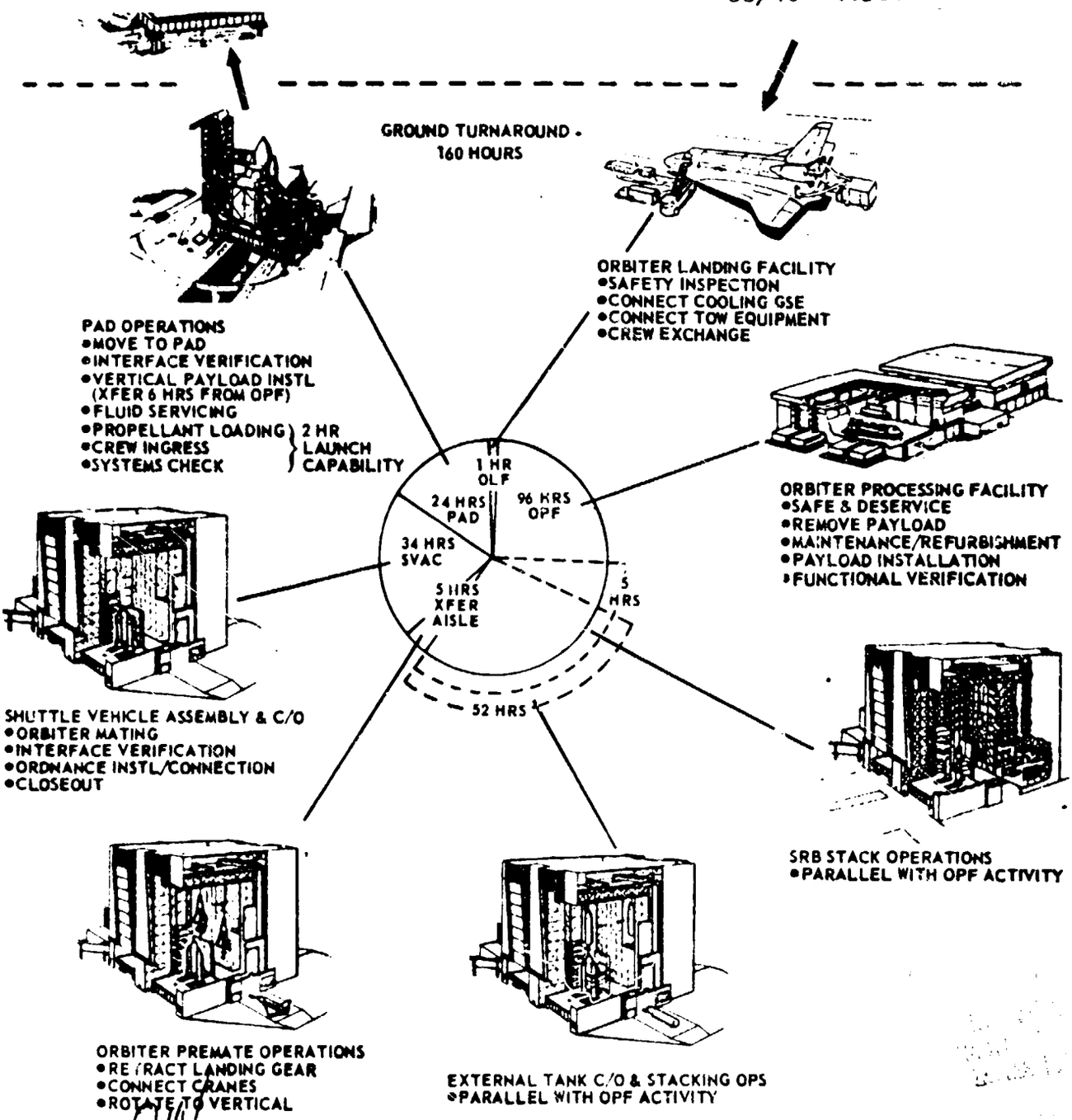
Hank Butler

# SHUTTLE TURNAROUND ANALYSIS REPORT

NO 017

DATE 3/14/79






PREPARED BY:

R. E. REEDY
ROCKWELL LO
OPERATIONS PLANNING

APPROVED BY:

E. M. SESTILE
STAG CHAIRMAN
KSC/SP-OPN

BSG 988

SPACE TRANSPORTATION SYSTEM

# SHUTTLE TURNAROUND ANALYSIS REPORT

(STAR 017)

14 AUGUST 1979

TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF ILLUSTRATIONS

## LIST OF ILLUSTRATIONS

# SECTION I

# INTRODUCTION

## 1.1 PURPOSE

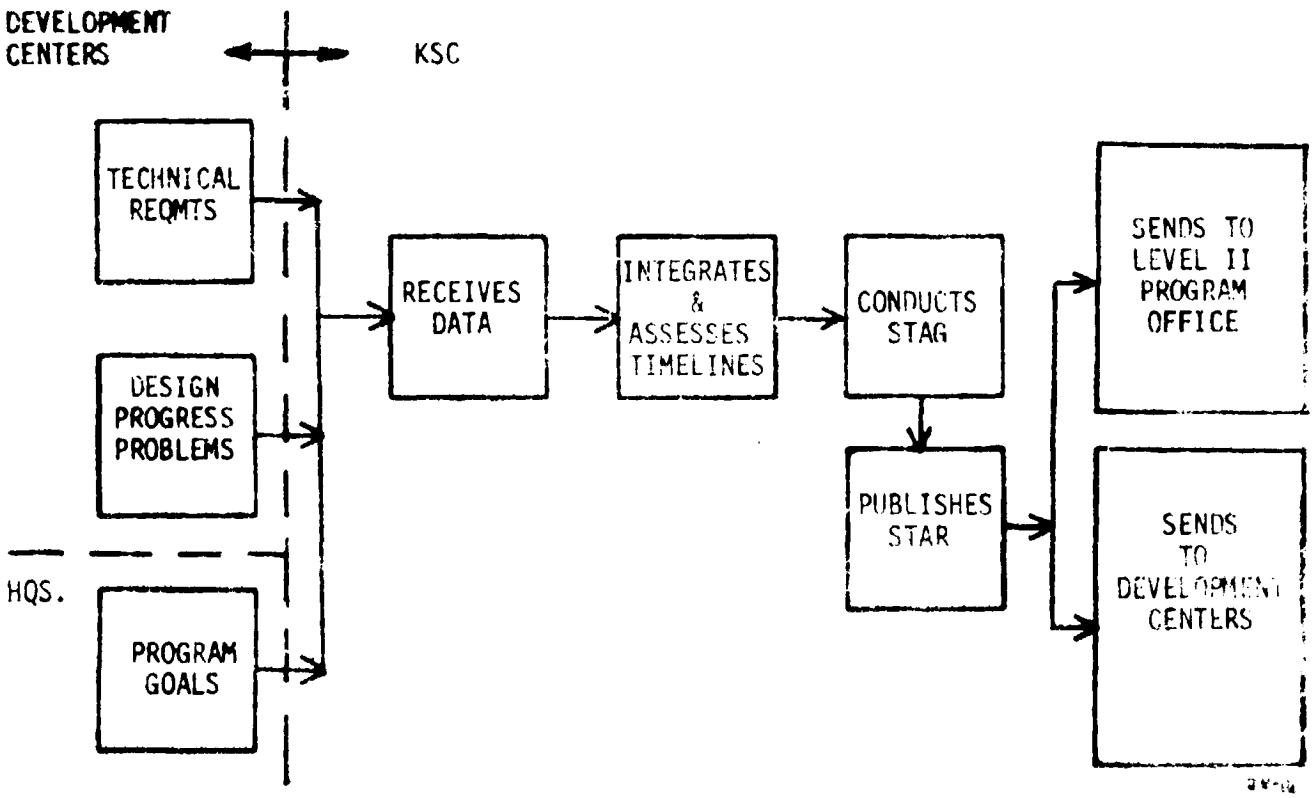
The purpose of the Shuttle Turnaround Analysis Report (STAR) is many fold. Its primary purpose is to show to the Shuttle Program Management the progress made by the various program elements in achieving the 160 hour ground turnaround goal.

The second purpose is to provide to all shuttle program personnel a "yard stick" whereby they can measure their task assessment time against the program allocation time and thereby formulate planning for eventual compliance with program objectives.

The third purpose is to identify problems early enough such that solutions can be found in a timely manner and thereby prevent or minimize schedule delays.

The fourth purpose is to identify problems as turnaround related or design related so that responsibility can be assigned for resolution.

This effort is monitored and encouraged by the Shuttle Turnaround Analysis Group (STAG). The STAG meets periodically, generally quarterly, to evaluate the progress being made by the various program elements in their efforts to achieve the program goals. The STAR reflects the result of the latest STAG meeting. The logic flow is illustrated as follows:



## 1.2 AUTHORITY

The STAR report is published by KSC SP-OPI under the authority of the Space Shuttle Level II Program Definitions and Requirements, Volume I, Program Description and Requirements Baseline and Volume IX, Ground Operations,(paragraph 3.5.2) of JSC 07700.

## 1.3 SCOPE

The STAR reports on the ground turnaround progress of the entire Space Transportation System. The system is composed of the orbiter, solid rocket boosters, external tank and related facilities. The facilities include:

a. Shuttle Landing Facility

b. Orbiter Processing Facility

c. Vehicle Assembly Building

d. Launch Pad

e. Mobile Launch Platform

f. Hypergolic Maintenance Facility

g. SRB Slip at Port Canaveral

h. SRB Dissassembly Facility at Hangar AF

i. SRB Refurbishment and Subassembly Facility in the VAB lowbay

j. Parachute Refurbishment Facility

k. SRB Disassembly Facility (Hangar AF)

l. Thiokol Plant, Corine, Utah

The STAR is presented to the Johnson Space Center Shuttle Program Office and depicts the operational turnaround function's current status. This report contains the following:

a. Level II Shuttle System operational allocation timelines and approved changes noted since the previous report. When appropriate, recommendations for changes in the timeline allocations will be submitted.

b. Level II assessment activity, including a delta comparison between allocation and assessment timeline.

c. Level II timeline allocation functional specification/ground rules and cnanges approved since the last report. Change recommendations will be submitted as required.

d. Integrated Shuttle turnaround allocation and assessment timelines.

e. Intergated STS turnaround assessments using typical cargo (Spacelab and Upper Stages).

f. Timeline assessment development history.

## 1.4 RESPONSIBILITY



This report is maintained by the KSC Shuttle Projects Operations Planning and Integration Office (SP-OPI). SP-OPI was assigned this task as a result of JSC Shuttle Program Office delegating to KSC the Level II chairmanship for STAG. Comments or questions on the contents of the STAR should be addressed to E. M. Sestile, SP-OPI.

## 1.5 REVISION

The Shuttle Turnaround Analysis Report (STAR) is updated after each STAG meeting. This is accomplished via the STAG minutes, which contains the minutes of the STAG proceedings. Revision control utilizes subsequent STAR numbering and dating, i.e. STAR 15, 16, 17, etc. The STAR change pages will include a new title page.

## 1.6 REFERENCES

a. JSC 07700, Level II Program Definitions and Requirements, Program Description and Requirements Baseline, Volume I, 160 hour turnaround requirement.

b. JSC 07700, Level II Program Definitions and Requirements, Program Description and Requirements Baseline, Volume IX, paragraph 3.5.2, delegates Level II chairmanship to KSC.

c. JSC 08171, Operations and Maintenance Requirements and Specifications Document (OMRSD), specifies test and checkout requirements.

d. K-STSM-09, KSC Ground Operations Plan, Operations Processing Analysis, Volume II, contains the STAR Level III Groundrules, Assumptions and Functional Specifications.

e. Letter, LG-7-221, dated December 17, 1973, delegates Level II chairmanship to KSC to conduct STAG meetings and publish the STAR.

## SECTION II

## LAUNCH & LANDING PROGRAM TURNAROUND REQUIREMENTS & IMPLEMENTATION



### 2.1 LEVEL I TURNAROUND TIME ALLOCATION

JSC 07700, Volume I establishes that, when the Space Shuttle system becomes operational, the time required for turnaround shall not exceed 160 working hours covering a span of 14 calendar days. The turnaround period commences with orbiter landing at the launch site and ends with vehicle launch. Additional payload verification, parameter update, payload access and/or servicing requirements which exceed the timeline allocation will require unique Shuttle operational scheduling and may extend the Shuttle turnaround time beyond 160 hours.

#### 2.1.1 SPACE SHUTTLE SYSTEM DESIGN COMPATIBILITY WITH TURNAROUND TIMELINE

The design of each element of the Space Shuttle vehicle shall be compatible with the Level II timeline allocations which identify timelines for shuttle with the payload installed in the OPF and on the launch pad. Each element project office is responsible for providing KSC with the latest approval design data. The design shall be of a fully operational Shuttle system. It shall consist of the latest approval design, technical operations requirements and maintenance requirements. Preliminary assessment timelines are also to be submitted. KSC will validate the timeline assessments and integrate the inputs into an integrated turnaround assessment. The assessment is reviewed at the next STAG meeting. KSC is responsible to bring to the attention of the program office for resolution those hardware designs that impact achievement of the 160 hour turnaround capability. Supporting hardware activities which could impact the facility sizing requirements and traffic model schedules are also presented.

#### 2.1.2 TURNAROUND CAPABILITY DEVELOPMENT

To achieve the 160-hour turnaround capability, an approach to ground operations will be selected that implements proven techniques and reduces subsystem-level checkout as performance confidence matures. Flight and ground hardware performance data baselines will be established during factory acceptance tests, major ground tests, the Approach and Landing Test Program, and the initial turnarounds and launches from KSC during the Orbital Flight Test Program (four developmental flights). This data base will be updated on each succeeding turnaround until the operational requirement of the 160-hour turnaround is attainable. Operations and maintenance tasks will be eliminated as a result of the reuse of the vehicle and the resultant confidence gained by previous performance of the systems. Ultimately, the ground operations goal is to utilize the maximum amount of data and information from previous flights during the turnaround, relying on broad "end-to-end" tests and "go/no-go" type data for flight readiness.

## 2.2 TURNAROUND ASSESSMENT

The operational turnaround assessment is an in-depth technical analysis of all of the tasks required for operational turnaround and their relationship to time and sequence from landing to launch. Figures 3 and 4 show a graphic representation of the assessment.

Each element program office is responsible for providing operating requirements and preliminary assessments of each function to be performed upon their element during the ground turnaround. This activity includes all handling, transportation, buildup, refurbishment, test, checkout, and launch functions associated with each flight. The element project offices are:

a. Orbiter (ORB) located at JSC

b. External Tank (ET) located at MSFC

c. Solid Rocket Booster (SRB) located at MSFC

d. Space Shuttle Main Engine (ME) located at MSFC

e. Launch and Landing (L&L) located at KSC

f. Payloads (PAY) located at JSC and KSC

Within each element program office , design engineers, test engineers, and operations planners examine the detailed aspects of equipment design and the test and checkout requirements. Ground Operations functional specifications are then generated and times to perform each function are assessed. These assessments are collected into timelines (integration into the overall timeline) and presented to the STAG meetings. As better data becomes available the timelines are updated periodically and retransmitted to STAG along with justification for the change.

Assessment timelines are generated for each required task identified in the 160 hour allocation. These allocations were apportioned in Level II and Level III detail by STAG. The STAG provided ground rules and functional specifications to identify each task represented in the timelines. It is intended that the test and checkout requirements contained in the Operations and Maintenance Requirements and Specifications Document (OMRSD-JSC-08171) will mature with a reduction in requirements during DDT and E to those contained in the STAR.

The times used for the assessments are those expected when the Shuttle Program is fully operational. This would occur after a number of flights have been performed such that the procedures and techniques have been optimized and the personnel have achieved a maximum level of proficiency. For the early STS flights, such as during the developmental flight stage, in which additional tasks other than those expected after being fully operational must be additions to the STAR assessments.

The assessments contained in this STAR represent the best possible turnaround time achievable without incorporating those product improvements which will be considered and implemented when the traffic model dictates a requirement for a more rapid turnaround.

### 2.2.1 STAR/STAG CHARTER

The Shuttle Program Manager in December 1973, delegated a Level II chairmanship to KSC to conduct STAG meetings and publish the STAR. The following table shows the centers and contractors and their areas of responsibility to the STAG meetings.

| CENTER | CONTRACTOR | RESPONSIBLE AREA |
|---|---|---|
| JSC | Rockwell | Orbiter |
| MSFC | Rocketdyne | SSME |
| MSFC | Martin Marietta | External Tank |
| MSFC | U.S.B.I. | SRB |
| MSFC | Thiokol | SRM |
| JSC/MSFC/USAF | - | Payloads |
| KSC/DE | - | Facility and GSE |
| KSC Directors | KSC Contractors | Integration |
| HQS (MH7/MO6) | - | Overview |



The STAG membership is composed of individuals from the various centers, contractors and DOD who are directly involved with the elements. A list of these members is shown in Appendix F.

The STAG meets periodically to consider significant changes known or proposed by members of the STAG who are responsible for evaluating turnaround processing. Generally, if the timelines changes are less than 10 hours, the meetings are postponed until the next scheduled meeting. Conversely, if significant timeline changes develop or if significant problems are found, meetings will be called more often.

After each meeting, minutes are published. The minutes contain a record of the proceedings, a copy of the presentation viewgraphs, allocation and assessment changes and justification, groundrule changes, etc. The level of detail of the assessment presentations are Level IV or lower.

The Shuttle Turnaround Analysis Report (STAR) is updated following each meeting. The level of detail in the STAR is III and II. It is presented to the Johnson Space Center Shuttle Program Office and depicts the operational turnaround's function's current status.

## 2.2.2 STAR/STAG DEFINITIONS

**Timeline Allocation:** The ground turnaround apportionment necessary to achieve the Shuttle Program Goal of turnaround from landing to liftoff in two weeks (160 hours) covering a span of 14 days.

**Timeline Assessment:** A collection of task time assessments arranged in logical work sequence. The task time assessments are generated from detailed analysis of the hardware design, hardware test experience, and operational test and checkout requirements. The Timeline Assessment is compared to the Timeline Allocations as a means of determining the shortcomings in the hardware and the operations procedures. The assessments are generally prepared to level IV detail and published in the STAR at a level III detail.

**Standard STAG Turnaround:** STAG flows which account for those tasks required on 50% or more of the flights. Two baseline turnaround flows are presented:

A. Payload installed horizontally in the OPF.

B. Payload installed vertically at the launch pad.

## 2.2.3 GROUND TURNAROUND OPERATIONS (FFD)

The typical operations presented in the STAR are represented in the Functional Flow Diagram (FFD, Figure 2-1). All of the timelines contained in this report represent a detailed breakdown of the activities represented in the Functional Flow Diagrams. The Level II detail charts represent the level of detail controlled by the Shuttle Program Manager. The level III charts represent a further detail breakdown used by STAG members to provide inputs and assessments from which the Level II charts are made.

Two basic turnaround timelines are presented:

A. Payload installed horizontally in the OPF.

B. Payload installed vertically at the launch pad.

## 2.2.4 STAR GROUND TURNAROUND TIMELINES

### 2.2.4.1 Level II

The STS assessments are the baseline timelines used as a point of departure for mission planning, user charge studies, traffic modeling, flight kit planning, resource requirements, facility sensitivity and flight hardware sensitivity.

Each basic turnaround has three sets of Level II timelines associated with it:

A. Level II Allocation Timeline is the apportionment of the 160 hour total time allocated to each task.

1. Figure 1 Level II Shuttle Assessment - Horizontal
2. Figure 2 Level II Shuttle Assessment - Vertical

B. Level II Shuttle Assessment Timelines reflect the STAG member's evaluation of the time required to perform the tasks based on current design and operations requirements. Payload related tasks are assumed to have reached their allocated times in order to enable visibility of shuttle tasks attainment of its goal.

1. Figure 3 Level II Shuttle Assessment - Horizontal
2. Figure 4 Level II Shuttle Assessment - Vertical

C. Level II STS Assessment Timelines reflect the STAG member's evaluation of the time required to perform both shuttle and payload related tasks. In order to determine reconfigure requirements specific cargos were used for "back-to-back" missions. In order to minimize the reconfiguration time, it was assumed that an orbiter was always available for each type of cargo. Thus major reconfigurations such as PRSD Kits, airlock relocations, etc. are eliminated. The cargo up and the cargo down payloads assumed by STAG for each type of mission are as follows:



1. Horizontal Payload (Spacelab)

   a. Cargo down - Spacelab 2+2 pallet

   b. Cargo up - Spacelab long module plus one pallet

2. Vertical Payload (Upper Stages)

   a. Cargo down - upper stages SSUS A and a SSUS D

   b. Cargo up - upper stages SSUS D and an IUS

These are depicted in Figures 2-2 and 2-3, respectively. The flight kit reconfiguration timelines for each mission are depicted in Figures 2-4 and 2-5. The STS assessments then assist in identifying the STS system drivers required for product improvement.

1. Figure 3A Level II STS Assessment - Horizontal
2. Figure 4A Level II STS Assessment - Vertical

2.2.4.2 Level III

Level III STS Assessment Timelines are the STAG member's work-sheets with a more detailed breakdown of each Level II task. These timelines represent the integration of project element

inputs. They provide the basis of detailed discussions at each STAG meeting. The Level III assessment timelines contained in the STAR are;

a. Figures 5-1 and 5-2, Level III STS Assessment - Spacelab

b. Figure 6-1 and 6-2, Level III STS Assessment - Upper Stages

c. Figure 7, Level III ET/SRB Processing in the VAB

d. Figure 8, Level III SRB Turnaround

e. Figure 9, Level III SRB Components Refurbishment and Subassembly Processing

f. Figure 10, Level III Launch Pad Refurbishment

g. Figure 11, Level III MLP Refurbishment

### 2.2.5 PERIODIC SIGNIFICANT SCHEDULED TASKS

Level II timeline ground rules do not reflect flows for tasks which occur on less than 50 percent of the turnarounds. The Level II and Level III Assessment Timelines now include a " " designation after certain items. These tasks may be impacted by periodic significant scheduled tasks (PSST). These timeline impacts are not reflected in the overall assessment flows; however, they must be considered as impacts in the mission planning and scheduling exercises. The STAR will continue to document the summary timeline information on these items. These items are shown in Appendix C.

### 2.2.6 SIGNIFICANT PROBLEM AREAS

Appendix D lists the major problems that confront the operational turnaround. The Project Office that is primarily responsible for the task is also listed; however, this does not mean that the item would only be worked by that office. Assessments/actions may be assigned to other groups for impacts. The dates when the problems were first discussed are also given. Following the list, the tasks are discussed individually as to their latest status.

### 2.2.7 ACTION ITEM SUMMARY

Appendix E lists actions assigned and current status as discussed in the last STAG meeting. These items generally include all significant problem areas that require further action. This summary is updated after each STAG meeting.

## 2.2.8 FLIGHT KITS

Flight kits are those items required to interface a specific payload to Orbiter. These consist of electrical harnesses (SMCH), bridges, keels and plumbing kits as required by payload needs. The reconfiguration of flight kits takes place in the OPF for both vertical and horizontal payloads. These kits are standardized to interface with multiple payloads. The installation and removal times are listed in KSC STS Ground Operations Plan, Volume III "STS Flight Kits Plan". Typical kit installation flows for horizontal and vertical installation are shown in Figures 2-4 and 2-5 respectively.

## 2.2.9 FLIGHT ASSIGNMENT MANIFEST (FAM) TURNAROUND ASSESSMENT

Ground Rules: (1) STAR 17 utilized as baseline; (2) Each specific flight turnaround is modified by cargo requirements, flight kits, mission duration, periodic orbiter tasks, and 48 hour Pad contingency.

Probable Considerations (not included): (1) No landing other than KSC; (2) no major Orbiter modifications; (3) no unscheduled Orbiter maintenance tasks that cannot be accomplished in parallel during normal OPF processing time; (4) no access through the payload bay doors at the Pad for horizontally installed payloads; (5) no rollback to the VAB or de-stacking for contingency access; and (6) no payload changeout.

A typical FAM assessment is shown in Figure 2-6.

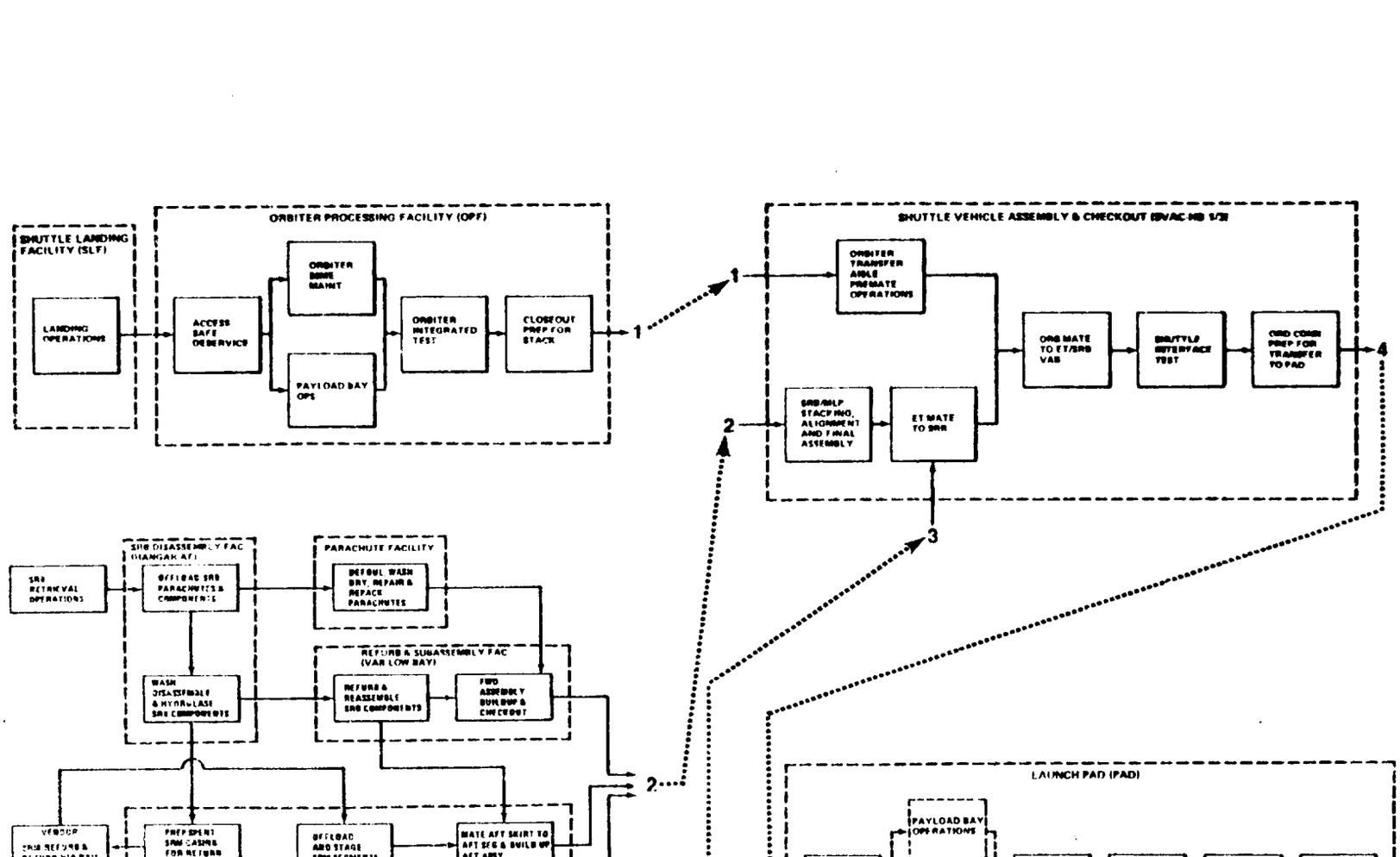
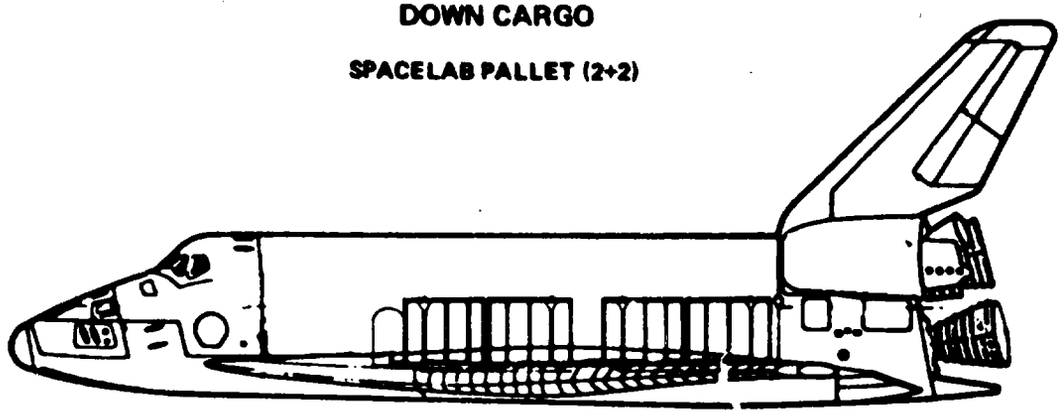



**Figure 2-1. KSC Ground Turnaround Operations**
**Functional Flow Diagram**

REF. FIGURE 5-1 & 5-2

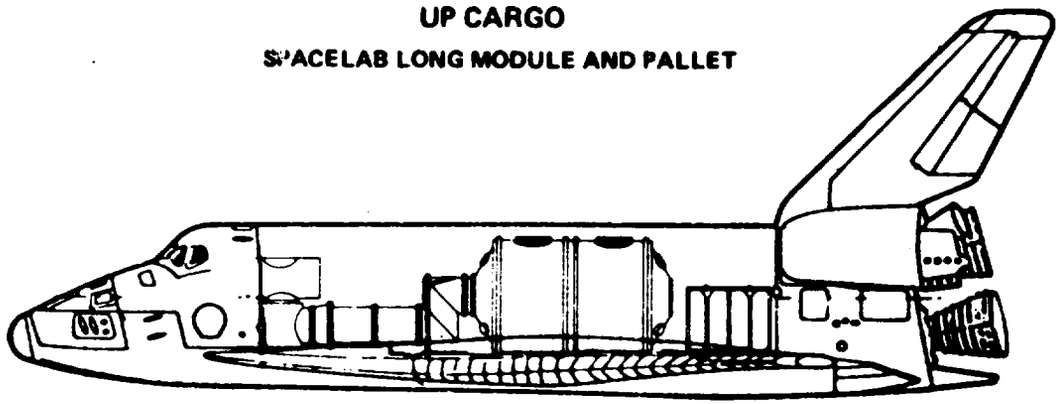
DOWN CARGO

SPACELAB PALLET (2+2)



UP CARGO

SPACELAB LONG MODULE AND PALLET



SG 1929

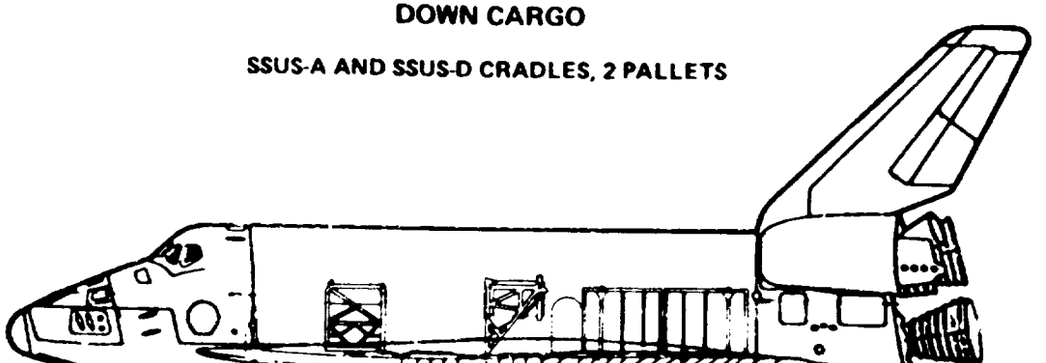


Figure 2-2. Shuttle T/A Assessment Cargo Configuration – Horizontal Payload (Spacelab)

REF. FIGURE 6-1 & 6-2

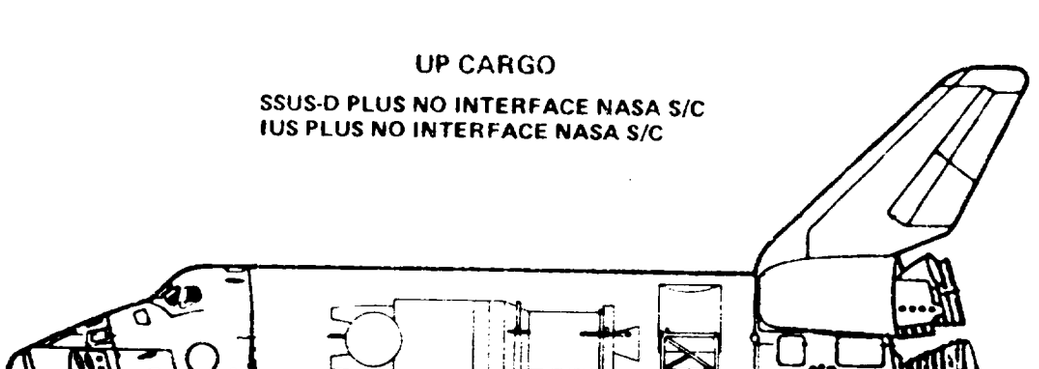
DOWN CARGO

SSUS-A AND SSUS-D CRADLES, 2 PALLETS



UP CARGO

SSUS-D PLUS NO INTERFACE NASA S/C
IUS PLUS NO INTERFACE NASA S/C



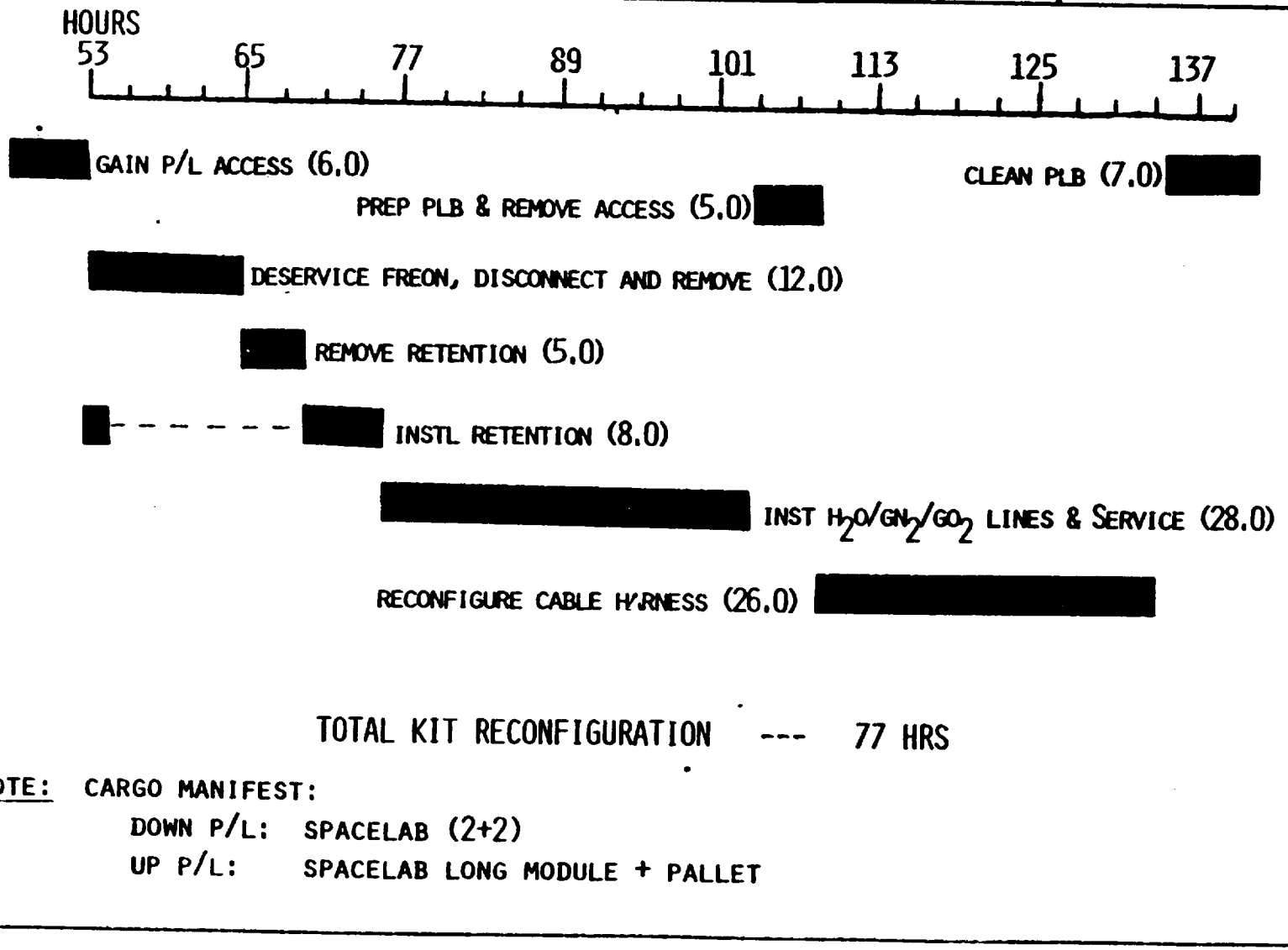
SG 1928

Figure 2-3. Shuttle T/A Assessment Cargo Configuration — Vertical Payload (Upper Stages)

KSC SPACE TRANSPORATION SYSTEM PROJECTS

TYPICAL

FLIGHT KIT ASSESSMENT FOR SPACELAB




TOTAL KIT RECONFIGURATION --- 77 HRS

NOTE: CARGO MANIFEST:

DOWN P/L: SPACELAB (2+2)

UP P/L: SPACELAB LONG MODULE + PALLET



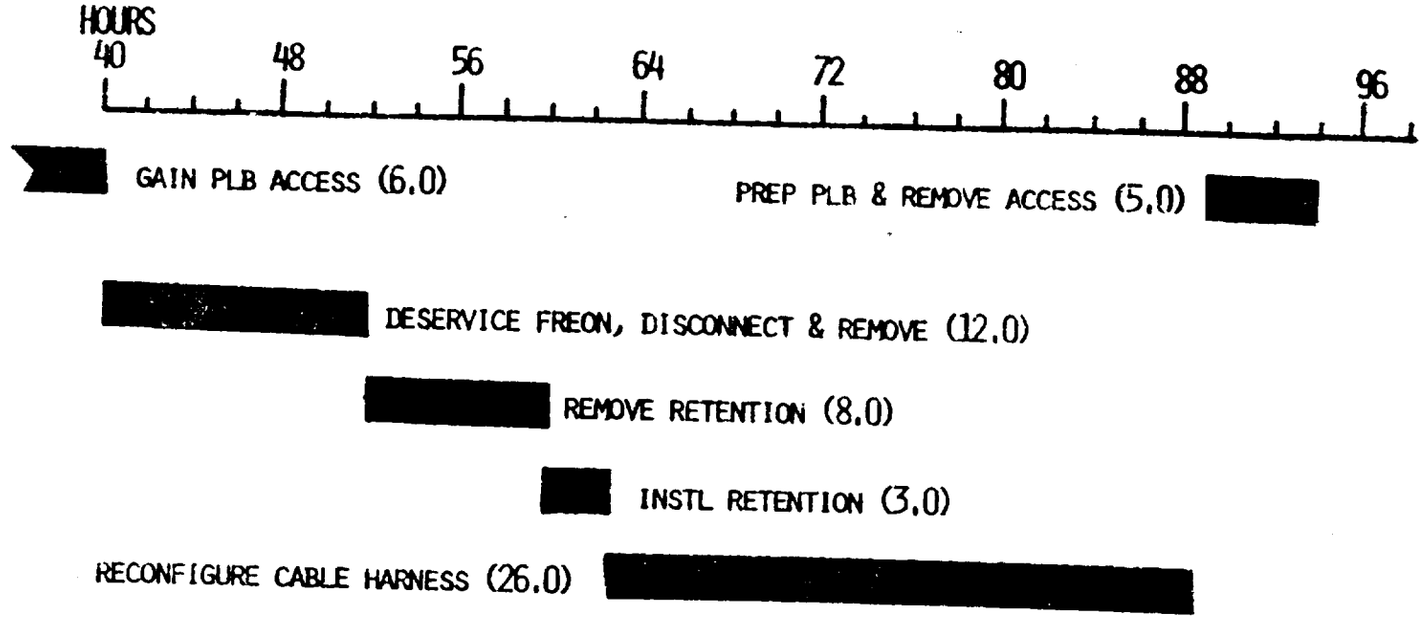
KSC FORM 10-95 (REV 8/77)

Figure 2-4. Flight Kit Assessment for Spacelab

KSC SPACE TRANSPORATION SYSTEM PROJECTS

TYPICAL

# FLIGHT KIT ASSESSMENT FOR UPPER STAGES




TOTAL KIT RECONFIGURATION ----- 49 HRS.

