NASA

National Aeronautics and
Space Administration

CR 160178

APR 24 1979

Lyndon B. Johnson Space Center
Houston Texas 77058

JSC-14805

PROGRAM DOCUMENTATION
PROGRAM DESCRIPTION AND USER INFORMATION FOR THE HYDRAULICS/AUXILIARY POWER UNIT (HYDRA) COMPUTER PROGRAM

CPD 906

Job Order 51-299

(NASA-CR-160178) PROGRAM DOCUMENTATION. PROGRAM DESCRIPTION AND USER INFORMATION FOR THE HYDRAULICS/AUXILIARY POWER UNIT (HYDRA) COMPUTER PROGRAM (Lockheed Electronics Co.) 176 p HC A09/MF A01 CSCL 09B G3/61 N79-24672 Unclas 23306

Prepared By

Lockheed Electronics Company, Inc.
Systems and Services Division
Houston, Texas

Contract NAS 9-15800

For

MISSION PLANNING AND ANALYSIS DIVISION

MARCH 1979

JSC-13265

JSC-14805

PROGRAM DOCUMENTATION
PROGRAM DESCRIPTION AND USER INFORMATION FOR THE HYDRAULICS/AUXILIARY POWER UNIT (HYDRA) COMPUTER PROGRAM

CPD 906

Job Order 51-299

PREPARED BY

W. J. Redwine

APPROVED BY

J. E. Hurst, Supervisor
Life Support Systems Section

W. J. Reicks, Manager
Applied Mechanics Department

Lockheed Electronics Company, Inc.
Systems and Services Division
Houston, Texas

MARCH 1979

LEC-13265

1. Report No.	2. Government Accession No	3. Recipient's Catalog No.
JSC-14805		

4 Title and Subtitle	5 Report Date
Program Description and User Information for the Hydraulics/ Auxiliary Power Unit (HYDRA) Computer Program	March 1979
	6 Performing Organization Code
7 Author(s) W. J. Redwine	8 Performing Organization Report No LEC-13265
9. Performing Organization Name and Address Lockheed Electronics Company, Inc. 1830 NASA Road 1 Houston, TX 77058	10. Work Unit No.
	11 Contract or Grant No. NAS 9-15800
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Lyndon B. Johnson Space Center Houston, TX 77058	13 Type of Report and Period Covered Computer Program Document
	14 Sponsoring Agency Code FM

15 Supplementary Notes

16. Abstract

Using a mission timeline, containing altitude, control surface deflection rates and angles, gimbal rates, main engine throttle settings and trajectory tape simulations, the APU fuel usage, power and tank pressure can be analyzed.

17 Key Words (Suggested by Author(s))	18 Distribution Statement
flow rates, speedbrake, timeline, engine control valves, elevons	

19 Security Classif. (of this report)	20. Security Classif (of this page)	21 No. of Pages	22 Price*
Unclassified	Unclassified	175	

*For sale by the National Technical Information Service, Springfield, Virginia 22161

TABLE OF CONTENTS

FIGURES

TABLES

PROGRAM MODIFICATIONS

The following is a list of elements names and the modifications of each along with a brief description.

MAIN/V6 - This element is the main routine of the HYDRA and FLUIDS program. Code was added to this routine to write an optional header on the three output print files for identification purpose if multi-runs are being executed and outputted. These modifications were added to the FLUIDS and HYDRA files.

TLINE/V6 - This element reads the input timeline and controls all card and tape input. Code was added to read new input variables in the timeline for outputting summary print during the non-averaging phase of program execution. These modifications were added to the FLUIDS file only.

PHASE/V6 - This element reads SSFS, SVDS and binary input tapes and overlays trajectory and system status data. Code was added to calculate the summary print variables during the non-averaging phase of program execution. These modifications were added to the FLUIDS file only.

SAPUM/V6 - This element averages the data, computes APU fuel requirements, prints the timeline profiles, APU fuel summary and writes the output data tape. Code was added for the non-averaging phase and additional parameters were added to the output tape format. These modifications were added to the FLUIDS file only.

HINGE/V6 - This element compares angular rates for the flight control surfaces against the maximum rate capability of the actuators. Code was added to bypass the body flap comparison due to rate violations on the input trajectory tapes. This modification was added to the FLUIDS file only.

1. INTRODUCTION

The purpose of this model is to perform consumables analyses of the Space Shuttle orbiter hydraulics/auxiliary power unit (APU) subsystem, (see Section 2.2.1 for hardware description), for both the OV-101 and OV-102 vehicle configurations. In addition, the program is capable of testing for violations of system constraints on hydraulic pump flow capacities and aerodynamic control surface actuator capabilities.

A timeline containing altitude, control surface deflection angles, rates and hinge-moment loads, thrust vector control gimbal rates and main engine throttle settings is used to drive the model. This timeline is constructed from the output of one or more trajectory simulation programs. Flow rates for each hydraulic load, discharge flow rates and input shaft horsepower for each of the three hydraulic pumps, and fuel usage rates for each of the three APU are then calculated. The fuel usage rates are integrated over the mission timeline to generate fuel usage profiles. An output tape containing the data listed above is generated. This tape may be used as input to either plotting packages or other models for further analysis.

The programming was performed by personnel of Lockheed Electronics Company. In addition to the author, programming support was provided by Diana Wiggins. The system models are based on the models used in the computer programs described in References 6 and 7. Engineering support was provided by Jim Walker of McDonnel Douglas. Technical guidance was provided by Walter Scott of NASA/FM2. The technical monitor for this development effort was Chuck Pace of NASA/FM2. This document is a revision to the document described in Reference 10. This document is a complete replacement for Reference 10.

2. PROGRAM DESCRIPTION

2.1 GENERAL DESCRIPTION

This program is driven by a mission timeline containing trajectory data (altitude, control surface deflection angles and rates, control surface hinge-moment loads, thrust vector control gimbal rates, and main engine throttle settings) which may be input from tape (SSFS, SVDS, binary or blocked binary), cards or a combination of both. The timeline is controlled by card input data consisting of time parameters, trajectory input source flags and a mission phase flag. System status data (valve status, system pressure modes and APU speeds), transient engine controller flow rates and averaged flow rates for the landing gear, nose wheel steering and brakes are automatically overlaid within the program based on mission phase, throttle settings, altitude, landing gear deploy flags and weight on wheels flags. The logic used for overlaying this data is given in the subroutine PHASE documentation. The user may override the program logic by defining his own system status and flow rate data with card input. System design data residing in the program may also be overridden with card input.

The input deflection rates for elevons, rudder, speed brake and body flap are compared against actuator capabilities. A maximum rate capability is computed as a function of surface position, hinge-moment load and number of hydraulic systems operating. If the input rate exceeds the maximum rate a warning message is printed for the user.

Each load is assigned to a system based on the loss management matrix and valve status. Servo, power spool and engine controller bypass valve leakages are scaled to the system operating pressure. A flow gradient is determined for each load based on the sign of the angular rate and the number of hydraulic systems operating.

Flow rates for each load are computed. Discharge flow rates and input shaft horsepower are computed for each of the three hydraulic pumps. Discharge flow rates are compared against guaranteed pump flow capacities and excessive flow rates are flagged to the user.

Up to this point all data points input have been processed. The user has the option to continue processing all input data points or to average the data computed thus far, flow rates and horsepower, over a time interval as specified by card input and continue processing with the averaged data.

APU fuel usage rates are calculated and then integrated over time to compute total quantities.

Tape output consists of load flow rates, system flow rates, pump shaft horsepower, altitude, APU fuel remaining, APU speed codes and a system configuration code.

2.2 TECHNICAL DESCRIPTION

2.2.1 SUBSYSTEM DESCRIPTIONS

2.2.1.1 Hydraulics

The hydraulic subsystem consists of 3 independent circuits. Each circuit may operate in pressurized, depressurized or off modes as defined in Table I. Figure 1 shows a schematic of the hydraulic subsystem as modeled in this program. Hydraulic power is provided by three variable displacement pumps which supply flow at a constant discharge pressure up to the maximum design flow. Power is distributed to the following hydraulic loads:

1. Thrust vector control (TVC) actuators - used to position the main engines. There are two actuators, pitch and yaw, for each engine. Each actuator is equipped with a hydraulically operated switching valve which can accept hydraulic power from any one

