	EA	1,040,000	\$ 1,040,000
2.	FORWARD ARM SEGMENT STRUCTURAL - TYPE T1	18	TON	3339	60,102
3.	HINGE PIN ASSEMBLY	1	EA	125,000	125,000
4.	AFT ARM SEGMENT STRUCTURAL - TYPE T1	24	TON	3339	80,136
5.	HINGE SUPPORT STRUCTURE A36	40	TON	3039	121,560
6.	LATCH BACK SUPPORT STRUCTURE A36	15	TON	3039	45,585
	SUB-TOTAL				\$ 1,472,383

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

O. NO. _____ PCN _____ DATE PREPARED 11-1-88 SHEET 11F OF 15F

PROJECT LRB INTEGRATION STUDY

LOCATION LC-39 PAD A OR B - ACCESS (LO₂/RP-1 MMC & LO₂/RP-1 PUMP GDCC) CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR _____

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	LRB FORWARD ACCESS -				
	MODIFY SRB END. ACCESS PLFM. & RSS	2	EA	40 ^K	80,000
2.	LRB INTERTANK ACCESS -				
	NEW PLFM.	2	EA	25 ^K	50,000
	NEW CATWALK	2	EA	30 ^K	60,000
3.	ET / ORBITER ACCESS -				
	MODIFY +4 B PLFM	1	EA	15 ^K	15,000
	MODIFY -Y B PLFM	1	EA	15 ^K	15,000
4.	ORBITER WEATHER PROTECTION (OWP) -				
	* DEFERRED INSUFFICIENT DATA				
	SUB-TOTAL				220,000
	SUB-OVERHEAD	15	%		x 1.15
	SUB-PROFIT	10	%		x 1.10
	PRIME MARK-UP	10	%		x 1.10
	FUND	1	%		x 1.05
	ESCALATED	5	%		x 1.05
	CONTINGENCY	15	%		x 1.15
	SPECIAL CONDITIONS	25	%		x 1.25
	TOTAL				467,000

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7.6

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

NO.	PCN	DATE PREPARED 11-1-88	SHEET <u>12E</u> OF <u>15E</u>
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PROJECT: **LRB INTEGRATION STUDY**

LOCATION: **LC-39 PAD A OR B - ACCESS (LO2/LH2 AND LO2/ RP-1 PRESS. GDSS)** CODE

ARCHITECT/ENGINEER: ESTIMATOR: **J. BURNS**

DRAWING NO.: CHECKED BY: APPROVED BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	LRB FORWARD ACCESS -				
	COLUMNS	49.6	TONS	3300	163,680
	BEAMS	148.8	TONS	3300	491,040
	DIAGONALS	40.9	TONS	3300	134,970
	MISC.	10.0	TONS	4100	41,000
	GRATING	3200	SF	17 ⁰⁰	54,400
	STAIRS	2	EA	20 ^K	40,000
	HAND RAIL / KICK PL.	480	LF	45 ⁰⁰	21,600
	SUB-TOTAL				946,690
	SUB OVERHEAD	15	%		x 1.15
	SUB PROFIT	10	%		x 1.10
	PRIME MARKUP	10	%		x 1.10
	BOND	1	%		x 1.01
	ESCALATION (1 YEAR)	5	%		x 1.05
	CONTINGENCH	15	%		x 1.15
	SPECIAL CONDITIONS	25	%		x 1.25
	TOTAL				2,009,000

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

O. NO. _____ PCN _____ DATE PREPARED 11-2-88 SHEET 13F OF 15F

PROJECT LRB INTEGRATION STUDY

LOCATION LC-39 PAD A OR B - PRESSURE SYSTEMS (MMC) CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. HELIUM CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	1/2" x .072 TUBING 6000 PSIG	400	LF	15 ⁰⁰	6,000.
2.	FITTINGS 1/2"	1	LOT	1000	1,000
3.	3/4" x .035 TUBING 6000 PSIG	50	LF	15 ⁰⁰	750
4.	FITTINGS 3/4"	1	LOT	200	200
5.	FLEX HOSES	3	EA	1000	3,000
6.	SUPPORTS	200	EA	20 ⁰⁰	4,000
7.	TAP-IN TO EXISTING 6000 PSIG LINE	40	HR	32 ⁰⁰	1,280
8.	REGULATOR PANEL	2	EA	90 ⁰⁰	180,000
9.	CLEANING	1	LOT	1000	1,000
10.	HYDROSTAT TESTING	1	LOT	1000	1,000
11.	LEAK TESTING	1	LOT	500	500
12.	PAINT	450	LF	2 ⁰⁰	900
13.	INSTRUMENTATION	1	LOT	5000	5,000
14.	HIGH PRESSURE STORAGE BOTTLES	10	EA	100 ⁰⁰	1,000,000
15.	MANIFOLD	1	EA	10 ⁰⁰	10,000
	SUB-TOTAL				1,214,630
	SUB OVERHEAD	15	%		x 1.15
	SUB PROFIT	10	%		x 1.10
	PRIME MARK-UP	10	%		x 1.10
		1	%		x 1.01
		5	%		x 1.05
		15	%		x 1.15
	SPECIAL CONDITIONS	25	%		x 1.25
	TOTAL				2,577,000