NOTE: CARGO MANIFEST:

DOWN P/L: SSUS-A AND SSUS-D + 2 PALLETS

UP P/L: IUS AND SSUS-D

Figure 2-5. Flight Kit Assessment for Upper Stages

/FOLDOUT FRAME

# STS ON-LINE PROCES

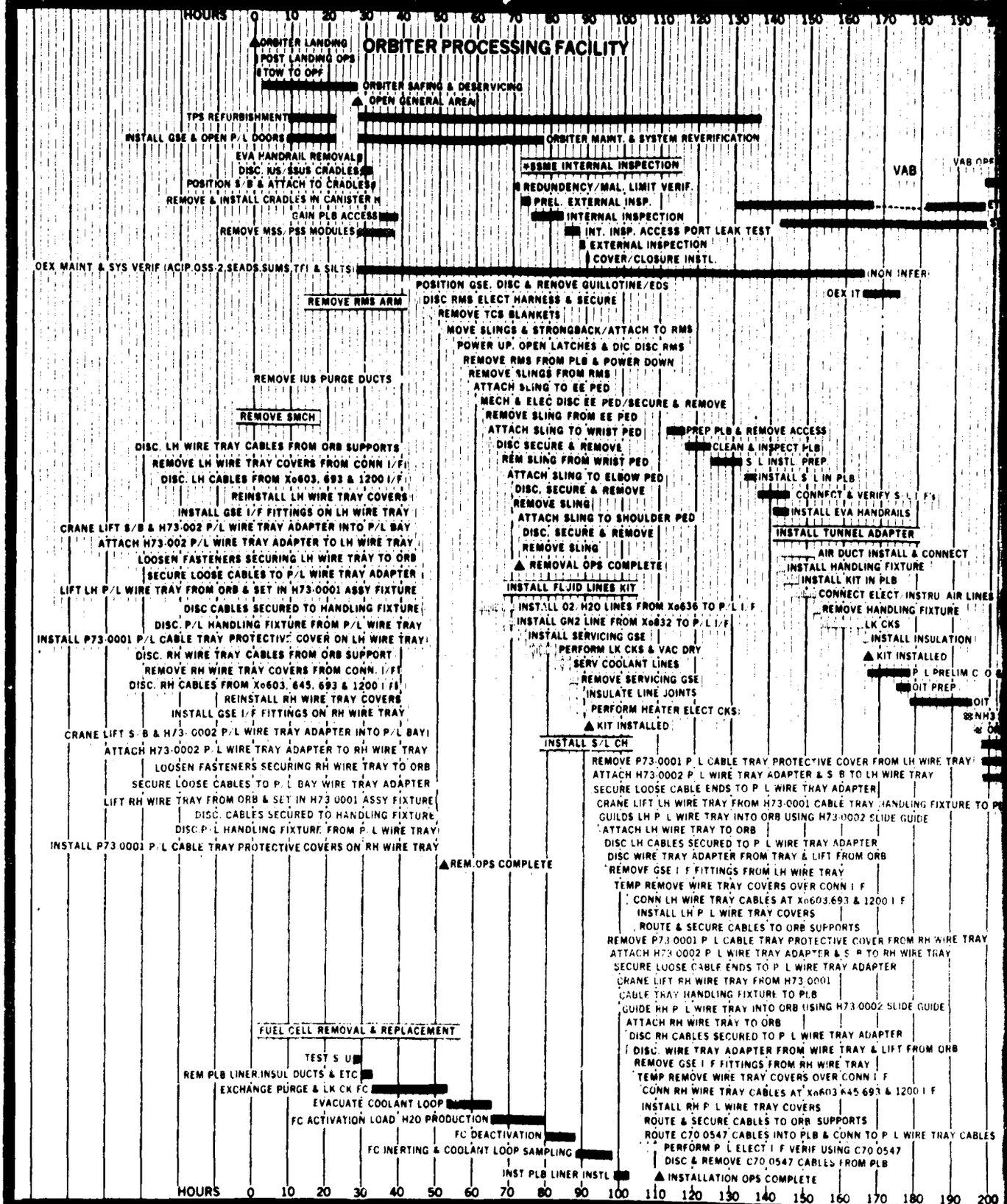



Figure 2-6. Typical

# OCESSING—FLIGHT 21

LEFT OUT FRAME

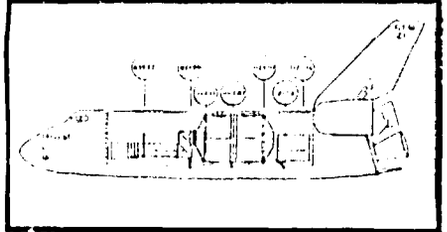
190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360

VAB OPERATIONS
ET MATE TO SRB'S & VERIF OF INTERFACES
ET CHECKOUT OPS
STACKING & ALIGNMENT
PAD
TRANSFER TO PAD
MLP HARD DOWN
EXT RSS & CRSM ACCESS ARM
MATE ET PROP SERVICE LINES
PURG
SERVICING PREP
LAUNCH READ VERIF
CABIN C/O
CLEAR PAD
FCLSS SERVICE
F/C CRYO SERVICE
HELIUM SERVICE
P/L SERVICE (AS REQ'D)
ET CONDITIONING
HYPERGOLIC SERVICE
OPEN PAD
SERVICE DISCNCT
VEHICLE CHECKOUT, GSE SECURE
RETRACT RSS
CLEAR PAD
STANDBY STATUS
IMU WARM UP
COUNT DOWN
LIFTOFF
PRELIM C/O & S/L INSTL C/O INSP
OIT
NH3 SERVICING
ORDNANCE CONNECT
CABIN STOWAGE
ORBITER CLOSE OUT
P/L PLB FINAL INSP & DOORS CLOSED
LOWER ORBITER & PREP FOR TOW
TOW TO VAB
RELOAD DEWARS & SERVICE PRSD

**ORBITER 102**

**CARGO MANIFEST:**

| | | | |
|---|---|---|---|
| | DOWN | IUS CRADLE<br>IUS PURGE DUCTS<br>RMS ARM | |
| PAYLOAD: | UP | S/L 3 | LM+P |
| ACCOM KITS | | KEELS/BRIDGES<br>S/L CH<br>PLT FLUIDS KIT<br>TUNNEL ADAPTER | |



**LEGEND**

- SHUTTLE TASK
- MOD ACCOMMODATION TASK (KIT)
- INTEGRATED PL-SHUTTLE TASK
- HAZARDOUS OPERATIONS
- PSST (PERIODIC SIGNIFICANT SCHEDULED TASK)

**STS ON-LINE PROCESSING**
**FLIGHT 21**

DATE 28 JUNE 1979
PREPARED BY F. WARGA
APPROVED BY C. W. MURPHY
APPROVED BY R. H. BUCKLEY SP-OPN

ROCKWELL DRL LINE ITEM 005

**PRELIMINARY PLANNING**

# SECTION III

## STAR 017 Analysis

### 3.1 SPECIAL STAG/STAR ANNOUNCEMENT

Since relatively few changes have occurred to assessments of the Shuttle element timelines in the last STAG meeting, the present plan is to postpone the next STAG meeting until after the First Manned Orbital Flight. At that time a complete review of the operational STS timeline assessments will be made.

Timeline reduction reviews and assessments of the cargo bay activities will continue with the Flight Kit Working Group and the STS Flight Assignment Manifest Working Group. If information becomes available which would cause a significant change (approximately 10 hours) in the STAR standard flow timelines, a STAG meeting will be scheduled earlier.

All project offices and their respective contractors are requested to continue to submit a quarterly report of their turnaround activity to the STAG Chairman to assure that the STAR report is maintained current.

The STAR 017 Report has been reformated to make it a stand-alone document for ease of understanding by all users.

### 3.2 INFORMATION SOURCES FOR STAR 017

This document comprises the output of the Shuttle Turnaround Analysis Group (STAG) meeting held on February 1-2, 1979, and integration of the following STAR 017 draft inputs.

a. Spacelab and Tunnel Timeline reevaluation submitted by G. Powers, VT-VPD.

b. AVO dated 11-21-78 to G. Powers, VT-VPD-2 from H. Lamberth, VE-FSD subject: Hazardous Servicing During Countdown.

c. Flight Kit Timeline reevaluation submitted by Rockwell, LO from the Flight Kit Working Group.

d. Pad Refurbishment/Turnaround submitted 1-19-79 by J. J. Talone, VT-SMD-1.

e. MLP Minimum Turnaround Study and Timeline submitted 1-22-79 by G. W. Warren, VT-SMD-1.

## 3.3 SIGNIFICANT CHANGES FROM STAR 016 TO STAR 017

The turnaround assessments generally decreased from STAR 016 to STAR 017, as can be seen from the assessment history charts, figures 12 through 14. The most recently assessed turnaround time is reduced by 26.0 hours to a total of 274.5 hours for a horizontally installed payload (Spacelab see Figure 12). The vertically installed payload turnaround time was decreased 2 hours to a 233 hour total. The bulk of the time change occurs in the OPF flow (Figure 13). Figure 14 shows the history of the VAB and the Pad flows. The details of the changes are discussed in the following paragraphs.

a. Allocation changes (Figure 1 & 2) - No change.

b. Shuttle Assessment (Figures 3 & 4) - Net delta increase = 1 hour. It was due to the increase in the hypergolic servicing time at the pad. The increase resulted from the procedure changes required to overcome the problems which were discovered during the OMS/RCS hypergolic servicing tests performed at the White Sands test facility. These problems are discussed in paragraph G of STAG 017 Minutes. The presentation pointed out that the servicing time could be reduced 2.5 hours by simultaneously servicing hypergolic oxidizer and fuel through the APS service panel. It was decided that STAR 017 should assume that the Safety requirement of "demonstrated capability" for simultaneous flow would have been met during the development phase of the program. Thus the net time increase is 1 hour as shown.

c. STS Assessment Spacelab (Horizontal) (Figure 3A) - Net delta decrease = 26 hours. Changes occurred to two areas of this timeline, the OPF and the Pad. Two changes were made to the OPF flow, resulting in a net reduction of 19 hours. The first change was made to the flight kit area. Reassessment and rearrangement of the flight kit timeline by Rockwell for the Flight Kit Working Group reduced the timeline by 26 hours. Most of this effort resulted from putting several of the tasks in parallel. The second change to the OPF flow was an increase of 7 hours to the tunnel installation. This change was a result of a reassessment by NASA VT-VPD.

d. Two changes were also made to the Pad flow. The first change was in the hypergolic servicing previously discussed under the Shuttle Assessment. The second change was a reduction of 8 hours to the flow by eliminating the Refill operations of the GSE Dewars for filling the 5th PRSD Tank Set. The Beach Thermal analysis indicates that there is sufficient margin to fill 5 PRSD tank sets with one load. See Appendix G of STAG Minutes 017. Thus the net PAD time reduction is 7 hours.

e. STS Assessment Upperstages (Vertical) (Figure 4A) - Net delta decrease = 2 hours. Two changes occurred to this flow which

account for the decrease. The Flight Kit tasks were reorganized reducing that portion of the flow by 3 hours. The hypergolic servicing (previously discussed under Shuttle Assessment) was increased by 1 hour resulting in the total net decrease of two hours.

f. The Launch Pad Refurbishment and Checkout timeline on Figure 10 was reduced from 72.5 hours to 48 hours as a result of the reassessment performed by NASA VT-SMD. See paragraph B of STAG 017 Minutes.

g. Due to the reevaluation conducted by Rockwell LO, the Flight Kit Removal and Installation times Periodic Significant Scheduled Task (PSST) numbers 0-5 through 0-8 were revised. They are discussed as follows:

h. PSST #0-5, Flight Kit Removal (PL in OPF) now consists of two items: "Remove Retention Kit", 8 hours, and "Deservice Freon Line, Disconnect and Remove", 12 hours. These items total 20 hours versus 35.5 hours for STAR 016. These items are in parallel with the Flight Kit Installation tasks.

i. PSST #0-6, Flight Kit Removal (PL at PAD) consists of "Remove Retention Kits", 20 hours and "Deservice Freon Line Disconnect and Remove", 12 hours, for a total of 32.0 hours. This is a reduction of 6 hours from STAR 016.

j. PSST #0-7, Flight Kit Installation (PL in the OPF) consists of two items: "Install Retention Kit", 25 hours and "Install $H_2O/GN_2/GO_2$ lines and service $H_2O$, 30 hours, totalling 55 hours compared to 50.5 hours in STAR 016.

k. PSST #0-8, Flight Kit Installation (PL at the PAD) consists of "Install Retention Kits", 17.0 hours. This is an increase of 0.5 hours from STAR 016.

l. PSST #P-3 was revised by the deletion of the 5th PRSD tank from those requiring the GSE Dewar reload. Based on Beech Aircraft thermal analysis, one dewar load will fill 5 PRSD tank sets with adequate reserve. See paragraph F and Appendix G of STAG 017 Minutes.

m. Two changes were made to the Significant problem areas. They are Hypergolic Servicing and Spacelab Removal and Installation.

(1) Hypergolic Servicing total servicing time is shown as 11.0 hours. This time assumes serial servicing of the hypergolic fuel and oxidizer through the APS service panel. As discussed in the "Summary Discussions" on previous pages, a decision was made at the meeting to assume parallel servicing. THus STAR 017 shows a total servicing time of 8.5 hours.

(2) A 7 hours increase is reflected for Spacelab Removal and Installation.

TABLE 3-1

STAR 016 TO STAR 017 CHANGE SUMMARY

| | REFERENCE | OLF | OPF (FK) | VAB | PAD | TOTAL | TOTAL DELTA |
|---|---|---|---|---|---|---|---|
| **ALLOCATION** | | | | | | | |
| o HORIZONTAL PL | FIGURE 1 | | | | | | |
| STAR 016 | | 1 | 96 (24) | 39 | 24 | 160 | 0 |
| STAR 017 | | 1 | 96 (24) | 39 | 24 | 160 | |
| o VERTICAL PL | FIGURE 2 | | | | | | |
| STAR 016 | | 1 | 87.5 (24) | 39 | 32.5 | 160 | 0 |
| STAR 017 | | 1 | 87.5 (24) | 29 | 32.5 | 160 | |
| **SHUTTLE ASSESSMENT** | | | | | | | |
| o HORIZONTAL PL | FIGURE 3 | | | | | | |
| STAR 016 | | 1 | 112.5 (24) | 52.0 | 34.5 | 200.0 | +1.0 |
| STAR 017 | | 1 | 112.5 (24) | 52.0 | 35.5 | 201.0 | |
| o VERTICAL PL | FIGURE 4 | | | | | | |
| STAR 016 | | 1 | 107.0 (24) | 52.0 | 45.0 | 205.0 | +1.0 |
| STAR 017 | | 1 | 107.0 (24) | 52.0 | 46.0 | 206.0 | |
| **STS ASSESSMENT** | | | | | | | |
| o SPACELAB (HOR) | FIGURE 3A | | | | | | |
| STAR 016 | | 1 | 205.0 (77.0) | 52.0 | 42.5 | 300.5 | |
| STAR 017 | | 1 | 186.0 (51.0) | 52.0 | 35.5 | 274.5 | -26.0 |
| o UPPER STAGE (VERT) | FIGURE 4A | | | | | | |
| STAR 016 | | 1 | 126.5 (49.0) | 52.0 | 55.5 | 235.0 | |
| STAR 017 | | 1 | 186.0 (51.0) | 52.0 | 56.5 | 233.0 | -2.0 |

| | REFERENCE | XFER AISLE | PSF | SLACK DUE TO SRB OPS | SVAC | ON-DOCK PRIOR TO ORB MATE | TOTAL DELTA |
|---|---|---|---|---|---|---|---|
| ET/SRB OPERATIONS | | | | | | | |
| o ET | FIGURE 7 | | | | | | |
| STAR 016 | | 9 | 92 | 87 | 10 | 196 | |
| STAR 017 | | 9 | 92 | 87 | 10 | 196 | 0 |
| o SRB/SRM | FIGURE 7 | | | | | | |
| STAR 016 | | | 100 | | 72 | 180 | |
| STAR 017 | | | 100 | | 72 | 180 | 0 |

## 3.4 LEVEL II TIMELINE ALLOCATIONS, APPROVED ALLOCATIONS CHANGES AND LEVEL II ASSESSMENTS

a. Current Allocations are as indicated below.

(1) Figure 1 depicts the current Level II Shuttle system operational timeline allocation breakdown for payload installation in the OPF.

(2) Figure 2 depicts the current Level II Shuttle system operational timeline allocation breakdown for payload installation on the launch pad.

b. Approval Allocation Changes are listed below and reflect the current Level II allocations timelines that have been approved since the last report.

(1) For Payload Installation in the OPF, add the retrieval, disassembly, and refurbishment of SRM/SRB components as follows:

(a) Add "ET VAB Transfer Aisle Ops."

(b) Add "SRM Components Refurb (RSF)."

(c) Add "SRM Flight Set (8) From Vendor."

(d) Add "Spent Cases to Vendor & Refurb for Flight."

(e) Add "SRB Disassembly (Hangar AR)."

(f) Add "Parachute Refurb (AF)."

(g) Add "SRB Retrieval."

(h) Add "Previous Launch."

(2) For Payload Installation at the Launch Pad the changes are the same as the changes that have been identified for the Payload Installation in the OPF.

(3) There are no Recommended Allocation Changes to be considered for the next STAR.

c. Level II Shuttle Assessments

(1) <u>Overview</u>

The probability of achieving the allocation turnaround time of 160 hours is low unless the maintainability features, which are required to be designed into the vehicle, associated SE, and facilities, are improved to

eliminate the deltas between the assessment times and allocation times.

The probability of achieving the present assessment turnaround time is also low unless the design and maintainability are improved to reduce the time required to perform the PSST.

The scheduling of maintenance PSST items must be carefully controlled to minimize their impact to specific turnaround operations.

Mission management must be exercised to minimize the flight kit PSST impacts to the turnaround.

(2) Level II Ground Rule

A star has been added to some of the assessment tasks, indicating the time shown is based on the Level II ground rule of not reflecting timelines for tasks which occur on less than 50 percent of the turnarounds. The star represents a probable impact when the turnaround timelines are applied to a particular mission. Timelines for periodic significant scheduled tasks (PSST) are added as Appendix C to the STAR for those tasks scheduled to occur less than 50 percent of the time.

(3) Level II Shuttle System Operational Ground Turnaround Timeline Assessment Breakdown

Figures 3 and 4 depict the current Level II Shuttle System Operational Ground Turnaround Timeline assessment breakdown. The allocated times are being used for payload-related activities. These figures are for Shuttle vehicle assessment rather than for STS assessment.

(4) Level II STS Allocation/Assessment Deltas with Project Office Responsibility for Follow-Up

The following is a list of the current differences between the Level II turnaround time allocation (figures 1 and 2) and the Level II STS timeline assessment (figures 3A and 4A). This listing denotes areas in which the current assessments, based on presently documented design concepts and known requirements or constraints, differ from the allocated times for those functions. The list also indicates the Shuttle Project Offices (SP) responsible for the tasks. Those tasks which are controlled by Level III and referred to on the Level II figures are indicated with their times in (). A further breakdown of Level III is shown in Section 4.6. The Shuttle Project Office codes are:

ORB - Orbiter
ET - External Tank
SRB - Solid Rocket Booster
SSME - Space Shuttle Main Engines
L&L - Launch and Landing
PAY - Payloads

Table 3-2. Level II Allocation-Assessment Deltas

| Function | Alloc. | Assmt. | Delta | SPO |
|---|---|---|---|---|
| Landing Area | 0.0 | 1.0 | 0.0 | |
| Orbiter Processing Facility (Payload) Installation at OPF (Spacelab (SL)) | 96.0 | 186.0 | 90.0 | |
| Orbiter Processing Facility (Payload Installation at Pad (Upper Stages (US)) | 87.5 | 123.5 | 36.0 | |
| Safing and Deservicing (ref.) | (10.0) | 27.0* | 17.0 | L&L/ORB |
| SSME Scheduled Maintenance | 24.0 | 54.0 | 30.0 | |
| Orbiter Scheduled Maintenance | 24.0 | 26.0* | 2.0 | L&L/ORB |
| TPS Refurbishment (ref.) | (40.0) | 109.50 | 69.5 | ORB |
| Unscheduled Maintenance (ref.) | (40.0) | 40.0 | 0.0 | |
| Systems Reverification, As Required (ref.) | (10.0) Serial | 10.0 Serial | 0.0 | |
| Install SE & Open PLB Doors (ref.) | (5.5) | 13.5 | 8.0 | L&L |
| Remove EVA Handrails (SL) | - | 1.0 | 1.0 | |
| Remove EVA Handrails (US) | - | 2.0 | 2.0 | |
| Remove Spacelab (2+2 Pallet) (SL) | 3.0 | 20.5 | 17.5 | L&L/PAY |
| SSUS Cradle and Pallet Removal (US) | 3.0 | 5.0 | 2.0 | L&L/PAY |
| Gain Payload Bay Access | (4.5) | 6.0 | 1.5 | ORB |
| Flight Kit Removal & Installation (SL) | 24.0 | 51.0 | 27.0 | L&L/ORB/PAY |
| Flight Kit Removal & Installation (US) | 24.0 | 46.0 | 22.0 | L&L/ORB/PAY |
| Prepare Payload Bay (ref.) | (9.0) | 12.0 | 3.0 | ORB |
| Spacelab Installation & Verification | 6.0 | 21.0 | 15.0 | L&L/ORB/PAY |
| SL Internal Closeout | 4.0 | 11.0 | 7.0 | L&L/ORB/PAY |
| Tunnell Installation Operations (SL) | - | 17.5 | 17.5 | L&L/ORB/PAY |
| P/L Final Inspection and Close Doors (SL) | 4.5 | 12.5 | 8.0 | L&L/ORB/PAY |
| Orbiter Integrated Test Prep | 5.0 | 5.0 | 0.0 | |
| Orbiter Integrated Test (ref.) (SL) | (12.0) | 16.0 | 4.0 | ORB |
| Orbiter Integrated Test (US) | (12.0) | 12.0 | 0.0 | ORB |
| Orbiter Prep for Stacking (ref.) (SL) | (9.5) | 16.0 | 6.5 | L&L/ORB |
| Orbiter Prep for Stacking (ref.) (US) | 9.5 | 14.5 | 5.0 | L&L/ORB |
| MLP Refurbishment and Checkout | 100.0 | 71.0 | -29.0 | |
| SRB Retrieval | (35.0) | 35.0 | 0 | |
| Parachute Refurbishment | (96.0) | 96.0 | 0 | |

| Function | Alloc. | Assmt. | Delta | SPO |
|---|---|---|---|---|
| SRB Disassembly (Hangar AF) | (128.0) | 128.0 | 0 | |
| SRB Components Refurbish (RSF) | (140.0) | 140.0 | 0 | |
| SRM Spent Cases to Vendor and Refurbish for flight | (12 wks.) | 12 wks. | 0 | |
| AFT Booster Buildup & SRM Offload | 100.0 | 100.0 | 0.0 | |
| SRM Stacking and Alignment | 65.0 | 72.0 | 0.0 | |
| ET Checkout Operations | 52.0 | 92.0 | 40.0 | |
| ET Mate to SRB and Verification of Interfaces | 10.0 | 10.0 | 0.0 | |
| Vertical Assembly Building | 39.0 | 52.0 | 13.0 | |
| Orbiter Premate Operations (Xfer Aisle) | 5.0 | 8.5 | 3.5 | ORB/L&L |
| Orbiter Mate & Interface Verification | 15.0 | 22.5 | 7.5 | ORB/ET |
| ET TPS Closeout | - | 22.5 | 22.5 | ET |
| Shuttle Integrated Operations | 19.0 | 21.0 | 2.0 | L&L |
| Launch Pad Refurbishment and Checkout | 80.0 | 48.0 | -32.0 | L&L |
| Launch Pad Operations (SL) | 24.0 | 35.5 | 11.5 | |
| Launch Pad Operations (US) | 32.5 | 56.5 | 24.0 | |
| Payload Installation in RSS (US) | 13.0 | 24.0 | 11.0 | |
| Fuel Cell Dewar Load (ref.) | (6.5) | 6.5 | 0.0 | |
| Transfer to Pad (ref.) | (7.0) | 7.0 | 0.0 | L&L |
| Mate MLP & Vehicle to Pad (ref.) | (6.5) | 8.0 | 1.5 | L&L |
| Extend RSS (ref.) | (0.5) | 1.0 | 0.5 | L&L |
| Power On | | | | |
| Shuttle Launch Readiness Verif. (ref.) | (3.0) | 6.0 | (3.0) | |
| PLB Door Open (US) | 3.0 | 6.5 | 3.5 | |
| Install P/L (US) | 2.5 | 8.5 | 6.0 | |
| US Orb I/F Verif. & Closeout (US) | 4.5 | 9.5 | 5.0 | |
| PLB Door Close (US) | 3.0 | 4.0 | 1.0 | |
| Cabin Closeout (ref.) | (1.5) | 2.0 | 0.5 | |
| Clear Pad (ref.) | (1.5) | 2.0 | 0.5 | |
| Hazardous Servicing (ref.) | (6.0) | (8.5) | 2.5 | L&L |
| Open Pad | (0.5) | 0.5 | 0.0 | |
| Service Disconnects | (0.5) | 0.5 | 0.0 | L&L/ORB |
| Veh. GSE Secure | (0.5) | 1.5 | 1.0 | |
| Retract RSS & Clear Pad | (0.5) | 2.5 | 2.0 | |
| Main Propellant Loading | 1.25 | 3.0 | 1.75 | L&L |
| Launch from Standby Status | 2.0 | 4.0 | 2.0 | L&L/ORB |

Total Allocation/Assessment Delta:
114.5 hours (for SL installation in the OPF)
73.0 hours (for US installation at the Pad)

* Indicates a probable impact by PSST.
@ TPS Refurb requires 3 shift/24 hrs. a day

## 3.5 APPROVED LEVEL II FUNCTIONAL SPECIFICATION CHANGES

A. Appendix B presents a Level II listing of significant activities which occur within the ground turnaround operations. Listed below are the changes, reflected in the current functional specifications, that have been approved since the last report.

1. B-2.4 Turnaround torque test and heat exchanger leak test.

   Justification: SSME Operational Turnaround Time Analysis Report, which now requires that these two tests be done every turnaround.

2. B-3 Change the entire section of B-3 as follows to add the ET and SRB timeline functions to STAR.

   Justification: The proposed changes are necessary in order to perform a complete SSV operational turnaround analysis and report to the Shuttle Program Manager the results and subsequent issues and problems. Resource planning, facility utilization, and flight hardware availability will also be determined from the information.

3. B-3 VEHICLE ASSEMBLY BUILDING. These functions start with transferring and stacking SRB assemblies and end with the Shuttle vehicle on the MLP prepared for rollout to the pad. These functions will include but not be limited to the following:

   a. Aft booster buildup and SRM offload.

   b. SRB stacking and alignment.

   c. ET transfer aisle operations.

   d. ET checkout cell operations.

   e. ET mate to SRB and verify interfaces.

   f. Tow the orbiter from the OPF to the VAB.

   g. Orbiter premate operations.

   h. Erect the orbiter and mate to the ET.

   i. Shuttle interface test.

j. Shuttle ordnance installation and electrical connection.

k. Preparations for roll out.

NOTE: The 39-hour allocation for this function applies only to have items d through i. Separate allocations have been established for items a, b, and c.

4. B-3.1 Aft Booster Buildup and SRM Offload. This function starts with the arrival of the aft skirts from the RSF and concludes with the loading of two spent segment cases. These functions will include but not be limited to the following:

a. Install left and right aft skirt in stand.

b. Mate aft segments to aft skirts.

c. Install aft assy stiffener rings and ETA rings.

d. Install nozzle extensions.

e. Install booster instrumentation cables.

f. Perform instrumentation cable continuity checks.

g. Install cable tray covers.

h. Install ETA struts.

i. Install heat shields.

j. Prep for stacking.

k. Offload solid fuel segments.

l. Ship spent segment cases.

5. B-3.2 SRB Stacking and Ready for ET Mate. This function begins with transferring the first SRB subassembly from the buildup area to the integration cell and attaching it to the MLP and ends with the SRB assemblies ready for SRB/ET mate. These functions will include but will not be limited to the following:

a. Transferring the SRB subassemblies from the buildup area (High Bay 4) and refurbishment subassembly facility (West Low Bay) and stacking each assembly to form a complete SRB.

b. Alignment checks, including any required adjustments.

c. Installation and preparation of ET mating interfaces on the SRB.

d. SRB intra-element interface verification.

e. Servicing of any SRB subsystems as required to support the Shuttle interface test to be performed after mating of the ET and the orbiter.

6. B-3.3 ET Transfer Aisle Operations. This function begins with the arrival of the ET at KSC and ends with lifting the ET to the ET checkout cell. These functions include but are not limited to:

a. ET offload preparations.

b. Move ET to transfer aisle.

c. Install lifting slings.

d. Disconnect ET from the transporter.

e. Rotate ET to vertical.

f. Lift and position ET above the checkout cell.

7. B-3.4 ET Checkout Cell Operations. This function starts with ET insertion into the ET checkout cell and ends with transfer of the ET into the integration cell for mate with the SRB. This function will include but not be limited to the following:

a. ET mate to ET checkout cell.

b. Installation of ship loose items.

c. Mechanical functional tests.

d. Electrical/Instrumentation tests.

e. Pressurization of LOX, $LH_2$ 2tanks.

f. Purge/Leak checks.

g. TPS installation.

h. Install RSS ordnance.

i. Install cable tray covers and fairings.

j. Prep for transfer to integration cell.

8. B-3.5 ET Mate to SRB, Verification of Interface. This function begins with the crane lift of the ET from its storage facility in the bay opposite the Shuttle integration cell and ends when the ET is mated to the SRB and is ready for the orbiter to be mated. This function will include but will not be limited to the following:

a. Crane-lift of the ET frum the checkout facility into the Shuttle integration cell.

b. Mechanical mating of the ET/SRB separation interfaces. This will include installation of ordnance devices (if any) which are integral to the mating process.

c. Connecting and verifying ET-to-SRB and ET-to-VAB interfaces.

d. Removing and positioning VAB integration cell access platforms as required to allow crane-lifting the orbiter into its mating position.

9. B-3.6 Orbiter Premate Operations. This function begins with towing the orbiter from the OPF to the VAB and ends when the orbiter is ready to be lifted from the transfer aisle into the integration cell. This function will include but not be limited to the following:

a. Towing the orbiter from the OPF to the VAB.

b. Connecting SE lifting slings.

c. Retracting the orbiter landing gear.

d. Rotating the orbiter to vertical.

e. Removing SE aft lifting sling.

10. B-3.7 Orbiter Mate to ET. This function begins with lifting the orbiter from the transfer aisle into the integration cell. It ends at the point where the Shuttle vehicle is ready for electrical power application. This function includes but is not limited to the following:

a. Lifting the orbiter into the integration cell.

b. Mechanical mating the orbiter to the ET.

c. Removing the orbiter-handling SE.

d. Connecting the orbiter-to-ET and orbiter-to-MLP umbilical interfaces.

e. Verifying interfaces connected under item d above to the extent practical without the application of electrical power.

11 B-3.8 Shuttle Integrated Operation. This function begins with Interface Test preparations and ends with the SSV/MLP ready for rollout. The function includes but is not limited to the following:

a. Shuttle Interface Test.

b. Installing and connecting all remaining Shuttle ordnance.

c. Preparations for rollout.

d. Making Shuttle ordnance connections.

12. B-4 LAUNCH PAD. This function starts when the Shuttle vehicle is ready for rollout from the VAB and ends with launch. This function does not include opening the orbiter payload bay doors but does include but is not limited to the following:

a. Rollout to the pad.

b. Connect and verify pad interfaces.

c. Positioning the RSS to the orbiter.

d. Servicing preparations.

e. Launch readiness verification.

f. Cabin closeout.

g. Hazardous servicing.

h. Servicing disconnects.

i. Retracting the RSS.

j. Main propellant loading.

k. Launch from standby.

B. SRB/SRM REUSE TURNAROUND (Retrieval, Disassembly, Refurbishment)

Justification: The proposed changes are necessary in order to perform a complete SSV operational turnaround analysis and report to the Shuttle Program Manager the results and subsequent issues and problems. Resource planning, facility utilization, and flight hardware availability will also be derived from the information.

1. BB-1 SRB and Parachute Retrieval Operations. This function starts with the alert of the recovery vessel at T-18.5 hours and ends with the arrival of the recovery vessel at the SRB slip in port. It includes but is not limited to the following:

a. Alert recovery vessel at T-18.5 hours.

b. Sail the recovery vessel to the SRM recovery area.

c. Locate the SRB and flight accessories.

d. Reduce the water level in the SRB's.

e. Retrieve the main parachutes, frustrum, and drogue parachutes.

f. Tow the SRB's to the SRB slip in port.

2. BB2 Parachute Refurbishment Operations. This function begins with removing the parachutes from the recovery vessel and ends with placing them in storage in preparation for a future launch. It includes but is not limited to:

a. Remove the parachutes from the recovery vessel.

b. Uncoil and defoul the parachutes.

c. Wash and dry the parachutes.

d. Repair and repack the parachutes.

e. Cluster the three main parachutes onto the spider.

f. Transfer the clustered chutes to storage.

3. BB-3 SRB/SRM Disassembly. This function begins with lifting the SRB's into the slip and ends with loading the spent SRM casings onto rail cars for shipment back to the plant. This function includes but is not limited to:

a. Hoist the SRB's into the slip (one at a time).

b. Safe SRB's.

c. SRB initial wash operations.

d. Move SRB's to hangar AF and disassemble.

e. Remove frustrums from recovery vehicle and transfer to wash facility.

f. Wash frustrum (Hydrolase TPS).

g. Disassemble frustrum.

h. Wash and dry frustrum.

i. Transport frustrum to the Refurbishment Subassembly Building (RSB).

j. Transport forward skirt and aft skirt to hydrolaser.

k. Hydrolase forward and aft skirts.

l. Transport forward and aft skirts to the RSB.

m. Transport the spent SRB cases to the VAB.

n. Load the spent SRB cases onto rail cars for shipment back to Thiokol.

4. BB-4 SRB Components Refurbishment (RSF). This function begins with performance of the critical dimension checks and ends with the aft skirt hotfire operations. These functions include but are not limited to:

a. Perform critical dimension checks.

b. Post-flight assembly checkout.

c. Paint and insulate.

d. Replace failed components.

e. Inspect electrical cables.

f. Install parachutes.

g. Mate and checkout nose cap, frustrum, and forward skirt.

h. Aft skirt hotfire operations.

i. Transfer forward skirt and aft skirt to the PSF.

5. BB-5 Refurbish SRM Spent Cases for Flight. This function begins with shipping the spent SRB cases to railroad center at Corine, Utah and ends with ship refurbished cases to KSC. This function includes but is not limited to:

a. Ship by rail the spent SRM cases to the rail center at Corine, Utah.

b. Transport from the rail center in Corine to the Thiokol plant.

c. Grit blast insulation from cases and inspect.

d. Clean, paint, insulate and line the cases.

e. Case propellant and cure.

f. Cleanup and final assembly.

g. Store as needed for factory surge.

h. Transport cases to rail center at Corine, Utah.

i. Ship refurbished cases to KSC.

C. There are no recommended Level II Allocation Functional Specification changes for the next STAR.

## 3.6 APPROVED LEVEL II ALLOCATIONS GROUND RULE CHANGES

None this report.

## 3.7 RECOMMENDED LEVEL II ALLOCATIONS GROUND RULE CHANGES

None this report.

## 3.8 Level III Timeline Allocations and Assessments

This section portrays timeline allocations and assessments at the next level of detail refered to as Level III. See discussions under "Timeline Allocations" paragraph 2.2.4D. Generally the allocations start at a general level (i.e. Level I) which has the least amount of detail. It is then subdivided into more detailed levels as a means of providing visibility and control at the working and planning level. The assessments on the other hand are started at the working level, generally Level IV, and are consolidated to succeeding higher levels (less detail) up to Level 1. The lowest level of detail shown in the STAR is Level III. This is the lowest level of detail commensurate with optimum visibility, planning, and control. Thus the allocations at this level are derived from Level II detail while the assessments are derived from Level IV. Whenever Level IV assessment timelines are presented to the STAG meetings, they are included in the minutes to that meeting. Thus Level IV assessments are distributed only once via the STAG minutes.

a. A summary of the changes to the Level III allocations and assessments from STAR 016 to 017 are presented in Table 3-3.

b. Level III Allocation and Assessment Delta

Figures 5-1 and 5-2 indicate the Level III activities reflected in Figures 3 and 3A; Figures 6-1 and 6-2 indicate the Level III activities reflected in Figures 4 and 4A. Figure 7 is the Level III breakdown of ET/SRB processing in the VAB.