TABLE I. SYSTEM MODES

MODE	PUMP DISCHARGE PRESSURE DESIGN REQUIREMENTS
PRESSURIZED	2950 ± 50 PSIG
DEPRESSURIZED	500 - 100 PSIG
OFF	0 PSIG

HYDRAULIC SYSTEM FLUID LOOP DIAGRAM

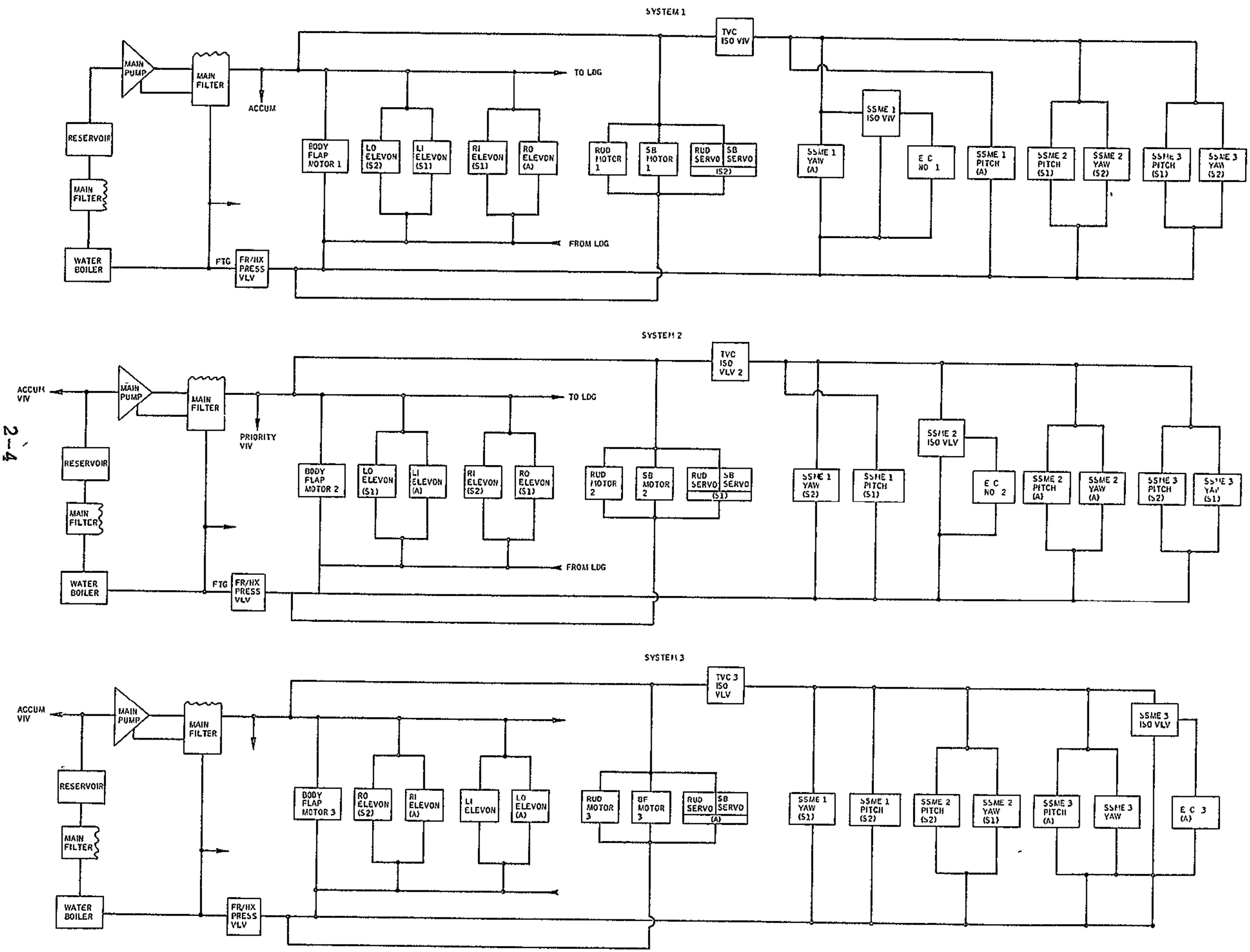


FIGURE 1

LANDING GEAR

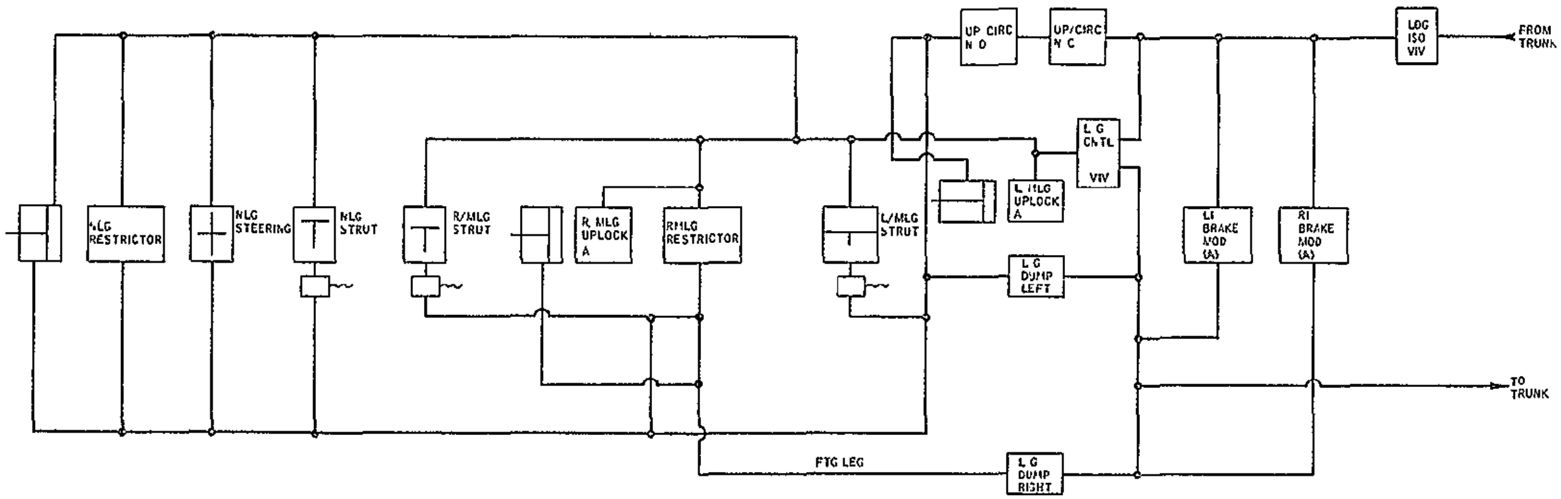


FIGURE 1 (continued)

of the three systems. Each actuator has an active system and two standbys. The switching valves are designed to detect a pressure loss in the supplying system and switch over to a standby system.

2. Space Shuttle main engine (SSME) engine controllers - controls fuel supply to main engines. There are five valve actuators for each engine. Each engine controller can only be supplied by one hydraulic system.

3. Aerodynamic control surfaces (ACS)
   a. Elevons - There are two actuators which activate two elevon surfaces, inboard and outboard, for each wing. Elevon actuators are also equipped with switching valves.

   b. Rudder/Speed Brake - The rudder control surface consists of two panels located on a common hinge-line. The two panels provide the rudder function when driven in the same direction and provide the speed brake function when driven in opposite directions. Three hydraulic motors are provided for each function. Each motor is directly supplied by one hydraulic system. The rudder and speed brake servos are equipped with switching valves and may be fed by any oneof the three systems.

   c. Body Flap - The body flap also contains three hydraulic motors each supplied by one hydraulic system.

4. Landing gear
   a. Uplock actuators - used to unlock the gear and initiate gear extension. The main landing gear uplocks are supplied with switching valves to accept any system but the nose landing gear uplock can only be supplied by one system.

   b. Strut actuators - used to retract and extend landing gear. These actuators can only be supplied by one hydraulic system.

5. Wheel brakes - Two hydraulic systems are active on each brake with a third system connected by a switching valve available for back-up.

6. Nose wheel steering actuator - used to provide nose wheeling steering control during rollout. This actuator can only be supplied by one hydraulic system.

Isolation valves are located in the lines which may be used to isolate the landing gear loop, main engine loop or engine controllers.

Only the components of the hydraulic subsystem which are applicable to this program have been discussed. Reference 8 contains a more detailed and complete description of the hydraulic subsystem.

2.2.1.2 APU

The APU subsystem consists of three independent power units whose function is to provide mechanical shaft power to drive the hydraulic pumps. Each unit contains a liquid hydrazine fuel supply, gas generator, turbine and gear box. Reference 9 contains a detailed description of the APU subsystem.

The APU subsystem is represented in this model by fuel usage rate curves giving fuel consumption rates as a function of pump shaft horsepower and altitude.

2.2.2 MATH MODELS

ACS deflections and deflection rates received from SSFS, SVDS and blocked binary tapes are referenced to the orbiter fuselage reference line (FRL). The rudder and speed brake deflections and rates input from SSFS and SVDS are converted into hinge-line coordinates.

Rudder:

$$\theta = \tan^{-1}\left(\frac{\tan\phi}{\cos\alpha}\right)$$

$$\dot{\theta} = \frac{\dot{\phi}\cos\alpha}{1 - \cos^2\phi\sin^2\alpha}$$

Speed Brake:

$$\theta = \left[\tan^{-1}\left(\frac{\tan\frac{\phi}{2}}{\cos\alpha}\right)\right] X\ 2$$

$$\dot{\theta} = \frac{\dot{\phi}\cos\alpha}{1 - \cos^2\left(\frac{\phi}{2}\right)\sin^2\alpha}$$

θ = Hingeline deflection angle - deg
ϕ = FRL deflection angle - deg
$\dot{\theta}$ = Hingeline deflection rate - deg/sec
$\dot{\phi}$ = FRL deflection angle - deg/sec
α = Rudder/Speed Brake hingeline angle with orbiter -z axis = 34.83°

For blocked binary input where deflection angles are not available, an approximation is used for both rudder and speed brake.

$$\dot{\theta} = \frac{\dot{\phi}}{\cos\alpha}$$

$\dot{\theta}$ = Hingeline deflection rate - deg/sec
$\dot{\phi}$ = FRL deflection rate - deg/sec
α = Rudder/Speed Brake hingeline angle with orbiter -z axis = 34.83°

Servo, power spool and engine controller bypass valve leakages are scaled to the system operating pressure.

$$Q = Q_o \times \sqrt{\frac{P}{P_o}}$$

Q = Leakage - GPM

Q_o = Leakage at reference pressure - GPM

P = System pressure - psi

P_o = Reference pressure = 3000 psi

A flow rate is computed for each hydraulic load.

TVCs and Elevons:

$$Q = \text{MAX}\left[(\dot{\delta} \times \text{QGRAD}),\ Q_{PS}\right] + Q_{SV}$$

Q = Flow rate for load - GPM

$\dot{\delta}$ = Deflection or gimbal rate - deg/sec

QGRAD = Flow graident - GPM/DEG/SEC

Q_{PS} = Power spool leakage - GPM

Q_{SV} = Servo leakage - GPM

Rudder and Speed Brake motors:

$$Q = \text{MAX}\left[(\dot{\delta} \times \text{QGRAD} \times \frac{3}{N}),\ Q_{PS}\right]$$

Q = Flow rate for motor - GPM

$\dot{\delta}$ = Deflection rate - deg/sec

QGRAD = Flow gradient for 3 systems pressurized - GPM/DEG/SEC

N = No of systems pressurized

Q_{PS} = Power spool leakage - GPM

Rudder and Speed Brake servos:

$$Q = Q_{SV}$$

Q = Load flow rate - GPM

Q_{SV} = Servo leakage - GPM

Body flap motors:

$$Q = Q_{LOWER} \quad \text{if } \dot{\delta} > 0$$
$$Q = Q_{RAISE} \quad \text{if } \dot{\delta} < 0$$
$$Q = 0 \quad \text{if } \dot{\delta} = 0$$

Q = Load flow rate - GPM

$\dot{\delta}$ = Deflection rate - deg/sec

Q_{LOWER} = Average flow rate required to lower body flap - GPM

Q_{RAISE} = Average flow rate required to raise body flap - GPM

Engine controllers:

$$Q = Q_{TRANS} + Q_{SV}$$

Q = Load flow rate - GPM

Q_{TRANS} = Transient flow rate - GPM

Q_{SV} = Servo leakage - GPM

Nose gear steering and brakes:

$$Q = Q_{AVG} + Q_{SV} \quad \text{if in operation}$$
$$Q = Q_{SV} \quad \text{if not in operation}$$

Q = Load flow rate - GPM

Q_{AVG} = Average flow rate when in operation - GPM

Q_{SV} = Servo leakage - GPM

Uplocks and struts:

$$Q = Q_{AVG} \quad \text{if in operation}$$
$$Q = 0 \quad \text{if not in operation}$$

Q = Load flow rate - GPM

Q_{AVG} = Average flow rate when in operation - GPM

Restrictors:

$$Q = Q_{AVG}$$

Q = Load flow rate - GPM

Q_{AVG} = Average flow rate - GPM

Flow rates of hydraulic loads which are downstream of a closed isolation valve are reset to zero.