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

7. NO. _____ PCN. _____ DATE PREPARED 11-2-88 SHEET 14F OF 15F

PROJECT LRB INTEGRATION STUDY

LOCATION LC-39 PAD A ORB - PRESSURE SYSTEMS (GRCC) CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. TRIDYME CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	1/2" x .072 TUBING 6000 PSIG	700	LF	15 ⁰⁰	10,500
2.	FITTINGS 1/2"	1	LOT	2000	2,000
3.	3/4" x .035 TUBING 6000 PSIG	50	LF	15 ⁰⁰	750
4.	FITTINGS 3/4"	1	LOT	200	200
5.	FLEX HOSES	5	EA	1000	5,000
6.	SUPPORTS	350	EA	20 ⁰⁰	7,000
7.	REGULATOR PANEL	2	EA	90 ⁰⁰	180,000
8.	MANIFOLD	2	EA	10 ⁰⁰	20,000
9.	INSTRUMENTATION	1	LOT	10 ⁰⁰	10,000
10.	CLEANING	1	LOT	2000	2,000
11.	HYDROSTAT TESTING	1	LOT	2000	2,000
12.	LEAK TESTING	1	LOT	1000	1,000
13.	PAINT	750	LF	2 ⁰⁰	1,500
	SUB-TOTAL				241,950
	SUB OVERHEAD	15	%		x 1.15
	SUB PROFIT	10	%		x 1.10
	PRIME MARK-UP	10	%		x 1.10
	BOND	1	%		x 1.01
	ESCALATION (1 YEAR)	5	%		x 1.05
	CONTINGENCY	15	%		x 1.15
	SUB-TOTAL				514,000
	TOTAL				514,000

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

O. NO. _____ PCN _____ DATE PREPARED 11-2-88 SHEET 15E OF 15E

PROJECT LRB INTEGRATION STUDY

LOCATION LC-39 PAD A OR B - TTV CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	TERMINATION TEST AND VERIFICATION (TTV)				
	MANPOWER 70				
	MHRS /YEAR x 2000				
	7 MONTHS x .583				
	DURATION				
	81,667	81667	HR	\$ 35.00	2,858,345
	ESCALATION (TO MID POINT @ 5%)	1.45	%		x 1.0145
	CONTINGENCY	15	%		x 1.15
	SPECIAL CONDITIONS	25	%		x 1.25
	SIES	10	%		x 1.10
	TOTAL				4,585,000

GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 10-10-88 SHEET 16 OF 24

PROJECT LRB INTEGRATION STUDY

LOCATION SIGNAL PROCESSING, LC-39, KSC FOR LRB. CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR R. H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>72-FIBER OPTIC CABLE:</u>				
<u>1.</u>	<u>LCC TO ROOM 203, PTCR, PAD A</u>	<u>21,620</u>	<u>LF</u>	<u>15.</u>	<u>324,300.</u>
<u>2.</u>	<u>LCC TO ROOM 203, PTCR PAD B</u>	<u>23,520</u>	<u>LF</u>	<u>15.</u>	<u>352,800.</u>
<u>3.</u>	<u>LCC TO VAB HiBAY 4</u>	<u>1,470</u>	<u>LF</u>	<u>15.</u>	<u>22,050.</u>
<u>4.</u>	<u>LCC TO MLP PARK SITE NO. 2</u>	<u>5,000</u>	<u>LF</u>	<u>15.</u>	<u>75,000.</u>
<u>5.</u>	<u>LCC TO LRB/ET PROCESSING FACILITY</u>	<u>3,300</u>	<u>LF</u>	<u>15.</u>	<u>49,500</u>
	<u>FIBER OPTIC TERMINATION DEVICES-MUX-DEMUX, ETC.</u>	<u>12</u>	<u>EA</u>	<u>10,870</u>	<u>130,440.</u>
	<u>SIGNAL HARD WIRING TO 48 SIGNAL PICKUP POINT (1-PR, T.S. #22AWG)</u>	<u>28,400</u>	<u>LF</u>	<u>0.92</u>	<u>25,560</u>
					<u>979,650</u>
	<u>SUB OVERHEAD</u>	<u>15</u>	<u>%</u>		<u>146,948</u>
	<u>SUB. PROFIT</u>	<u>10</u>	<u>%</u>		<u>112,660</u>
	<u>PRIME MARKUP</u>	<u>10</u>	<u>%</u>		<u>123,926</u>
	<u>BOND</u>	<u>1</u>	<u>%</u>		<u>12,432</u>
	<u>ESCALATION</u>	<u>5</u>	<u>%</u>		<u>62,940</u>
	<u>CONTINGENCY</u>	<u>15</u>	<u>%</u>		<u>1,662,534</u>
					<u>1,700,000</u>
	<u>TOTAL</u>			<u>SAY</u>	<u>1,700,000</u>