Listed below in Table 3-4 are the Level III activities and the difference in time between the allocation for each task and the present assessment. Included in the listing are changes reflected in the current Level II assessment timeline that have been noted since the last report. Those items which

increase or decrease the dwell time at a facility are considered to have a serial impact on the schedule. Any other increase or decrease is considered to be a parallel effort.

(X.XS) = Serial time increase or decrease

P = Parallel effort

The listing denotes the Project Offices responsible for tracking and reporting the progress and problems of the tasks in which the assessments are greater than the allocated times. The Project Office is also responsible for the hardware maturity status.

C. Assessment History

Figures 12, 13 and 14 report the turnaround assessment figures for previous STAR's for the Shuttle System, the SLF/OPF, and SVAC/pad.

D. Changes to the Flight Kit Assessments

| FLIGHT KIT | CHANGE |
|---|---|
| Spacelab Cargo Harness | Deleted |
| Emergency Rescue | Reclassified as Flight Crew Equipment |
| Manned Maneuvering Unit (MMU) Storage Provisions Kit | Reclassified as Flight Crew Equipment |

E. Changes to PSST from Last STAR

The following changes were made to the Periodic Significant Scheduled Tasks (PSST).

| PSST Number | Timelines Description, PSST Description, and Remarks | Present Assessment | Change in PSST Assessment Wa:/Is |
|---|---|---|---|
| O-5 | Flight Kit Removal (PL in OPF) | 20 | - |
| O-6 | Flight Kit Removal (PL at Pad) | 32.0 | - |
| O-7 | Flight Kit Installation (PL in OPF) | 55.0 | - |
| O-8 | Flight Kit Installation (PL at Pad) | 17.0 | - |
| P-3 | Reload Dewars and Service PRSD Tanks reassessed to be required for PRSD tank sets 6, 7 and 8. The original dewar load will fill tank sets 1 thru 5. | 0 | 8.0 |

F. Significant Problem Areas Changes from STAR 016 to STAR 017

The following is a list of changes to the Significant Problem Areas since STAR 016.

o Hypergolic Servicing - Servicing time increases to 11.0 hours.

The increase from 7.5 hours since the last assessment was due to the following changes:

- The vacuum fill requirement for the RCS Manifold was added
- The RCS Fill rate was reduced
- The pressure differentials for RCS drain/blowdown was increased

The hypergolic servicing timeline assessment was prepared considering the following groundrules:

- Load the OMS tanks in the opposite Pod from the fill port first to sweep out the crossfeed line.
- No simultaneous liquid $N_2O_4$ and MMH flows thru the APS service panel.
- Fill the APS oxidizer and the FRCS fuel in parallel then fill the APS fuel and FRCS oxidizer in parallel. No additional time is added to the timeline because the APS servicing is the pacing item. However, it does simplify operations by eliminating dual flow demands from the GSE loop.

NOTE: If the second ground rule is changed to permit parallel servicing, 2½ hours could be saved reducing the timeline to 8½ hours. This would require safety approval.

o Spacelab Removal and Installation - Installation time increased by 7 hours to 63.5 hours.

The installation time of Spacelab and tunnel was reassessed. Although some of the individual tasks were reduced in time, many of them were changed from parallel tasks to serial tasks. The overall effect was an increase in time.

G. Action Item Summary

The Action Item Summary is contained in Appendix D.

KSC SPACE TRANSPORATION SYSTEM PROJECTS

TABLE 3-3

LEVEL III ALLOCATION/ASSESSMENT CHANGES FROM STAR 016

FIGURES 5-1 AND 6-1

FEBRUARY 1&2, 1979

| ITEM DESCRIPTION | ALLOC. | ASSESSMENT STAR 016 | ASSESSMENT THIS REPORT | TIMELINE INC. (DEC.) | REASON FOR CHANGE |
|---|---|---|---|---|---|
| FLIGHT KIT REMOVAL, SPACELAB (INDIVIDUAL FLIGHT KIT CHANGES ARE LISTED AS FOLLOWS:) | 8.0 | 17.0 | 20.0* | (26.0) S | THIS TASK, RECONFIGURE SIGNAL AND POWER HARNESS ASSEMBLIES AND FLIGHT KIT INSTALLATION, SPACELAB TASK HAVE BEEN CHANGED FROM SERIAL TO PARALLEL TASKS. THE RESULT IS A NET SAVINGS TO THE TIME-LINE EVEN THOUGH SOME INDIVIDUAL TASKS INCREASED. THIS WAS DONE AS A RESULT OF REASSESSMENT BY ROCK-WELL-LO, NASA/VT-VPD AND NASA/SP. |
| REMOVE RETENTION KIT (2 LONGERONS AND 1 KEEL BRIDGE) | - | 5.0 | 8.0 | 3.0 P | |
| FLIGHT KIT REMOVAL, UPPER STAGES (INDIVIDUAL FLIGHT KIT CHANGES ARE LISTED AS FOLLOWS:) | 8.0 | 20.0 | 20.0* | ( 3.0) S | THIS TASK AND THE FLIGHT KIT INSTALLATION, UPPER STAGES TASK HAVE BEEN CHANGED FROM SERIAL TO PARALLEL TASKS. THE RESULT IS A NET SAVINGS TO THE TIMELINE OF 3.0 EVEN THOUGH SOME INDIVI-DUAL TASKS HAVE INCREASED. THIS CHANGE IS A RESULT OF REASSESSMENT BY ROCK-WELL/LO, NASA/VT-VPD, AND NASA/SP. |
| REMOVE RETENTION KIT (6 LONGERONS AND 2 KEELS) | - | 8.0 | 20.0 | 12.0 P | |

* DOES NOT INCLUDE REMOVAL AND INSTALLATION OF SIGNAL AND POWER HARNESS ASSEMBLIES.

KSC SPACE TRANSPORATION SYSTEM PROJECTS

TABLE 3-3

LEVEL III ALLOCATION/ASSESSMENT CHANGES FROM STAR 016

FIGURES 5-1 AND 6-1

FEBRUARY 1&2, 1979

| ITEM DESCRIPTION | ALLOC. | ASSESSMENT STAR 016 | ASSESSMENT THIS REPORT | TIMELINE INC. (DEC.) | REASON FOR CHANGE |
|---|---|---|---|---|---|
| INSTALL RETENTION KIT (5 LONGERONS AND 2 KEELS) | - | 8.0 | 25.0 | 17.0 P | CHANGED TO PARALLEL TASK AS NOTED IN "FLIGHT KIT REMOVAL SPACELAB" REASSESSMENT BY ROCKWELL-LO, NASA/VT-VPD, AND NASA/SP. |
| INSTALL $H_2O$, $GN_2$, $GO_2$ LINES SERVICE $H_2O$ | - | 28.0 | 30.0 | 2.0 P | REASSESSMENT AS NOTED ABOVE. |
| FLIGHT KIT INSTALLATION, UPPER STAGES | 16.0 | 3.0 | 17.0* | 14.0 P | CHANGED TO PARALLEL TASK AS NOTED IN "FLIGHT KIT REMOVAL UPPER STAGES" REASSESSMENT BY ROCKWELL-LO, NASA/VT-VPD, AND NASA/SP. |
| (THE INDIVIDUAL FLIGHT KITS ARE LISTED AS FOLLOWS:) | | | | | |
| INSTALL RETENTION KIT (2 LONGERONS AND 1 KEEL) | - | 3.0 | 17.0 | 14.0 P | NOTED ABOVE. |

* DOES NOT INCLUDE REMOVAL AND INSTALLATION OF SIGNAL AND POWER HARNESS ASSEMBLIES.

KSC SPACE TRANSPORATION SYSTEM PROJECTS

TABLE 3-3

LEVEL III ALLOCATION/ASSESSMENT CHANGES FROM STAR 016
Figures 5-1 and 6-2

February 1 & 2, 1979

| Item Description | Allocation | Assessment STAR 016 | Assessment This Report | Timeline Increase (Decrease) | | Reason for Change |
|---|---|---|---|---|---|---|
| Spacelab Internal Closeout (formerly Payload Preliminary Closeout and Spacelab Internal Inspection). | 4.0 | 12.0 | 11.0 | 9.0 | S | As a result of a reassessment by VT-VPD this function was changed from a parallel task to an essentially serial task. |
| Tunnel Installation Preps | - | 6.0 | 2.5 | (1.0) | S | VT-VPD Reassessment |
| Tunnell Installation Operations | - | 17.5 | 4.5 | (13.0) | S | The decrease in elapsed time is a result of VT-VPD reassessment. This function was divided into three functions of which the two additional are as follows: |
| Tunnel Mate | - | - | 9.0 | 8.0 | S | Formerly part of Installation Ops |
| Tunnel/Airlock Internal Checkout | - | - | 4.0 | 4.0 | S | Formerly part of Installation Ops |

KSC SPACE TRANSPORATION SYSTEM PROJECTS

TABLE 3-3

LEVEL III ALLOCATION/ASSESSMENT CHANGES FROM STAR 016
Figures 5-2 and 6-2

February 1 & 2, 1979

| Item Description | Allocation | Assessment STAR 016 | Assessment This Report | Timeline Increase (Decrease) | | Reason for Change |
|---|---|---|---|---|---|---|
| Hypergolic Service | 6.0 | 7.5 | 11.0 | 3.5 | S | Reassessment by VE-FSD (discussed in Significant Problems) |
| Reload Dewars and Service PRSD Tank Set No. 5 | - | 8.0 | 0.0 | (8.0) | S | Reassessment by VE-FSD |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1.0 | 1.0 | 1.0 | 0.0 | - | LANDING AREA | - | - | - |
| 1.0 | 1.0 | 1.0 | 0.0 | - | Postlanding Operations | - | - | - |
| 0.5 | 0.5 | 0.5 | 0.0 | - | Provide ECLSS Coolant and Orbiter Purge | - | - | Task is 15 minutes. |
| 1.0 | 1.0 | 1.0 | 0.0 | - | Crew Exchange | - | - | - |
| 96.0<br>87.5 | 205.0<br>134.0 | 186.0<br>123.5 | 90.0<br>36.0 | (-19.0)<br>(-3.05) | ORBITER PROCESSING FACILITY(SL)-<br>ORBITER PROCESSING FACILITY(US) | | - | - |
| 0.5 | 1.0 | 1.0 | 0.5 | - | Tow to OPF | L&L | Fabrication complete | Operational require to stop prior to en ing OPF. No decrea anticipated. |
| 2.5 | 2.5 | 2.5 | 0.0 | - | Transfer to Facility Services | - | - | - |
| 3.0 | 3.0 | 3.0 | 0.0 | - | Jack and Level | - | - | - |
| 0.5 | 2.0 | 2.0 | 1.5 | - | Position Orbiter Access Platforms. Task relocated ahead of purge and dry SSME operations and becomes totally serial. | L&L | Basic design complete | No decrease anticipated |
| - | 0.5 | 0.5 | 0.5 | - | Clear OPF High Bay of nonessential personnel. Safety requirement in preparation for hyper OPS. All remaining will be in special protective clothing. | L&L | - | - |
| - | 14.5 | 14.5 | 14.5 | - | Preparation for APS/FRCS Safing. Move to commence ahead of SSME purge operations. | ORB | - | - |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 2.0 | 16.0 | 16.0 | 14.0 | - | Purge and Dry SSME - PRCBD 4123 resulted in a longer (12-hr minimum) purge. The purge will be vented, via yet to be defined GSE, external to the OPF. This allows the purge to be a nonhazardous, parallel operation. The task includes 3 hrs. of preps, 12 hrs. for the purge and 1 hr. to obtain dew point moisture samples and secure. | | | |
| - | 0.5 | 0.5 | 0.5 | - | Clear Nonessential Personnel | L&L | N/A | Operational/Safing Requirement. |
| - | 1.5 | 1.5 | 1.5 | - | APS/FRCS Pod Safing | ORB | - | - |
| 3.0 | 4.0 | 4.0 | 1.0 | - | Vent, Drain, & Purge PRSD | ORB | - | - |
| 0.5 | 2.0 | 2.0 | 1.5 | - | Vent ECLSS GO2/GN2 | L&L | - | Operations requirem |
| 4.0 | 6.0 | 6.0 | 2.0 | - | Prep and Service APU | ORB | - | - |
| - | 0.5 | 0.5 | 0.5 | - | Open Noncontrolled Areas | L&L | N/A | Operations/Safety requirement. |
| - | - | - | - | - | Open General Area | | - | - |
| 5.0 | 4.5 | 4.5 | -0.5 | - | Gain Vehicle Access | | - | - |
| 5.0 | 4.0 | 4.0 | -1.0 | - | Remove Cabin Stowage | | - | - |
| 8.0 | 7.0 | 7.0 | -1.0 | - | Install SSME Access | | - | - |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| - | - | 16.0 | 16.0 | - | SSME Heat Shield Removal The heat shields must be removed to provide access to the turbopumps for torque testing as part of SSME maintenance. | ORB | - | - |
| 24.0 | 8.0 | 13.0 | -11.0 | - | Scheduled SSME Maintenance Rocketdyne has identified a new requirement to perform the turbopump torque test and heat exchanger leak test every turnaround. | ME | - | - |
| - | - | 25.0 | 25.0 | - | SSME Heat Shield Installation and Retest. The heat shields must be reinstalled and leak tested after every turbopump torque test as part of SSME maintenance. | ORB | - | - |
| 15.0 | 14.5 | 14.5 | -0.5 | - | Post Flight Visual Inspection | | - | - |
| - | 26.0 | 26.0 | 26.0 | - | APS/FRCS Pod Checkout and Disconnect | ORB | - | - |
| 24.0 | 24.0 | 24.0 | 0.0 | | Scheduled Orbiter Maintenance | ORB | - | - |
| 40.0 | 40.0 | 40.0 | 0.0 | - | Unscheduled Orbiter Maintenance | - | - | - |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 10.0 Serial | 10.0 Serial | 10.0 Serial | 0.0 | - | System Reverification as Required | - | - | - |
| 40.0 | 109.5* | 109.5* | 69.5 | | TPS Refurbishment | ORB | - | - |
| 5.5 | 13.5 | 13.5 | 8.0 | - | Install SE and Open Payload Bay Doors | L&L | Design complete | No decrease anticip Assessment has previously been reduce to 13.5 as a result the "rolling bridge design for SE. The assessment includes the "0-G" fixture i stallation which is part of the rolling bridge. |
| - | 1.0 | 1.0 | 1.0 | - | Remove EVA Handrails (SL) | ORB | - | - |
| - | 2.0 | 2.0 | 2.0 | - | Remove EVA Handrails (US) | ORB | - | - |
| 3.0 | 20.5 | 20.5 | 17.5 | - | Remove Spacelab (2+2 Pallet) and Igloo. | L&L & PAY | Fabrication in work | No decrease anticipated. |
| 3.0 | 5.0 | 5.0 | 2.0 | - | Remove SSUS Cradles | L&L & PAY | Fabrication in work | No decrease anticip |
| 4.5 | 6.0 | 6.0 | 1.5 | - | Gain Payload Bay Access | ORB/ PAY | Concept | - |

*Required 3 shift/24 hours a day operation. The assessment is based on this requirement.

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 8.0 | 17.0 | 20.0* | 12.0* | (-26.0S) | Flight Kit Removal, Spacelab.* This task, Reconfigure Signal and Power Harness Assemblies and Flight Kit Installation, Spacelab, have been changed from Serial to Parallel tasks. The result is a net savings to the time line even though some individual tasks increased. This was done as a result of reassessment by Rockwell-LO, VT-VPD and SP. These flight kits are listed individually as follows: | ORB/ PAY | Concept | Changes are anticipated as specific payloads are changed |
| - | 12.0 | 12.0 | - | - | Deservice, disconnect, and remove freon fluid lines kit. | | | |
| - | 5.0 | 8.0 | - | 3.0P | Remove retention kit (2 longerons, 1 keel). Reassessment as noted in Flight Kit Removal, Spacelab. | | | |
| 8.0 | 20.0 | 20.0* | 12.0* | (-3.0S) | Flight Kit Removal, Upper Stages. * This task and the Flight Kit Installation, Upper Stages have been changed from Serial to Parallel tasks. The result is a net savings to the timelime of 3.0 hours even though some individual tasks have increased. This change is a result of a reassessment by Rockwell-LO, VT-VPD and SP. These flight kits are listed individually as follows: | ORB/ PAY | Concept | Changes are anticipated as specific payloads are changed. |

* Does not include removal and installation of Signal and Power Harness Assemblies.

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| - | 12.0 | 12.0 | - | - | Deservice, disconnect, and remove freon fluid lines kit. | - | - | - |
| - | 8.0 | 20.0 | - | +12.0P | Remove retention kit (6 longerons, 2 keels). | - | - | - |
| - | 26.0 | 26.0 | - | - | Reconfigure Signal and Power Harness Assemblies. Changed to Parallel task as noted in Flight Kit Removal, Spacelab It remains as a Serial task for Flight Kit Removal, Upper Stages. | - | - | - |
| 16.0 | 36.0 | 55.0* | 39.0* | - | Flight Kit Installation, Spacelab. * Changed to parallel task as noted in Flight Kit Removal, Spacelab. These flight kits are listed individually as follows: | ORB/ PAY | Concept | Changes anticipated as specific payload are changed |
| - | 8.0 | 25.0 | - | 17.0P | Install retention kit (5 longerons, 2 keels). Reassessment as noted in Flight Kit Installation, Spacelab. | | | |
| - | 28.0 | 30.0 | - | 2.0 | Install $H_2O$, $GN_2$, $GO_2$ lines and service $H_2O$. Reassessment as noted in Flight Kit Installation, Spacelab. | | | |
| 16.0 | 3.0 | 17.0* | -13.0* | +14.0P | Flight Kit Installation, Upper Stages. Change to parallel task as noted in Flight Kit Removal, Upper Stages. * These flight kits are listed individually as follows: | ORB/ PAY | Concept | Changes are anticipa as specific payloads are changed. |

* Does not include removal and installation of Signal and Power Harness Assemblies.

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| - | 3.0 | 17.0 | - | +14.0P | Install retention kit (2 longerons, 1 keel). Reassessed as noted in Flight Kit Installation, Upper Stages. | - | - | - |
| 2.0 | 5.0 | 5.0 | 3.0 | - | Prepare Payload Bay and Remove Access. | ORB | - | - |
| 7.0 | 7.0 | 7.0 | 0.0 | - | Clean and Inspect Payload Bay | - | - | - |
| - | - | - | - | - | Cranes Released to Spacelab | - | - | |
| - | 8.5 | 8.5 | 8.5 | - | Spacelab Installation Preparations. | L&L/ PAY | - | Changes are anticipa as specific payloads are changed. |
| 4.0 | 3.5 | 3.5 | -0.5 | - | Install Spacelab in Payload Bay. | L&L/ PAY | - | Changes are anticipa as specific payloads are changed. |
| 2.0 | 9.0 | 9.0 | 7.0 | - | Connect and Verify Spacelab/ Orbiter Interface. | L&L/ Pay | - | Changes are anticipa as specific payloads are changed. |
| - | 2.5 | 2.5 | 2.5 | - | Install EVA Handrails. (SL). | ORB | - | - |
| - | 1.5 | 1.5 | 1.5 | - | Install EVA Handrails (US). | ORB | - | - |
| - | - | - | - | - | Crane Released from Spacelab. | - | - | |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 5.0 | 5.0 | 5.0 | 0.0 | - | Orbiter Integrated Test Preparations | - | - | - |
| 4.0 | 12.0 | 11.0 | 7.0 | (+9.0S) | Spacelab Internal Closeout - Formerly Payload Preliminary Closeout and Spacelab Internal Inspection. (SL) As a result of a reassessment by VT-VPD this function was changed from a parallel task to an essentially serial task. | - | - | - |
| 12.0 | 16.0 | 16.0 | 4.0 | - | Orbiter Integrated Test (SL) | ORB | - | Changes are anticip as specific payload are changed. |
| 12.0 | 12.0 | 12.0 | 0.0 | - | Orbiter Integrated Test (US) | ORB | | |
| - | 6.0 | 2.5 | 2.5 | (-1.0S) | Tunnel Installation Preparations. Result of reassessment by VT-VPD. | | | Changes are anticip as specific payload are changed. |
| - | 17.5 | 4.5 | 4.5 | (-13.0S) | Tunnel Installation Operations - Decrease in elapsed time a result of reassessment by VT-VPD. This function was divided into three functions of which the two additional are as follows: | - | - | - |
| - | - | 9.0 | 9.0 | (+8.0S) | Tunnel Mate - Formerly part of Tunnel Installation OPS. | | | |
| - | - | 4.0 | 4.0 | (+4.0S) | Tunnell/Airlock Internal checkout - formerly part of Tunnel Installation OPS. | | | |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1.5 | 2.5 | 2.5 | 1.0 | - | $NH_3$ Servicing | ORB | - | - |
| 1.5 | 1.5 | 1.5 | 0.0 | - | Connect Ordinance | - | - | - |
| 6.0 | 6.0 | 6.0 | 0.0 | - | Cabin Stowage | - | - | - |
| 7.0 | 7.5 | 7.5 | 0.5 | - | Orbiter Closeout. | ORB/L&L | - | - |
| 4.5 | 12.5 | 12.5 | 8.0 | - | Payload Bay Final Inspection, Close Doors (SL) | ORB/ PAY | - | - |
| 4.5 | 11.0 | 11.0 | 6.5 | - | Payload Bay Final Inspection, Close Doors (US) | | | |
| 3.0 | 0.0 | 0.0 | -3.0 | - | Install Erection Fixture. item deleted; task will be accomplished in VAB Transfer aisle. Load beams to be installed with slings. This does not change the allocation since the allocation was a parallel task. | ORB/ L&L | Facility design complete | |
| 1.0 | 2.5 | 2.5 | 1.5 | - | Lower Orbiter and Prepare to Tow. | ORB | - | - |
| 39.0 | 52.0 | 52.0 | 13.0 | | VEHICLE ASSEMBLY BUILDING | - | - | - |
| 1.0 | 1.0 | 1.0 | 0.0 | - | Tow to VAB | - | - | - |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1.0 | 2.5 | 2.5 | 1.5 | - | Install Erection Fixture and Slings. Operations with the orbiter simulator have indicated that the load beams can be attached to the slings in the VAB, prior to orbiter arrival. The load beams then become attached to the sides of the orbiter with the slings in the transfer aisle. The operation adds 1.0 hr to VAB, but reduces the overall turnaround by 4.0 hrs. | ORB/L&L | - | May drive the crane operation into the critical path both cranes employed for longer time with/ bail beam operations prior to Orbiter arrival. |
| 1.5 | 2.5 | 2.5 | 1.0 | - | Retract Landing Gear | ORB | - | - |
| 1.0 | 1.0 | 1.0 | 0.0 | - | Rotate to Vertical | - | - | - |
| 1.0 | 1.5 | 1.5 | 0.5 | - | Remove Aft Erection Hardware | ORB | - | - |
| 1.5 | 3.0 | 3.0 | 1.5 | - | Transfer to Integration Cell | L&L/ ORB | Concept | Platform constraint limitations. No decrease anticipated. |
| 3.0 | 7.0 | 7.0 | 4.0 | - | Mate Orbiter to ET | ORB/ ET | Fabrication in work | No decrease anticipated. |
| 2.5 | 2.5 | 2.5 | - | | Remove Orbiter Forward Erection Sling | - | - | - |
| 8.0 | 10.0 | 10.0 | 2.0 | - | Connect Orbiter/MLP Interface and Verify | L&L | - | No decrease anticipated. |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 8.0 | 10.0 | 10.0 | 2.0 | - | Connect Orbiter/ET Interface and Verify | L&L | - | No decrease anticipated. |
| - | - | - | - | - | Power on | - | - | |
| 7.5 | 8.0 | 8.0 | 0.5 | - | Shuttle Interface Test | L&L | - | - |
| 1.0 | 1.0 | 1.0 | - | - | Clear Area | - | - | - |
| - | - | - | - | - | Power Off | - | - | - |
| 6.0 | 5.5 | 5.5 | -0.5 | - | Install and Connect Ordn. | - | - | - |
| 1.0 | 1.0 | 1.0 | 0.0 | - | Open Area | - | - | - |
| - | 22.5 | 22.5 | 22.5 | - | ET TPS Closeout. | MSFC | - | - |
| 3.5 | 5.5 | 5.5 | 2.0 | - | Prep for Rollout | ORB | - | - |
| 0.0 | 18.5 | 18.5 | 18.5 | - | PL Installation in RSS (US) | - | - | - |
| 0.0 | 6.5 | 6.5 | 6.5 | - | PL Cannister Removal (US). | - | - | - |
| 0.0 | 1.0 | 1.0 | 1.0 | - | Clear Pad (US). | - | - | - |
| 0.0 | 6.5 | 6.5 | 6.5 | - | Launch Pad Fuel Cell Dewar Load. | - | - | - |
| 24.0 | 42.5 | 38.0 | 14.0 | (-4.5S) | LAUNCH PAD (SPACELAB) | - | - | - |
| 32.5 | 55.5 | 55.5 | 29.0 | - | LAUNCH PAD (UPPER STAGE) | - | - | - |
| 7.0 | 7.0 | 7.0 | 0.0 | - | Transfer to Pad | - | - | - |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0.5 | 1.0 | 1.0 | 0.5 | - | Extend RSS & Cabin Access Arm (SL) | | | |
| 0.5 | 1.0 | 1.0 | 0.5 | - | Extend RSS and Cabin Access Arm. US. | - | Fabrication in work | |
| 6.5 | 6.5 | 6.5 | 0.0 | - | Mate Facility/ET Propulsion Service Lines | - | Fabrication in work | - |
| 6.5 | 8.0 | 8.0 | 1.5 | - | Mate MLP and Vehicle to Pad and Verify Interface | L&L | Fabrication in work | - |
| 2.0 | 3.5 | 3.5 | 1.5 | - | Purge and Sample Facility LO2 and LH2 Systems | L&L | Fabrication in work | - |
| 6.0 | 6.0 | 6.0 | 0.0 | - | Servicing Preps | - | - | - |
| 3.0 | 6.0 | 6.0 | 3.0 | - | Launch Readiness Verification | ORB | - | - |
| 1.0 | 2.0 | 2.0 | 1.0 | - | Extend RSS/Orb seals (US) | - | - | - |
| 0.0 | 2.0 | 2.0 | 2.0 | - | Payload Bay Door GSE Installation | - | - | - |
| 0.5 | 2.5 | 2.5 | 2.0 | - | Purge Interstitial Area and Open RSS Doors. (US) | - | - | - |
| 1.0 | 4.0 | 4.0 | 3.0 | - | Open Payload Bay Doors, Extend R/R Antenna, and Rotate RMS (US) | - | - | - |
| 0.5 | 6.5 | 6.5 | 6.0 | - | Move PGHM, Extend IUS and SSUS-D into Payload Bay (US) | - | - | - |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1.0 | 1.0 | 1.0 | 0.0 | - | Orbiter-IUS/SSUS-D Electrical Mate (US) | - | - | - |
| 2.0 | 2.0 | 2.0 | 0.0 | - | Mechanically Mate IUS and SSUS-D to Orbiter (US) | - | - | - |
| 4.0 | 4.0 | 4.0 | 0.0 | - | IUS and SSUS-D Power ON Interface Readiness Verification (US) | - | - | - |
| - | - | - | - | - | Orbiter IUS and SSUS-D (US) Power On | - | - | - |
| - | 0 | 0 | - | - | Payload stand alone testing time will not be shown in the STAR timelines, per NASA HQ instructions. Such testing time will be available only as an optional service. | | | |
| - | 1.0 | 1.0 | 1.0 | - | Payload Launch Readiness Verification (US) | PAY | - | - |
| - | 2.0 | 2.0 | 2.0 | - | Connect Payload S&A (US) | PAY | - | - |
| 0.5 | 3.5 | 3.5 | 3.0 | - | Disconnect/Extract PGHM from Payload Bay (US) | - | - | - |
| 1.0 | 1.5 | 1.5 | 0.5 | - | Retract R/R Antenna, Rotate Remote Manipulator System, and Close Payload Bay Doors (US) | - | - | - |
| - | 0.5 | 0.5 | 0.5 | - | Close RSS Doors (US) | - | - | - |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| - | 2.0 | 2.0 | 2.0 | - | Payload Bay Door SE Removal (US) | ORB | Concept | - |
| 1.5 | 2.0 | 2.0 | 0.5 | - | Cabin Closeout | ORB | - | - |
| 0.5 | 1.0 | 1.0 | 0.5 | - | Clear Pad | L&L/ ORB | - | - |
| - | - | 21.0 | 21.0 | - | IMU Warmup, Preflight Calibration & Alignment. T-21.0 Hrs. | ORB | - | - |
| 4.0 | 1.0 | 1.0 | -3.0 | - | ECLSS Service | - | - | - |
| 4.0 | 3.5 | 3.5 | -0.5 | - | F/C Cryo Service | - | - | - |
| 4.0 | 4.0 | 4.0 | 0.0 | - | Helium Servicing | - | - | - |
| 4.0 | 4.0 | 4.0 | 0.0 | - | Payload Service (As Required) | - | - | - |
| 4.0 | 4.0 | 4.0 | 0.0 | - | ET Conditioning | - | - | - |
| 6.0 | 7.5 | 8.5 | 2.5 | (+1.05) | Hypergolic Service - Increase results from reassessment by VE-FSD | L&L | - | Operations/Safety conservatism preve total parallel flo |
| - | 8.0 | 0.0 | 0.0 | (-8.05) | Reload Dewars and Service PRSD Tank Set No. 5 (SL) - Item deleted as a result of reassessment of GSE Dewar capability by VE-FSD. | - | - | - |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

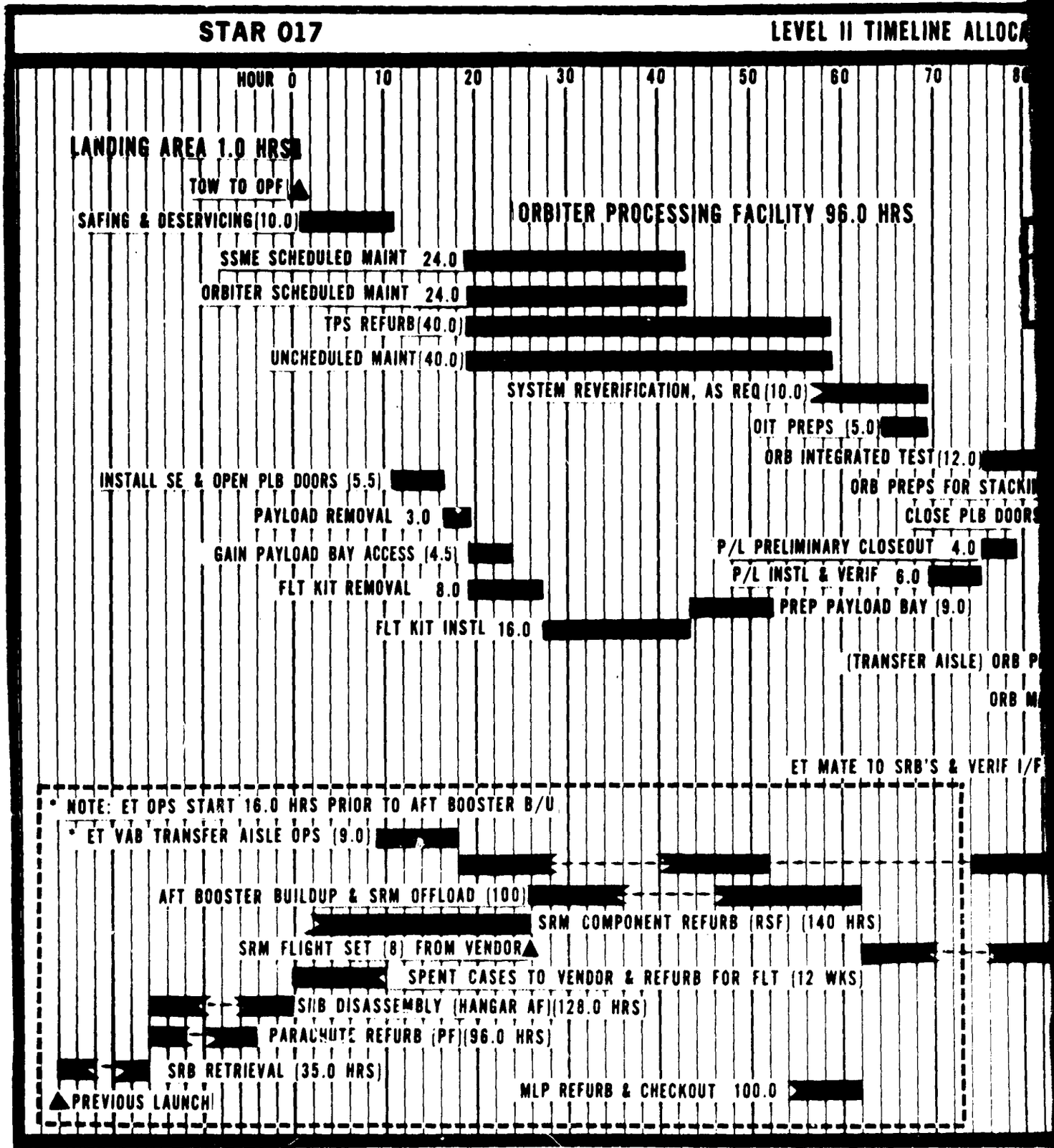
| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0.5 | 0.5 | 0.5 | 0.0 | - | Open Pad | - | - | - |
| 0.5 | 0.5 | 0.5 | 0.0 | - | Servicing Disconnect | - | - | - |
| 0.5 | 1.5 | 1.5 | 1.0 | - | Vehicle Closeout/GSE Securing | ORB L&L | - | - |
| - | - | - | - | - | T-6.5 Hours Hold (If Req'd.) Late Payload Bay Access | - | - | - |
| 0.5 | 2.0 | 2.0 | 1.5 | - | Retract RSS | - | - | - |
| 0.5 | 0.5 | 0.5 | - | - | Clear Pad | - | - | - |
| 2.0 | 4.0 | 4.0 | 2.0 | - | Countdown | - | - | - |
| - | - | 9.0 | - | - | ET Transfer Aisle Ops | ET | - | - |
| 52.0 | 92.0 | 92.0 | 40.0 | - | ET Checkout cell Operations A complete reassessment of these operations resulted in an elapsed time increase of 34.0 hrs. This increase was mainly due to the addition of RSS ordnance operations. Figure 7 carries a breakdown of these additions. | ET | - | - |
| 100.0 | 100.0 | 100.0 | 0.0 | - | Aft Booster Buildup & SRM Offload. | SRB | - | - |
| - | - | 140.0 | - | - | SRB Components refurbish. (new) | SRB | (RSF) | - |

TABLE 3-4

LEVEL III ALLOCATIONS/ASSESSMENT DELTAS

| Alloc. | Assessment Previous Report | Assessment Present Report | Alloc. Assmt. Delta | Assmt. Increase Impact | Item Description | SPO | Hardware Maturity Status | Remarks |
|---|---|---|---|---|---|---|---|---|
| 65.0 | 72.0 | 72.0 | 7.0 | - | SRB Stacking Alignment. Increase in time resulted from latest USBI re-assessment which realigns order of subtasks. | SRB | - | - |
| 80.0 | 93.0 | 72.5 | -7.5 | - | Launch Pad Refurbishment and Checkout | L&L | - | - |
| 100.0 | 73.0 | 73.0 | -27.0 | - | MLP Refurbishment and Checkout | L&L | - | - |
| - | 35.0 | 35.0 | - | - | SRB retrieval. | MSFC | - | - |
| - | 96.0 | 96.0 | - | - | Parachute refurbish (PF) | - | - | - |
| - | 128.0 | 128.0 | - | - | SRB disassembly | (HANGAR AF) | - | - |
| - | 12 wks. | 12 wks. | - | - | SRB Spent Cases to Vendor, Refurbish, and Return to KSC. | - | - | - |