The switching valve logic is represented by a loss management matrix containing an active, 1st standby and 2nd standby system for each hydraulic load.

The active, 1st standby and 2nd standby systems are checked in order for a pressurized system. The load is assigned to the first system found to be pressurized. If none of the systems are pressurized the process is repeated checking for depressurized systems.

The total flow rate for each system is found by summing the flow rates of all the loads assigned to that system.

$$Q_T = \Sigma Q_i$$

Q_T = Total flow rate for system - GPM

Q_i = Load flow rate - GPM

Pump efficiencies are computed from curve fit polynomials.

$$E = f(Q_T, V, P)$$

E = Pump efficiency

Q_T = Total system flow rate - GPM

V = APU speed

P = System pressure

Input pump shaft horsepower is then computed.

$$HP = \frac{Q_T \times P}{1714 \times E}$$

HP = Input horsepower

Q_T = Total system flow rate - GPM

P = System pressure - PSI

E = Pump efficiency

APU fuel usage rates for sea level and space conditions are computed from curve fit polynomials.

$$\dot{Y}_{SL} = f(HP)$$

$$\dot{Y}_{SP} = f(HP)$$

$\dot{Y}_{SL}$ = fuel usage rate at sea level - lbs/hr

$\dot{Y}_{SP}$ = fuel usage rate at space - lbs/hr

HP = pump input horsepower

Atmospheric pressure is computed using a curve-fit polynomial.

$$P_{ALT} = \frac{14.696}{\left|f(h)\right|^{4}}$$

P_{ALT} = atmospheric pressure - psi

h = altitude - ft

A linear interpolation with atmospheric pressure is performed to find the fuel usage rate at the operating altitude.

$$\dot{y} = \dot{y}_{SP} + (\dot{y}_{SL} - \dot{y}_{SP}) \frac{P_{ALT}}{14.696}$$

$\dot{y}$ = fuel usage rate at operating altitude - lbs/hr
$\dot{y}_{SP}$ = fuel usage rate at space - lbs/hr
$\dot{y}_{SL}$ = fuel usage rate at sea level - lbs/hr
P_{ALT} = atmospheric pressure - psi

Fuel usage rates are integrated over time to compute total quantities.

$$y = \dot{y} \times \Delta t$$

$$y_T = y_T + y$$

$$y_{REM} = y_{LOAD} - y_T$$

y = fuel used - lbs
$\dot{y}$ = fuel usage rate - lbs/hr
Δt = time interval - hrs
y_T = total fuel used - lbs
y_{LOAD} = fuel loaded - lbs
y_{REM} = fuel remaining - lbs

Horsepower is also integrated over time to compute energy used.

$$\varepsilon = HP \times \Delta t$$

$$\varepsilon_T = \varepsilon_T + \varepsilon$$

ε = energy - hp-hr
Δt = time interval - hr
HP = pump input horsepower
ε_T = total energy used - hp-hr

Coefficients for the curve-fit polynomials are listed in the appropriate subroutine documentation.

2.2.3 CONSTRAINT VIOLATION TESTING

When the system flow demands exceed the guaranteed pump flow capacities, the constant discharge pressure assumption of the program becomes invalid and the program output corresponding to that flow demand is also invalid. Excessive flow demands are flagged in the max rate warning column of the timeline profile report.

$$Q_{GUAR} = f(V)$$

If $Q_T > Q_{GUAR}$, warning flag is set

Q_{GUAR} = guaranteed pump flow - GPM

V = APU speed

Q_T = system flow rate - GPM

ACS deflection rates received as input are compared against actuator capabilities. Elevon, rudder and speed brake rates are tested only in cases with an opposing hinge moment load. Body flap rates are tested for both aiding and opposing loads.

Elevons - A maximum surface rate is computed as a function of system pressure, surface position and hinge-moment load.

$$HM_o = \frac{P}{2900} \times a_1 \times \cos\left[a_2 \times (a_3 - \delta)\right]$$

$$\dot{\delta} = a_4 \times \sqrt{1.0 - \left|\frac{HM}{HM_o}\right|}$$

HM_o - stall hinge moment - in-lbs

P - system pressure - psi

δ - surface position - deg

HM - hinge moment load - in-lbs

$\dot{\delta}$ - maximum surface rate - deg/sec

Rudder, Speed Brake and Body Flap - a maximum surface rate is computed as a function of hinge-moment load and the number of hydraulic systems operating using curve-fit equations.

Coefficients for max rate vs hinge-moment equations are listed in the HINGE subroutine documentation.

The input rates are tested against the maximum surface rates.

If $|\dot{\delta}| > \dot{\delta}_{max}$ a warning message is printed for the user.

$\dot{\delta}$ - input deflection rate - deg/sec

$\dot{\delta}_{max}$ - max deflection rate - deg/sec

3. PROGRAM USAGE

3.1 INPUT DESCRIPTION

This program can be run with card input alone or a combination of cards and tape(s).

3.1.1 CARD INPUT

Input cards are in the following format

Card Column	Description
1-3	Data number
5-24	Data

Data numbers are right-justified integers. Alphanumeric data must be left-justified. All other data is in floating point. A card with 999 in the first three columns will terminate one data set and two 999 cards will stop the simulation. By setting 999 equal to zero gives no summary print. For a summary print in the averaging or non-averaging phase set 999 equal to zero followed by a 999 equal to one.

3.1.1.1 System Design Data

Data Number	Description	Units	Default
	Power spool leakages at 3000 psi for:		
1	SSME 1TVC Pitch	GPM	1.02
2	SSME 1 TVC Yaw		1.02
4	SSME 2 TVC Pitch		1.02
5	SSME 2 TVC Yaw		1.02
7	SSME 3 TVC Pitch		1.02
8	SSME 3 TVC Yaw		1.02
10	Rudder motor 1		.25
11	Rudder motor 2		.25
12	Rudder motor 3		.25
14	Speed Brake motor 1		.25
15	Speed Brake motor 2		.25

Data Number	Description	Units	Default
16	Speed Brake motor 3	GPM	.25
18	LO Elevon		.10
19	LI Elevon		.50
20	RO Elevon		.10
21	RI Elevon		.50
	Servo valve leakages at 3000 psia for:		
51	SSME 1 TVC Pitch		.50
52	SSME 1 TVC Yaw		.50
53	SSME 1 Engine Controller		2.50
54	SSME 2 TVC Pitch		.50
55	SSME 2 TVC Yaw		.50
56	SSME 2 Engine Controller		2.50
57	SSME 3 TVC Pitch		.50
58	SSME 3 TVC Yaw		.50
59	SSME 3 Engine Controller		2.50
63	Rudder Servo		.85
67	Speed Brake Servo		.85
68	LO Elevon		1.0
69	LI Elevon		1.0
70	RO Elevon		1.0
71	RI Elevon		1.0
75	LO Brake Module		.45
76	LI Brake Module		.45
77	RO Brake Module		.45
78	RI Brake Module		.45
85	Nose landing gear steering		.27
	Flow gradients for:	GPM/DEG/SEC	
101	SSME 1 TVC Pitch		3.354
102	SSME 1 TVC Yaw		2.705
103	SSME 1 Engine Controller		1.0
104	SSME 2 TVC Pitch		2.705
105	SSME 2 TVC Yaw		2.705
106	SSME 2 Engine Controller		1.0

Data Number	Description	Units	Default
107	SSME 3 TVC Pitch		2.705
108	SSME 3 TVC Yaw		2.705
109	SSME 3 Engine Controller		1.0
118	LO Elevon		.719
119	LI Elevon		1.493
120	RO Elevon		.719
121	RI Elevon		1.493
	Flow gradients with three systems pressurized for:	GPM/DEG/SEC	
110	Rudder motor 1		.685
111	Rudder motor 2		.685
112	Rudder motor 3		.685
114	Speed Brake motor 1 (Open)		1.013
115	Speed Brake motor 2 (Open)		1.013
116	Speed Brake motor 3 (Open)		1.013
164	Speed Brake motor 1 (Close)		1.041
165	Speed Brake motor 2 (Close)		1.041
166	Speed Brake motor 3 (Close)		1.041
	Average flow rates for:	GPM	
122	Body flap motor 1 (Lower)		1.936
123	Body flap motor 2 (Lower)		1.936
124	Body flap motor 3 (Lower)		1.936
172	Body flap motor 1 (Raise)		2.50
173	Body flap motor 2 (Raise)		2.50
174	Body flap motor 3 (Raise)		2.50
125	LO Brake Module		3.546
126	LI Brake Module		3.546
127	RO Brake Module		3.546
128	RI Brake Module		3.546
129	L MLG Uplock		9.194

Data Number	Description	Units	Default
130	R MLG Uplock	GPM	9.194
131	L MLG Strut		8.457
132	R MLG Strut		8.457
133	NLG Uplock		1.530
134	NLG Strut		1.828
135	NLG Steering		1.15
86	NLG Restrictor		1.164
87	RLG Restrictor		1.164
651	Maximum system flow rate at 100% APU speed	GPM	63.0
652	Maximum system flow rate at 110% APU speed		69.6
675	System pressure for a pressurized system	psi	3000.0
676	System pressure for a depressurized system	psi	1000.0
	APU fuel loaded	lbs	
653	System 1		350.0
654	System 2		350.0
655	System 3		350.0
	APU unusable fuel	lbs	
656	System 1		30.5
657	System 2		30.5
658	System 3		30.5
800	Altitude for landing gear arm	ft	3000.0
801	Altitude for landing gear deploy	ft	1000.0
803	Time from lift-off for engine thrust level cut-back from 110% to 100% (using a negative time deletes the 110% thrust level for prelaunch)	hrs	.0375
804	Duration of landing gear	sec	1.0
805	Duration of landing gear strut	sec	6.5