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GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

J. NO. _____ PCN _____ DATE PREPARED 9-30-88 SHEET 14 OF 64

PROJECT LRB INTEGRATION STUDY

LOCATION LETF - BASIC LSE ALL CONFIGURATIONS CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>SUMMARY</u>				
	<u>INSTALLATION & LETF CERTIFICATION TESTING</u>				<u>2,760,000</u>
	<u>LSE REFURB / REMOVE / SHIP FACILITY MODIFICATIONS</u>				<u>1,840,000</u>
					<u>1,520,000</u>
					<u>525,000</u>
	<u>SUB-TOTAL</u>				<u>9,645,000</u>
	<u>LETF INTEGRATION / FAC</u>	<u>60%</u>			<u>5,787,000</u>
	<u>MAINTENANCE / DOCUMENTATION</u>				
	<u>SUB-TOTAL</u>				<u>15,432,000</u>
	<u>ESCALATION (2 YEARS)</u>	<u>10.25%</u>			<u>x 1.1025</u>
	<u>CONTINGENCY</u>	<u>15%</u>			<u>x 1.15</u>
	<u>ACTIVATION MGMT.</u>	<u>15%</u>			<u>x 1.15</u>
	<u>TOTAL</u>				<u>22,500,000</u>

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GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED **9-30-88** SHEET **44** OF **64**

PROJECT **LRS INTEGRATION STUDY**

LOCATION **LETE- ADDITIONAL LSE LO₂ / RP-1** CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR **S. BURNS**

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	ALL LO ₂ / RP-1 CONFIGURATIONS -				
	DELTA COSTS MUST BE ADDED TO SUMMARY TOTAL SHOWN ON SHEET 1				
	INSTALLATION & LETE -				
	RP-1 UMBILICAL	2	EA	40 ^k	80,000
	CERTIFICATION TESTING -				
	RP-1 UMBILICAL	2	EA	60 ^k	120,000
	REURB / MAINTENANCE / REMOVE / SHIP -				
	RP-1 UMBILICAL	2	EA	15 ^k	30,000
	SUB-TOTAL				230,000
	INTEGRATION / FACILITY MAINT. / DOCUMENTATION	60	%		138,000
	SUB-TOTAL				368,000
	REGALATION / O-HEAD	10.25	%		1,125
	ACTIVATION MGMT.	15	%		1,125
	TOTAL				537,000

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GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 9-30-88 SHEET 5H OF 6H

PROJECT LRS INTEGRATION STUDY

LOCATION LETF - ADDITIONAL LSE LO₂/LH₂ GDSS CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR S. BURNS

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>LO₂ / LH₂ PUMP FED CONFIGURATION -</u>				
	<u>DELTA COSTS MUST BE ADDED TO SUMMARY TOTAL SHOWN ON SHEET</u>				
	<u>1</u>				
	<u>INSTALLATION @ LETF -</u>				
	<u>ET GOX VENT ARM</u>	<u>2</u>	<u>EA</u>	<u>230^k</u>	<u>460,000</u>
	<u>LH₂ T-O UMBILICAL</u>	<u>4</u>	<u>EA</u>	<u>220^k</u>	<u>880,000</u>
	<u>1</u>				
	<u>CERTIFICATION TESTING -</u>				
	<u>ET GOX VENT ARM</u>	<u>2</u>	<u>EA</u>	<u>240^k</u>	<u>480,000</u>
	<u>LH₂ T-O UMBILICAL</u>	<u>4</u>	<u>EA</u>	<u>480^k</u>	<u>1,920,000</u>
	<u>REFURB / MAINTENANCE / REMOVE / SHIP -</u>				
	<u>ET GOX VENT ARM</u>	<u>2</u>	<u>EA</u>	<u>190^k</u>	<u>380,000</u>
	<u>LH₂ T-O UMBILICAL</u>	<u>4</u>	<u>EA</u>	<u>135^k</u>	<u>540,000</u>



GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO.	PCN	DATE PREPARED 10-6-88	SHEET 1 I OF 6 I
PROJECT LRB INTEGRATION STUDY			
LOCATION HIGH VOLTAGE DISTRIBUTION			CODE
ARCHITECT/ENGINEER		ESTIMATOR R. H. WASSUM	
DRAWING NO.	CHECKED BY	APPROVED BY	

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	SUMMARY:				
1.	LRB & ET PROCESSING FACILITY SUBSTATION	2	EA	\$510,436	\$1,020,872
2.	PAD A LOX SUBSTATION	1	EA	510,436	510,436
3.	PAD A FUEL SUBSTATION	1	EA	510,436	510,436
4.	FEEDERS-60-39 AREA	1	EA	10,846,045	10,846,045
5.	LRB & ET UPS	1	EA	424,260	424,260
6.	LRB & ET EMERGENCY POWER	1	EA	220,372	220,372
7.	PAD B LOX SUBSTATION	1	EA	510,436	510,436
8.	PAD B FUEL SUBSTATION	1	EA	510,436	510,436
9.	NEW MLP SUBSTATIONS *	2	EA	—	— *
10.	PAD A LOX EMERGENCY POWER	1	EA	220,372	220,372
11.	PAD A FUEL EMERGENCY POWER	1	EA	220,372	220,372
12.	PAD B LOX EMERGENCY POWER	1	EA	220,372	220,372
13.	PAD B FUEL EMERGENCY POWER	1	EA	220,372	220,372
					\$15,434,781
	TOTAL			SAY	\$15,500,000

GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED 10-6-88 SHEET 3 I OF 6 I

PROJECT: LRB INTEGRATION STUDY

LOCATION: LC-39, KSC, HIGH VOLTAGE DISTRIBUTION CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR: R.H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	FEEDERS:				
	LRB GET PROCESSING FACILITY (4600')				
1.	13.8KV @ 200 A (4 EA)	55,200	LF	5 ⁰⁰	276,000
2.	480V @ 400A (1 EA)	18,400	LF	4 ⁰⁰	73,600
3.	DUCT BANK (6-4")	4,600	LF	11 ⁰⁰	50,600
	MLP PARK SITE #2 (4000')				
4.	13.8KV @ 200A (2 EA)	24,000	LF	5 ⁰⁰	120,000
5.	480V @ 400A (1 EA)	16,000	LF	4 ⁰⁰	64,000
6.	DUCT BANK (4-4")	4,000	LF	7 ⁰⁰	28,000
	PAD LOX (52000')				
7.	13.8KV @ 200A (2 EA)	312,300	LF	5 ⁰⁰	1,561,500
8.	400A EMERGENCY (1 EA)	208,200	LF	4 ⁰⁰	832,800
9.	DUCT BANK (4-4")	52,000	LF	8 ⁰⁰	416,000
	PAD FUEL (52,000')				
10.	13.8KV @ 200A (2 EA)	312,300	LF	5 ⁰⁰	1,561,500
11.	400A EMERGENCY (1 EA)	208,200	LF	4 ⁰⁰	832,800
12.	DUCT BANK (4-4")	52,000	LF	8 ⁰⁰	416,000
	VAB HI-BAY 4 (2500')				
13.	13.8KV @ 200A (1 EA)	7,500	LF	5 ⁰⁰	37,500
14.	DUCT BANK (1-4")	2,500	LF	2 ⁰⁰	5,000
15.	TERMINALS	12	LF	3000	37,000
16.	ESCAPE 24 1/4" DIA	16,100	LF	1 ⁰⁰	16,100
	SUB-TOTAL				<u>7,371,160</u>

GROUND SUPPORT EQUIPMENT KSC PRELIMINARY COST ESTIMATE WORK SHEET CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED: 10-7-88 SHEET 4E OF 6E

PROJECT: RB INTEGRATION STUDY
LOCATION: HIGH VOLTAGE DISTRIBUTION, LC-39, KSC CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR: R.H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	UNINTERRUPTED POWER SYSTEM (UPS), 3PHASE, 208/120VAC, 600KVA WITH BATTERY BANK	1	EA	250,000	250,000 *
	SUB OVERHEAD	15	%		37,500
	SUB PROFIT	10	%		28,750
	PRIME MARKUP	10	%		31,625
	BOND	1	%		3,479
	ESCALATION (1YR)	5	%		17,568
	CONTINGENCY	15	%		55,338
					\$424,260