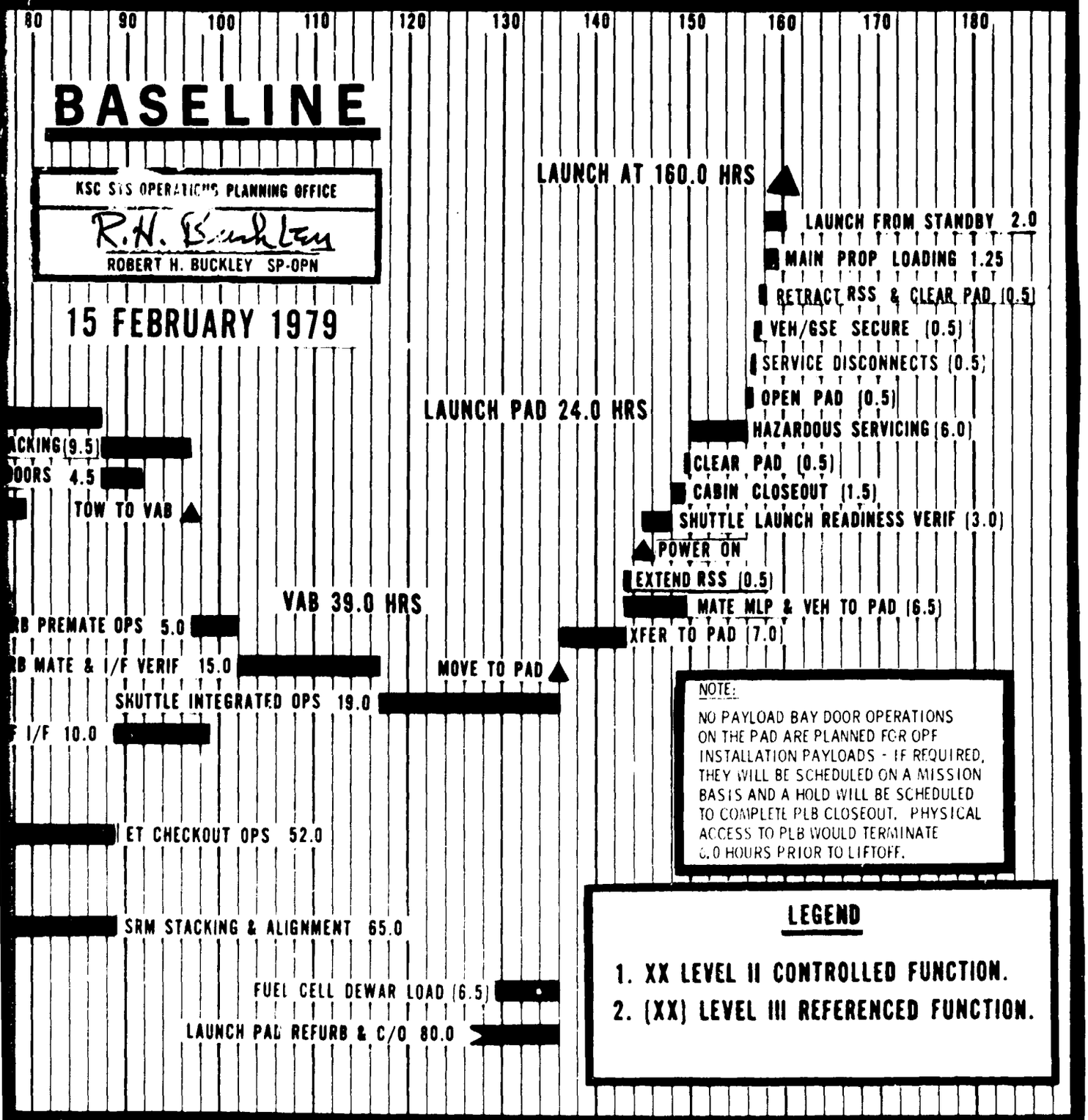
/FOLDOUT FRAME



ROLLOUT NAME

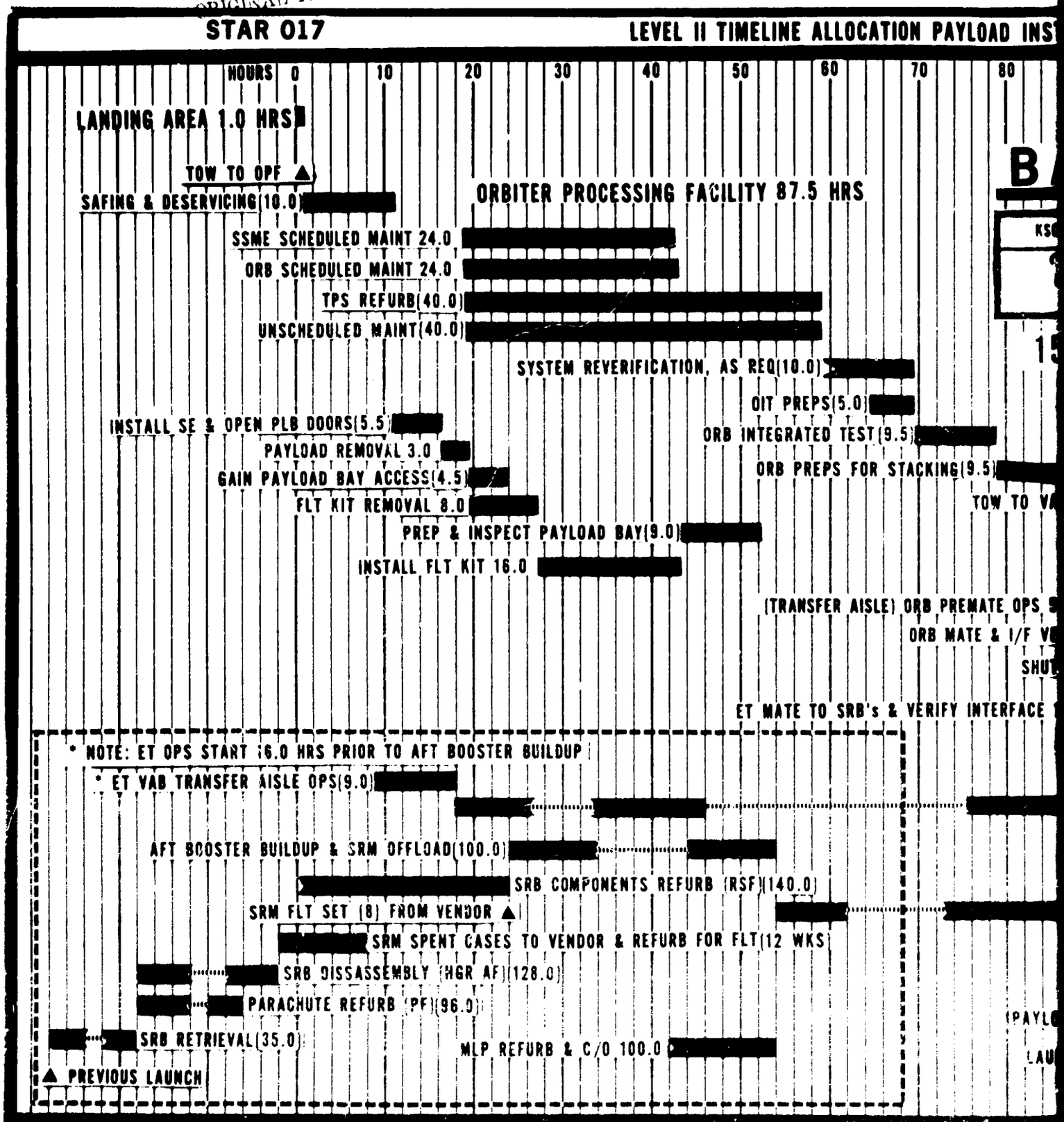
OCATIONS PAYLOAD INSTALLATION IN OPF

FIGURE 1



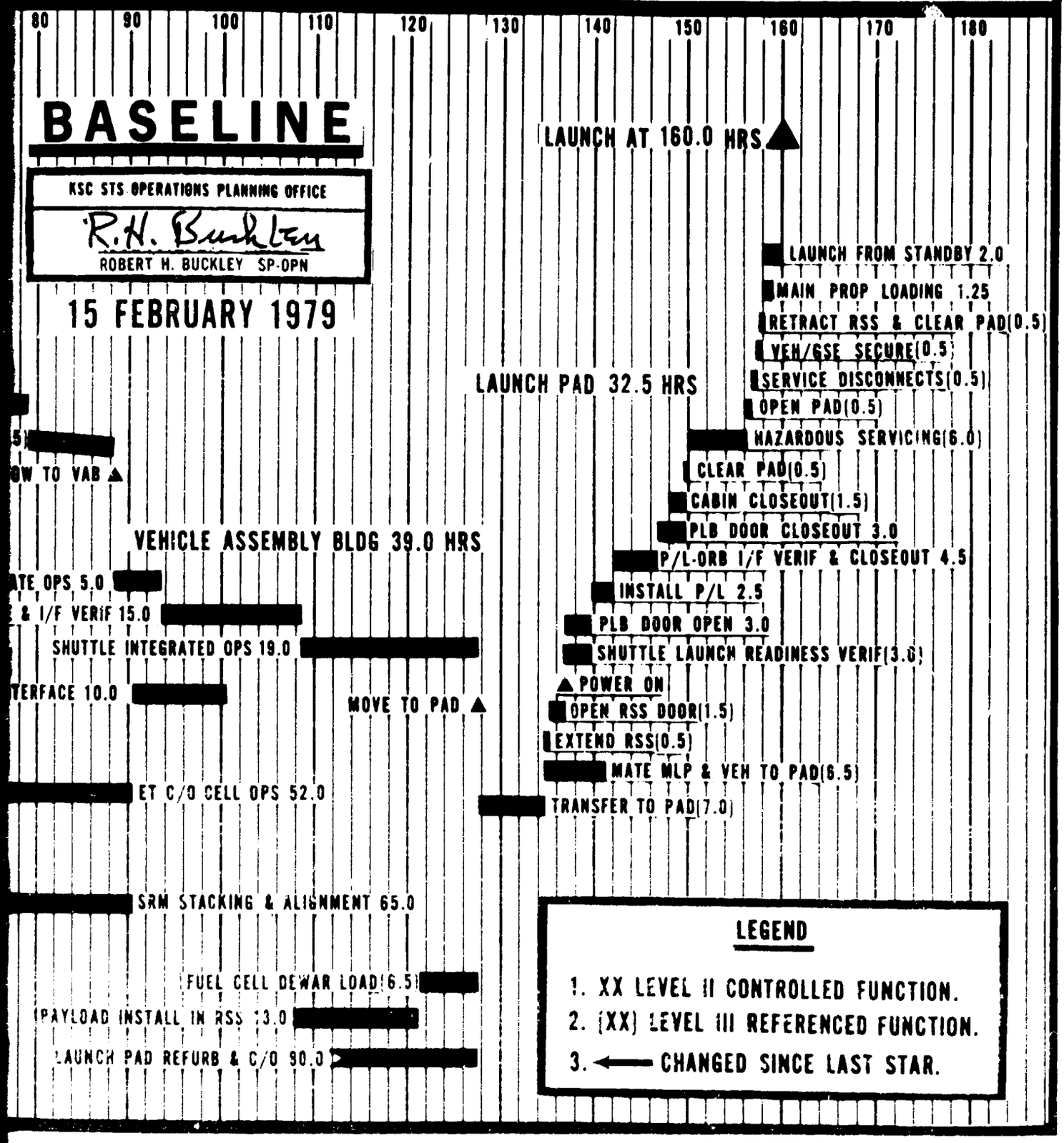
FOLDOUT FRAME

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR



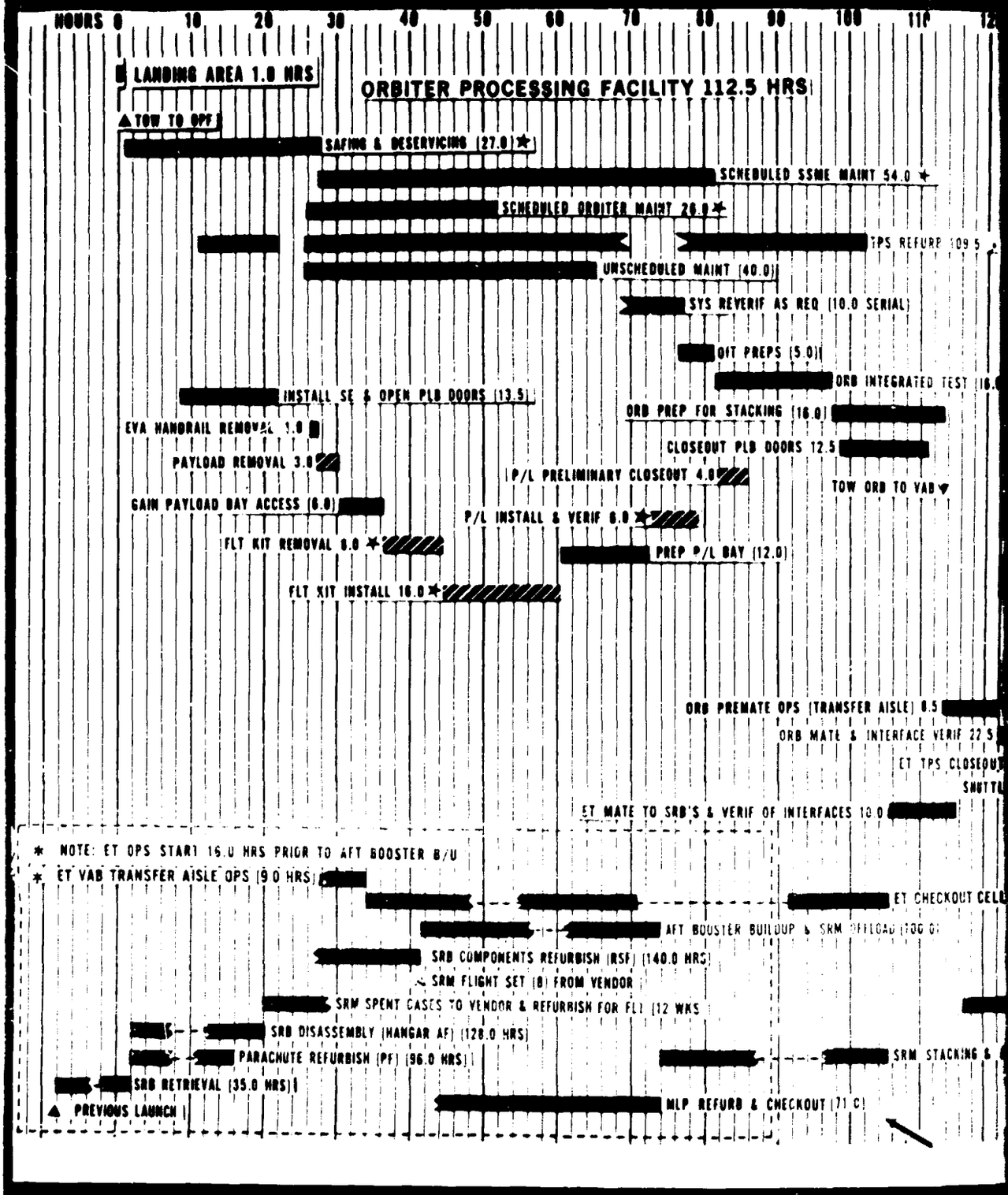
AD INSTALLATION AT LAUNCH PAD

FIGURE 2



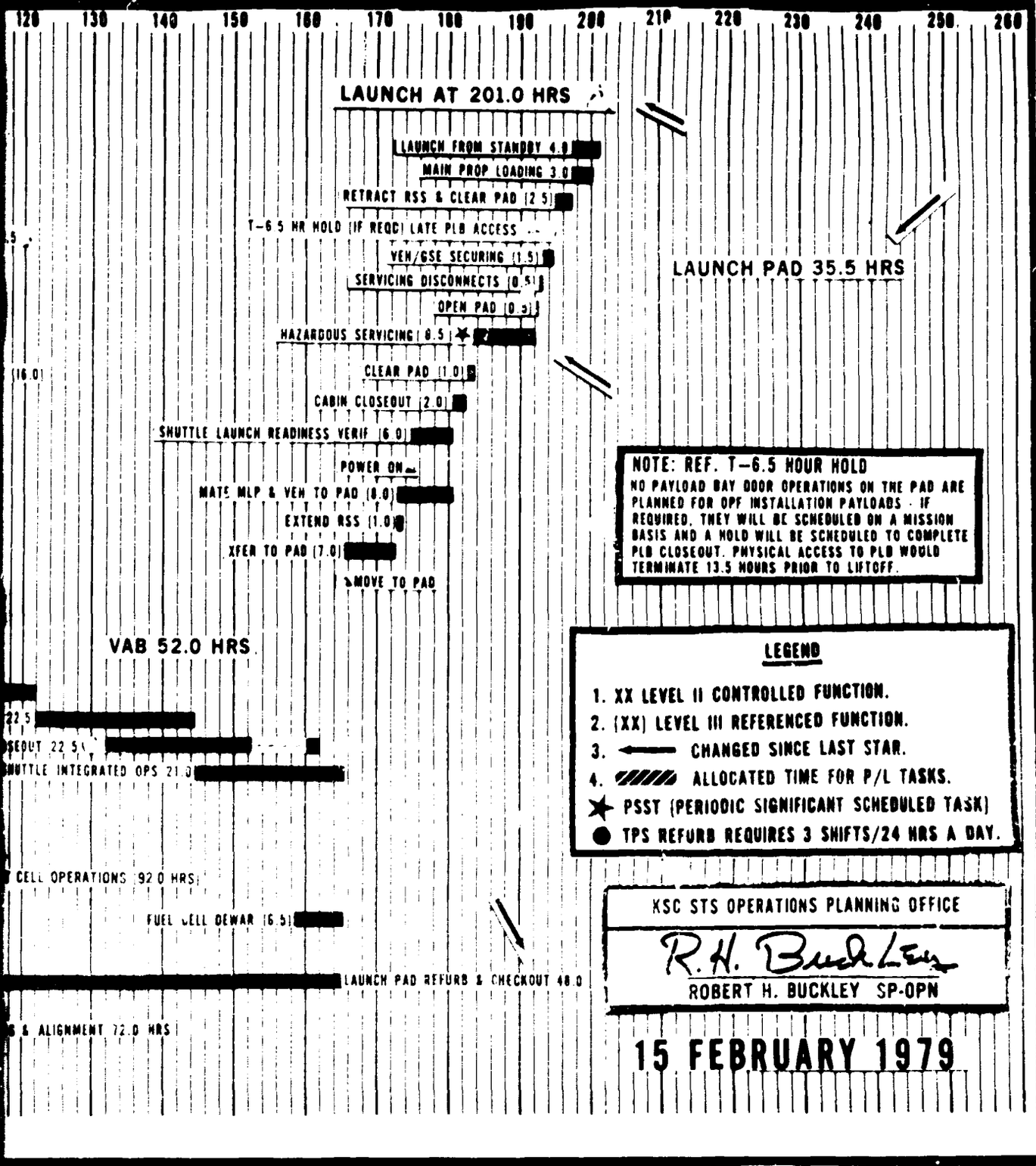
FOLDOUT FRAME

# STAR 017 LEVEL II TIMELINE SHUTTLE ASSES



# ESSMENT PAYLOAD INSTALLATION IN OPF

FIGURE 3




KSC STS OPERATIONS PLANNING OFFICE

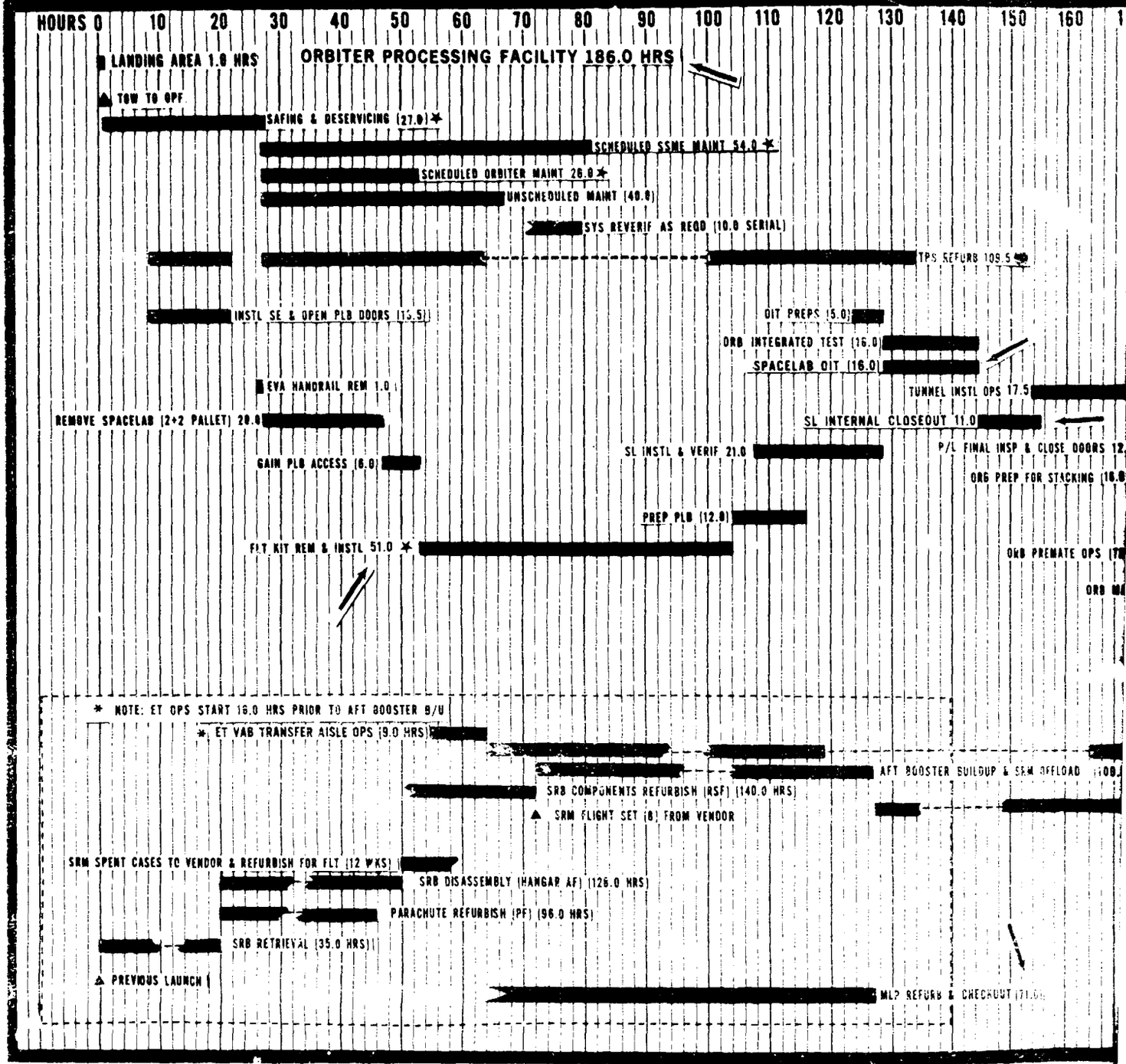
R.H. Buckley

ROBERT H. BUCKLEY SP-OPN

15 FEBRUARY 1979

STAR 017

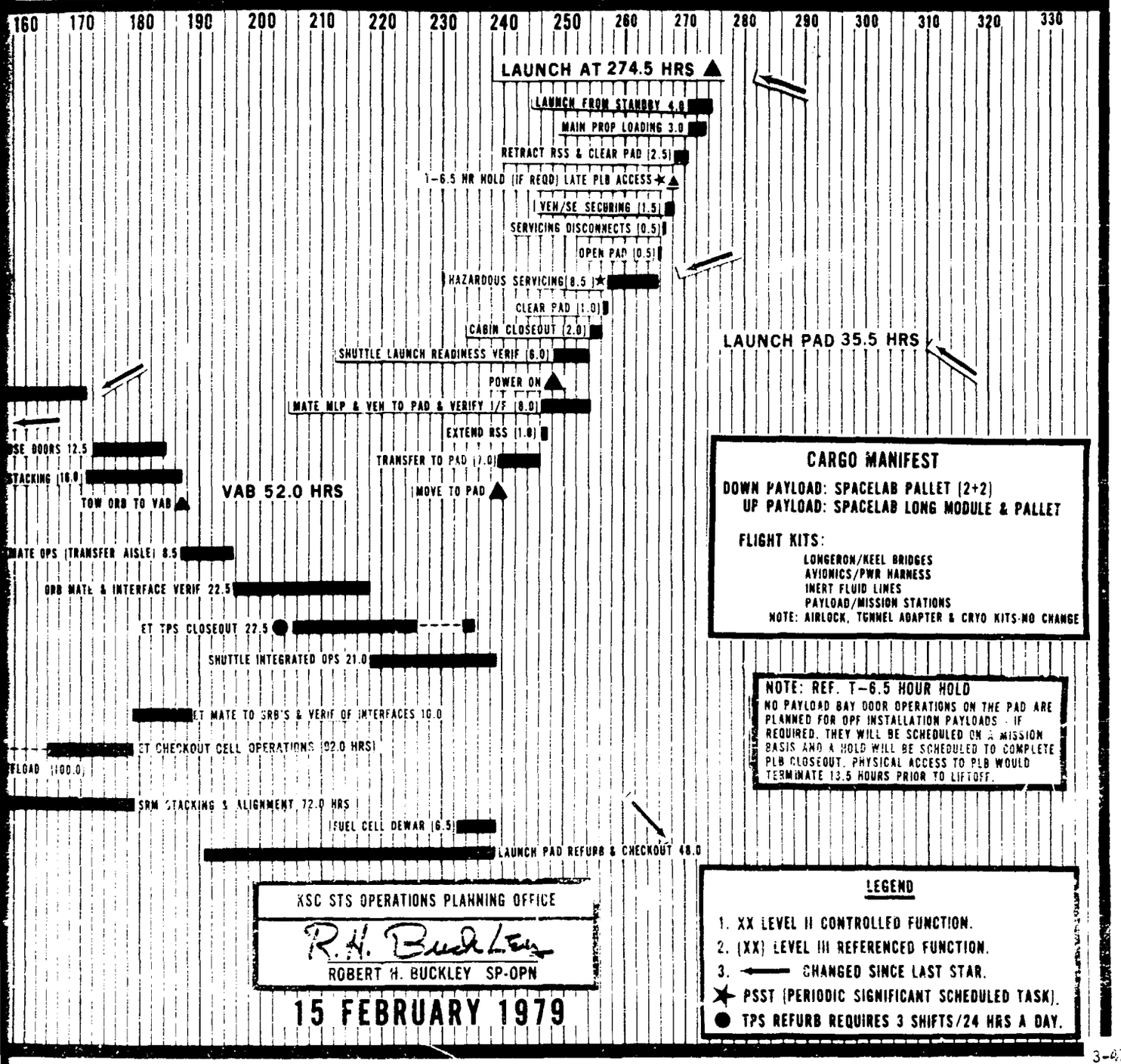
# LEVEL II STS TURNAROUND ASSESSME



FOLDOUT FRAME

# SSMENT SPACELAB INSTALLATION AT OPF

FIGURE 3A




## CARGO MANIFEST

DOWN PAYLOAD: SPACELAB PALLET (2+2)
UP PAYLOAD: SPACELAB LONG MODULE & PALLET

FLIGHT KITS:

- LONGERON/KEEL BRIDGES
- AVIONICS/PWR HARNESS
- INERT FLUID LINES
- PAYLOAD/MISSION STATIONS

NOTE: AIRLOCK, TGNNEL ADAPTER & CRYO KITS-NO CHANGE

**NOTE: REF. T-6.5 HOUR HOLD**

NO PAYLOAD BAY DOOR OPERATIONS ON THE PAD ARE PLANNED FOR OPF INSTALLATION PAYLOADS - IF REQUIRED, THEY WILL BE SCHEDULED ON A MISSION BASIS AND A HOLD WILL BE SCHEDULED TO COMPLETE PLB CLOSEOUT. PHYSICAL ACCESS TO PLB WOULD TERMINATE 13.5 HOURS PRIOR TO LIFTOFF.

XSC STS OPERATIONS PLANNING OFFICE

R.H. Buckley

ROBERT H. BUCKLEY SP-OPN

**15 FEBRUARY 1979**

**LEGEND**

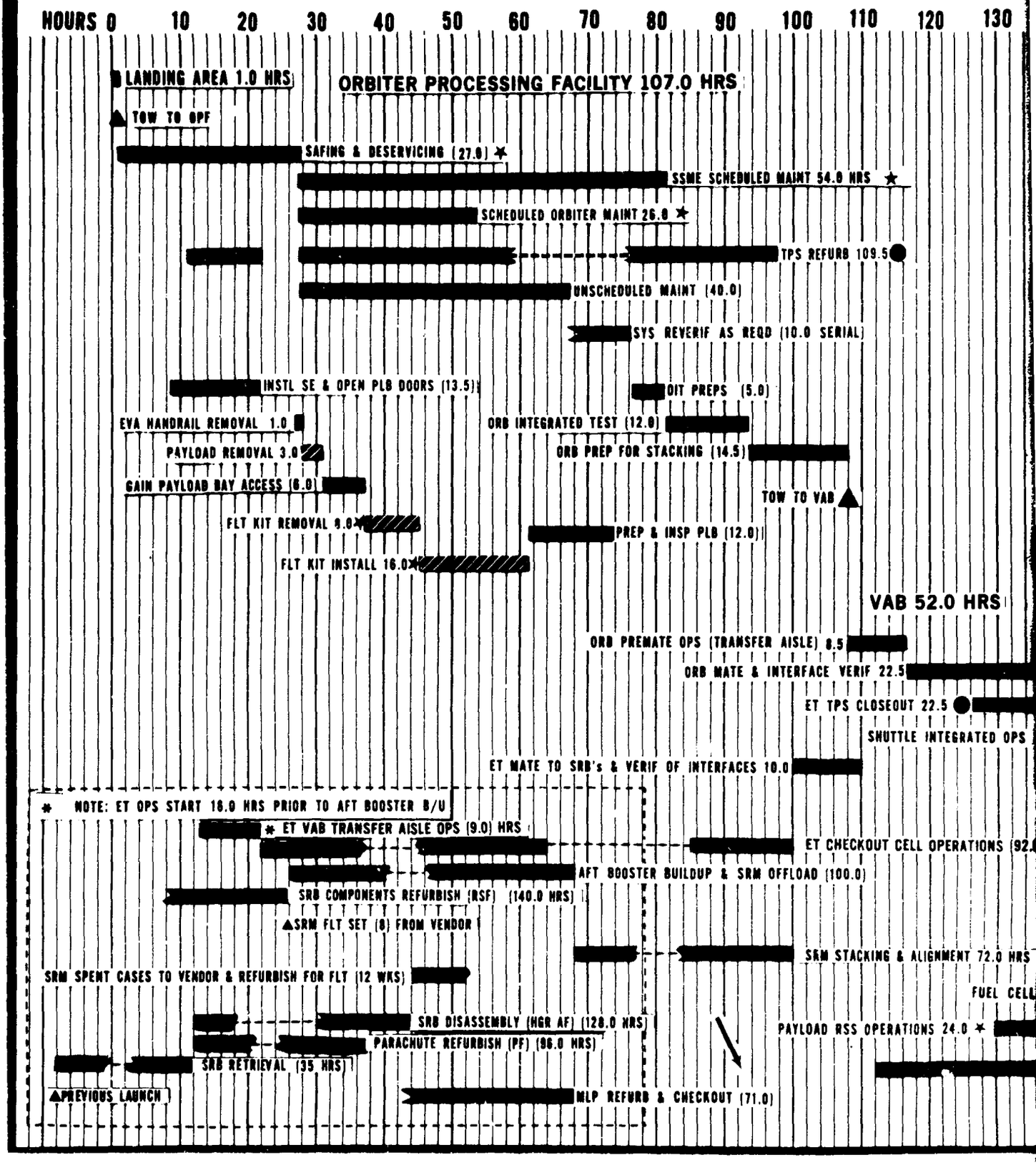
1. XX LEVEL II CONTROLLED FUNCTION.
2. (XX) LEVEL III REFERENCED FUNCTION.
3. ⟵ CHANGED SINCE LAST STAR.

★ PSST (PERIODIC SIGNIFICANT SCHEDULED TASK).

● TPS REFURB REQUIRES 3 SHIFTS/24 HRS A DAY.

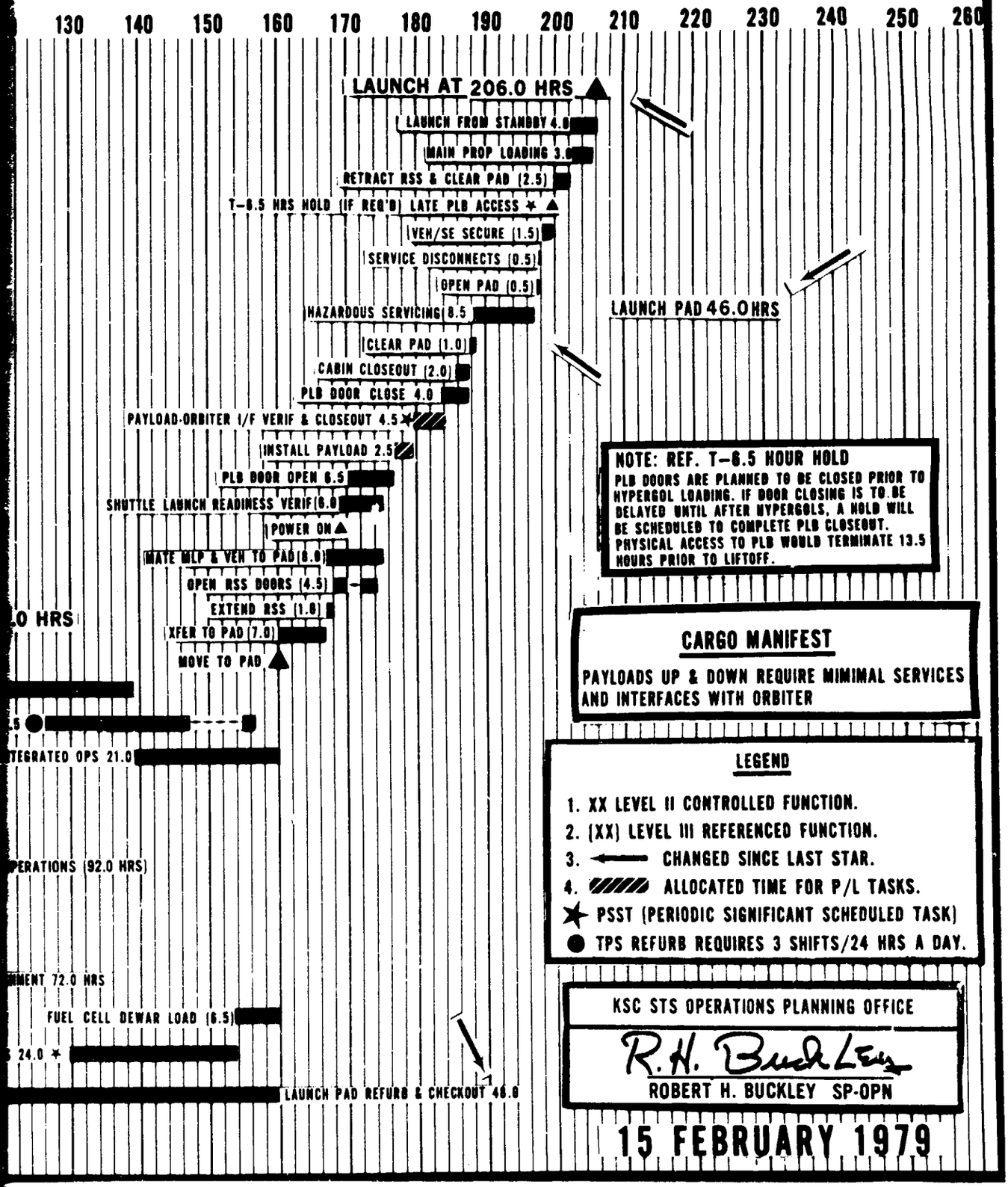
BEST AVAILABLE FRAME

# STAR 017 LEVEL II SHUTTLE TURNAROUND TIMELINE ASSESSM



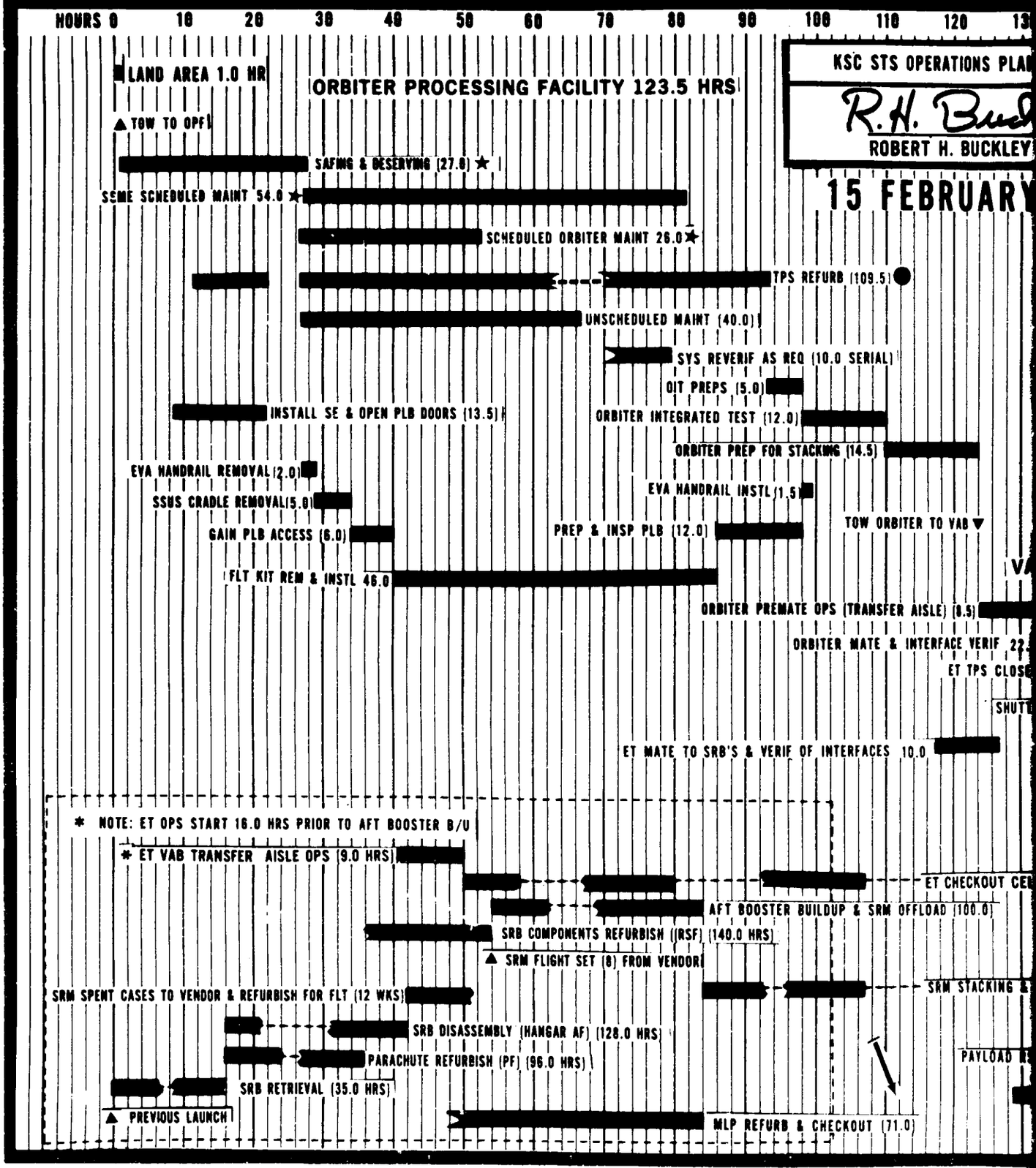
# ESSMENT PAYLOAD INSTALLATION AT LAUNCH PAD