Data Number	Description	Units	Default
810	Engine controller transient flow rate for throttle setting changes	GPM	1.0
811	Duration of engine controller transients	sec	1.0

3.1.1.2 System Status Data

System status data input from cards will override status defaults within the program. The documentation of subroutine PHASE explains the logic used to determine status defaults. Status codes are as follows:

Valve status	= 1.0 Open
	= 2.0 Closed
System mode status	= 1.0 Pressurized
	= 2.0 Depressurized
	= 3.0 Off
APU Speeds	= 1.0 100%
	= 2.0 110%

Data Number	Description
666	Status of TVC isolation valves
667	Status of landing gear isolation valves
668	Status of landing gear valve - This a dummy valve which simulates the configuration of the landing gear control, landing gear up/circ and landing gear dump valves
787	Status of system 1 engine controller bypass valve
788	Status of system 2 engine controller bypass valve
789	Status of system 3 enginer controller bypass valve

Data Number	Description
669	Mode of system 1
670	Mode of system 2
671	Mode of system 3
672	APU speed of system 1
673	APU speed of system 2
674	APU speed of system 3

3.1.1.3 Timeline Data

Data Number	Description	Units	Default
660	Start time	HRS	-
661	Restart time	HRS	-
662	Trajectory input source flag = 0.0 Card input only (Note: When using card input as the only source for trajectory data, the system status data will not be automatically overlaid. It must be defined with card input) = 1.0 SSFS plot tape = 2.0 SVDS plot tape = 3.0 Binary tape = 4.0 Blocked binary tape NOTE: Times input from tape are added to the first timepoint for the current mission phase.		
663	Input unit		2.0
659	Delta time to be added to time on input tape	HRS	

Data Number	Description	Units	Default
664	Mission phase flag 1.0 Prelaunch 2.0 Ascent 4.0 On-orbit 5.0 Mated flight 6.0 Entry 7.0 Rollout		
665	Stop time	hrs	
783	Averaging flag 0.0 Data will be averaged before processing for fuel computations and data output 1.0 All data points will be processed		
781	Time interval for averaging data	sec	1.0
784	Output unit (unit 20 for MOPS plot)		3.0
786	Timeline profiles flag 1.0 Print profiles 0.0 Suppress print		1.0

Symbolic names for data values on SSFS or SVDS plot tapes for:

Data Number	
251	Time
252	SSME 1 TVC Pitch angular rate
253	SSME 1 TVC Yaw angular rate
255	SSME 2 TVC Pitch angular rate
256	SSME 2 TVC Yaw angular rate
258	SSME 3 TVC Pitch angular rate
259	SSME 3 TVC Yaw angular rate
261	Rudder angular rate
262	Speed brake angular rate

Data Number	Description
263	LO Elevon angular rate
264	LI Elevon angular rate
265	RO Elevon angular rate
266	RI Elevon angular rate
267	Body flap angular rate
284	Rudder hinge moment
285	Speed brake hinge moment
286	LO Elevon hinge moment
287	LI Elevon hinge moment
288	RO Elevon hinge moment
289	RI Elevon hinge moment
290	Body flap hinge moment
307	Rudder surface deflection
308	Speed brake surface deflection
309	LO Elevon surface deflection
310	LI Elevon surface deflection
311	RO Elevon surface deflection
312	RI Elevon surface deflection
313	Body flap surface deflection
321	Altitude
322	Vehicle load
323	SSME 1 throttle setting
324	SSME 2 throttle setting
325	SSME 3 throttle setting

3.1.1.4 Trajectory Data

Card input for trajectory data can be used alone or in conjunction with tape input. Angular and fluid flow rates read from cards will be added to rates returned from the PHASE subroutine. Altitude, vehicle load and actuator operational flags input from cards will override data returned from the PHASE subroutine. The documentation of subroutine PHASE explains the logic used to overlay trajectory data.

Flag codes are as follows:

Rate flag = 1.0 angular rate in deg/sec
= 2.0 fluid flow rates in gpm

Actuator operational flag
= 1.0 actuator in operation
= 0.0 actuator not in operation

Actuator operational flag for body flap
= 1.0 body flap lower
= -1.0 body flap raise
= 0.0 body flap not in operation

Data Number	Description	Units
680	SSME 1 TVC pitch rate flag	
681	SSME 1 TVC pitch rate	
682	SSME 1 TVC yaw rate flag	
683	SSME 1 TVC yaw rate	
684	SSME 1 engine controller rate flag	
685	SSME 1 engine controller rate	
686	SSME 2 TVC pitch rate flag	
687	SSME 2 TVC pitch rate	
688	SSME 2 TVC yaw rate flag	
689	SSME 2 TVC yaw rate	
690	SSME 2 engine controller rate flag	
691	SSME 2 engine controller rate	
692	SSME 3 TVC pitch rate flag	
693	SSME 3 TVC pitch rate	
694	SSME 3 TVC yaw rate flag	
695	SSME 3 TVC yaw rate	
696	SSME 3 engine controller rate flag	
697	SSME 3 engine controller rate	
698	Rudder rate flag	

Data Number	Description	Units
699	Rudder rate	
700	Speed brake rate flag	
701	Speed brake rate	
702	LO Elevon rate flag	
703	LO Elevon rate	
704	LI Elevon rate flag	
705	LI Elevon rate	
706	RO Elevon rate flag	
707	RO Elevon rate	
708	RI Elevon rate flag	
709	RI Elevon rate	
710	Body flap operational flag	
711	Left brake modules operational flag	
712	Right brake modules oeprational flag	
713	MLG uplocks operational flag	
714	MLG struts operational flag	
715	NLG uplock operational flag	
716	NLG strut operational flag	
717	NG steering operational flag	
678	Altitude	FT
679	Vehicle load	G

3.1.2 TAPE INPUT

Tapes in any of the following formats may be used as input to the program.

3.1.2.1 SSFS Plot Tapes

A description of the SSFS plot tape format is contained in Reference 3.

The program uses the following data from SSFS or SVDS plot tapes.

Description	Units
Time	SEC
Angular FRL rates	DEG/SEC
Hinge - moments	IN-LBS
Surface deflections	DEG
Altitude	FT
Vehicle load	G
SSME throttle settings	%

3.1.2.2 SVDS Plot Tapes

A description of the SVDS plot tape format is contained in Reference 4.

See Section 3.1.2.1 SSFS plot tapes for description of data used from SVDS plot tapes.

3.1.2.3 Binary Tapes

A description of the binary tape format is shown in Figure 2. These tapes are single precision FORTRAN binary tapes.

3.1.2.4 Blocked Binary Tapes

A description of the blocked binary tape format is shown in Figure 3. These tapes are single precision non-Fortran binary tapes. Twenty logical records are blocked into one physical record.

Binary Tape Format

Word #	Units	Description
1	HRS	Time
2	FT	Altitude
3	G	Vehicle load
4	DEG/SEC	SSME 1 TVC Pitch angular rate
5	DEG/SEC	SSME 2 TVC Pitch angular rate
6	DEG/SEC	SSME 3 TVC Pitch angular rate
7	DEG/SEC	SSME 1 TVC Yaw angular rate
8	DEG/SEC	SSME 2 TVC Yaw angular rate
9	DEG/SEC	SSME 3 TVC Yaw angular rate
10	DEG/SEC	LO Elevon angular rate
11	DEG/SEC	LI Elevon angular rate
12	DEG/SEC	RO Elevon angular rate
13	DEG/SEC	RI Elevon angular rate
14	DEG/SEC	Rudder angular hinge-line rate
15	DEG/SEC	Speed brake angular hinge-line rate
16	DEG/SEC	Body flap angular rate
20	IN-LBS	LO Elevon hinge moment
21	IN-LBS	LI Elevon hinge moment
22	IN-LBS	RO Elevon hinge moment
23	IN-LBS	RI Elevon hinge moment
24	IN-LBS	Rudder hinge moment
25	IN-LBS	Speed brake hinge moment
26	IN-LBS	Body flap hinge moment
27		System 1 mode
28		System 2 mode
29		System 3 mode
		= 1 Pressurized
		= 2 Depressurized
		= 3 Off

FIGURE 2

Blocked Binary Tape Format

Word #	Units	Description
1	.2 SEC	Time
2	FT	Altitude
3	G	Vehicle load
4	DEG/SEC	SSME 1 TVC Pitch angular rate
5	DEG/SEC	SSME 2 TVC Pitch angular rate
6	DEG/SEC	SSME 3 TVC Pitch angular rate
7	DEG/SEC	SSME 1 TVC Yaw angular rate
8	DEG/SEC	SSME 2 TVC Yaw angular rate
9	DEG/SEC	SSME 3 TVC Yaw angular rate
10	DEG/SEC	LO Elevon angular rate
11	DEG/SEC	LI Elevon angular rate
12	DEG/SEC	RO Elevon angular rate
13	DEG/SEC	RI Elevon angular rate
14	DEG/SEC	Rudder angular FRL rate
15	DEG/SEC	Speed brake angular FRL rate
16	DEG/SEC	Body flap angular rate
20	IN-LBS	LO Elevon hinge moment
21	IN-LBS	LI Elevon hinge moment
22	IN-LBS	RO Elevon hinge moment
23	IN-LBS	RI Elevon hinge moment
24	IN-LBS	Rudder hinge moment
25	IN-LBS	Speed brake hinge moment
26	IN-LBS	Body flap hinge moment
27	DEG/SEC	NG Steering angular rate
28	-	Touchdown flag
29	-	Landing gear flag
30	-	Right braking force
31	-	Left braking force
32	-	-

FIGURE 3

3.2 OUTPUT DESCRIPTION

Output from this program consists of printed reports and data tapes.

3.2.1 PRINTER OUTPUT

Three printed reports are output from this program.