INCLUDES VENDOR QUOTE ON SYSTEM OF \$171,637.00

GROUND SUPPORT EQUIPMENT **KSC PRELIMINARY COST ESTIMATE WORK SHEET** CONSTRUCTION

NO. _____ PCN _____ DATE PREPARED _____ SHEET 51 OF 61

PROJECT LRB INTEGRATION STUDY

LOCATION 1000 A EMERGENCY POWER SYSTEM AND TRANSMISSION AND DISTRIBUTION RACKS, LC-39, KSC CODE _____

ARCHITECT/ENGINEER _____ ESTIMATOR R. H. WASSUM

DRAWING NO. _____ CHECKED BY _____ APPROVED BY _____

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
	<u>TYPE CDP CONVERTIBLE DISTRIBUTION PANELBOARD:</u>				
1.	<u>PANELBOARD 480/277V, 3Φ, 4W, 1000A</u>	1	EA	2,500	2,500
2.	<u>MAIN LUG 1200A, 3Φ, 4W</u>	1	EA	2,700	2,700
3.	<u>CIRCUIT BREAKER 600A/ADT.</u>	6	EA	1,900	11,400
	<u>TRANSFORMERS:</u>				
4.	<u>480V-208/120V, 3Φ, 4W, 112.5KVA</u>	2	EA	12,000	24,000
5.	<u>480V-208/120V, 3Φ, 4W 75.0 KVA</u>	2	EA	9,400	18,800
6.	<u>480V-208/120V, 3Φ, 4W/7.5KVA</u>	2	EA	1,000	2,000
	<u>SECONDARY DISTRIBUTION:</u>				
7.	<u>42 CKT, 3Φ, 4W, 225A, 208/120V</u>	2	EA	1125	2250
8.	<u>42 CKT, 3Φ, 4W, 100A, 208/120V</u>	2	EA	1000	2,000
9.	<u>1P CIRCUIT BREAKERS 50AF</u>	100	EA	50	5,000
10.	<u>3P CIRCUIT BREAKERS 225AF</u>	90	EA	540	48,600
					119,250
	<u>SUB OVERHEAD</u>	15	%		17,887
	<u>SUB PROFIT</u>	10	%		13,714
	<u>PRIME MARKUP</u>	10	%		15,085
	<u>BOND</u>	1	%		1,659
	<u>ESCALATION (1YR.)</u>	5	%		8,380
	<u>CONTINGENCY</u>	15	%		26,396
	<u>TOTAL</u>				<u>\$220,372</u>

GROUND SUPPORT EQUIPMENT

KSC PRELIMINARY COST ESTIMATE WORK SHEET

CONSTRUCTION

V. NO.

PCN

DATE PREPARED

SHEET 6 I OF 6 I

PROJECT

LRB INTEGRATION STUDY

LOCATION

HIGH VOLTAGE POWER DISTRIBUTION DOUBLE ENDED SUBSTATION

CODE

ARCHITECT/ENGINEER

ESTIMATOR

R. H. WASSUM

DRAWING NO.

CHECKED BY

APPROVED BY

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE MATERIAL & LABOR	ESTIMATED AMOUNT
1.	PRIMARY SWITCH 13.8KV, 3Φ, 4W TWO POSITIONS WITH 600A CIRCUIT BREAKER	2	EA	18,000	36,000
2.	TRANSFORMER, DRY TYPE, 2500KVA Δ-Y, 13.8KV-480/277V DISTRIBUTION RACKS:	2	EA	42,000	84,000
3.	21" X 60" WITH 4 SPACES	7	EA	8,500	59,500
4.	34" X 72" WITH 3 SPACES	2	EA	6,000	12,000
5.	12" X 72" TRANSITION RACK	2	EA	2,000	4,000
6.	20" X 55 1/4" TRANSITION RACK	2	EA	2,500	5,000
7.	33" X 55 1/4" PRIMARY SWITCH RACK	2	EA	4,000	8,000
	LOAD CENTERS				
8.	DS206 800A ADT. C.B. PANEL	16	EA	2,930	46,880
9.	DS416 1600A ADT. C.B. PANEL	5	EA	6,800	34,000
10.	DS840 4000A ADT. MAIN G.B.	2	EA	2,200	4,400
11.	INSTRUMENT/REMOTE SENSE PANEL	2	EA	3,500	7,000
					300,780
	SUB OVERHEAD	15	%		45,117
	SUB PROFIT	10	%		34,590
	PRIME MARKUP	10	%		38,049
	POND	1	%		4,185
	ESCALATION (1%)	5	%		