FIGURE 4



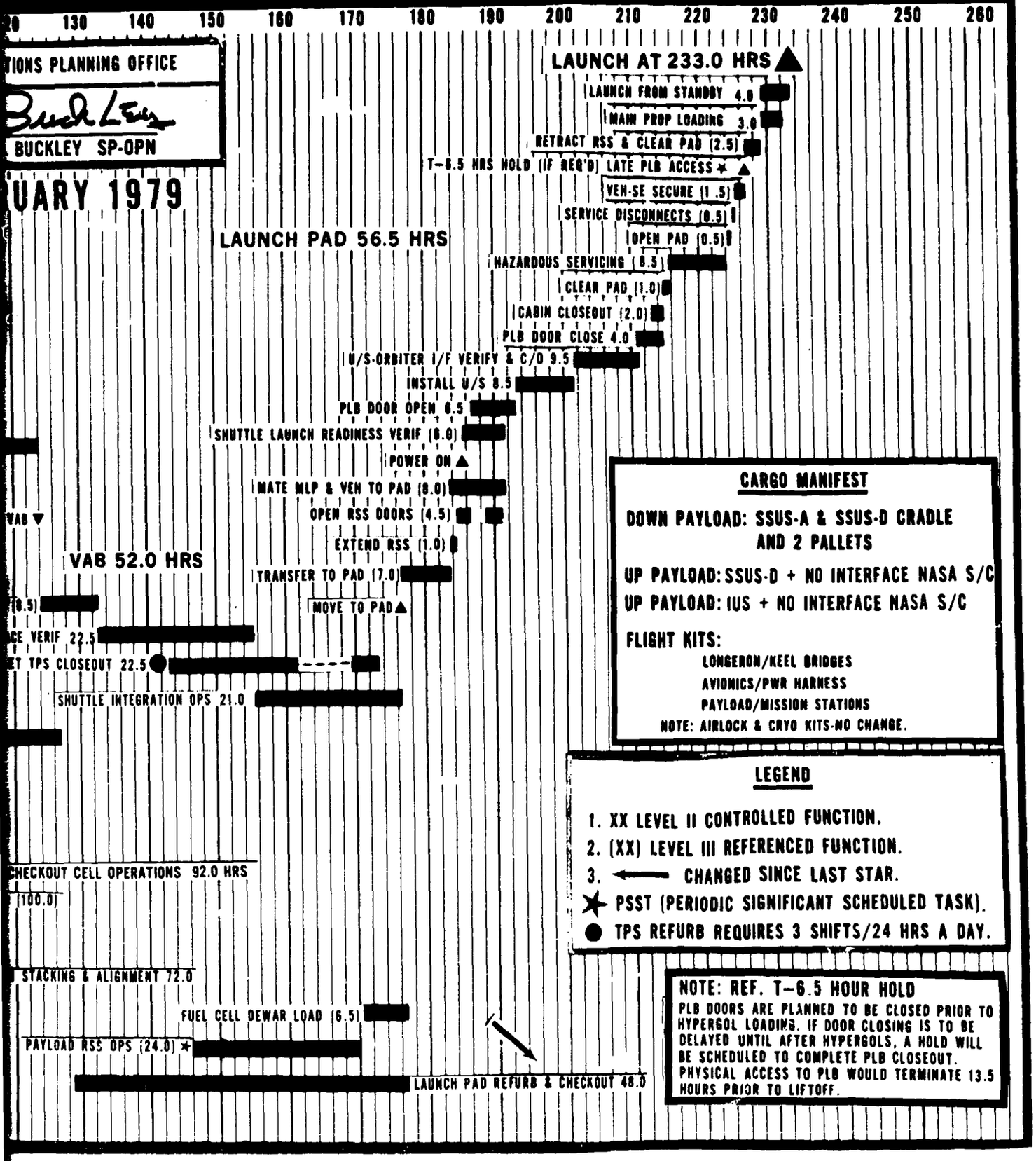
/ BLACKOUT FRAME

# STAR 017 LEVEL II STS TURNAROUND ASSESSMENT UPR



# UPPER STAGES INSTALLATION AT LAUNCH PAD

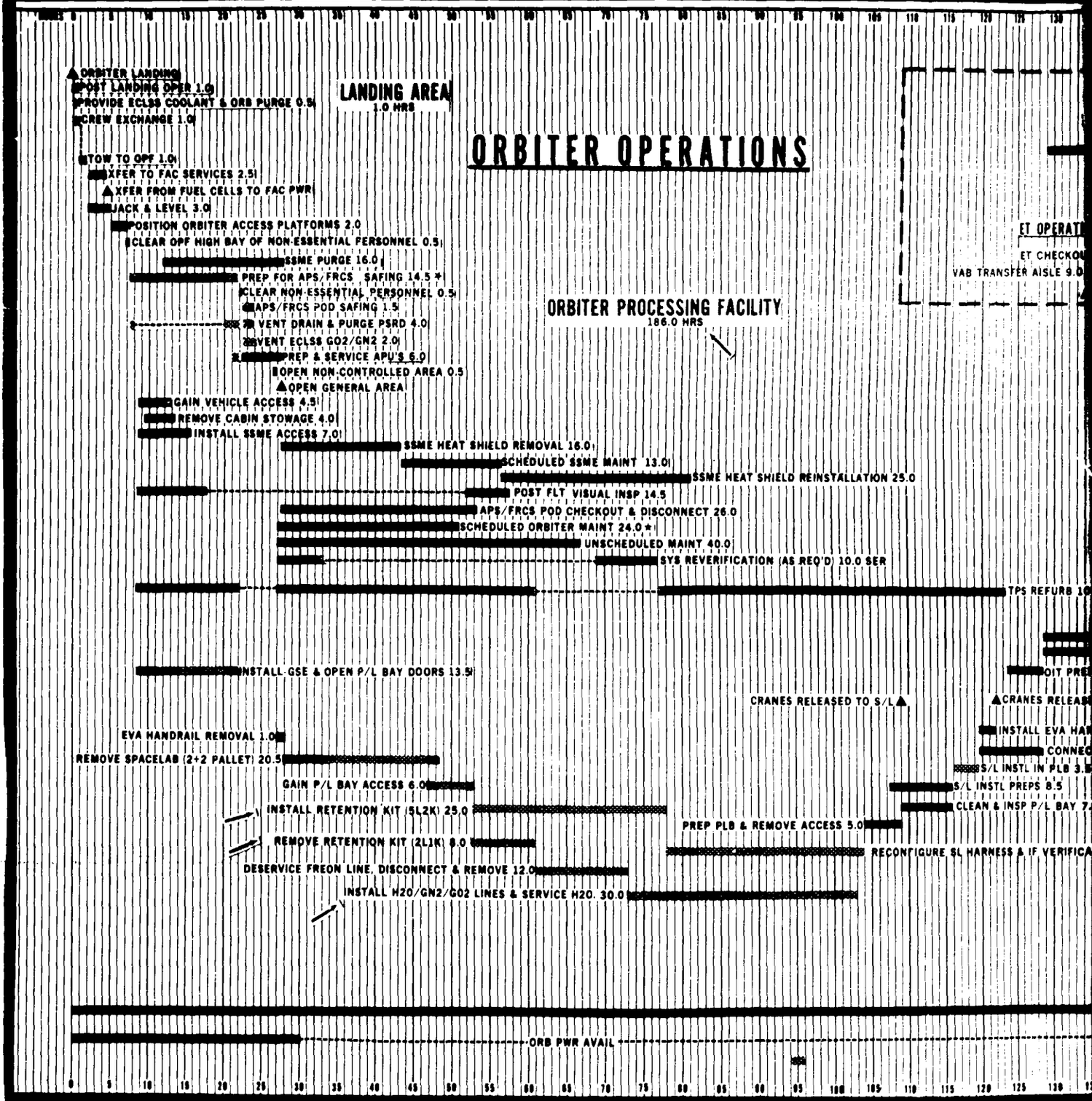
FIGURE 4A



FOLDOUT FRAME

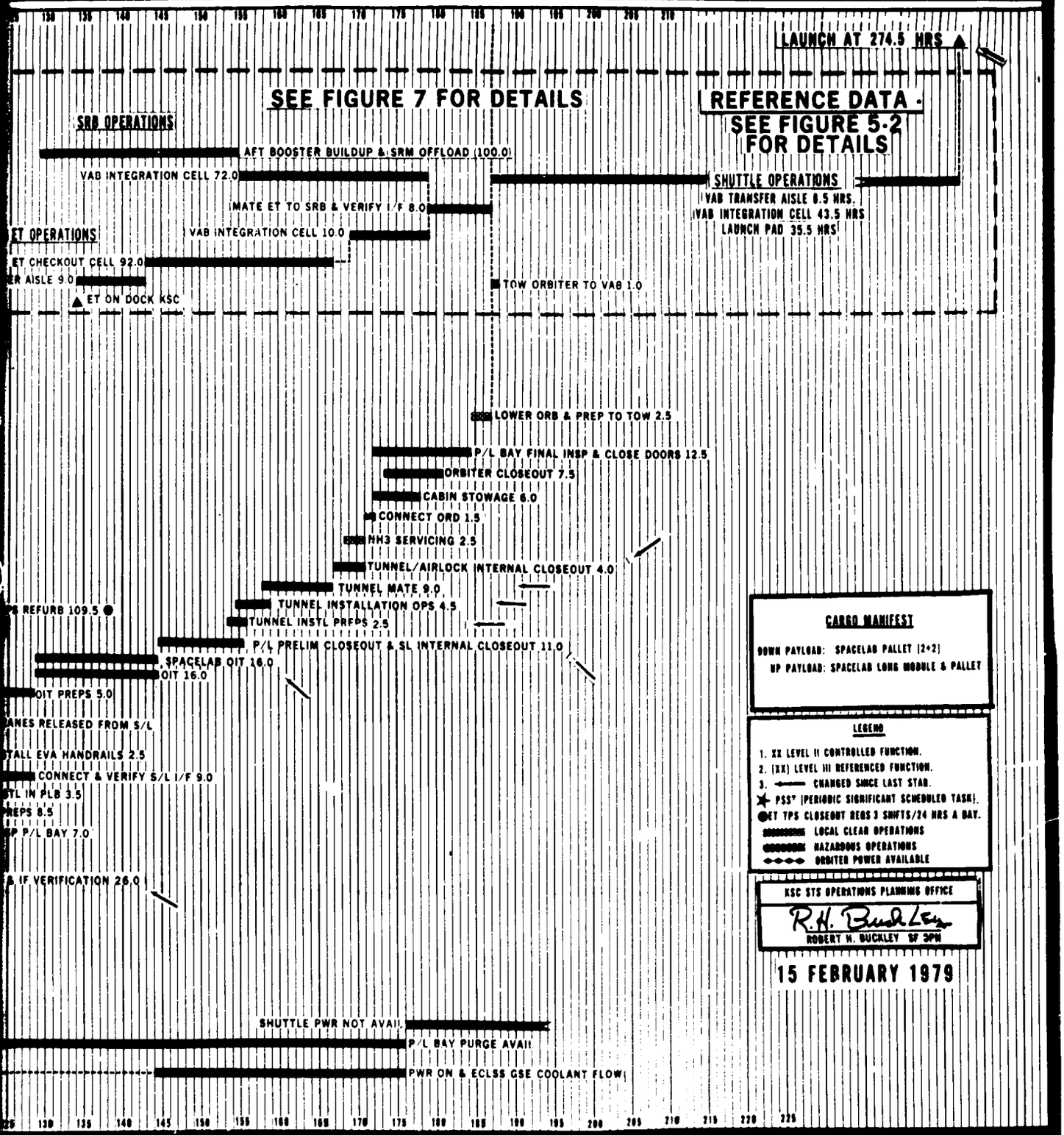
STAR 017

# LEVEL III STS TURNAROUND ASSESSMENT SPACELA



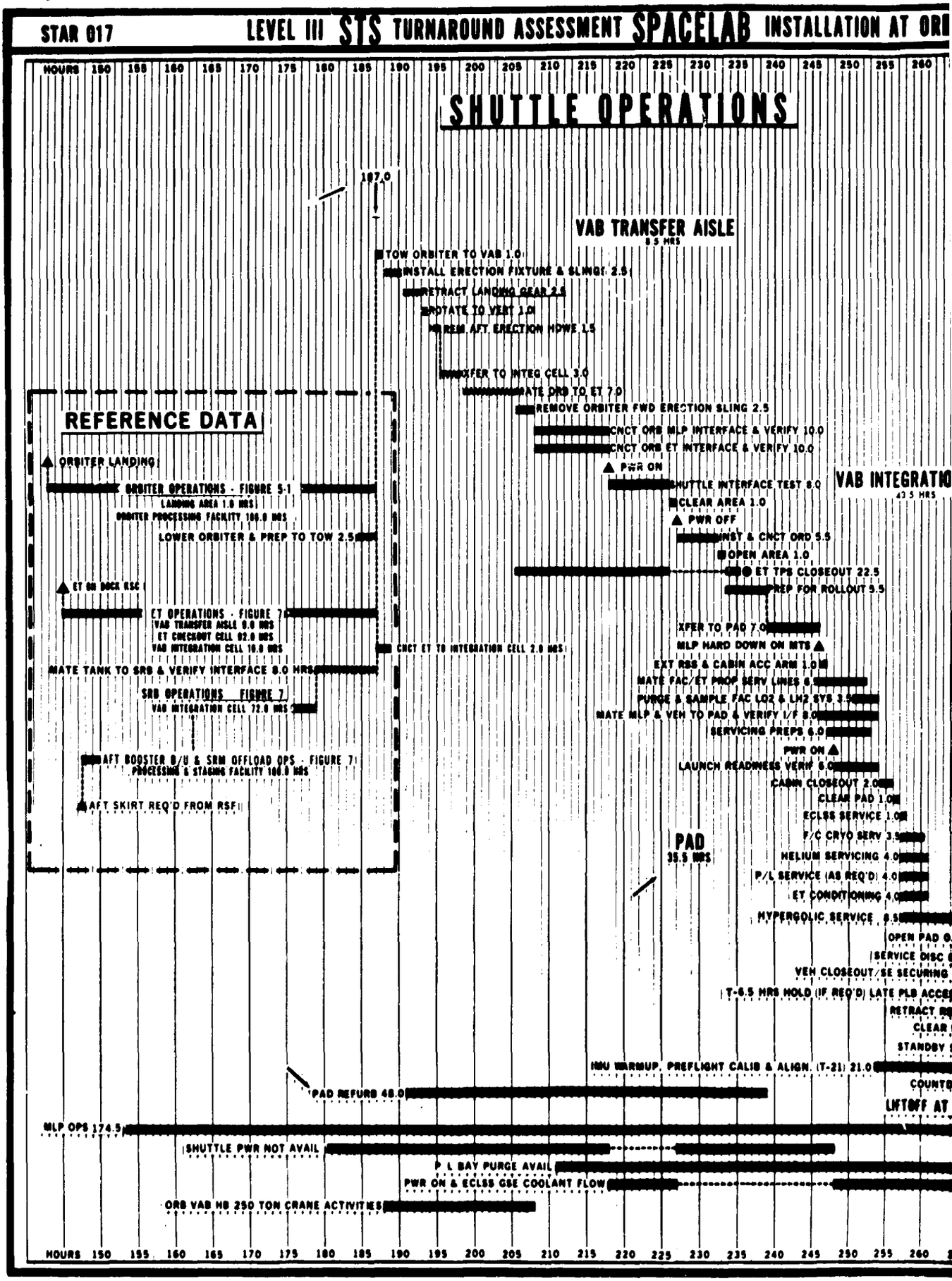
FOLDOUT FRAME

# CELAB INSTALLATION AT ORBITER PROCESSING FACILITY KB-39 FIGURE 5-1



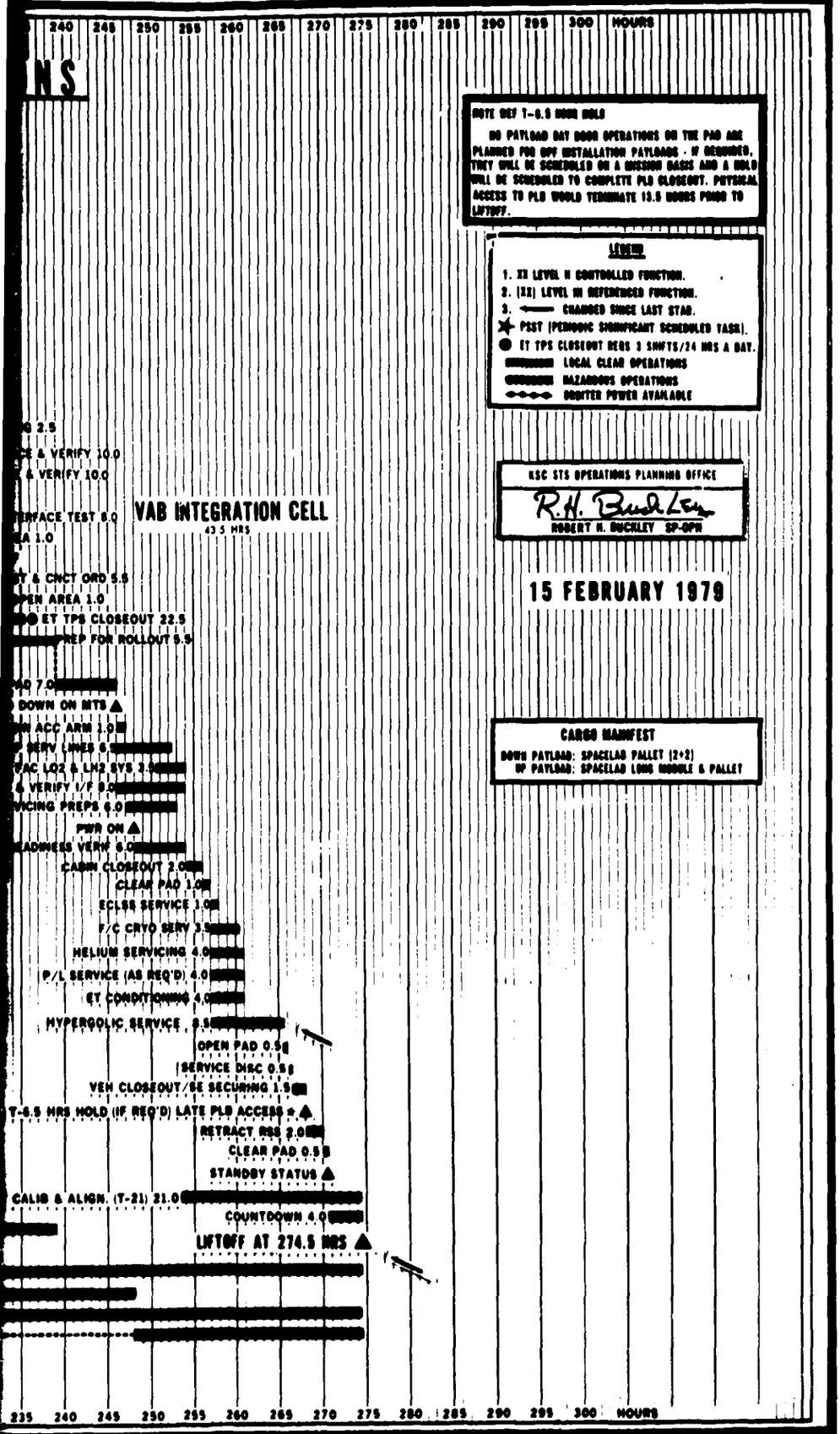
FOLDOUT FRAME

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

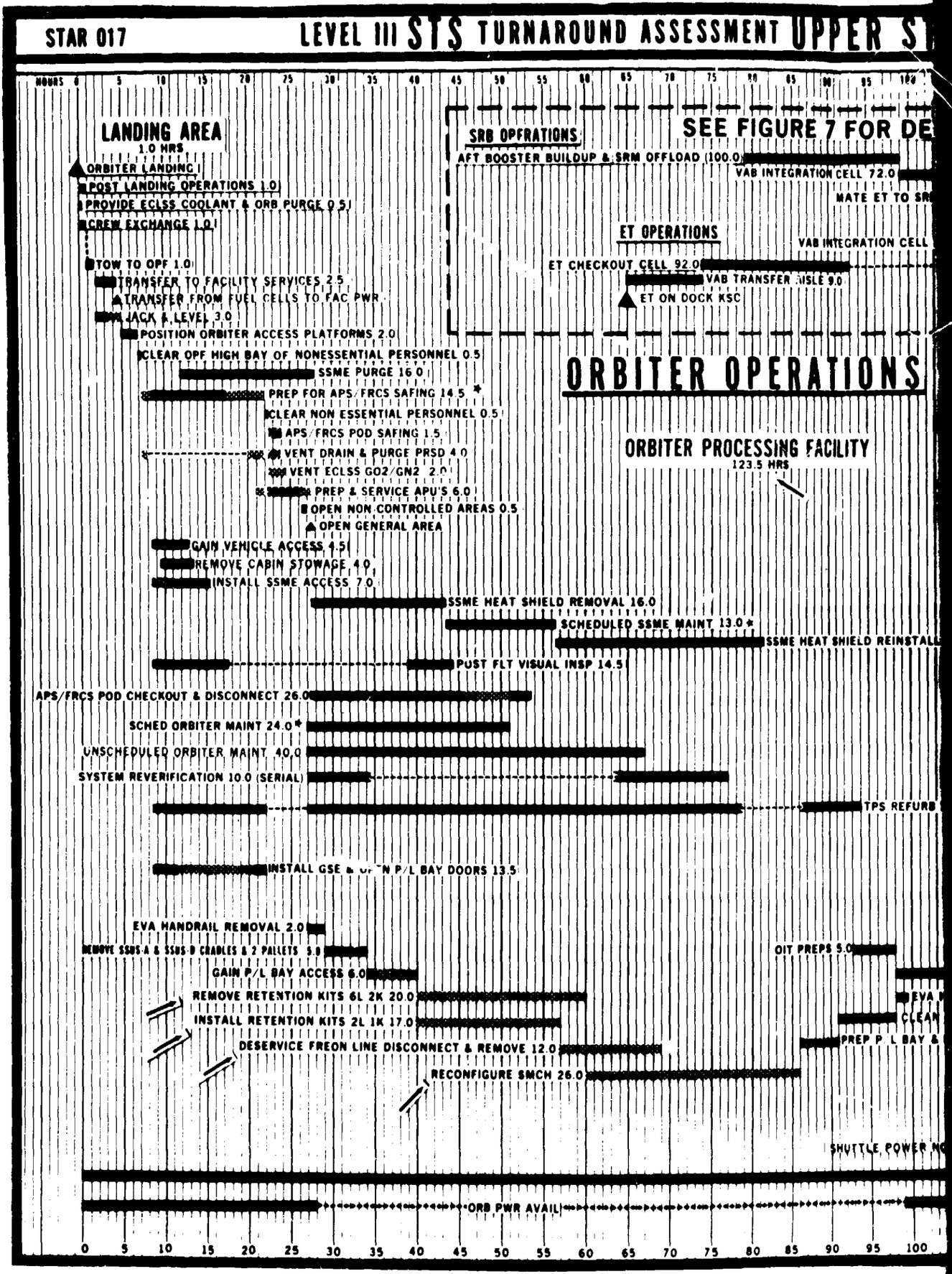


2 FOLDOUT FRAME

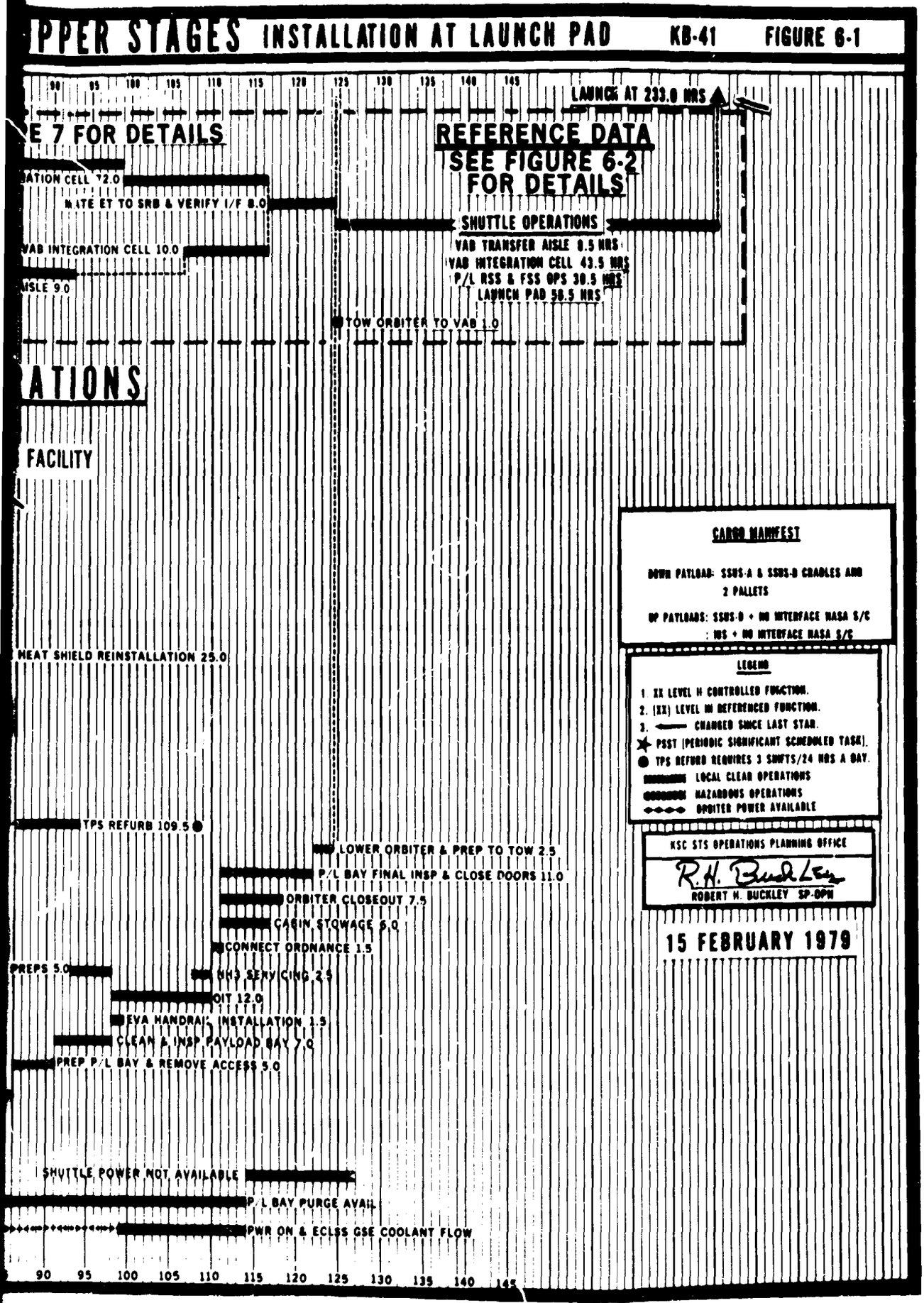
# INSTALLATION AT ORBITER PROCESSING FACILITY KB-40 FIGURE 5-2



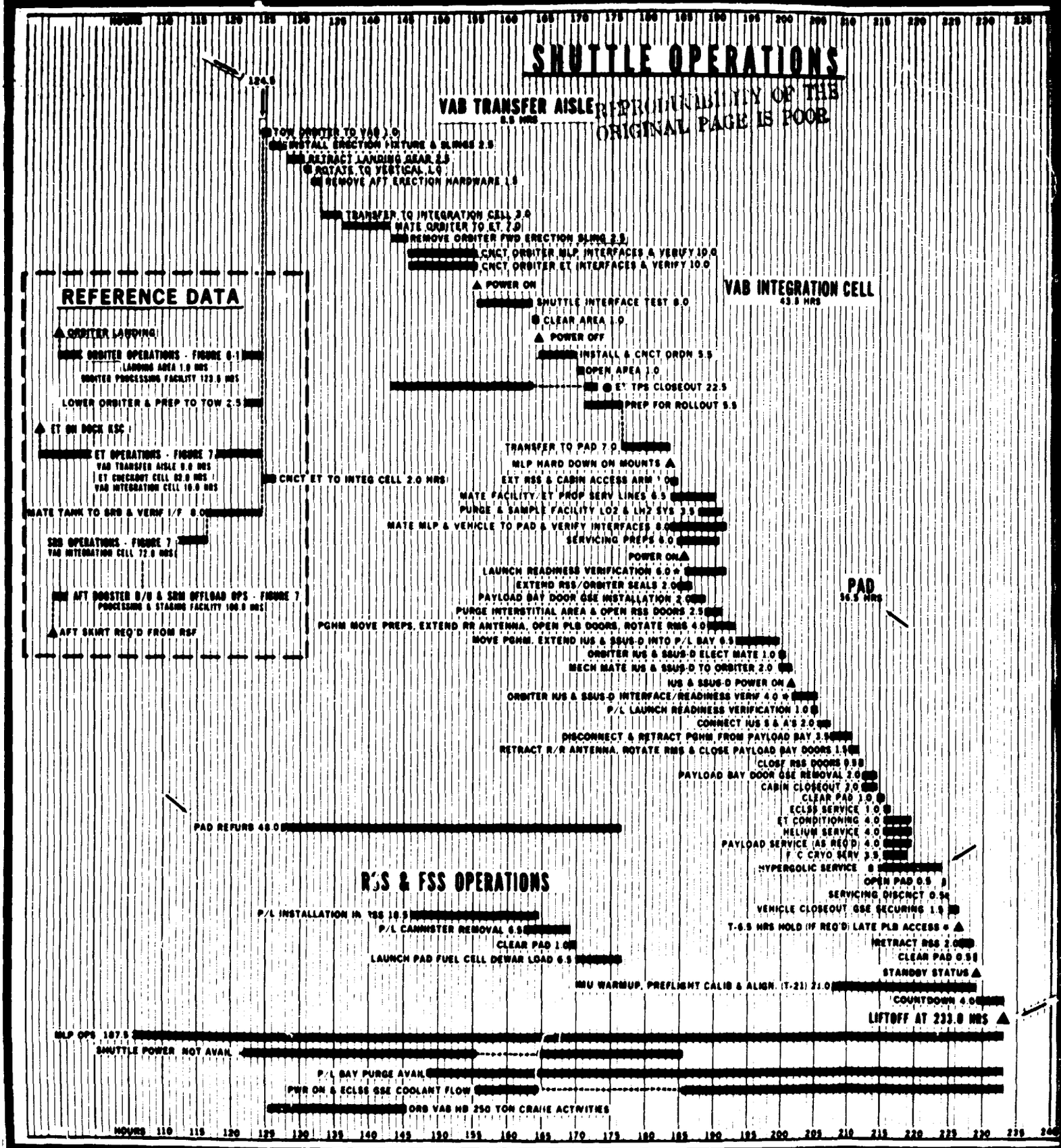
SOLDOUT FRAME



2 FOLDOUT FRAME



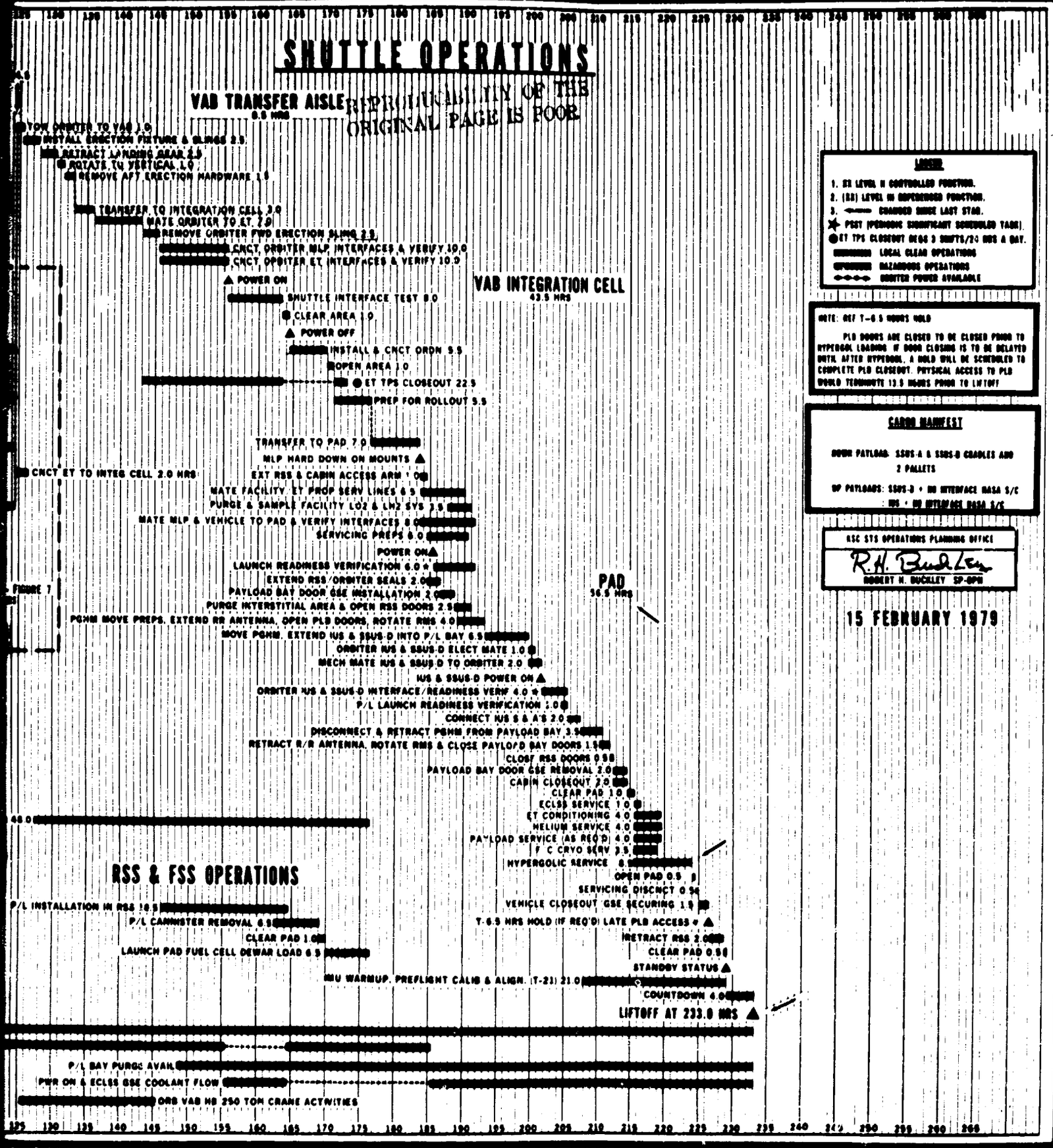
STAR 017 LEVEL III STS TURN AROUND ASSESSMENT UPPER STAGES INSTALLATION AT LAUN



2 FOLDOUT FRAMES