1. Hydraulic load data report
2. Timeline profile of flow rates, pump shaft horsepower and fuel remaining
3. APU fuel usage summary

Samples of these reports can be found in Section 5.5 Sample Input/Output

3.2.2 TAPE OUTPUT

A description of the output tape is shown in Figure 4. System configuration codes and APU speed codes are shown in Figure 5. The tape is a single precision FORTRAN binary tape. The user may request this output by setting data number 784 to the output tape number.

Output Tape Format

Word #	Type	Units	Description
1	R	HRS	Time
			Flow Rates For:
2	R	GPM	SSME 1 TVC Pitch
3	R	GPM	SSME 1 TVC Yaw
4	R	GPM	SSME 1 Engine Controller
5	R	GPM	SSME 2 TVC Pitch
6	R	GPM	SSME 2 TVC Yaw
7	R	GPM	SSME 2 Engine Controller
8	R	GPM	SSME 3 TVC Pitch
9	R	GPM	SSME 3 TVC Yaw
10	R	GPM	SSME 3 Engine Controller
11	R	GPM	Rudder Motor #1
12	R	GPM	Rudder Motor #2
13	R	GPM	Rudder Motor #3
14	R	GPM	Rudder Servo
15	R	GPM	Speed Brake Motor #1
16	R	GPM	Speed Brake Motor #2
17	R	GPM	Speed Brake Motor #3
18	R	GPM	Speed Brake Servo
19	R	GPM	LO Elevon
20	R	GPM	LI Elevon
21	R	GPM	RO Elevon
22	R	GPM	RI Elevon
23	R	GPM	Body Flap Motor #1
24	R	GPM	Body Flap Motor #2
25	R	GPM	Body Flap Motor #3
26	R	GPM	LO Brake Module
27	R	GPM	LI Brake Module
28	R	GPM	RO Brake Module
29	R	GPM	RI Brake Module
30	R	GPM	L MLG Uplock
31	R	GPM	R MLG Uplock

FIGURE 4

Word #	Type	Units	Description
32	R	GPM	L MLG Strut
33	R	GPM	R MLG Strut
34	R	GPM	NLG Uplock
35	R	GPM	NLG Strut
36	R	GPM	NLG Steering
37	R	GPM	NLG Restrictor
38	R	GPM	RLG Restrictor
			Total Flow Rates For:
39	R	GPM	System #1
40	R	GPM	System #2
41	R	GPM	System #3
			Pump Shaft Horsepower For:
42	R	HP	System #1
43	R	HP	System #2
44	R	HP	System #3
45	I	-	System Configuration Code
			APU Speed Code For:
46	I	-	System 1
47	I	-	System 2
48	I	-	System 3
49	R	G	Vehicle Load
50	R	FT	Altitude
			APU Fuel Remaining For:
51	R	LBS	System 1
52	R	LBS	System 2
53	R	LBS	System 3

FIGURE 4 (continued)

Output Codes

System Configuration Code	System 1	System 2	System 3
1	P	P	P
2	P	P	D
3	P	P	O
4	P	D	P
5	P	D	D
6	P	D	O
7	P	O	P
8	P	O	D
9	P	O	O
10	D	P	P
11	D	P	D
12	D	P	O
13	D	D	P
14	D	D	D
15	D	D	O
16	D	O	P
17	D	O	D
18	D	O	O
19	O	P	P
20	O	P	D
21	O	P	O
22	O	D	P
23	O	D	D
24	O	D	O
25	O	O	P
26	O	O	D
27	O	O	O

P = Pressurized

D = Depressurized

O = Off

APU Speed Code	APU Speed
1	100%
2	110%

FIGURE 5

3.3 RUN PREPARATION

See Figure 6 for a sample deck set up.

SAMPLE DECK SET UP

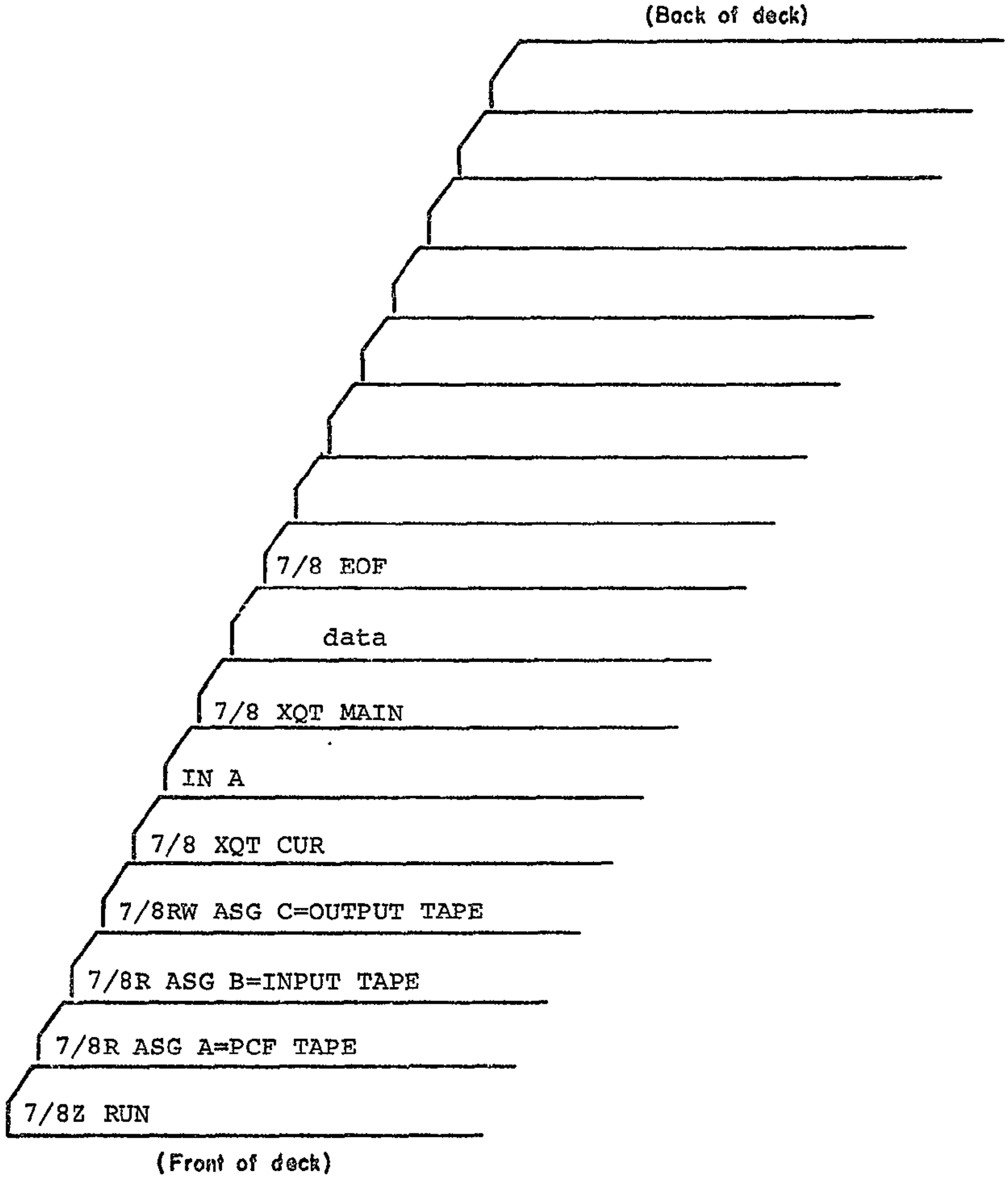


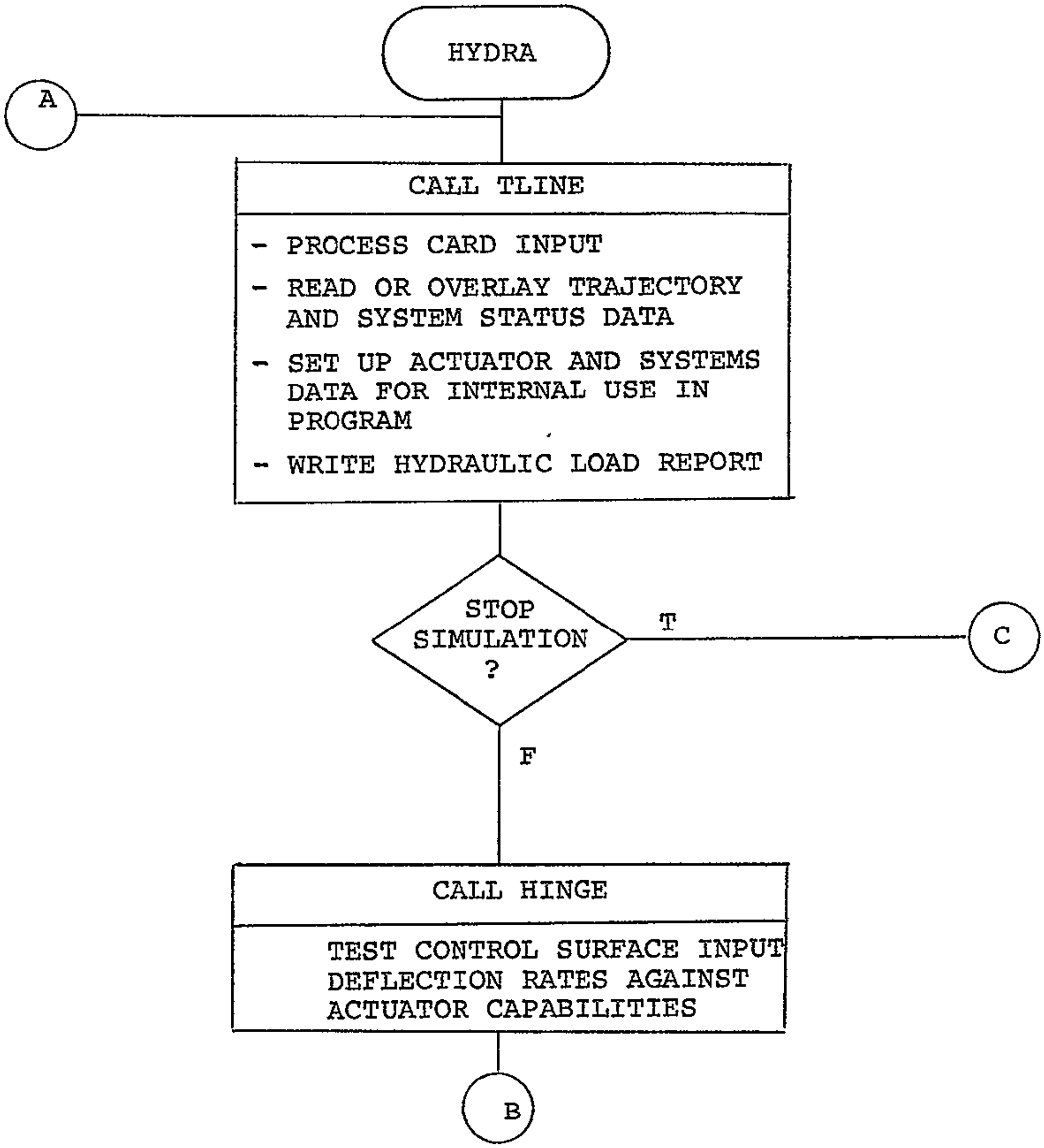
FIGURE 6

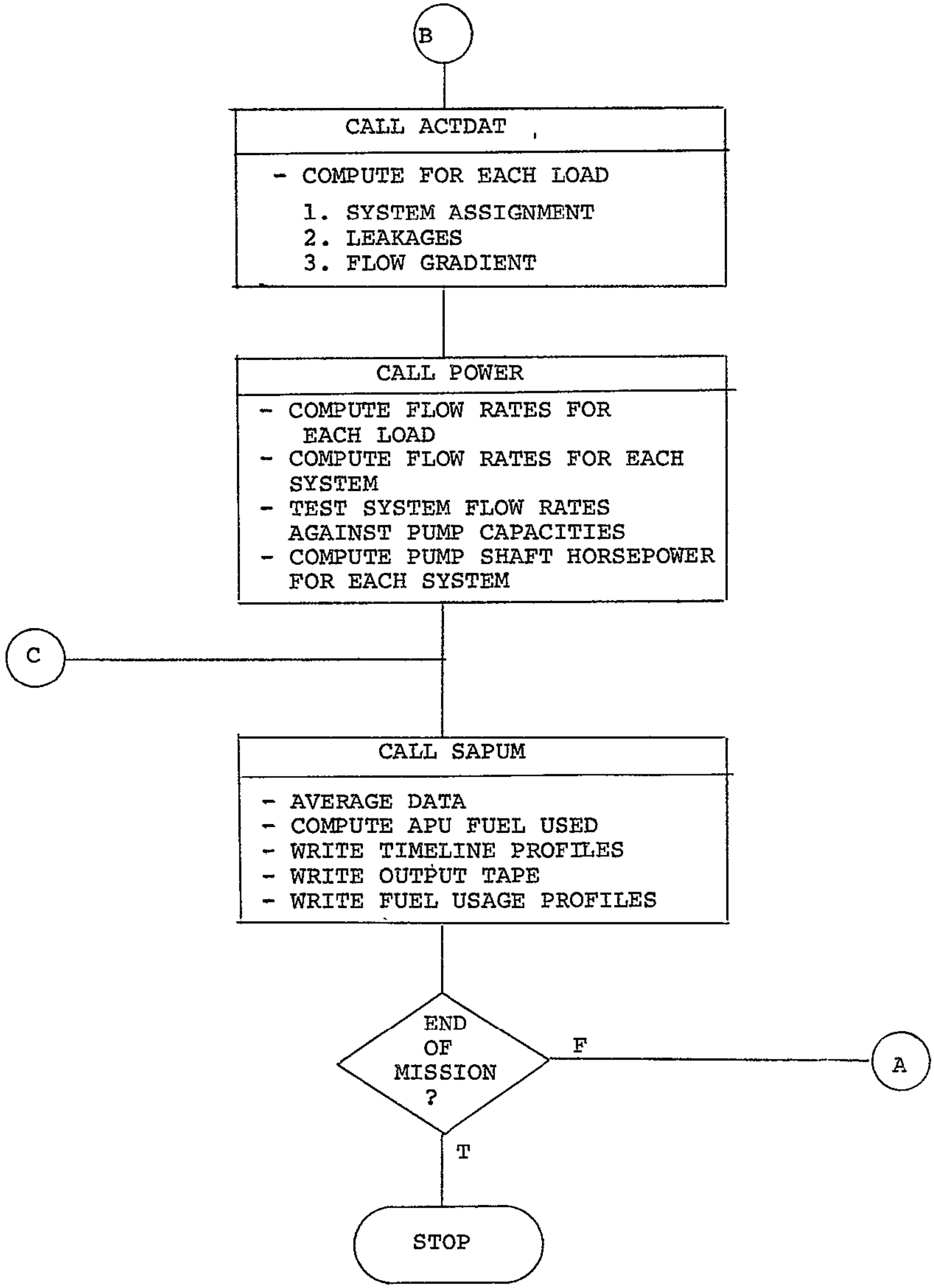
4. EXECUTION CHARACTERISTICS

This program requires 15,339 decimal locations in core. The execution time varies with the mission length and input sample frequency. A 28 minute entry with a sample frequency of 50 milliseconds required 15 minutes of execution time.

5. REFERENCE INFORMATION

5.1 GENERAL FLOW CHART




B
CALL ACTDAT
- COMPUTE FOR EACH LOAD
1. SYSTEM ASSIGNMENT
2. LEAKAGES
3. FLOW GRADIENT
CALL POWER
- COMPUTE FLOW RATES FOR EACH LOAD
- COMPUTE FLOW RATES FOR EACH SYSTEM
- TEST SYSTEM FLOW RATES AGAINST PUMP CAPACITIES
- COMPUTE PUMP SHAFT HORSEPOWER FOR EACH SYSTEM
C
CALL SAPUM
- AVERAGE DATA
- COMPUTE APU FUEL USED
- WRITE TIMELINE PROFILES
- WRITE OUTPUT TAPE
- WRITE FUEL USAGE PROFILES
END OF MISSION ?
F
A
T
STOP

5.2 ACTUATOR NAME - NUMBER CORRELATION

ACTUATOR NO.	ACTUATOR NAME
1	SSME 1 TVC Pitch
2	SSME 1 TVC Yaw
3	SSME 1 Engine Controller
4	SSME 2 TVC Pitch
5	SSME 2 TVC Yaw
6	SSME 2 Engine Controller
7	SSME 3 TVC Pitch
8	SSME 3 TVC Yaw
9	SSME 3 Engine Controller
10	Rudder
11	Speed Brake
12	LO Elevon
13	LI Elevon
14	RO Elevon
15	RI Elevon
16	Body Flap
17	Left Brake Modules
18	Right Brake Modules
19	MLG Uplocks
20	MLG Struts
21	NLG Uplock
22	NLG Strut
23	NG Steering

5.3 HYDRAULIC LOAD NAME - NUMBER CORRELATION

LOAD NO	LOAD NAME
1	SSME 1 TVC Pitch
2	SSME 1 TVC Yaw
3	SSME 1 Engine Controller
4	SSME 2 TVC Pitch
5	SSME 2 TVC Yaw
6	SSME 2 Engine Controller
7	SSME 3 TVC Pitch
8	SSME 3 TVC Yaw
9	SSME 3 Engine Controller
10	Rudder motor 1
11	Rudder motor 2
12	Rudder motor 3
13	Rudder servo
14	Speed Brake motor 1
15	Speed Brake motor 2
16	Speed Brake motor 3
17	Speed Brake servo
18	LO Elevon
19	LI Elevon
20	RO Elevon
21	RI Elevon
22	Body flap motor 1
23	Body flap motor 2
24	Body flap motor 3
25	LO Brake Module
26	LI Brake Module
27	RO Brake Module
28	RI Brake Module
29	L MLG Uplock

LOAD NO.	LOAD NAME
30	R MLG Uplock
31	L MLG Strut
32	R MLG Strut
33	NLG Uplock
34	NLG Strut
35	NLG Steering
36	NLG Restrictor
37	RLG Restrictor

5.4 SUBROUTINE DOCUMENTATION

In the following section, each element is individually documented.

SUBROUTINE ACTDAT

Identification

Name/Title	-	ACTDAT
Author/Date	-	E. Taylor/October 1975
Organization/Installation	-	LEC for MPAD-JSC
Machine Identification	-	Univac 1108
Source Language	-	FORTRAN V

Purpose

Subroutine ACTDAT computes leakage flow rates and flow gradients for the hydraulic loads.

Usage

Calling Sequence

CALL ACTDAT

Data In/Out

Variables in labeled common are listed in Appendix A

Block Name	Input	Output
/TARRAY/	T(1000)	
/RATES/	RATE(NA)	
/NAMES/	IACTNO(NL)	
/LKGS/	PSLKG(NL)	XPSLKG(NL)
	SVLKG(NL)	XSVLKG(NL)
/LMMTRX/	IPTR(3,3,3)	IASGN(NL)
	ICODE(27,NL)	
	ISOV(NL)	
/CONF/	ISYS(3)	P(3)
	IVALVE(3)	
	NOS	
/GRAD/	FGRAD(NL,2)	FLGRAD(NL)

Storage

Coding occupies 365_8 (245_{10}) locations. Internal data occupies 41_8 (33_{10}) locations.

Method

Local Variables

Variable Name	Type	Units	Description
IPOINT	I	-	System configuration code
NA	I	-	No. of actuators
NL	I	-	No. of loads
PIN	R	PSI	Reference pressure for leakages

Model

The system assignment for each load is determined from the loss management matrix and the status of the isolation valves and landing gear circuitry.