# LEVEL III STS TURN AROUND ASSESSMENT UPPER STAGES INSTALLATION AT LAUNCH PAD KB-42 FIGURE B-2

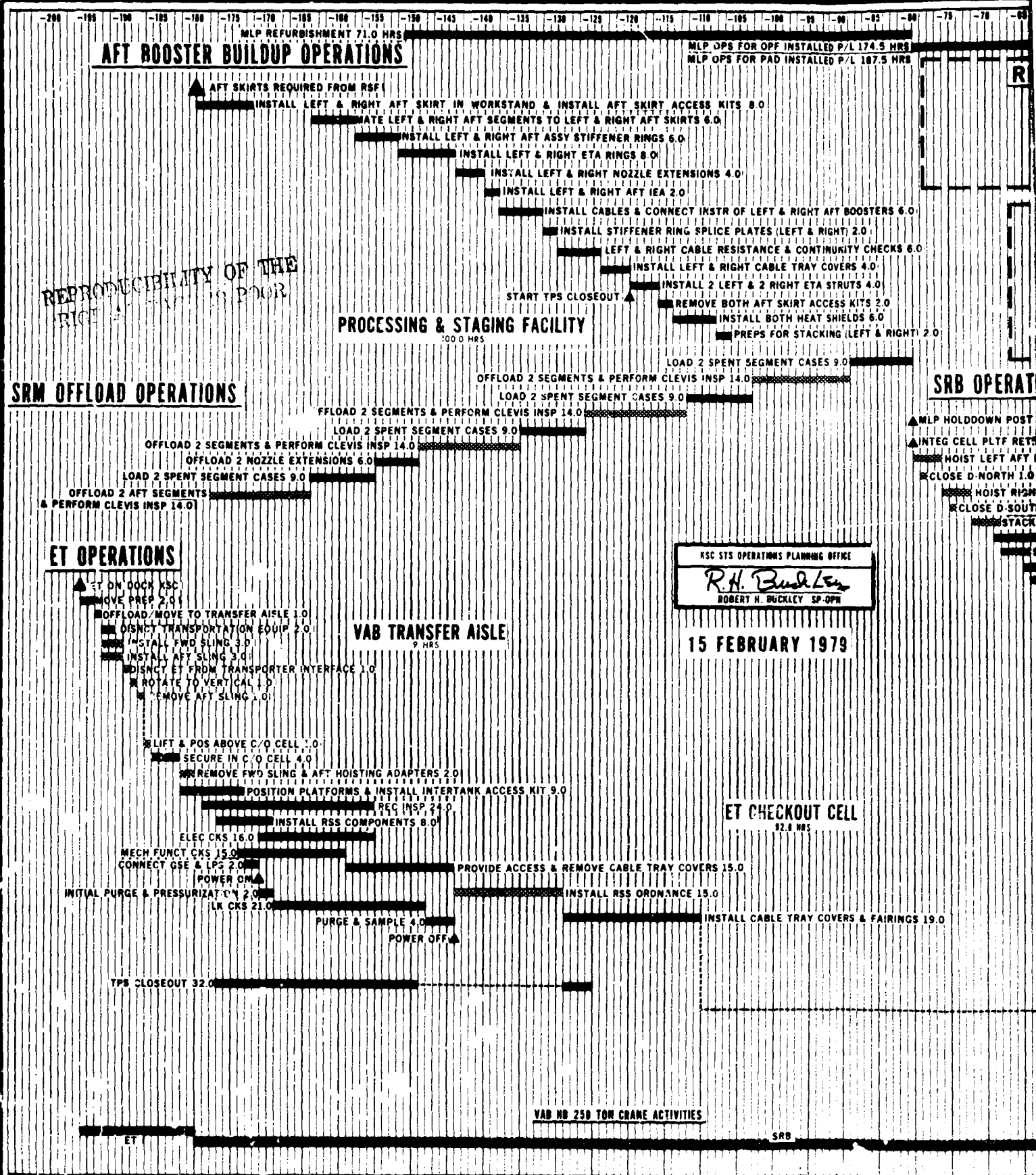




FOLDOUT FRAME

STAR 017

# LEVEL III STS TURNAROUND ASSESSMENT ET/SRB

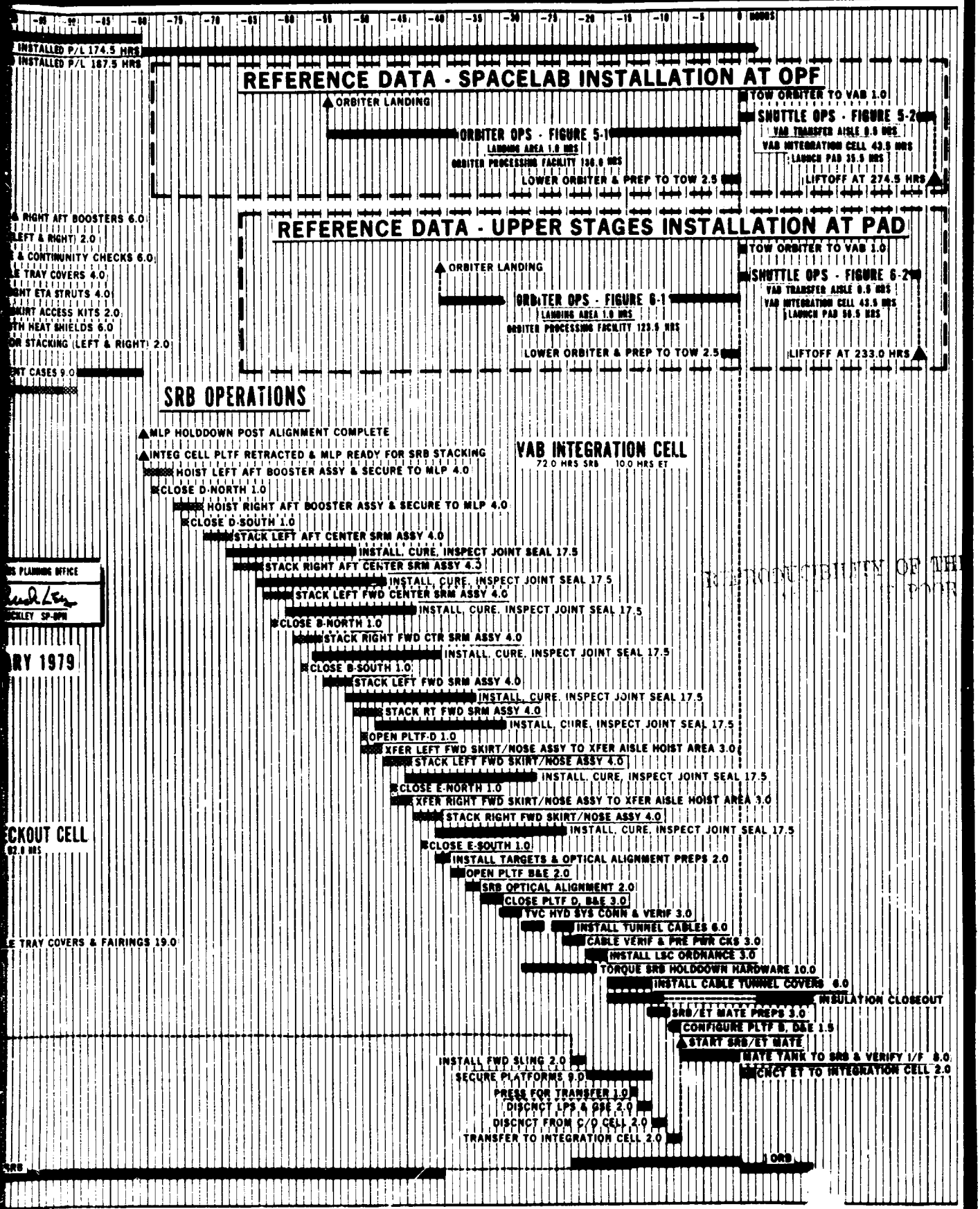


FOLDOUT FRAME 2

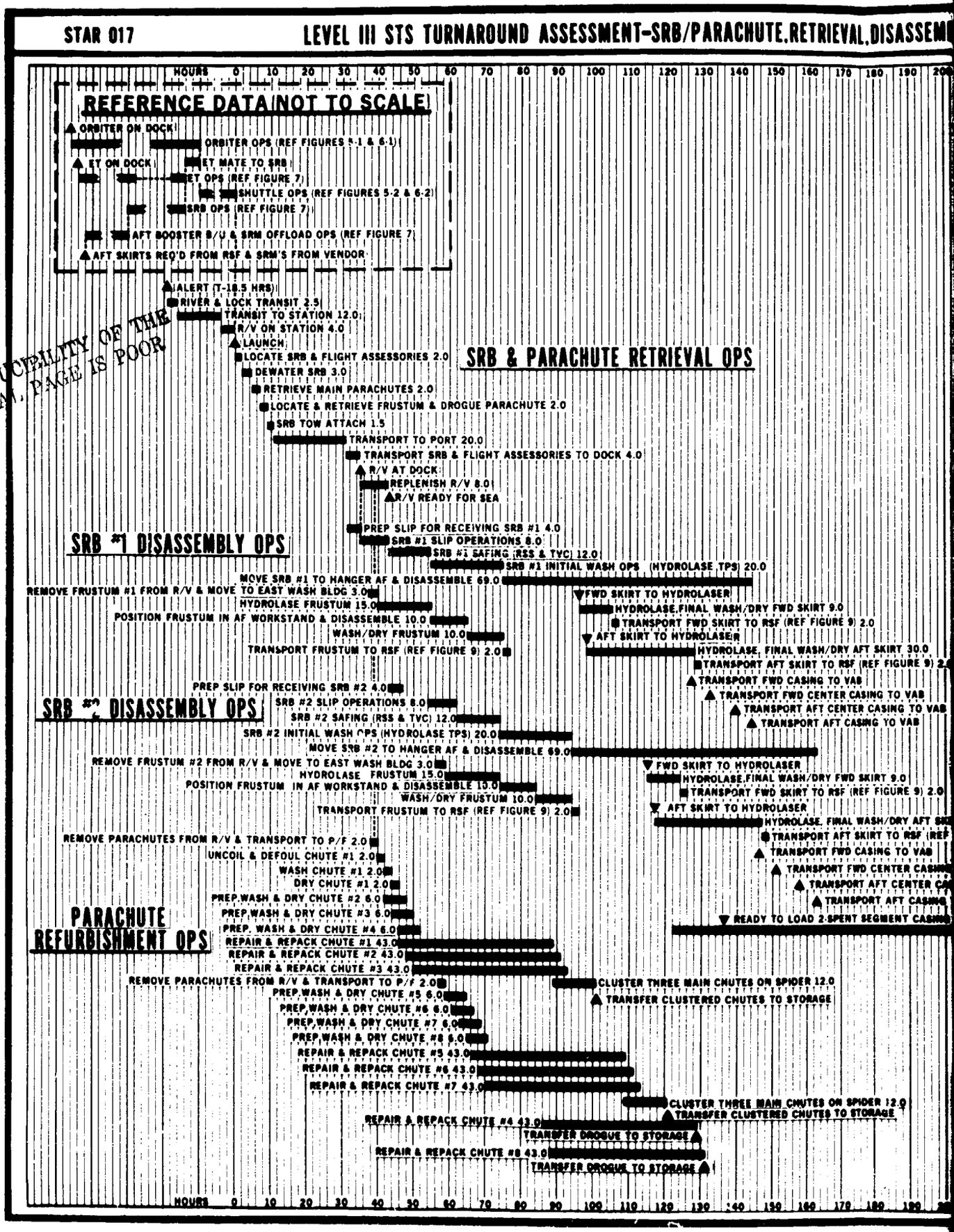
# ASSESSMENT ET/SRB VAB PROCESSING

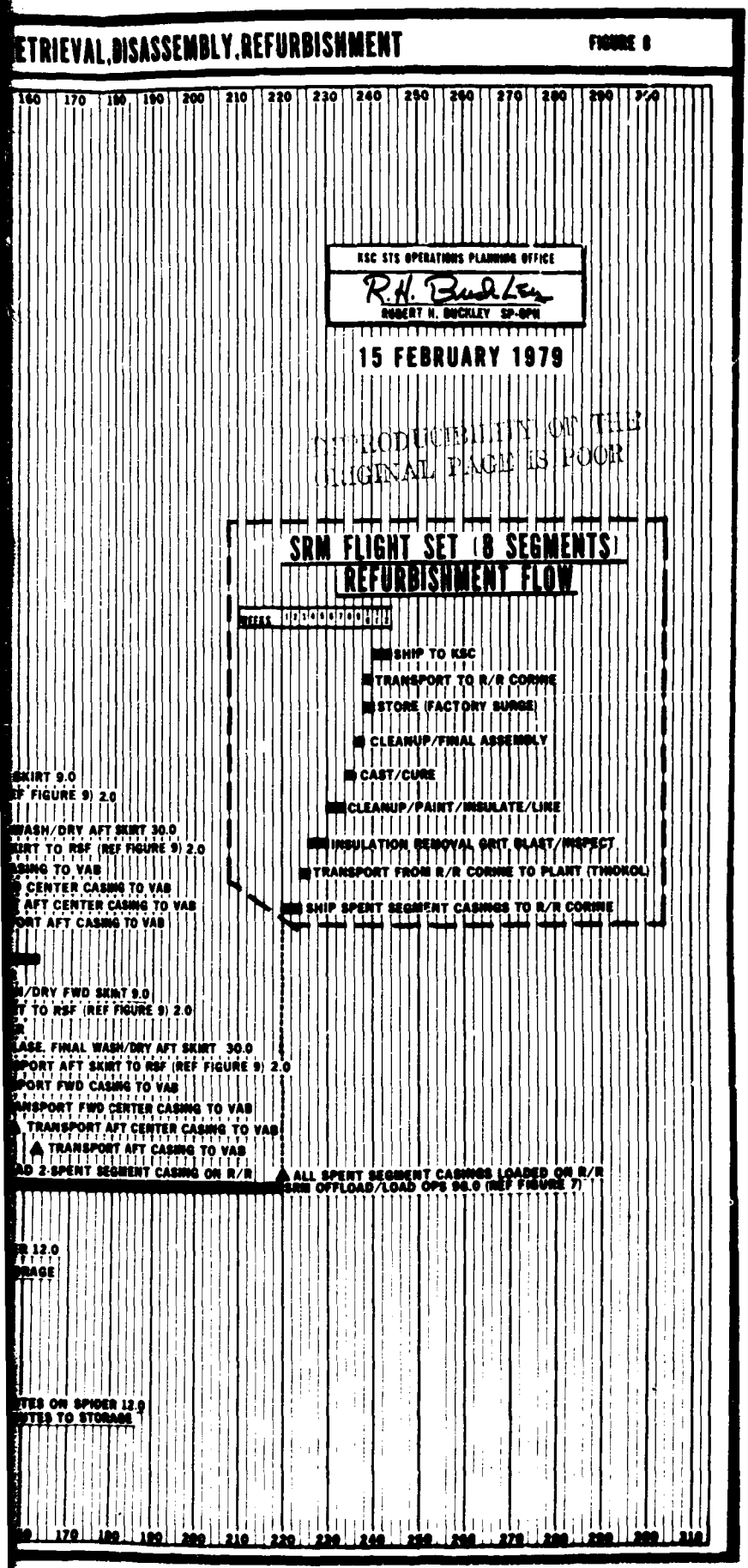
KB-43

FIGURE 7



FOLDOUT FRAME

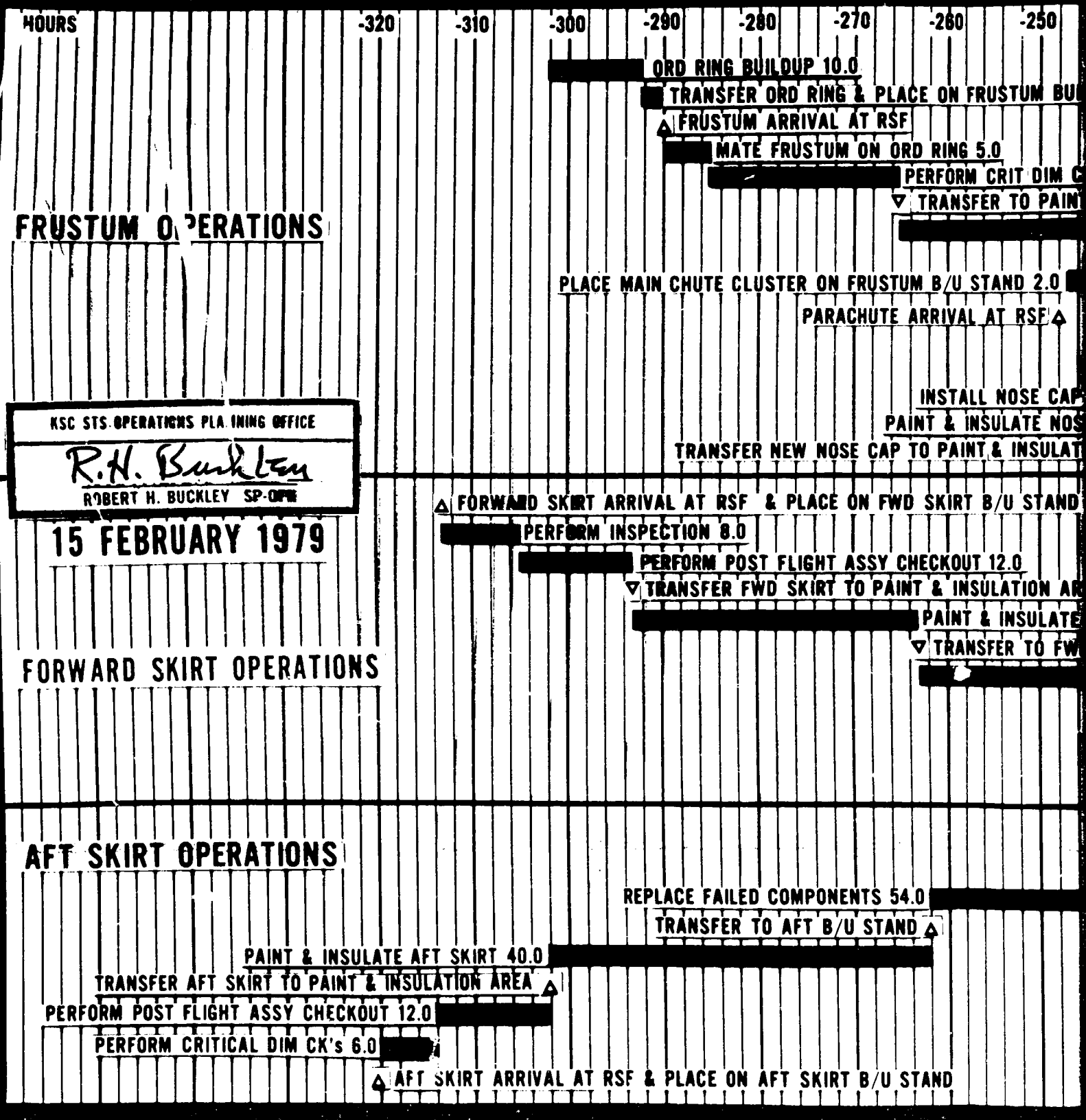




FOLDOUT FRAME

STAR 017

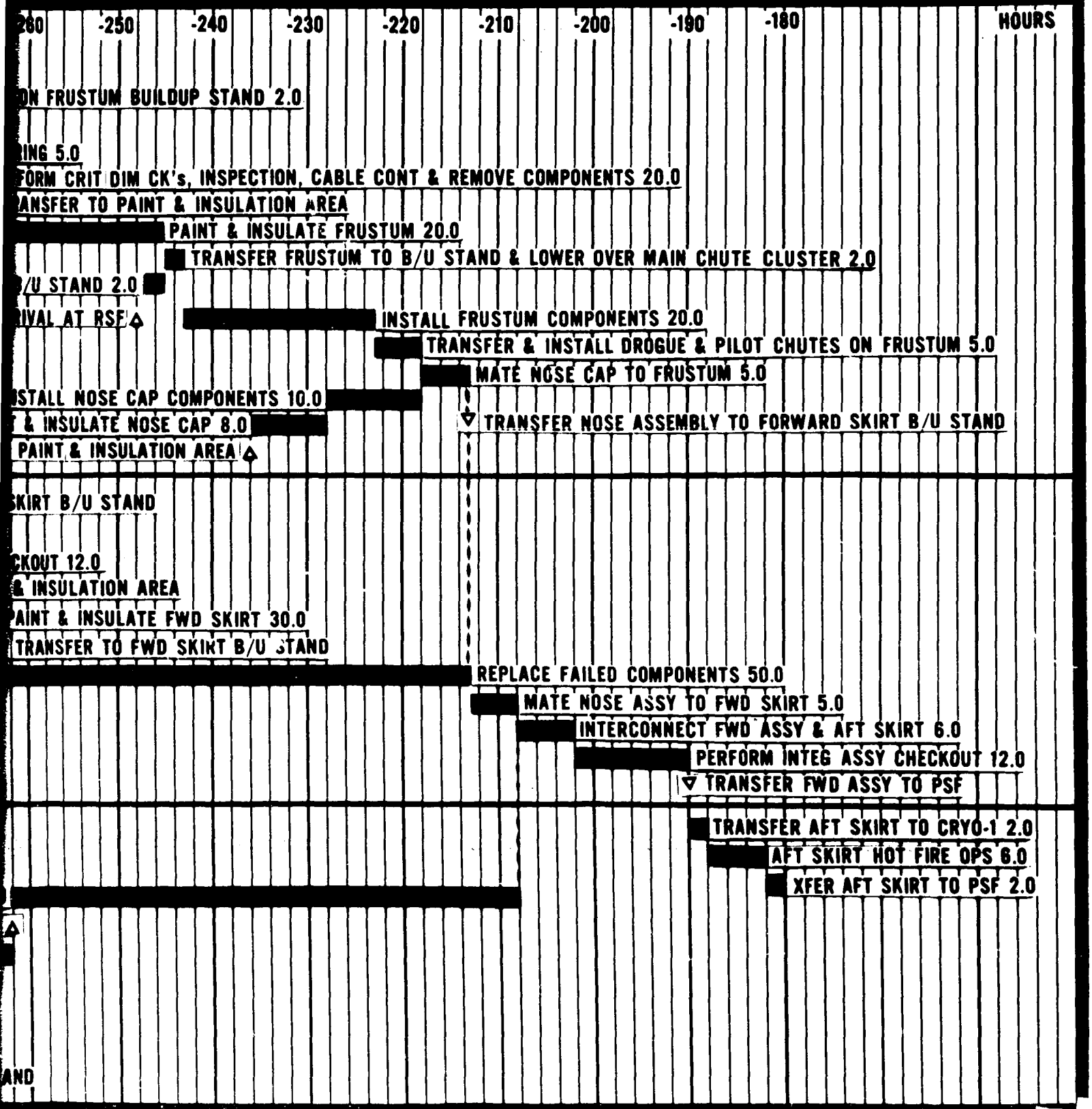
# LEVEL III STS TURNAROUND ASSESSMENT – SRB COMPONENT



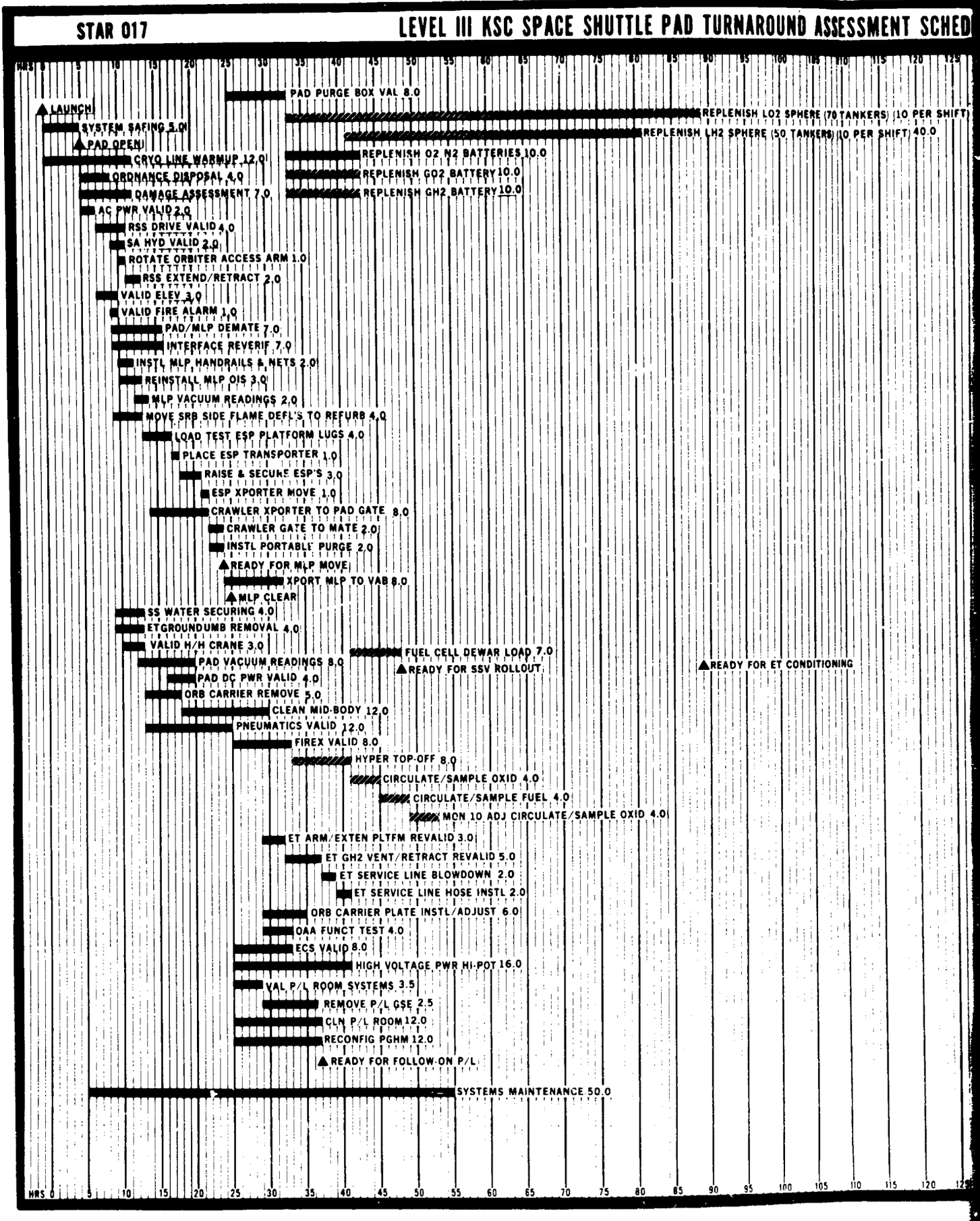
FOLDOUT FRAME 2

# OMPONENTS REFURBISHMENT & SUBASSEMBLY PROCESSING

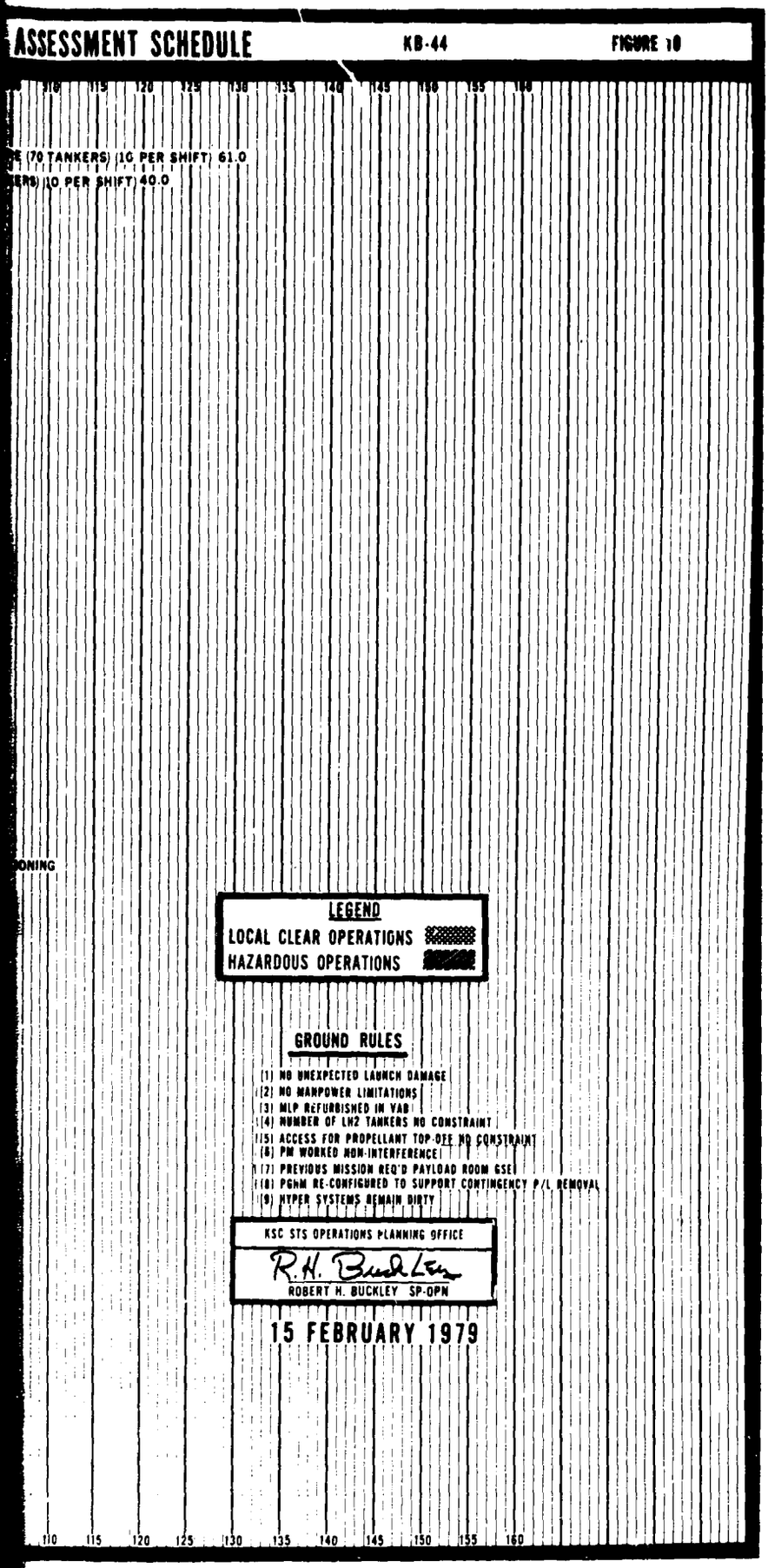
FIGURE 9



/ SOLDOUT FRAME



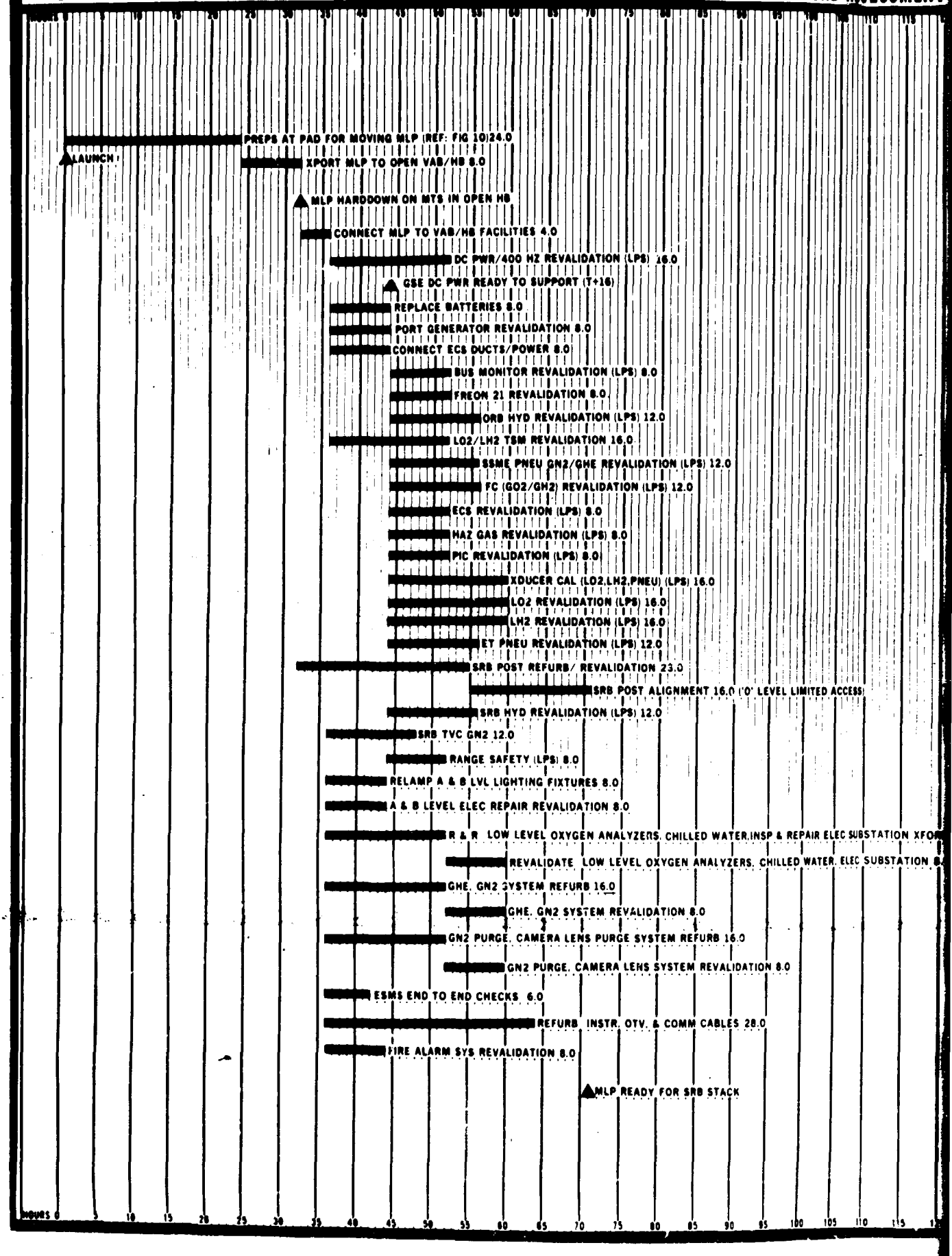
FOLDOUT FRAME 2



FOLDOUT FRAME

STAR 017

# LEVEL III KSC SPACE SHUTTLE MLP TURNAROUND ASSESSMENT



2

FOLDOUT FRAME

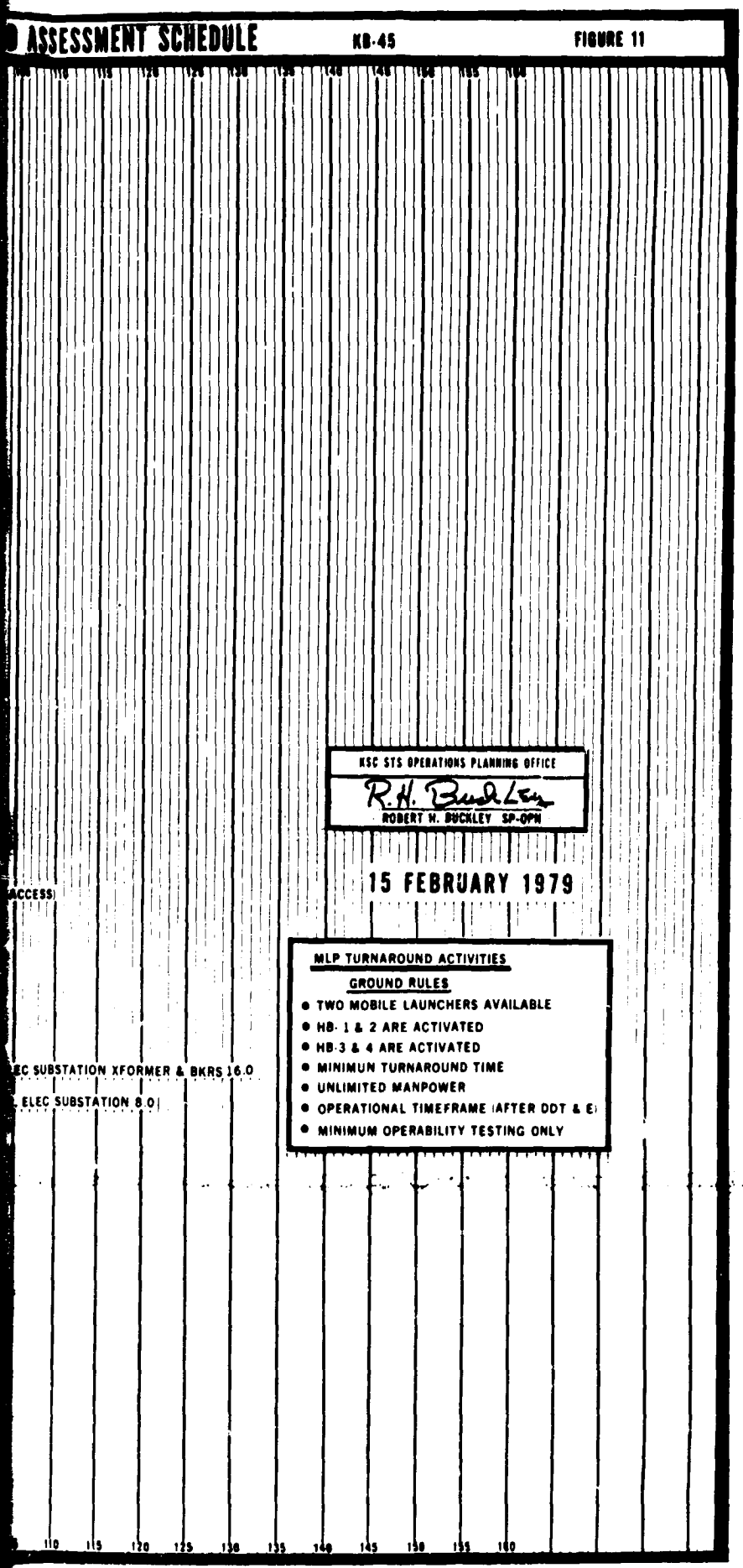
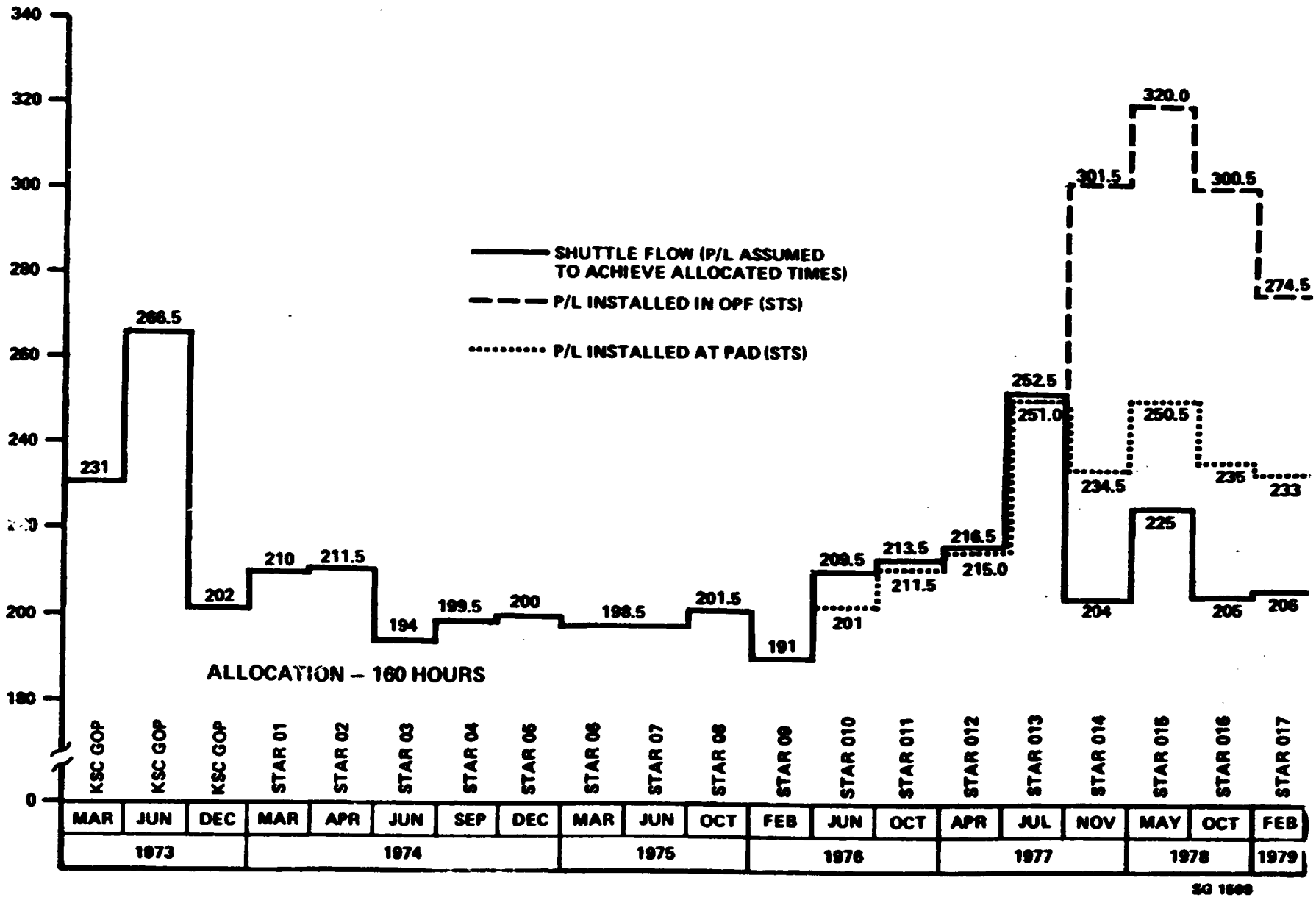