Load leakages are computed as follows:

$$Q_{SV} = Q_{SV_o} \times \sqrt{P/P_o}$$

$$Q_{PS} = Q_{PS_o} \times \sqrt{P/P_o}$$

Q_{SV_o} = Load servo valve leakage at P_o, GPM, if load bypass valve is open

Q_{SV_o} = Load bypass flow at P_o, GPM, if load bypass valve is closed

Q_{PS_o} = Load power spool leakage at P_o, GPM

P = System pressure, psi

P_o = Reference pressure = 3000 psi

Q_{SV} = Load servo valve leakage, GPM

Q_{PS} = Load power spool leakage, GPM

Flow gradients for each load are computed as follows:

$$QGRAD = 0$$

When:

1. The system to which the load is assigned is off.
2. The system to which the load is assigned is depressurized. This applies only to rudder, speed brake and body flap motors.

$$QGRAD = QGRAD_{Pos(Neg)}$$

$QGRAD_{Pos(Neg)}$ = Load flow gradient for positive (negative) rates

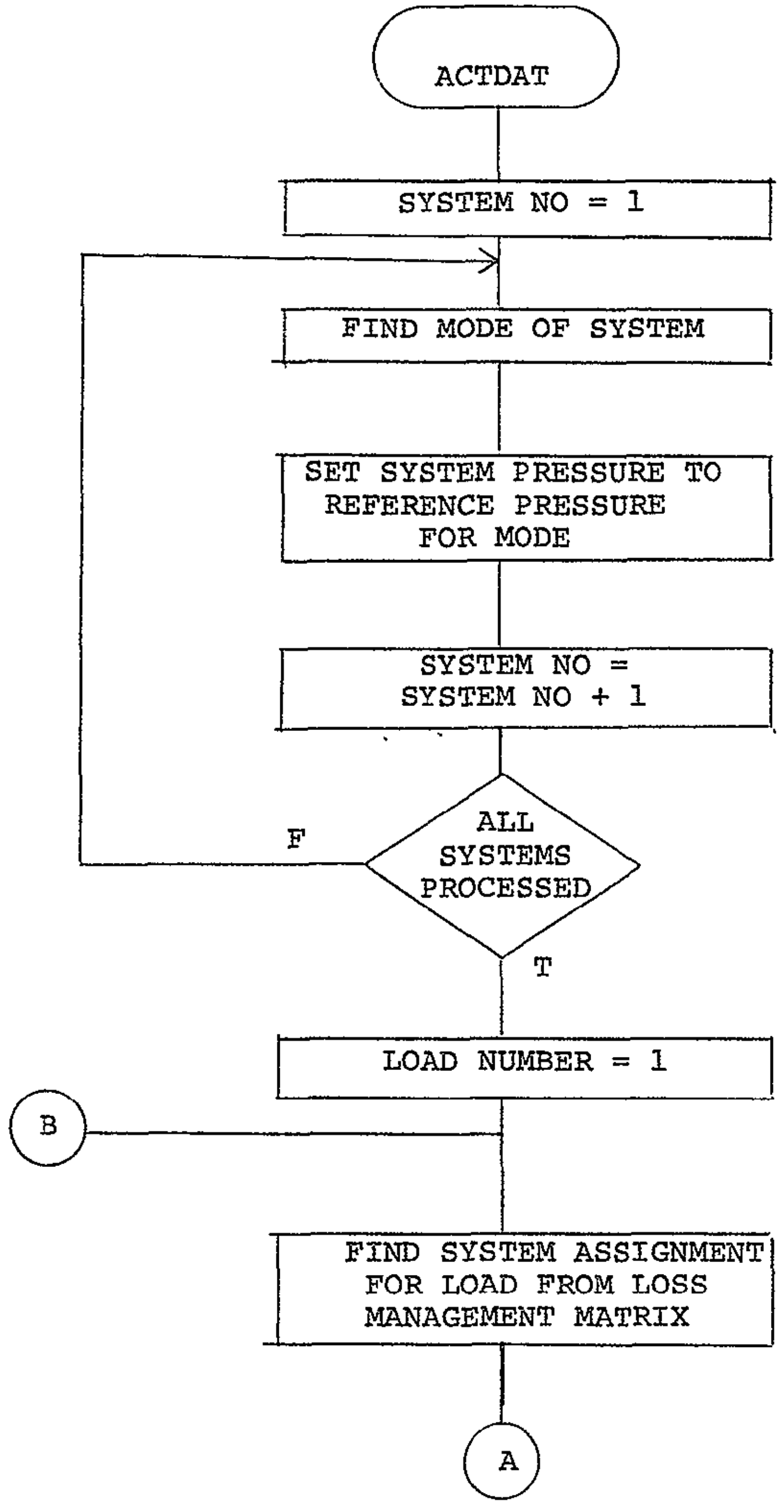
When:

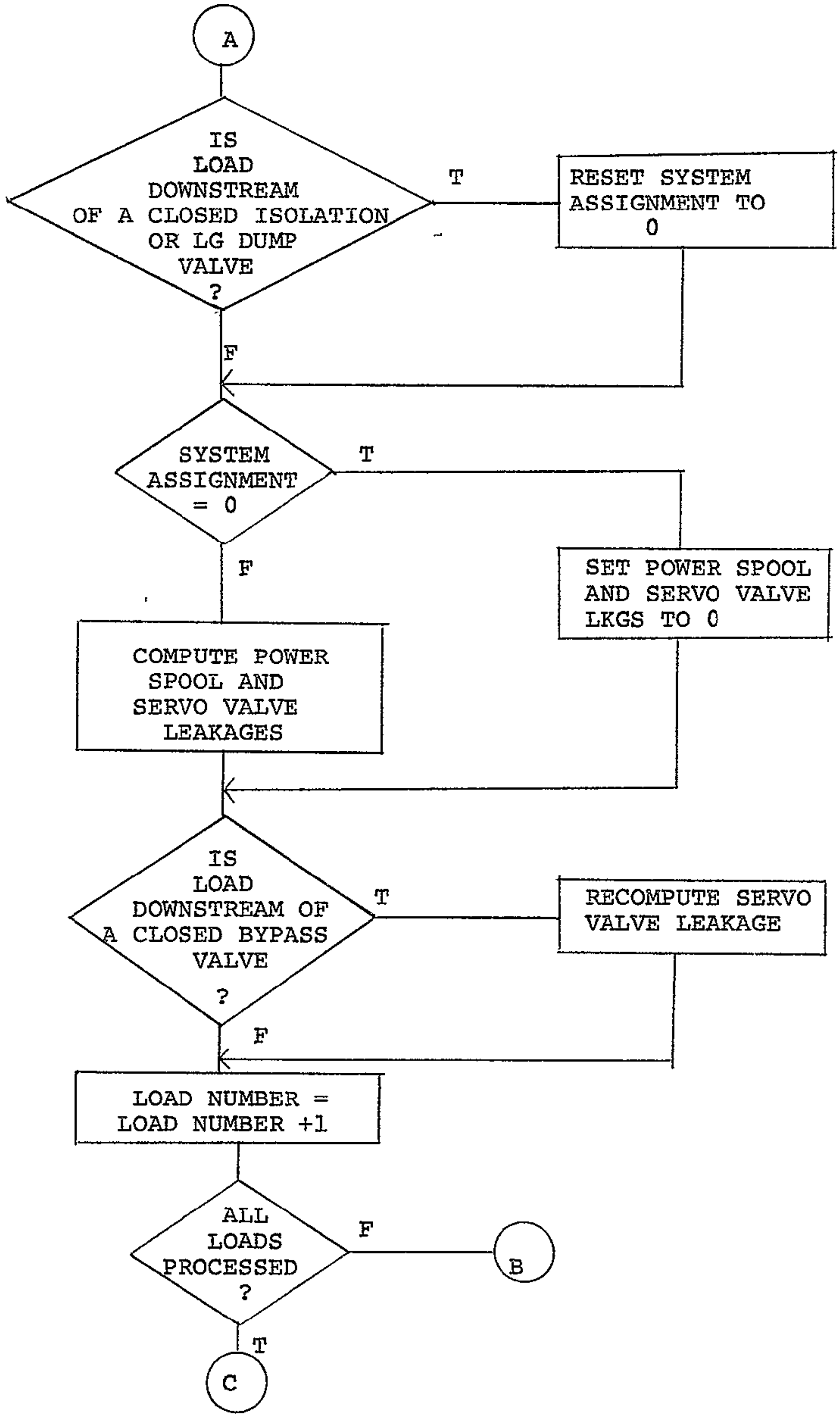
The corresponding actuator has a positive (negative) angular rate.

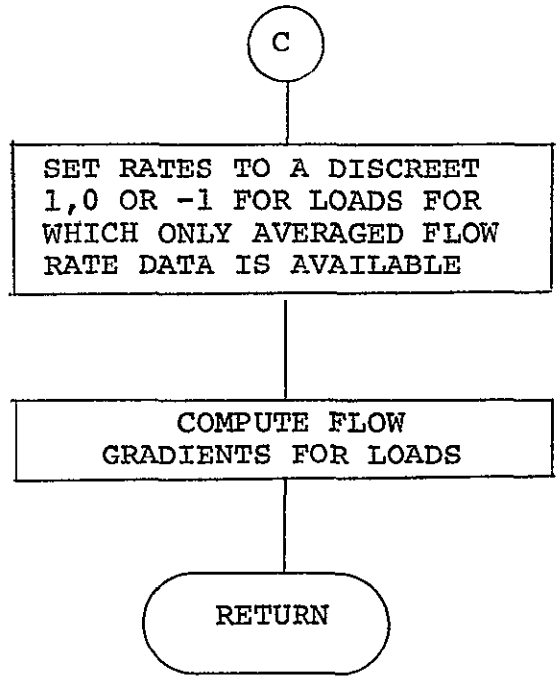
The flow gradients for rudder and speed brake motors are further adjusted by the equation.

$$QGRAD = QGRAD \times \frac{3}{N}$$

N = No. of systems pressurized


ACTDAT
SYSTEM NO = 1
FIND MODE OF SYSTEM
SET SYSTEM PRESSURE TO REFERENCE PRESSURE FOR MODE
SYSTEM NO = SYSTEM NO + 1
ALL SYSTEMS PROCESSED
F
T
LOAD NUMBER = 1
B
FIND SYSTEM ASSIGNMENT FOR LOAD FROM LOSS MANAGEMENT MATRIX
A


A
IS LOAD DOWNSTREAM OF A CLOSED ISOLATION OR LG DUMP VALVE ?
T
RESET SYSTEM ASSIGNMENT TO 0
F
SYSTEM ASSIGNMENT = 0
T
SET POWER SPOOL AND SERVO VALVE LKGS TO 0
F
COMPUTE POWER SPOOL AND SERVO VALVE LEAKAGES
IS LOAD DOWNSTREAM OF A CLOSED BYPASS VALVE ?
T
RECOMPUTE SERVO VALVE LEAKAGE
F
LOAD NUMBER = LOAD NUMBER +1
ALL LOADS PROCESSED ?
F
B
T
C


C
SET RATES TO A DISCREET
1,0 OR -1 FOR LOADS FOR
WHICH ONLY AVERAGED FLOW
RATE DATA IS AVAILABLE
COMPUTE FLOW
GRADIENTS FOR LOADS
RETURN

SUBROUTINE HINGE

Identification

Name/Title	-	HINGE
Author/Date	-	E. Taylor/October 1975
Organization/Installation	-	LEC for MPAD-JSC
Machine Identification	-	Univac 1108
Source Language	-	FORTRAN V

Purpose

Subroutine HINGE compares angular rates for the flight control surfaces against the maximum rate capability of the actuators.