FIGURE 12

SHUTTLE/STS TURNAROUND ASSESSMENT HISTORY



# FIGURE 13

## SHUTTLE TURNAROUND ASSESSMENT HISTORY – OLF AND OPF

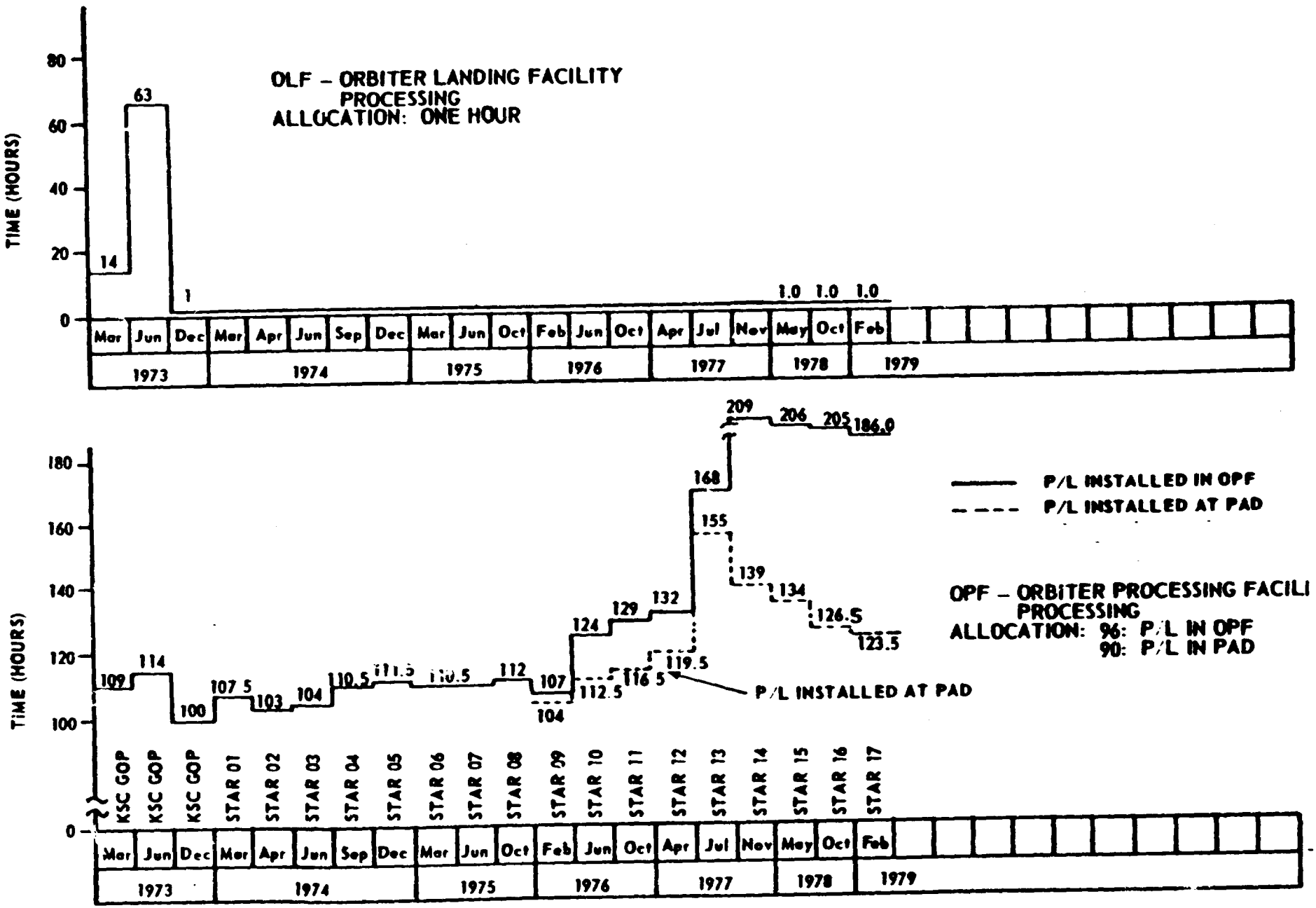
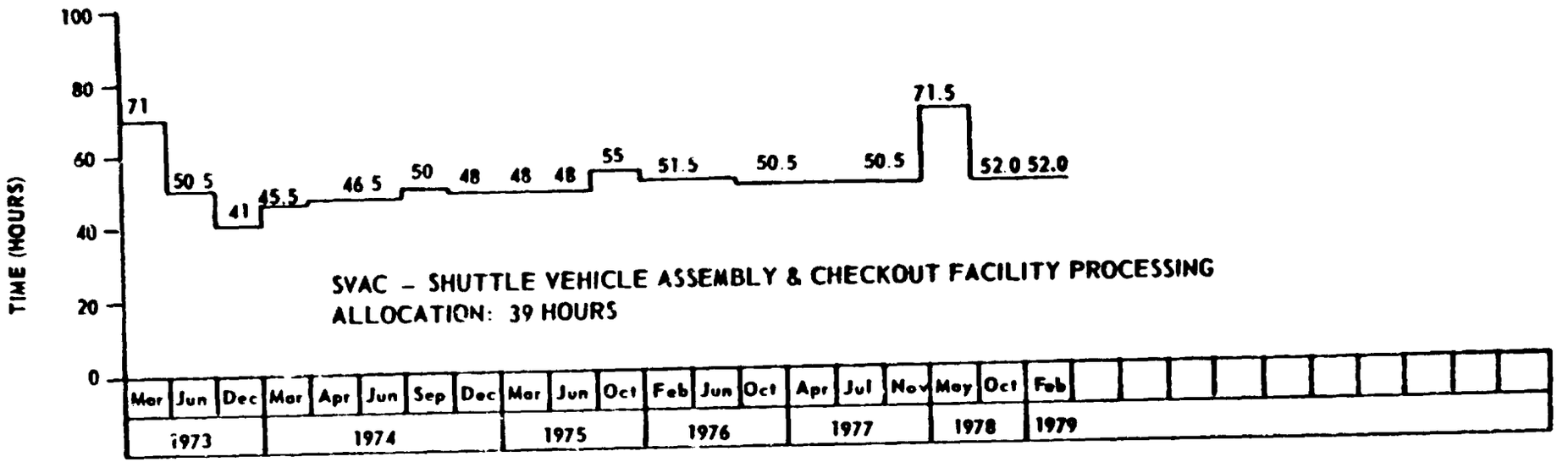
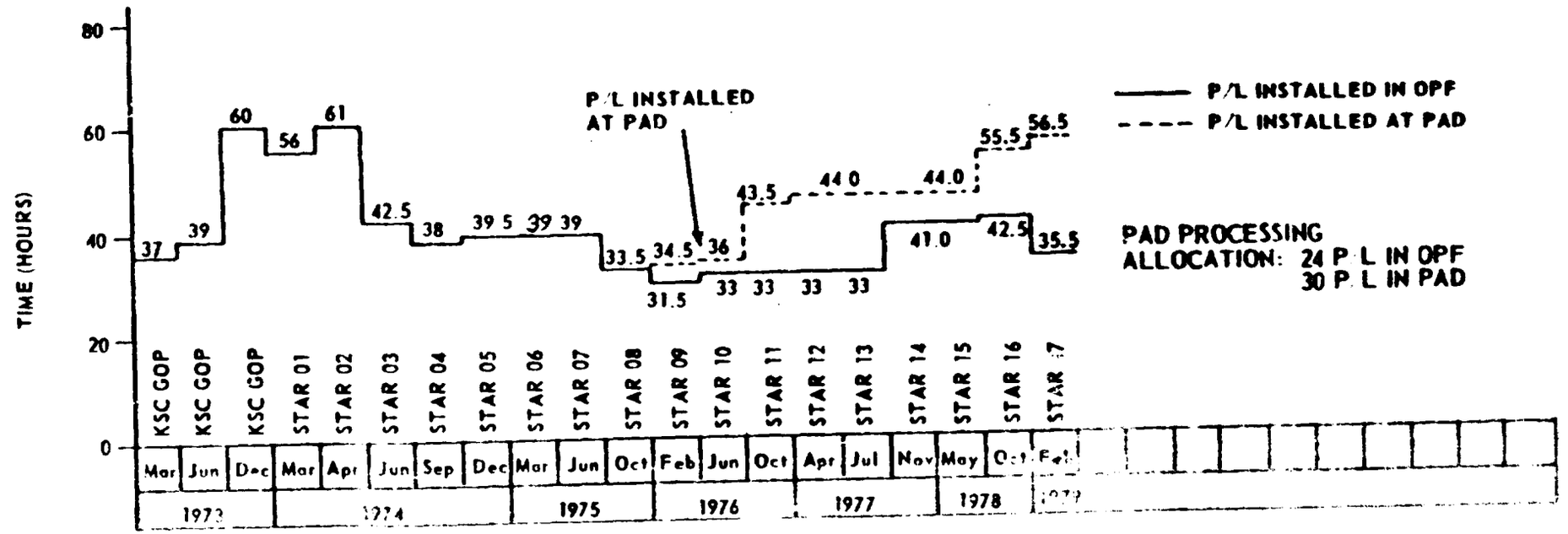


FIGURE 14
SHUTTLE TURNAROUND ASSESSMENT HISTORY – SVAC AND PAD



# APPENDIX A

## LEVEL II TIMELINE ALLOCATION

## GROUND RULES

## LEVEL III TIMELINE ASSESSMENT

## GROUND RULES

## APPENDIX A

## LEVEL II TIMELINE ALLOCATION GROUND RULES

**The following is a listing of ground rules associated with the Level II timeline allocations that qualify the major tasks that occur within the landing area, OPF, VAB, and the launch pad.**

### GENERAL

1. Turnaround is success-oriented. Except for the unscheduled maintenance period specified for the orbiter during the OPF flow, there is no time allocated for contingencies.

2. Operations at all work stations except the launch pad are performed on a nominal two-shift, five-day-week basis.

3. All elements, including payload, are ready and checked out prior to interfacing with another element.

4. SSME checkout and functional payload and orbiter interface verification, which can be best performed during integrated checkout, will not be accomplished during the SSME maintenance timeframe nor while the payload is being installed.

5. Timelines for payload-related functions are generalized allocations applicable to all payloads.

6. No time has been allocated for Shuttle system mission "plus time" simulations.

7. No time has been allocated for a crew compartment compatibility fit and functional check between cabin and carry-on items during the operational ground turnaround.

8. No time is included in any of the turnaround functions for taking closeout photos.

9. Timelines are being developed for periodic significant scheduled tasks (PSST) which occur less than 50 percent of the time. The items that will be affected by those tasks are identified with a "★" on the assessment timelines.

10. Flight kits (which include kits that interface directly with the payload and kits required to extend the capabilities of the orbiter to support the mission) will be available for installation at the beginning of the flight kit installation time, except that the PSS and MSS equipment will be available in time to prevent impact to the flow.



A-2

11. The cleanliness levels, as specified in Volume X, JSC-07700, of the payload and payload bay will be maintained.

12. The orbiter maintenance recorder will be dumped to the ground via the telemetry link incrementally during the mission, prior to the start of reentry. Such data will be relayed to KSC in near real time to optimize planning and scheduling of maintenance activities.

13. Software and ground communication network testing will not be performed as a function of Shuttle vehicle testing.

LANDING

14. Flight crew will be egressed and ground crew ingressed while the orbiter is on the landing strip.

15. Ground crew/convoy communications will be established while the orbiter is in the landing area.

OPF

16. Payload removal and SSME and orbiter maintenance tasks will begin in the OPF after safing operations have been completed.

17. All payload and orbiter live ordnance is removed and/or safed in the OPF during safing operations.

VAB

18. Electrical power will not be applied to the orbiter during its tow to the VAB, its premate hoisting (except for raising the landing gear), or to the SSV during ordnance connection or rollout operations. However, conditioned air must be supplied to the orbiter for purge of the payload bay during ordnance connection and rollout operations.

19. Shuttle system mating operations do not require optical alignment.

20. Final verification of element interfaces is accomplished in the mate station and will be performed through the orbiter and MLP interfaces.

21. All Shuttle system ordnance is installed, electrically connected, and mechanically/electrically safed prior to rollout from the VAB. (This does not preclude ordnance installation and connection prior to arriving at the mate station, as appropriate.)

PAD

22. The time required to roll the Shuttle vehicle from the VAB to the launch pad is included in the 24-hour Notification to Launch.

23. Launch pad operations are performed on a nominal "around-the-clock" basis.

## LEVEL III ASSESSMENT GROUND RULES

The following is a listing of ground rules associated with the construction of the Level III assessment timelines (figures 5-1, 5-2, 6-1, and 6-2). These ground rules are categorized into General, Safety, Landing, OPF, VAB, and Pad groups.

### GENERAL

1. TPS refurbishment involves three shifts/24 hours a day operations.

2. Orbiter tow speeds are 5 mph maximum. Tow speeds for transport of the hypergolic modules is 15 mph maximum.

3. No serial time is included in the timeline for quality assurance inspection.

4. The MPS engines must not be allowed to drift such that the thrust chambers contact either each other or any other hardware which could cause thrust chamber damage. To maintain proper engine clearances, the following methods will be utilized:

   a. Landing through Orbiter Safing - Lockup of hydraulic actuators plus insertion of external protective pads as required if engine contact is imminent.

   b. OPF Maintenance and Checkout - Periodic engine nulling (mechanically or hydraulically) and/or use of gimbal locks.

   c. Orbiter Premate through Start of CD - Null engines hydraulically and lockup during premate operations in transfer aisle. Repeat null and lockup whenever hydraulics are subsequently available.

5. Hardware required to support the job and technicians requirements used in preparation of the allocation and assessment timelines will be sufficient to support without access impact.

6. ET intertank area will be purged during main propellant loading only.

7. With the orbiter in the horizontal position, GSE will be required to support opening or closing of the main ingress/egress hatch. GSE will not be required with the orbiter in the vertical position.

8. The functions and timespans shown on the allocation and assessment timelines reflect only direct hands-on work effort. No time is allocated or assessed for shift changes, lunch/rest breaks, or any non-hands-on preparation or securing activities.

9. The one-piece cables and the piece-by-piece forward cable tunnels will be installed after stacking SRB subassemblies. Checkout may be started after all electrical connections are mated and will not be constrained by installation of the tunnel sections. The aft cable tunnel will be installed on the aft booster assemblies in the build-up area (HB4, VAB) prior to stacking.

10. The OMS, RCS, and APU propellant tanks will not be drained or purged during a normal turnaround. If scheduled maintenance is slated for a particular turnaround or if review of inflight data indicates an anomaly necessitating propellant tank or associated line entry/component replacement, the affected propellant tanks will be drained and purged.

11. Each facility is provided with an intercommunication system capable of simultaneous communication from each area within the facility. An inter-communication system is also provided for simultaneous communications between facilities to permit parallel task accomplishment and satisfy safety requirements.

12. Continuity tests will be performed on all Shuttle pyrotechnic devices utilizing LPS prior to roll-out to the pad.

## SAFETY

1. SRB build-up in the VAB requires that an area be cleared of personnel not having a need for proximity to the build-up operation.

2. Handling of hypergolic modules containing residual propellants requires clearance of 200 feet around and under the modules. All personnel working within that radius must be in SCAPE suits.

3. Access is controlled in local areas during all crane hoisting operations.

4. When the orbiter temperature is 113 degrees or greater, personnel protective clothing will be required for access.

5. During ammonia servicing, no work will be performed in the aft fuselage areas.

6. The safety verification after landing will use telemetered systems data, pilot reports, and other data in support of a visual external safety check.

7. Before leak-testing reassembled SSME engine joints/connections in the gaseous helium or hydraulic supply, the system must be proof-tested at 1.5 times the safe operating pressure before exposing personnel to the pressurized system.

8. When required, grounding straps will be used on identified elements of the Shuttle during performance of selected operations, i.e., storage processing and buildup of SRB segments, when the orbiter is in a static condition, handling hyper pods with residuals, and the ET in the processing cell.

9. Personnel are not permitted in the SSME thrust chamber bell with the throat plug installed when pressures to the throat plug are above throat plug leak-check pressure.

10. SSME systems that are pressurized above the maximum design operating pressure require the immediate area to be cleared of all personnel. Personnel must be at a safe distance or behind protective barricades to preclude any hazard.

11. The only planned OMS/RCS system activity during safing operations for a normal turnaround is to vent propellant system pressure to not more than 33 percent design burst and to drain/purge engine manifolds and crossfeed/transfer lines.

LANDING

1. Maintenance recorder data dump (data accomplished since last on-orbit data dump) will be performed in the landing area and/or while the vehicle is under tow. The data dump will be performed via RF air link.

2. The flight crew will safe the vehicle from the cockpit prior to ground crew exchange. Nonessential subsystems are powered down by flight crew.

3. Access is required for:

   Crew ingress/egress hatch.
   Nose wheel well.
   Aft umbilicals, right hand and left hand.
   Main gear wheel wells.

4. All support equipment is standing by and capable of approaching the orbiter and being in position for hookup within five minutes of roll-out.

5. Orbiter nose gear torque links must be disconnected prior to tow.

6. For a nominal mission, no pressurants will be vented and no fluids will be drained in the landing area with the exception of $NH_3$.

7. MPS He tanks will have been bled off in orbit to personnel safe level, and the MPS propellant ducting will be inerted with He to a blanket pressure of less than 20 psig prior to reentry.

8. The flight crew postlanding checklist will include rotation of the aft body flap to the horizontal position and retraction of the air data sensors.

9. ECLSS and PV&D GSE positioning and connection will not be held up for completion of the ongoing safety inspections. Ground crews performing these tasks will wear appropriate protective clothing and breathing apparatus until an "all clear" is received from Safety.

OPF (Safing Tasks)

1. MPS preliminary internal drying will be performed using helium and $GN_2$ supplied through the aft umbilicals from the OPF facilities.

2. The orbiter is jacked and leveled for stability to support removal of APS and RCS modules and the payload.

3. All pressure vessels will be vented to a pressure not more than (KSC Safety Guidelines for Technical Operating Procedure SD77-SK-0015):

   a. 25 percent design burst pressure for hazardous propellant systems.

   b. In accordance with the Fracture Control Plan for nonhazardous systems.

4. Fuel cells will be operated (to preclude cryogenic tank venting) until the PRSD system is configured for detanking or T-0 venting in the OPF.

   a. The PRSD will be vented within two hours after fuel cells are shut down.

   b. PRSD safing will consist of venting and inerting the system.

OPF, ORBITER (Maintenance and Checkout Tasks)

1. Functional path checkout will include:

   a. Reverification of functional paths which were disrupted by maintenance.

   b. Verification of orbiter-to-payload interfaces.

   c. Verification of orbiter-to-hyper module interface when hyper modules are removed from the orbiter.

   d. Reverification of functional paths needed for the next flight but not used or verified on the previous flight.

   e. Reverification of functional paths needed for the next flight but for which down time has been excessive.

   f. All active redundant FP's and all energized passively redundant FP's will be reverified if necessary to assure that the vehicle is safe to launch or safe for takeoff.

2. TPS refurbishment activities and equipment requirements are compatible with the cleanliness required for the OPF.

3. The one manipulator arm must be rotated outboard automatically and the rendezvous radar deployed from the cockpit after the payload bay doors are opened (serial operations), before the payload removal/installation. This operation does not require use of assist GSE for the 1-g environment.

4. Pyrotechnic installation and checkout tasks will be performed in parallel, using multiple teams.

5. Scheduled visual external and internal inspections commence after safing as soon as access to each zone area is made available.

6. The OPF bays are constructed such that hazardous operations in one bay do not impact operations in the other bay.

7. Scheduled maintenance tasks are preidentified for the turnaround and include scheduled LRU replacements and nonhazardous subsystems servicing.

8. All reverification testing will be completed within 10 hours after completion of maintenance.

9. All stowage will be accomplished while the orbiter is in the OPF.

10. Lifting beams (handling GSE) will be installed on the orbiter in the OPF.

11. Protective cover installations will be completed in the OPF (i.e., RCS, MPS). Protective GSE covers will be installed on aft body MPS ducting as soon as access is gained to the compartment to preclude duct damage from personnel traffic.

12. Unscheduled maintenance task from inflight recorders, pilot's log, or related sources are identified within eight hours after starting the unscheduled maintenance period.

OPF, SSME (Maintenance and Checkout Tasks)

1. Routine maintenance will be conducted on each flight. Additionally, a requirement exists for each engine to receive an internal inspection and an internal leak test at 12-flight intervals. The inspection and leak tests will be conducted during separate turnaround to optimize turnaround time.

2. Periodic internal leak tests are based on the total-system leak-test approach. The time assigned for periodic internal leak tests assumes a success path based on results of combined leakage measurements. The timelines do not include isolation to the individual components. If combined leakages exceed the maximum allowed, component isolation will be performed during unscheduled maintenance.

3. No separate joint hydraulic leak tests are identified in the timelines; it is assumed that this requirement is satisfied by the visual external inspection after the hydraulic system has been pressurized/exercised.

4. Vehicle pressurization requirements are introduced to the engine from the vehicle flight systems through engine-to-vehicle interfaces.

5. Duct cover removal and final inspection during the prep for rollout operation assumes no further personnel entry into the vehicle thrust section after final inspection.

VAB, ORBITER

1. To retract the landing gear in the VAB transfer aisle, orbiter hydraulic power is required, necessitating the following GSE:

   a. Facility electrical power.

   b. GSE cabin access and door SO-1 access.

   c. GSE hydraulics.

   d. GSE jacks.

   e. GSE aft fuselage access.

   f. Auxiliary GSE to operate hydraulic isolation valve and verify gear operation.

2. GSE erection fixtures are attached to the crane power to orbiter arrival in transfer aisle.

3. VAB high bay access equipment will be designed not to require temporary installations such as scaffolding to perform normal work.

4. Pyrotechnic installation and checkout tasks can be performed in parallel utilizing multiple teams.

5. Orbiter midbody umbilical will not be mated in the VAB.

VAB, SRB

1. Sufficient access will be provided in the aft skirt to remove and replace a defective LRU in the thrust vector control subsystem after the SRB's are stacked on the MLP, except that the nozzle extension must be removed prior to removal and replacement of a TVC actuator.

2. Access will be provided in the VAB to ET/SRB attach points, for aft struts, support equipment, and torque requirements.

3. SRB igniter safe-and-arm mechanical lock pins will be removed in the VAB.

VAB, ET

1. ET subsystem tests can be performed using the LPS.

2. The ET processing station will provide 100 percent access to ET areas using fixed or movable platforms.

3. No serial TPS refurbishment is factored into the flow.

4. ET ship-loose items can be installed within eight hours (serial).

5. No modification will be accomplished on the ET involved in the turn-around flow.

6. The ET will be under blanket pressure during rollout.

7. The ET destruct system will be installed prior to rollout from the VAB.

LAUNCH PAD

1. Pressurant/propellant/reactant loading and pressurization of fuel cell reactants require the launch pad to be clear of all personnel.

2. The flight crew will leave the launch pad barricade when MPS/ET propellant "fast fill" has been terminated.

3. The flight crew ingress and vehicle closeout will require the assistance of a ground crew. The ground crew must complete their closeout task and egress to a safe area prior to APU startup.

4. GSE supplied PV&D air will be supplied to the orbiter umbilical interfaces during rollout and during the dwell time at the pad. The PV&D ground system will be switched to a $GN_2$ source prior to the start of ET propellant loading.

5. Hazardous activities are grouped to minimize the pad-clear elapsed time; pad-clear time is serial when it occurs.

6. On the launch pad, the following access to the SSV will be provided:

   a. Main ingress/egress hatch (24).

   b. Cabin windows.

c. Side access door (50-1) (contingency).

d. Forward RCS (includes propellant and helium service points) (21-19) and 21-20).

e. APS pods (includes propellant and helium service points and nozzles (59-1, 59-2, 59-23, and 59-24)).

f. APU tank propellant and helium service points (56-1, 56-2) (contingency).

g. Midbody umbilical (45).

h. Aft umbilicals (54 and 55).

i. SRB TVC $N_2H_4$/GHe service points.

j. Mid-fuselage maintenance access door (44).

k. Payload bay (contingency).

l. Payload (contingency).

m. Accessible orbiter pyrotechnic installations (contingency).

n. Right and left SRB fwd skirt (contingency).

o. ET intertank umbilical plate and access door.

p. Payload umbilical for payload storable propellants.

7. A hatch seal integrity and cabin pressure integrity check will be performed following final hatch closeout.

# APPENDIX B

## LEVEL II TIMELINE ALLOCATION

## FUNCTIONAL SPECIFICATIONS

PART 1 PAYLOAD INSTALLATION BASELINED IN THE OPF

PART 2 PAYLOAD INSTALLATION BASELINED ON THE LAUNCH PAD (DESCRIBING ONLY THOSE DIFFERENCES FROM THE FUNCTIONAL SPECIFICATIONS NOTED IN PART I)

PART 3 SRB/SRM REUSE TURNAROUND (RETRIEVAL, DISASSEMBLY, REFURBISHMENT)

APPENDIX B

LEVEL II TIMELINE ALLOCATIONS
FUNCTIONAL SPECIFICATIONS

## PART 1 PAYLOAD INSTALLATION BASELINED IN THE OPF

B-1 LANDING AREA - ORBITER. This task starts when the orbiter rolls to a stop after landing and ends when the orbiter is ready to be towed to the OPF. This function includes but is not limited to the following:

a. Crew exchange.

b. Connecting tow equipment.

c. Connecting and activating support equipment (e.g., electrical power source, ECLSS coolant, PV&D air source, communications, etc.).

B-2 ORBITER PROCESSING FACILITY. This task starts with towing the orbiter from the landing strip to the OPF and ends when the orbiter is ready to be towed from the OPF to the VAB for mating. This function includes but is not limited to the following:

a. Towing from the landing strip to the OPF.

b. Safing and deservicing.

c. Payload removal (as required).

d. Maintenance and TPS refurbishment.

e. Flight kit removal and installation.

f. Preparing and inspecting payload bay.

g. System reverification as required and OIT preparations.

h. Payload installation.

i. Orbiter integrated test.

j. Preparations for stacking.

B-2.1 Safing and Deservicing. This function starts after the orbiter has arrived in the OPF and ends when the area is opened for general access. It includes but is not limited to the following:

a. Safety inspection.

b. Transfer to facility services, and jack and level the orbiter. Install and position access to hypergolic, cryogenic, and APU servicing panels. Connect SE to FRCS module, APS pods, APU servicing ports, and the T-0 and midbody umbilicals.

c. Purge and dry the SSME.

d. Vent RCS/OMS propellant and pressurance tanks, PRSD tanks, $O_2/N_2$ (ECLSS) tanks, and APU systems. Purge OMS and RCS manifolds and crossfeeds. Drain cryogens and leave blanket pressure in PRSD tanks. Service APU systems and pressurize $O_2$ and $N_2$ (ECLSS) tanks for flight.

B-2.2 Payload Removal Preparations. This function begins with access platforms positioned and local clear restrictions not in effect. This function includes but is not limited to the following:

a. Gaining access to payload bay door attach points and installing door-opening SE.

b. Opening doors to maintenance position. Positioning zero-G fixture and removing SE.

B-2.3 Payload Removal. This task starts after the payload bay doors have been opened and all access equipment has been installed and ends when the down payload has been lifted from the orbiter and placed on its SE transporter. This function includes but is not limited to the following:

a. Installing and removing payload-lifting SE.

b. Lifting the payload from the orbiter onto its SE transporter. This will not include any payload preparations beyond the point of releasing the crane after lifting operations.

B-2.4 SSME Maintenance. This function is performed concurrently with equivalent tasks for the orbiter. This function includes but is not limited to the following:

a. Removing, replacing, and retesting limited-life LRU.

b. Scheduled inspections and functional verifications.

c. Scheduled servicing (if required).

d. Turnaround torque test and heat exchanger leak test.

NOTE: These do not include any SSME checkout and servicing that can be best performed during the orbiter or Shuttle level checkout or launch preparations.

B-2.5 Orbiter Scheduled Maintenance. This function begins after payload removal and is performed concurrently with SSME scheduled maintenance. This function includes but is not limited to:

a. Removing, replacing, and retesting limited-life LRU.

b. Scheduled inspections and functional verifications.

c. Scheduled servicing.

NOTE: These items do not include any orbiter checkout and servicing. This can be best performed during the orbiter integrated test or Shuttle level checkout or launch preparations.

B-2.6 Gain Payload Bay Access. This function begins as soon as the payload has been removed from the cargo bay. This function includes but is not limited to the following:

a. Installing payload bay access SE above the liner.

b. Connecting support SE to access equipment.

B-2.7 Flight Kit Removal. This function begins after payload removal and is performed concurrently with orbiter and SSME scheduled maintenance. This function includes but is not limited to:

a. Verification of installation of payload bay platforms sufficient to provide access.

b. Removal of PSS and MSS modules when required.

b. Removal of flight kits from orbiter.

B-2.8 Flight Kit Installation. This function begins after completion of flight kit removal (from previous mission) and is performed concurrently with orbiter and SSME scheduled maintenance. This function includes but is not limited to:

a. Installing PSS and MSS modules.

b. Installing flight kits in orbiter.

c. Removing payload bay platforms not required for ensuing payload bay activities.

B-2.9 Payload Bay Preparation. This function begins as soon as the flight kits have been installed and maintenance activities inside the payload bay have been completed. This function includes but is not limited to the following:

a. Cleaning and inspecting payload bay liner, bulkhead, doors, and radiator covers.

b. Preparing orbiter interface for payload installation.

c. Removing payload bay access SE above the liner.

B-2.10 Payload Installation and Verification. This function is performed prior to the start of the orbiter integrated checkout. It begins with crane-lifting the payload from its SE transporter into the orbiter and ends with the final closing of the payload bay doors prior to transfer of the orbiter from the OPF to the VAB. This function includes but is not limited to the following.

a. Maintaining payload and payload bay cleanliness levels.

b. Payload/orbiter interface verification by inspection, leak check, or functional operations, as appropriate. However, functional interfaces which can be more efficiently verified during the OIT should not be verified during this period.

B-2.11 Orbiter Integrated Preparations and Test. These functions begin after completing maintenance, systems reverification, and orbiter/payload (when installed) interface connections are complete. These functions include but are not limited to the following:

a. Configuring access platforms and SE.

b. Applying electrical power, instrumentation, and LPS and verifying SE/orbiter subsystem interfaces.

c. Orbiter-to-payload interface tests (when installed).

d. Functional path verification for orbiter systems, flight control system, performance test, and SSME flight readiness verification.

e. $NH_3$ servicing.

B-2.12 Orbiter Preparations for Stacking. This function begins after OIT is complete. This function includes but is not limited to the following:

a. Orbiter pyrotechnic installation and verification.

b. Removal of all remaining internal access SE (mid- and aft-fuselage).

c. Orbiter closeout and cabin stowage.

d. Installing erection fixtures.

e. Lowering orbiter and preparing for towing to the VAB.

B-3 VEHICLE ASSEMBLY BUILDING. These functions start with transferring and stacking SRB assemblies and end with the Shuttle vehicle on the MLP prepared for rollout to the pad. These functions will include but not be limited to the following:

a. Aft booster buildup and SRM offload.

b. SRB stacking and alignment.

c. ET transfer aisle operations.

d. ET checkout cell operations.

e. ET mate to SRB and verify interfaces.

f. Tow the orbiter from the OPF to the VAB.

g. Orbiter premate operations.

h. Erect the orbiter and mate to the ET.

i. Shuttle interface test.

j. Shuttle ordnance installation and electrical connection.

k. Preparations for roll out.

NOTE: The 39-hour allocation for this function applies only to items d through i. Separate allocations have been established for items a, b, and c.

B-3.1 Aft Booster Buildup and SRM Offload. This function starts with the arrival of the aft skirts from the RSF and concludes with the loading of two spent segment cases. These functions will include but not be limited to the following:

a. Install left and right aft skirt in stand.

b. Mate aft segments to aft skirts.

c. Install aft assy stiffener rings and ETA rings.

d. Install nozzle extensions.

e. Install booster instrumentation cables.

f. Perform instrumentation cable continuity checks.

g. Install cable tray covers.

h. Install ETA struts.

i. Install heat shields.

j. Prep for stacking.

k. Offload solid fuel segments.

l. Ship spent segment cases.

B-3.2 SRB Stacking and Ready for ET Mate. This function begins with transferring the first SRB subassembly from the buildup area to the integration cell and attaching it to the MLP and ends with the SRB assemblies ready for SRB/ET mate. These functions will include but will not be limited to the following:

a. Transferring the SRB subassemblies from the buildup area (High Bay 4) and refurbishment subassembly facility (West Low Bay) and stacking each assembly to form a complete SRB.

b. Alignment checks, including any required adjustments.

c. Installation and preparation of ET mating interfaces on the SRB.

d. SRB intra-element interface verification.

e. Servicing of any SRB subsystems as required to support the Shuttle interface test to be performed after mating of the ET and the orbiter.

B-3.3 ET Transfer Aisle Operations. This function begins with the arrival of the ET at KSC and ends with lifting the ET to the ET checkout cell. These functions include but are not limited to:

a. ET offload preparations.

b. Move ET to transfer aisle.

c. Install lifting slings.

d. Disconnect ET from the transporter.

e. Rotate ET to vertical.

f. Lift and position ET above the checkout cell.

B-3.4 ET Checkout Cell Operations. This function starts with ET insertion into the ET checkout cell and ends with transfer of the ET into the integration cell for mate with the SRB. This function will include but not be limited to the following:

a. ET mate to ET checkout cell.

b. Installation of ship loose items.

c. Mechanical functional tests.

d. Electrical/Instrumentation tests.

e. Pressurization of LOX, $LH_2$ 2tanks.

f. Purge/Leak checks.

g. TPS installation.

h. Install RSS ordnance..

i. Install cable tray covers and fairings.

j. Prep for transfer to integration cell.

B-3.5 ET Mate to SRB, Verification of Interface. This function begins with the crane lift of the ET from its storage facility in the bay opposite the Shuttle integration cell and ends when the ET is mated to the SRB and is ready for the Orbiter to be mated. This function will include but will not be limited to the following:

a. Crane-lift of the ET from the checkout facility into the Shuttle integration cell.

b. Mechanical mating of the ET/SRB separation interfaces. This will include installation of ordnance devices (if any) which are integral to the mating process.

c. Connecting and verifying ET-to-SRB and ET-to-VAB interfaces.

d. Removing and positioning VAB integration cell access platforms as required to allow crane-lifting the Orbiter into its mating position.

B-3.6 Orbiter Premate Operations. This function begins with towing the Orbiter from the OPF to the VAB and ends when the Orbiter is ready to be lifted from the transfer aisle into the integration cell. This function will include but not be limited to the following:

a. Towing the Orbiter from the OPF to the VAB.

b. Connecting SE lifting slings.

c. Retracting the Orbiter landing gear.

d. Rotating the Orbiter to vertical.

e. Removing SE aft lifting sling.

B-3.7 Orbiter Mate to ET. This function begins with lifting the Orbiter from the transfer aisle into the integration cell. It ends at the point where the Shuttle vehicle is ready for electrical power application. This function includes but is not limited to the following:

a. Lifting the Orbiter into the integration cell.

b. Mechanical mating the Orbiter to the ET.

c. Removing the Orbiter-handling SE.

d. Connecting the Orbiter-to-ET and Orbiter-to-MLP umbilical interfaces.

e. Verifying interfaces connected under item d above to the extent practical without the application of electrical power.

B-3.8 Shuttle Integrated Operation. This function begins with Interface Test preparations and ends with the SSV/MLP ready for rollout. The function includes but is not limited to the following:

a. Shuttle Interface Test.

b. Installing and connecting all remaining Shuttle ordnance.

c. Preparations for rollout.

d. Making Shuttle ordnance connections.

B-4 LAUNCH PAD. This function starts when the Shuttle vehicle is ready for rollout from the VAB and ends with launch. This function does not include opening the orbiter payload bay doors but does include but is not limited to the following:

a. Rollout to the pad.

b. Connect and verify pad interfaces.

c. Positioning the RSS to the orbiter.

d. Servicing preparations.

e. Launch readiness verification.

f. Cabin closeout.

g. Hazardous servicing.

h. Servicing disconnects.

i. Retracting the RSS.

j. Main propellant loading.

k. Launch from standby.

B-4.1 Rollout to the Pad. This function starts with first motion of the crawler/transporter after the VAB doors have been opened and all VAB platforms have been retracted. It ends when the MLP is hard down on the launch pad mounts. It includes but is not limited to the following:

a. Transferring the MLP and SSV to the launch pad.

b. Maintaining the air conditioning purge to the payload bay.

Justification: Greater clarification.

B-4.2 Connect and Verify Pad Interfaces. This function starts after the MLP is hard down on the launch pad mounts. It ends when all pad-to-MLP and pad-to-SSV interfaces have been connected, excluding the servicing interfaces defined in 4.4. It includes but is not limited to the following:

a. Switch scanning and applying facility power.

b. Checking and self-testing launch critical functions and RF "open loop."

c. Verifying orbiter and pad interface of the mid-body umbilical payload-unique electrical functions.

NOTE: Functions a and c will not include interface verifications that can best be performed as part of the launch readiness verification test.

B-4.3 Position the RSS to the Orbiter. This function starts after the MLP is hard down on the launch pad mounts. It ends when the RSS is in place around the orbiter and has been configured to support servicing preparations and opening the payload bay doors. It includes but is not limited by the following:

a. Rotating the RSS from the park position to the orbiter.

b. Interfacing the RSS seal with the orbiter.

c. Initiating RSS utility services.

d. Opening RSS-to-orbiter doors.

e. Deploying RSS access devices.

B-4.4 Servicing Preparations. This function starts when orbiter access is available for the RSS. It ends with subsystems servicing. It includes but is not limited to the following:

a. Installation of mid-body umbilicals and other interfaces required for PRSD cryogens loading.

b. Installing SRB APU service lines and carrier plates.

c. Positioning and installing FRCS module/APS pod servicing equipment.

d. All nonhazardous preparations for hypergolic servicing.

e. $N_2$ and $O_2$ servicing preparations.

f. Payload servicing preparations as required.

B-4.5 Shuttle Launch Readiness Verification. This function begins with the SSV ready to support power-up operations. This function includes but is not limited to the following:

a. Switch scanning and applying facility power.

b. Checking and self-testing launch critical functions and RF "open loop."

c. Verifying orbiter and pad interface of the midbody umbilical payload unique electrical functions.

d. SSV flight control check (less hydraulics) including the SRB.

e. SSV launch readiness status check.

B-4.6 Cabin Closeout. This function begins with the completion of launch readiness verification and includes but is not limited to the following:

a. Configuring cabin switches for remote servicing.

b. Loading and verifying orbiter software.

c. Installing LiOH containers in the $CO_2$ control assembly.

d. Contingency stowage and closeout inspection.

e. Egressing the ground crew and temporarily closing the hatch.

B-4.7 Hazardous Servicing. This function begins with the pad clear of personnel and the SSV/SE configured for remote servicing. This function will include but is not limited to the following:

a. PRSD loading and fuel cell activation.

b. External tank conditioning with $GN_2$/GHe.

c. Payload servicing as required.

d. Servicing FRCS/APS system with hypergolic fluids and He.

e. Topping off the ECLSS $GO_2/GN_2$ spheres.

B-4.8 Servicing Disconnect. This function shall commence at the end of hazardous servicing and includes but is not limited to the following:

a. Opening pad to limited crew.

b. Disconnecting all hazardous service lines and installing flight caps and TPS.

c. Removing servicing SE.

d. Retracting PCR and clearing the pad.

B-4.9 Retracting the RSS

B-4.10 Main Propellant Loading. This function is performed concurrently with the countdown operations and includes loading main propellant to the ET.

B-4.11 Launch from Standby. The T-2 hour countdown begins with main propellant loading and ends with liftoff. This function includes but is not limited to the following:

a. Flight crew and passenger ingress.

b. Electrical power transfers and APU startup.

c. Final sequencing and status checks.

## APPENDIX B

## LEVEL II TIMELINE ALLOCATIONS
## FUNCTIONAL SPECIFICATIONS

PART 2 PAYLOAD INSTALLATION BASELINED ON THE LAUNCH PAD (DESCRIBING ONLY THOSE DIFFERENCES FROM THOSE NOTED IN PART 1)

B-1 LANDING AREA, ORBITER. Same as Part 1.

B-2 ORBITER PROCESSING FACILITY. Same as Part 2, except Item g, Payload Installation.

B-2.1 Safing and Deservicing. Same as Part 1.

B-2.2 Payload Removal Preparations. Same as Part 1.

B-2.3 Payload Removal. Same as Part 1.

B-2.4 SSME Maintenance. Same as Part 1.

B-2.5 Orbiter Scheduled Maintenance. Same as Part 1.

B-2.6 Gain Payload Bay Access. Same as Part 1.

B-2.7 Flight Kit Removal. Same as Part 1.

B-2.8 Flight Kit Installation. Same as Part 1.

B-2.9 Payload Bay Preparation. Same as Part 1.

B-2.10 Payload Installation and Verification. DELETE

B-2.11 Orbiter Integrated Test. Same as Part 1.

B-2.12 Orbiter Preparations for Stacking. Same as Part 1.

B-3 VEHICLE ASSEMBLY BUILDING. Same as Part 1.

B-3.1 SRB Stacking and Ready for ET Mate. Same as Part 1.

B-3.2 ET Mate to SRB, Verification of Interface. Same as Part 1.

B-3.3 Orbiter Premate Operations. Same as Part 1.

B-3.4 Orbiter Mate to ET. Same as Part 1.

B-3.5 Shuttle Integrated Operation. Same as Part 1.

B-4.0 LAUNCH PAD. Same as Part 1, with the following additions:

a. Payload installation in RSS.

b. Payload bay door operations.

c. Payload installation and launch readiness verification.

B-4.1 Payload Installation in RSS. This function includes but is not limited to the following:

a. Mating payload canister to RSS.

b. Payload translation from canister to RSS.

c. Removing payload canister from RSS and launch pad.

B-4.2 Launch Pad Operations. Same as Part 1, paragraph 4.1, with the following addition: "h. Payload bay door operations."

B-4.3 Shuttle Launch Readiness Verification. Same as Part 1, paragraph B-4.2.

B-4.4 Payload Bay Door Operations. This function begins after the RSS/orbiter seal has been inflated. This function includes but is not limited to the following:

a. Payload bay door SE installation.

b. Opening payload bay doors.

c. Closing payload bay doors after payload installation.

d. Removing payload bay door SE.

B-4.5 Payload Installation and Launch Readiness Verification. This function includes but is not limited to the following:

a. Extending payload into payload bay.

b. Mechanically connecting orbiter/payload interface.

c. Electrically connecting orbiter/payload interface.

d. Making fluid connections of the orbiter/payload interface (as required).

e. Orbiter/payload interface verification.

f. Retracting SE from payload bay.

B-4.6 Cabin Closeout. Same as Part 1, paragraph B-4.3.

B-4.7 Hazardous Servicing. Same as Part 1, paragraph B-4.4.

B-4.8 Servicing Disconnects. Same as Part 1, paragraph B-4.5.

B-4.9 Main Propellant Loading. Same as Part 1, paragraph B-4.6.

B-4.10 Launch from Standby. Same as Part 1, paragraph B-4.7.

# APPENDIX C

## PERIODIC SIGNIFICANT

## SCHEDULED TASKS

## APPENDIX C

## PERIODIC SIGNIFICANT SCHEDULED TASKS

### OVERVIEW

**The probability of achieving the allocation turnaround time of 160 hours is nil unless the design and maintainability are improved to eliminate the deltas between the assessment times and allocation times.**

**The probability of achieving the assessment turnaround time is low unless the design and maintainability are improved to eliminate the periodic significant scheduled tasks (PSST).**

### Appendix Explanation

A star (★) has been added to some of the tasks of the Level II and Level III assessment charts, indicating that the time on the bar chart is based on the Level II ground rule of not reflecting timelines for tasks which occur on less than 50 percent of the turnarounds. The star (★) represents a probable impact when the turnaround timeline is applied to a particular mission. Candidate PSST items are submitted to the STAG along with preliminary timeline assessments. Those which impact the Level II or III assessment timelines and are scheduled to occur on less than 50 percent frequency are then included in this appendix.

The times included in this appendix are the minimum assessed times for the particular starred bar chart line with the assumption that the routine turnaround activity can be worked in parallel. This may not always be the case, and the times may be serial impacts depending on mission planning.

In addition to this appendix, there are other periodic scheduled tasks which individually do not impact the bar chart time assessment and therefore are not included. However, combinations of these nonimpacting tasks for a particular mission could also represent impacts. Judicious mission planning will be required to preclude this.

The PSST alpha-numeric number used in the addendum is coded as follows:

PSST Number: X - N - X

- X: Alpha designator of the turnaround facility in which the timeline occurs, i.e.,
  - L = Landing Field
  - O = OPF
  - V = VAB
  - P = PAD
- N: Sequential numerical designator of a starred timeline
- X: Sequential alpha designator of a PSST

PERIODIC SIGNIFICANT SCHEDULED TASKS

IMPACT TO STAR ASSESSMENTS

| ASSESSMENT CHART P/L in OPF | P/L at Pad | PSST NUMBER | BAR CHART LINE DESCRIPTION AND PSST DESCRIPTION AND REMARKS | FREQ. | PRESENT ASSESSMENT IN HOURS | PSST ASSESSMENT IN HOURS |
|---|---|---|---|---|---|---|
| ★ | ★ | O-1 | SAFING AND DESERVICING | | 27.0 | |
| | | A | Hyper Pod Removal (includes safing operations, SE removal, disconnection of fluid interfaces, and mechanical removal of FRCS and APS pods). | @ 5 flts. | | 36.5 |
| ★ | ★ | O-2 | PAYLOAD REMOVAL | | | |
| | | A | Spacelab and Tunnel Removal | 50 | 3.0 | 24.5 |
| ★ | ★ | O-3 | SCHEDULED SSME MAINTENANCE | | 54.0 | |
| | | A | Engine Removal and Reinstallation (includes 14 hours for orbiter dome assembly portion of heat shield removal and reinstallation; engine-mounted heat shield can remain installed. Change in time is the result of KSC impact to PCIN 17235. | 55 flts. | | 66.0(80) |
| | | B | Internal Inspection (includes 54 hours for routine maintenance on three engines). | 1 eng/ 4 flts. | | 11.0(65.0) |
| | | C | Internal Leak Tests | 1 eng/ 4 flts. | | 24.0(78.0) |
| | | O-4 | ORBITER SCHEDULED MAINTENANCE | | 26.0 | |
| | | A | Payload Bay Liner. | 2-3 times/ 100 missions | | 34.0 |

PERIODIC SIGNIFICANT SCHEDULED TASKS

IMPACT TO STAR ASSESSMENTS

| ASSESSMENT CHART P/L in OPF | P/L at Pad | PSST NUMBER | BAR CHART LINE DESCRIPTION AND PSST DESCRIPTION AND REMARKS | FREQ. | PRESENT ASSESSMENT IN HOURS | PSST ASSESSMENT IN HOURS |
|---|---|---|---|---|---|---|
| | | B | Payload Bay Thermal Control Systems; Partial Replacement (576 and 1307 bulkhead)(1250 manhours for 600 blankets). | 2-3 times/ 100 missions | | 89.0 |
| | | B-1 | Payload Bay Thermal Control System; Total Replacement (4400 manhours for 1200 blankets) without a Liner | 2-3 times/ 100 missions | | 312.0 |
| | | C | Fuel Cell Removal and Replacement (3). | 2000 hr. or 50 cycles | | 53.0 |
| | | D | Hyper Module Offline Checkout. | @ 5 flt. | | 106.0 |
| | | E | Hyper Module Reinstallation (includes mechanical installation, connecting plumbing, and verifying interfaces). | @ 5 flt. | | 20.5 |
| | | F | APU Replacement. | 20 hr | | 32.0 |
| | | O-5 | FLIGHT KIT REMOVAL | Mission Planning | 20.0 | |
| ★ | | A | Airlock Outside to Inside (paralleled some operations that had been serial before, deleted 30 psi cabin leak check, and added psig cabin and seals leak check; shortened time for installing bolts). | | | 96.0 |
| | | B | Cryo Tank Kit (brazed fittings). | | | 109.0 |
| | ★ | O-6 | FLIGHT KIT REMOVAL | Mission Planning | 29.0 | |

PERIODIC SIGNIFICANT SCHEDULED TASKS

IMPACT TO STAR ASSESSMENTS

| ASSESSMENT CHART P/L in OPF | P/L at Pad | PSST NUMBER | BAR CHART LINE DESCRIPTION AND PSST DESCRIPTION AND REMARKS | FREQ. | PRESENT ASSESSMENT IN HOURS | PSST ASSESSMENT IN HOURS |
|---|---|---|---|---|---|---|
| | | A | Airlock Outside to Inside. (Paralleled some operations that had been serial before, deleted 30 psi cabin leak check, and added psig cabin and seals leak check. Shortened time for installing bolts.) | | | 96.0 |
| | | B | Cryo Tank Kit Tank Sets 3 and 4 | | | |
| ★ | | O-7 | FLIGHT KIT INSTALLATION | | | 192.0 |
| | | | | Mission Planning | 56.0 | |
| | | A | Airlock Inside to Outside. | | | |
| | | B | Rescue Kit. | | | 98.0 |
| | | C | Cryo Tank Kit - Tank Sets 3 & 4 | | | TBD |
| | | D | Cryo Tank Kit - Tank Sets 5, 6 and 7 | | | 248.0 |
| | ★ | O-8 | FLIGHT KIT INSTALLATION | | | TBD |
| | | | | Mission Planning | 43.0 | |
| | | A | Airlock Inside to Outside. | | | |
| | | B | Rescue Kit. | | | 98.0 |
| | | C | Cryo Tank Kit Tank Sets 3 and 4 | | | TBD |
| | | | | | | 248.0 |

PERIODIC SIGNIFICANT SCHEDULED TASKS

IMPACT TO STAR ASSESSMENTS

| ASSESSMENT CHART P/L in OPF | P/L at Pad | PSST NUMBER | BAR CHART LINE DESCRIPTION AND PSST DESCRIPTION AND REMARKS | FREQ. | PRESENT ASSESSMENT IN HOURS | PSST ASSESSMENT IN HOURS |
|---|---|---|---|---|---|---|
| | ★ | P-1 | PAYLOAD INSTALLATION IN RSS | Mission | 13.0 | |
| | | A | DoD Factory-to-Pad Concept | | | 194.5 |
| | | | (1) Assumptions:<br>IUS preassembled (2-stage) .<br>Single DoD spacecraft .<br>No refurbishment interference.<br>Mobile airlock is available for spacecraft installation.<br>No IUS checkout in RSS. | | | |
| | | | (2) Task begins at lift-off. | | | |
| | | | (3) Task includes:<br>Pad saving and RSS validation.<br>Previous mission SE removal.<br>PGHM reconfiguration and SE installation.<br>IUS installation in RSS.<br>Removal of NASA canister.<br>Installation of mobile airlock.<br>Mating spacecraft to IUS.<br>IUS/SC checkout.<br>SC propellant load. | | | |

PERIODIC SIGNIFICANT SCHEDULED TASKS

IMPACT TO STAR ASSESSMENTS

| ASSESSMENT CHART P/L in OPF | P/L at Pad | PSST NUMBER | BAR CHART LINE DESCRIPTION AND PSST DESCRIPTION AND REMARKS | FREQ. | PRESENT ASSESSMENT IN HOURS | PSST ASSESSMENT IN HOURS |
|---|---|---|---|---|---|---|
| | | | (4) Task ends with ready for pad fuel cell dewar load. | | | |
| | | B | IUS/TDRS PROCESSING | | | 96.0 |
| | | | (1) Task includes:<br>Installing SE in RSS.<br>SE validation.<br>Preparing RSS.<br>Positioning canister.<br>Removing cargo from canister.<br>Connecting TDRS SE.<br>Connecting battery cooling ducts.<br>TDRS functional test.<br>TDRS battery conditioning.<br>Disconnecting TDRS SE.<br>Connecting ordnance.<br>Securing RSS and clearing pad. | | | |
| | | | (2) Task ends with pad fuel cell dewar ready to load. | | | |
| | ★ | P-2 | PAYLOAD INSTALLATION AND LAUNCH READINESS VERIFICATION | Mission Planning | 7.0 | |
| | | A | DoD Factory-to-Pad Concept<br>(Six hours serial time required for payload preps and closeout (refer to Level III bar "Orbiter Payload Interface/Readiness Verification")) | | | 13.0 |
| | | B | IUS | | | |

PERIODIC SIGNIFICANT SCHEDULED TASKS

IMPACT TO STAR ASSESSMENTS

| ASSESSMENT CHART P/L in OPF | P/L at Pad | PSST NUMBER | BAR CHART LINE DESCRIPTION AND PSST DESCRIPTION AND REMARKS | FREQ. | PRESENT ASSESSMENT IN HOURS | PSST ASSESSMENT IN HOURS |
|---|---|---|---|---|---|---|
| ★ | | P-3 | RELOAD DEWARS AND SERVICE PRSD TANKS<br><br>When the 6th and 7th Tank Sets are installed in orbiter and required to support the mission. The original dewar load will support tank sets 1 thru 5. | | 0 | 8.0 |
| ★ | | P-4 | T-6.5 HOUR HOLD (IF REQUIRED) - LATE PAYLOAD BAY ACCESS | Mission Planning | | |
| | | A | Payload Bay Door Opening and Closing<br>No planned opening of payload bay door on the pad for OPF-installed payload. This task will require a "hold" to complete payload bay closeout.<br><br>The task includes:<br><br>. Extend RSS/Orb Seals (2.0)<br>. PLB door SE installation (2.0).<br>. RSS seal inflation and purge and open RSS doors (2.5).<br>. Open PLB doors (1.0).<br>. Extend PGHM (3.5).<br>. Retract PGHM (3.5).<br>. Close PLB doors (1.0).<br>. Close RSS doors (0.5).<br>. PLB door SE removal (2.0).<br><br>NOTE: Payload operations. are not included in this timeline. Physical access to the PLB would terminate 13.0 hours prior to liftoff. | | 0 | 18.0 |

PERIODIC SIGNIFICANT SCHEDULED TASKS

IMPACT TO STAR ASSESSMENTS

| ASSESSMENT CHART P/L in OPF | P/L at Pad | PSST NUMBER | BAR CHART LINE DESCRIPTION AND PSST DESCRIPTION AND REMARKS | FREQ. | PRESENT ASSESSMENT IN HOURS | PSST ASSESSMENT IN HOURS |
|---|---|---|---|---|---|---|
| | ★ | P-5 | T-6.5 HOUR HOLD (IF REQUIRED) - LATE PAYLOAD BAY ACCESS | Mission Planning | | |
| | | A | Delayed Payload Bay Door Closing.<br>PLB doors are planned to be closed prior to hypergolic servicing for a pad-installed payload. Delaying the PLB closing until after hypergolic servicing will require a "hold" to complete payload bay closeout prior to retracting the RSS. The delayed tasks are:<br><br>. Retract PGHM (3.5).<br>. Close PLB doors (1.0).<br>. Close RSS doors (0.5).<br>. Remove PLB door SE (2.0).<br><br>NOTE: Payload operations are not included in this timeline. Physical access to the PLB would terminate 13.5 hours prior to liftoff. | | 0 | 7.0 |

# APPENDIX D

## SIGNIFICANT PROBLEM AREAS

APPENDIX D

Significant Problem Areas

Operational Turnaround

| Item | Office of Prime Responsibility | First Discussed |
|---|---|---|
| TPS Refurbishment | KSC - Orbiter | STAR 1 March 1974 |
| Countdown | KSC | STAR 1 March 1974 |
| Hypergolic Servicing | KSC | STAR 1 March 1974 |
| Tunnel Hatch-Seal Leak Check | Orbiter | STAR 9 Feb 1976 |
| Spacelab Removal & Inst'l | JSC | STAR 9 Feb 1976 |
| PL Bay Door GSE Operations at the Pad | JSC-Orbiter | STAR 10 July 1976 |
| Rescue Kit Base Line | JSC | STAG 11 Oct 1976 |
| Airlock Changeout Operations | JSC | STAR 11 Dec 1976 |
| Safing and Deservicing | MSFC-JSC-KSC | STAR 11 Dec 1976 |
| SSME Heat Shield Operations | JSC-MSFC | STAR 11 Dec 1976 |
| Flight Kits | JSC | STAR 12 May 1977 |
| Flight Kit Installation in Vertical | KSC | STAG 13 July 1977 |
| Integrated Testing Philosophy | KSC | STAG 13 July 1977 |
| Flight Kits - Horizontal Installation | JSC | STAR 13 Aug 1977 |
| Elevon Cove Seal Verification | Orbiter | STAG 14 Nov 1977 |
| Hydraulic Lifters, OPF | KSC | STAG 14 Nov 1977 |
| APU Hot Fire | JSC | STAG 15 May 1978 |
| SRB TPS | MSFC | STAG 15 May 1978 |
| SSME Routine Maintenance | JSC | STAG 16 Oct 1978 |
| RCS Thruster Valve Leakage | JSC | STAG 17 Feb 1979 |
| $LH_2$ Replenish Logistics Between Launches | KSC | STAG 17 Feb 1979 |

A. TPS Refurbishment - As a result of a TPS refurbishment review, the updated assessment of 109.5 hours is shown on the STAR timelines. Because certain TPS refurbishment tasks require continuous time greater than 16 hours, this assessment requires a 3-shift, 24-hour day to accomplish. The assessed timeline shows the 109.5 hour time, but indicates that it is not a serial impact. The timeline note explains the task.

1. The timeline is based on the following assumptions:

   a. TPS refurbishment is limited to early operations (pre OV-105 delivery).

   b. The critical path is assessed to be: ordering a batch of 50 tile from Palmdale/LMSC that is

identified for replacement prior to the next launch with no spares available for this batch of damaged tile. Each additional batch of 50 tile in this category would increase the assessed time 17 hours.

c. Any tile identified as being damaged repetitively would have spares available at KSC with the SIP bonded and ready for vehicle installation when required.

d. Replacement of tile with available spares is not critical path and would not cause serial impact up to four batches of 50 tile.

e. Tile damage of a minor nature can be repaired in place with single/multimission techniques, and such repair will not cause a serial impact to the TPS turnaround assessment.

f. All tile ordered by part number (or cavity digitizer data) from Palmdale or LMSC can be ordered six sides complete and no molds/patterns required.

g. Minitile and regular tile do not have to be fit checked (mismatch comparitor) prior to SIP bonding.

h. No PQV test will be required after bonding cure.

i. There is SE available to work a batch of 50 tile in cure at any one time.

j. The inspection and identification of damaged tile is complete at the start of the TPS repair/ refurbishment period.

k. There is no "snowball effect" on rework of single/ multimission repairs from previous turaround periods.

2. The TPS refurbishment assessment is being coordinated between the Orbiter Project Office, KSC, and Rockwell-Downey/Palmdale/KSC.

3. The continuing refinement of techniques during the R&D phase of the program will dictate periodic updates of the assessed timelines.

4. Areas of concern that will affect the assessed timelines:

a. Palmdale/LMSC manufacturing capabilities to support KSC operations (fabricate 50 tile in 40 hours) are under consideration.

b. Tracer pattern and minitile dicing machines to allow KSC to fabricate "washcoat" single-mission tile for a repair capability are not included in this timeline. Washcoat tile would support normal turnaround activities and provide a contingency capability to replace tile damaged late in the turnaround flow.

5. The current TPS timeline considers the repair and refurbishment of HRSI and LRSI tile. There are several other components of TPS that may affect the turnaround timelines. The items listed are currently planned as portions of TPS, but adequate repair/refurbishment data is not available at this time. Such data will be included in the timelines as future assessments are made.

   a. Flexible reusable surface insulation (FRSI).

   b. Filler bar (under gaps between tile).

   c. Gap fillers between tiles in high thermal/aero loads areas.

   d. Reinforced carbon-carbon (RCC) and leading edge subsystem (LESS).

   e. Thermal barriers and seals.

B. Countdown - There is a requirement to perform an aided flight crew ingress/cabin integrity check. The Level II decision has been made to defer ET LOX service flow rate of 5,000 gpm until required by the traffic model. Existing 6-inch facility line limits the flow rate to 1,250 gpm. The present assessment for terminal countdown activities is four hours.

C. Hypergolic Servicing - This task has been reassessed and remains at 7.5 hours. The delta of 1.5 serial hours is due to the requirement to load the OMS tanks from the opposite OMS Pod to sweep the crossover lines initially. Both left hand and right hand OMS are loaded prior to RCS because of back pressure in the SE. Present safety requirements do not allow simultaneous liquid flows ($N_2O_4$ and MMH) through the APS servicing panel. KSC Safety has indicated that a staggered-start simultaneous flow would be permissible provided that prior experience with the serial flow established the necessary system confidence. The 6.0-hour allocation could be realized if simultaneous flow is performed.

D. Tunnel Hatch Seal Leak Test - During the STAG 9 meeting, the requirement for the pressure leak test of the tunnel hatch seal was recommended by Rockwell/Downey. The test consists of closing the airlock adapter/tunnel pressure hatch and

applying a differential pressure of 2 psid across the hatch. It was recommended that the differential pressure be applied by pressurizing the tunnel and spacelab volume. This procedure, however, results in over-pressurizing the spacelab. The spacelab equipment was not designed to withstand pressures greater than 14.7 psia.

During a subsequent STAG meeting (10) an alternate procedure was proposed. The 2-psid differential pressure would be applied by evacuating the tunnel, leaving the crew module and the spacelab at atmospheric pressure.

At the STAG 12 meeting, JSC reported that a new hatch-seal concept was undergoing a design review with the object of eliminating the requirement for spacelab pressurization.

At STAG 15, action was assigned to the Cargo Integration Working Group (D. Mathews, Chairman) for resolution.

E. Spacelab Removal and Installation - The Level II/III allocations for payload removal and installation are three and four hours, respectively. To provide access to the spacelab during Orbiter Integrated Test, it was requested that the tunnel be installed during or after OIT. Studies have indicated that, except when a payload is installed over the tunnel or when the airlock has been installed at 90 degrees from the baseline configuration (parallel to the X axis), this concept is functionally feasible. However, this concept will require additional allocated time. The present KSC Spacelab Operational Assessment denotes 24.5 hours to remove the spacelab and tunnel and 63.5 hours for the installation.

F. Payload Bay Door Operations at Pad - On September 10, 1976, Level II PRCB approved the use of SE (torque tubes) to support the payload bay door opening and closing at the launch pad. All timelines concerning payload installation and payload access at the launch pad, including late life-science access, will be impacted. Latest access through the payload bay doors will terminate at T-13.5 hours (based on a 4-hour countdown) compared to program requirement of T-6.0 hours (based on a 2-hour countdown).

G. Rescue Kit Baseline - JSC was assigned an action item during the STAG 11 meeting to determine the composition of the baseline rescue kit for inclusion in the STAR as a PSST items. The preliminary assessment of a typical rescue kit was presented at the STAG 12 meeting. The recommended philosophy and approach are:

1. Eliminate the requirement for opening the payload bay doors on the pad for rescue operations to minimize response time.

2. Except as otherwise required for safety reasons, carry the rescue equipment in the rescue vehicle.

3. No or minimal impact to the orbiter baseline.

4. Rescue kit on orbit to be "add ons."

The preliminary typical rescue kit is composed of:

a. Up to ten seats depending on the size of the crews in the disabled vehicle and the rescue vehicle.

b. Side hatch opening tool

c. Rescue transfer "can."

d. Contingency repair device.

e. Additional safety repair kit.

f. Disabled vehicle repressurization supply.

g. Rescue vehicle expendables (if required).

The rescue kit will be refined as more definitions becomes available.

H. Airlock Changeout - Missions that require any relocation of the airlock (from inside the cabin to cargo bay or the reverse) will create a significant impact to the turnaround. Of specific importance:

- The structural integrity of the cabin may not be maintained after removal and replacement of the manufacturing panel. To perform the reinstallation without a high-pressure cabin integrity verification accepts a risk. Accomplishing the verification drives the airlock task out beyond the present assessment.

- The only way to preclude a large turnaround impact to flights 8 through 27 is to optimize the flight kit planning and to assign the airlock inside the cabin for all flights. Present design is to place the airlock inside the cabin on all orbiters. A design change would be required to permit EVA on a spacelab flight which requires simultaneous shirt sleeve access to the lab.

- For those spacelab flights in Orbiter 102, a modification to the ARS system is required for the airlock-inside and the tunnel-adapter-outside configuration.

I. Safing and Deservicing

I-1. APS/FRCS Pod Safing - APS/FRCS pod safing in the OPF requires removal of 13 access panels per pod, installation of 12 scupper sets per pod, connection of 47 lines per pod during the 14½ hours of preparation for safing/deservicing.

I-2. SSME Purge and Dry - The SSME $GN_2$ purge required 4 hours of serial time during the safing/deservicing operations. Level II PRCBD #4123 was approved to eliminate the serial impact and to perform the task in parallel with other safing/deservicing tasks. The operation takes 16 parallel hours now but the $GN_2$ is vented outside the OPF now. -3 hours to set up the vent, 12 hours for the purge and 1 hour to reconfigure after the purge.

This change eliminates the item from the significant problem area.

J. SSME Routine Maintenance - The SSME routine maintenance was increased from 8 to 54 hours. The requirement was generated when Rocketdyne experienced turbopump failures during the SSME test program. It was learned that the only way to reliably find indications of all or most pump problems was to conduct a turbopump torque test after every turnaround. The torque test itself consumes 13 hours, however, the SSME heat shields must be removed prior to the test to provide access and then they must be reinstalled and leak tested after the torque test. The engine heat exchangers must also be leak tested using helium and mass spectrometers.

This impact may be greatly reduced or even eliminated after two or three flights when sufficient actual flight environment data is available to redesign the heat shields to reduce weight and provide a torque test access panel. Such a redesign would permit turbopump torque tests without having to remove the heat shields.

The timelines were generated assuming that three mass spectrometers are available simultaneously so that the three heat exhangers can be leak checked with helium in parallel. It was also assumed that the engine compartment is leak tested by differential pressure flow rather than by individually testing each heat shield with the baggy concept.

J-1. SSME Heat Shield Installation/Removal - Flows that require access to any of the main engines for LRU replacement could be impacted by the removal and installation of heat shield assemblies. The removal of any engine heat shield has been assessed as a 6.5-hour task with present design. The time required to reinstall the heat shield was assessed as 11.3 hours. This is a reduction in time due to recent enhancement mods to the dome mounted heat shield.

K. Flight Kits - Present flight kit designs indicate a shift away from the "kit" concept of easy, rapid installation/removal. As an example, one of the PRSD cryo tank kit configuration options requires a number of brazed fittings. This trend, if continued, will result in an increase in time and manpower and will significantly impact the turnaround.

L. Vertical Flight Kit Installation - Currently, there is a Level II requirement for horizontal and vertical installation of flight kits. Although a requirement exists to have the capability to change out a payload at the pad, no GSE exists to remove or install flight kits at the pad.

M. Integrated Testing Philosophy - The question arose during the STAG 13 meeting as to what is the proper test philosophy of major integrated tests, i.e., OIT, SIT, Launch Readiness Verification, and Countdown.

KSC SP OPN presented testing philosophy at the STAG 14 meeting.

Previous flight data analysis will serve as prime verification of subsystems. The tests will also demonstrate compatibility and verification for flight readiness for:

1. Systems interface.
2. Shuttle element interface.
3. Orbiter/payload interface.
4. Facility/GSE interface.
5. Software interface.
6. Flight crew interface.
7. Launch support.
8. Launch team training.
9. Countdown OMI.
10. Launch commit criteria.

The action is open pending further determination by KSC SP-OPN of the intent of these tests as indicated in Volume X.

N. Horizontal Flight Kit Installation - The flight kit cable installation design concepts have been recently changed to facilitate handling operations. First, the interface for cable installations for all missions, except the weight-critical assignments, will be in the payload wire tray at Station $X_O 603$. To

accomplish this change, a standard set of cables will be installed from the $X_O576$ bulkhead interface to the $X_O603$ location. This will provide a connection point at the new interface that will be adaptable for most mixed payload requirements.

Second, the cable tray from $X_O603$ to the $X_O1307$ bulkhead is being modified to permit reconfiguring of flight kit cables in the flight vehicle. This change permits other operational considerations, such as the cable foldback (or loopback) technique, that will enhance reconfiguring operations.

O. Elevon Cove Seal Verification - The original concept proposed for verifying the primary and secondary elevon cove seals was identified as a significant ground turnaround problem. Rockwell SD presented a revised concept at a TSR held on 19 January 1978. The revised checkout concept is greatly simplified and requires only two go/no-go flow measurements per elevon. It is estimated that six hours per wing will be required for this checkout, assuming a "go" condition for each measurement. This estimate includes time for opening/closing the no. 4 and no. 12 flipper doors and connection/removal of GSE. Rockwell SD is proceeding with the design to support this checkout concept which was agreed upon during the 19 January 1978 TSR.

P. Hydraulic Lifters in the OPF - Because of cost and potential interference, hydraulic lifts were not planned for installation in the OPF to position the orbiter. Instead, floor jacks will be used. Mr. John Fraley, KSC-VE, presented to the STAG 14 meeting a concept for installing and using the hydraulic lifts. He was given an action item to determine the time savings to the turnaround to be gained by installing and using the lifts. Mr. Fraley has determined that a 4 hour 40 minute time savings could be realized if the lifters were used in place of the jacks. An Engineering Support Request was submitted on June 20, and PRC is presently doing a cost analysis for design and fabrication of the OPF hydraulic lifters.

Q. APU Hot Fire - During the STAG 15 meeting, KSC-VE was requested to present a briefing on the problems being confronted by the requirement to replace the APU after 20 hours of operation, followed by a hot fire in the OPF. This item is presently being carried in Appendix C as a PSST item.

R. SRB TPS - The current SRB closeout operations reflect 17.5 hours to install, cure, and inspect the joint seal between each SRM segment due to the baselined epoxy bonded EPDM seal band. However, the baseline was changed during the CDR of the SRB/SRM Joint Protector Band at MSFC on January 4-5, 1979 when MSFC and Thiokol agreed that Conoco HD2 grease will provide adequate protection from salt corosion to the SRB/SRM fuel points. SRB closeout operations will be updated and SRB/SRM disassembly operations will be reassessed to reflect this change in the baseline for STAR 018.

# APPENDIX E

## ACTION ITEM SUMMARY

ACTION ITEM SUMMARY

| ACTION ITEM # | ORIGIN DATE | DESCRIPTION | STATUS | RESULTS | DATE DUE | ACTION ASSIGNED TO: |
|---|---|---|---|---|---|---|
| 9-4 | 02/10/76 | Verify the requirement to pressurize the Spacelab for tunnel hatch seal leak check. | Open as of 5-5-78 | No report. | STAG 017 | Cargo Integration Working Group Dennis Matthews NASA-KSC-SP |
| 11-1 | 10/14/76 | Evaluate respective areas of responsibility for means of reducing assessed time to allocation time. | Open as of 5-5-78 | Item remains open; there is no schedule for completion. | Continuing | All Project Offices |
| 11-8 | 10/14/76 | Evaluate the rescue kit to determine what it consists of for inclusion as a PSST item. | Open as of 5-5-78 | Open pending definitions of what constitutes the baseline kit by Orbiter Project Office. An MCR will be required to identify the elements of the kit.<br><br>Each Rescue Kit is expected to be different. It will be based on the configuration of the Orbiter with the emergency and the quantity of personnel to be rescued. It is difficult to conceive of this kit as a PSST item where usage frequency cannot be predicted and reconfiguration of the rescue vehicle will be variable. | STAR 017 | J. Hamilton, JSC (MP) |

ACTION ITEM SUMMARY

| ACTION ITEM # | ORIGIN DATE | DESCRIPTION | STATUS | RESULTS | DATE DUE | ACTION ASSIGNED TO: |
|---|---|---|---|---|---|---|
| | | | | Engineering action to further define the Rescue Kit is not expected in the near future because two flying Orbiters will not be in the program until September 1981. | | |
| 13-1 | 07/24/77 | Supply information as to which flight kits are to be vertically installed at the Pad. | Open as of 5-5-78 | Flight Kit Working Group to continue to define requirements. PCIN 04522 Vertical Installation. PCIN 05010 PLB Interfaces. | Continuing | F.W. Stallard KSC - SP |
| 13-5 | 07/29/77 | Provide a briefing which defines the philosophy of major integrated testing. (i.e. OIT, SIT Launch Readiness Verification, and Countdown). | Open as of 5-5-78 | Delayed pending receipt of additional information defining Dynamic Integrated Test. | STAG 016 | KSC-SP-OPN |
| 14-1 | 11/18/78 | Assess the time savings of hydraulic lifters used to position the orbiter in the OPF. | Open as of 5-5-78 | Possible serial time savings is 4 hours & 40 minutes. A design cost analysis is underway. STAG will be kept current on the progress. | continuing | Fraley KSC-VE |

ACTION ITEM SUMMARY

| ACTION ITEM # | ORIGIN DATE | DESCRIPTION | STATUS | RESULTS | DATE DUE | ACTION ASSIGNED TO: |
|---|---|---|---|---|---|---|
| 15-1 | 05-05-78 | Investigate and report at the STAG the logistics problem of replenishing the pad supply LH2 sphere with liquid hydrogen for the 160-hour turnaround and based on the current traffic model. | Open 10-12-78 | | | NASA-KSC-TS-SOM Roy Tharpe |
| 15-6 | 05-05-78 | Provide PSST frequency and timeline for all payload flows in STS Flight Assessment Baseline Document JSC 13000-0 dated 10-15-1977. | Contin-uing | Flights 7 through 23 | STAR 017 | Cargo Integra-tion Working Group Dennis Mathews |
| 15-8 | 05/05/78 | Verify requirement for Rudder Speed Brake PDU and Body Flap timeline and frequency of task. | Open | PSST Item. The Mechanical Actuation Systems (Actuators) design group confirms the initial requirement to check the Rudder-Speedbrake PDU every flight. However, as confidence develops in this mechanical circuit, the interval may be increased. | STAR 017 | JSC-MT Jay Hamilton |

ACTION ITEM SUMMARY

| ACTION ITEM # | ORIGIN DATE | DESCRIPTION | STATUS | RESULTS | DATE DUE | ACTION ASSIGNED TO: |
|---|---|---|---|---|---|---|
| 15-9 | 05/05/78 | Resolve replacement code for PRSD cryo filters. Determine replacement time and frequency of replacement. | Open | PSST Items. Current requirements for filter element replacement and filter cleaning every 25 flights appears to be a valid requirement at present. The operations are complex and time consuming and should not be undertaken unless the filter is determined to be clogged.<br><br>At present there are two ideas under consideration that would reduce the time required for this PSST item. The first would involve performing a delta-p check of the portion of the PRSD system containing the subject filter. This could be performed with GSE connected to PRSD mold line interfaces. Results of the delta-p check with the respect to go/no-go criteria would determine when the subject filter must be changed. This concept would eliminate the time and effort that would be expended to change a filter element that was not yet dirty. | STAR 017 | JSC-MT Jay Hamilton |

ACTION ITEM SUMMARY

| ACTION ITEM # | ORIGIN DATE | DESCRIPTION | STATUS | RESULTS | DATE DUE | ACTION ASSIGNED TO: |
|---|---|---|---|---|---|---|
| 15-9 | | | | Since the changeout of the subject filter elements can be realistically expected sometime during the 100 mission life of the Orbiter, RI Maintainability is also investigating possible design changes that would simplify the changeout procedure.<br><br>Status of the two considerations will be provided to STAG as information becomes available. Action remains open pending receipt of replacement time. | - | - |
| 16-2 | 10/12/78 | Provide MLP Timeline Update | Closed | | STAG 017 | VT-SMD/TS |
| 16-3 | 10/12/78 | Review the Preliminary contingency access timelines presented by Spacelab (VT-VPP). Update timelines with STAR 016 pad times and present integrated times for STAR input. | New | Inputs included in figures 10 and 11. | STAG 017 | SP-OPN Dennis Matthews |

# APPENDIX F

## STAG MEMBERS

## APPENDIX F

## SHUTTLE TURNAROUND ANALYSIS GROUP MEMBERS

| NAME | FUNCTION ORG. | MAIL CODE | TELEPHONE NO. (FTS) |
|---|---|---|---|
| | **INTEGRATION** | | |
| E. Sestile, Chairman | KSC | SP-OPN | 823-3123 |
| E. Johnson | KSC | SP-OPN-1 | 823-3123 |
| H. D. Matthews | KSC | SP-OPN-1 | 823-2720 |
| S. R. Lewellen | KSC | SP-OPN-1 | 823-2720 |
| L. Barnett | KSC | VT-VPD-1 | 823-3844 |
| J. Blum | KSC | VT-VPD-1 | 823-3844 |
| J. Harrington | KSC | VT-VPD-1 | 823-7401 |
| H. Widick | KSC | VT-VPD-1 | 823-3844 |
| K. Davis | KSC | SF-ENG | 823-4493 |
| R. Reedy | Rockwell/LO | ZK-14 | 823-2680 |
| E. A. Armstrong | JSC | LG | 525-6471 |
| H. Bess | MSFC | SA23 | 872-3296 |
| | **ORBITER** | | |
| W. Branning | KSC | SP-OPN | 823-2720 |
| D. Moja | KSC | SP-FGS-1 | 823-4925 |
| J. Fraley | KSC | VE-MSD-12 | 823-3928 |
| H. J. DeLaRosa | KSC | VE-MSD-11 | 823-2713 |
| J. Hamilton | JSC | JSC-MT | 525-5107 |
| R. Weaver | Rockwell/Downey | FA-42 | 985-1017 |
| | **SSME** | | |
| R. Taylor | Rocketdyne | ROC-91 | 823-9083 |
| V. Wheelock | Rocketdyne | 055-CA40 | 984-2254 |
| J. Green | MSFC/SSME | SA-52 | 872-3052 |
| W. Willey | KSC | VE-FSD-11 | 823-3700 |
| | **ET** | | |
| T. Levann | KSC | VT-VPD-1 | 823-7401 |
| T. Marsh | KSC | SP-FGS | 823-4925 |
| M. Goodking | MMC | MMC-1 | 823-7074 |
| J. Newton | MSFC | SA32 | 872-3656 |
| | **SRB** | | |
| W. Dickinson | KSC | SP-FGS | 823-3123 |
| J. Kelley | KSC | VT-VPD-1 | 823-7401 |
| J. Rowell | MSFC | EE-11 | 872-2730 |
| V. Caruso | MSFC | SK | 872-4521 |
| C. Mitchell | MSFC | SA-42 | 872-3659 |
| F. Wolf | USBI | SO-2 | 823-7720 |

## SHUTTLE TURNAROUND ANALYSIS GROUP MEMBERS

| NAME | FUNCTION ORG. | MAIL CODE | TELEPHONE NO. (FTS) |
|---|---|---|---|
| | **AIR FORCE** | | |
| Maj. J. Goodwin | DoD | SAMSO/LVRO | 793-1590 |
| Capt. J. F. Sanks | DoD | SAMSO/LVVE | 793-1590 |
| Maj. A. Burr | DoD | SP-AF-2 | 823-7407 |
| Maj. C. Etrick | DoD | SP-AF-1 | 823-3595 |
| | **KSC FACILITIES/GSE** | | |
| E. Kicklighter | KSC | TS-OSM | 823-7456 |
| R. Tharpe | KSC | TS-OSM | 823-7551 |
| T. Ragan | KSC | DF-SPE | 823-2665 |
| J. Talone, Jr. | KSC | VT-SMD | 823-8661 |
| | **NASA HEADQUARTERS** | | |
| O. Bumgardner | Hqtrs | MHS-7 | 755-3173 |
| R. Heuser | Hqtrs | MOI-6 | 755-2354 |
| | **PAYLOADS** | | |
| S. Cristofano | KSC-IUS | SP-PAY-T | 823-3183 |
| T. Keenan | KSC | SP-PAY-SL | 823-3647 |
| P. Kolasky | KSC | SP-PAY-SL | 823-3647 |
| E. Popovich | KSC | SP-PAY | 823-3183 |
| J. Fitzsimmons | KSC | VT-VPD-2 | 823-4062 |
| G. Powers | KSC | VT-VPD-2 | 823-7862 |
| L. Lawson | MSFC-Payloads | JA41 | 872-2375 |