Usage

Calling Sequence

CALL HINGE

Data In/Out

Variables in labeled common are listed in Appendix A

Block Name	Input	Output
/RATES/	RATE(NA)	
	HM(NA)	
	DEF(NA)	
/CONF/	NOS	
	P(3)	
/NAMES/	IACTNO(NL)	
/LMMTRX/	IASGN(NL)	

Storage

Coding occupies 715_8 (461_{10}) locations. Internal data occupies 223_8 (147_{10}) locations.

Method

Local Variables

Name	Type	Units	Description
NA	I	-	Number of actuators
NL	I	-	Number of loads
RATMAX	R	DEG/SEC	Maximum rate
STLHM	R	IN-LB	Stall hinge moment

Model

An aiding (opposing) load is assumed if the sign of the hinge moment and rate are equal (not equal) for the elevons, rudder and body flap. For the speed brake an aiding (opposing) load is assumed if the sign of the rate is negative (positive)

The maximum rates are calculated as follows:

INBOARD ELEVONS - OPPOSING LOADS

$$HM_o = \frac{P}{2900.} * 0.956 * 10^6 * \cos\left[1.011*(-7.42 - \delta)\right]$$

$$\dot{\delta} = 32.97 * \sqrt{1.0 - \left|\frac{HM}{HM_o}\right|}$$

OUTBOARD ELEVONS - OPPOSING LOADS

$$HM_o = \frac{P}{2900.} \times 0.4595 \times 10^6 \times \cos\left[0.995 \times (-8.6 - \delta)\right]$$

$$\dot{\delta} = 33.11 \times \sqrt{1.0 - \left|\frac{HM}{HM_o}\right|}$$

HM = hinge moment load - in-lbs

HM_o = stall hinge moment - in-lbs

P = system pressure - psi

δ = surface position - deg

$\dot{\delta}$ = max rate - deg/sec

RUDDER AND SPEED BRAKE - OPPOSING LOADS

$$\dot{\delta} = a_1 \; |HM| + a_2$$

BODY FLAP - AIDING AND OPPOSING LOADS

$$\dot{\delta} = \frac{a_1 + \sqrt{a_2 + \left[a_3 (a_4 - |HM|)\right]}}{a_5}$$

HM = Hinge moment load - in-lbs x 10^6

$\dot{\delta}$ = Max rate - deg/sec

If the magnitude of the angular rate exceeds the maximum rate calculated, the following message is printed

Actuator Name angular rate input X.XX DEG/SEC exceeds maximum allowable rate X.XX DEG/SEC at X.XX hrs.

No comparisons are made for aiding loads on the elevons, rudder and speed brake.

The hinge moment vs max rate curves were based on data received informally from Rockwell.

COEFFICIENTS FOR RUDDER AND SPEED BRAKE
HINGE MOMENT VS MAX RATE CURVES

Eqn	a_1	a_2
1	-35.588235	27.047058
2	-71.176470	54.094117
3	-106.764700	81.141174
4	-11.296296	26.207306
5	-22.592592	52.414813
6	-33.888888	78.622218

1) Rudder, 1 system pressurized
2) Rudder, 2 systems pressurized
3) Rudder, 3 systems pressurized
4) Speed brake, 1 system pressurized
5) Speed brake, 2 systems pressurized
6) Speed brake, 3 systems pressurized

FIGURE 7

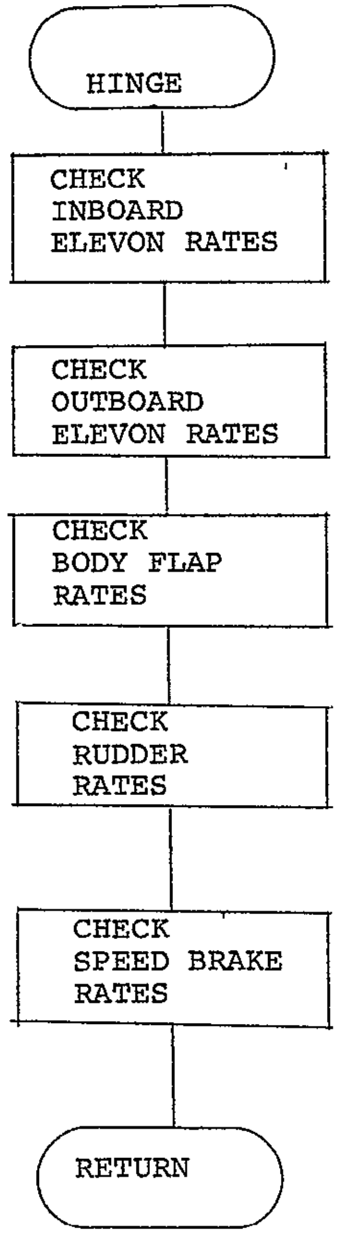
COEFFICIENTS FOR BODY FLAP

HINGE MOMENT VS MAX RATE CURVES

Eqn	a_1	a_2	a_3	a_4	a_5
1	-.1285543	.0165232	9.0381008	1.3856317	4.5190504
2	-.1283966	.0164856	2.0565236	1.3981675	1.0282618
3	-.09473478	.0090125	.9216732	1.4121217	.4608366
4	1.4058356	1.9763737	-4.1202264	.4793893	2.0601132
5	.7925523	.6281391	-1.1173654	.56156701	.558677
6	.56952602	.3243598	-.5227108	.62047078	.2613554

1) Body flap, opposing load, 1 system pressurized
2) Body flap, opposing load, 2 systems pressurized
3) Body flap, opposing load, 3 systems pressurized
4) Bod y flap, aiding load, 1 system pressurized
5) Body flap, aiding load, 2 systems pressurized
6) Body flap, aiding load, 3 systems pressurized

FIGURE 8


HINGE
CHECK INBOARD ELEVON RATES
CHECK OUTBOARD ELEVON RATES
CHECK BODY FLAP RATES
CHECK RUDDER RATES
CHECK SPEED BRAKE RATES
RETURN

SUBROUTINE PHASE

Identification

Name/Title	-	PHASE
Author/Date	-	E. Taylor/October 1975
Organization/Installation	-	LEC for MPAD-JSC
Machine Identification	-	Univac 1108
Source Language	-	FORTRAN V

Purpose

Subroutine PHASE reads SSFS, SVDS and binary input tapes and overlays trajectory and system status data.

Usage

Calling Sequence

CALL PHASE

Data In/Out

Variables in labeled common are listed in Appendix A

Block Name	Input	Output
/CONF/		ISYS(3)
		IVALVE(3)
		IAPUSD(3)
		IBYPV(3)
/TARRAY/	T(1000)	WRT(75)
/TRAJ/		IETP

Storage

Coding occupies 1206_8 (646_{10}) locations. Internal data occupies 1126_8 (598_{10}) locations.

Method

Local Variables

Name	Type	Units	Description
ALPHA	R	DEG	Rudder/Speed Brake hingeline angle with Orbiter-z-axis
ALRAD	R	RAD	Rudder/Speed Brake hingeline angle with Orbiter-z-axis
COSAL	R	-	COS (ALPHA)
COSPH	R	-	COS (PHI)
ECTRAN(I), I=1,3	R	HRS	Start time of engine controller transient
IPHASE	I	-	Mission phase flag
ISYM	A	-	Symbolic names on SSFS and SVPS input tapes
ITYPE	I	-	Input type flag
IUNIT	I	-	Input unit
IWOW	I	-	Touchdown flag
LPHASE	I	-	Last mission phase
LTYPE	I	-	Last input type
LUNIT	I	-	Last input unit
PHI	R	RAD	Rudder/Speed Brake deflection angle
PHSTRT	R	HRS	Start time for current mission phase
SINAL	R	-	SIN (ALPHA)
THROTL(I), I=1,3	R	%	Last throttle setting
TLGDWN	R	HRS	Start time for landing gear deploy

Name	Type	Units	Description
T804	R	HRS	Duration of uplock transient
T805	R	HRS	Duration of strut transient
T811	R	HRS	Duration of engine controller transient

Model

The following logic is used to overlay trajectory data:

Engine controller transients are added for each throttle setting change. The duration and flow rate of these transients are controlled by card input.

Averaged flow rates for the landing gear uplock and strut actuators are added during landing gear deployment. The duration of these transients is controlled by card input. The strut transient immediately follows the uplock transient.

Averaged flow rates for the brake modules and nose gear steering actuators are added after touchdown.

The following logic is used to determine system status defaults:

SSME isolation valves are initially open, then closed after MPS purge.

Landing gear isolation valves are initially closed, then opened at landing gear arm.

Landing gear deploy circuitry status is switched at landing gear deploy.

Engine controller bypass valves remain open.

All systems are pressurized.

APU speeds are switched to 110% at lift-off, -30 seconds then cut-back to 100% at a time controlled by card input.

Rudder and Speed Brake deflection angles and rates are converted from FRL to hinge-line using the equations below:

For SSFS and SVDS input:

RUDDER

$$\theta = \tan^{-1}\left(\frac{\tan\phi}{\cos\alpha}\right)$$

$$\dot{\theta} = \frac{\dot{\phi}\cos\alpha}{1 - \cos^2\phi\sin^2\alpha}$$

Speed Brake

$$\theta = \left[\tan^{-1}\left(\frac{\tan\frac{\phi}{2}}{\cos\alpha}\right)\right] \times 2$$

$$\dot{\theta} = \frac{\dot{\phi}\cos\alpha}{1 - \cos^2\left(\frac{\phi}{2}\right)\sin^2\alpha}$$

For blocked binary input:

$$\dot{\theta} = \frac{\dot{\phi}}{\cos\alpha}$$

θ = Rudder/Speed Brake hingeline deflection angle

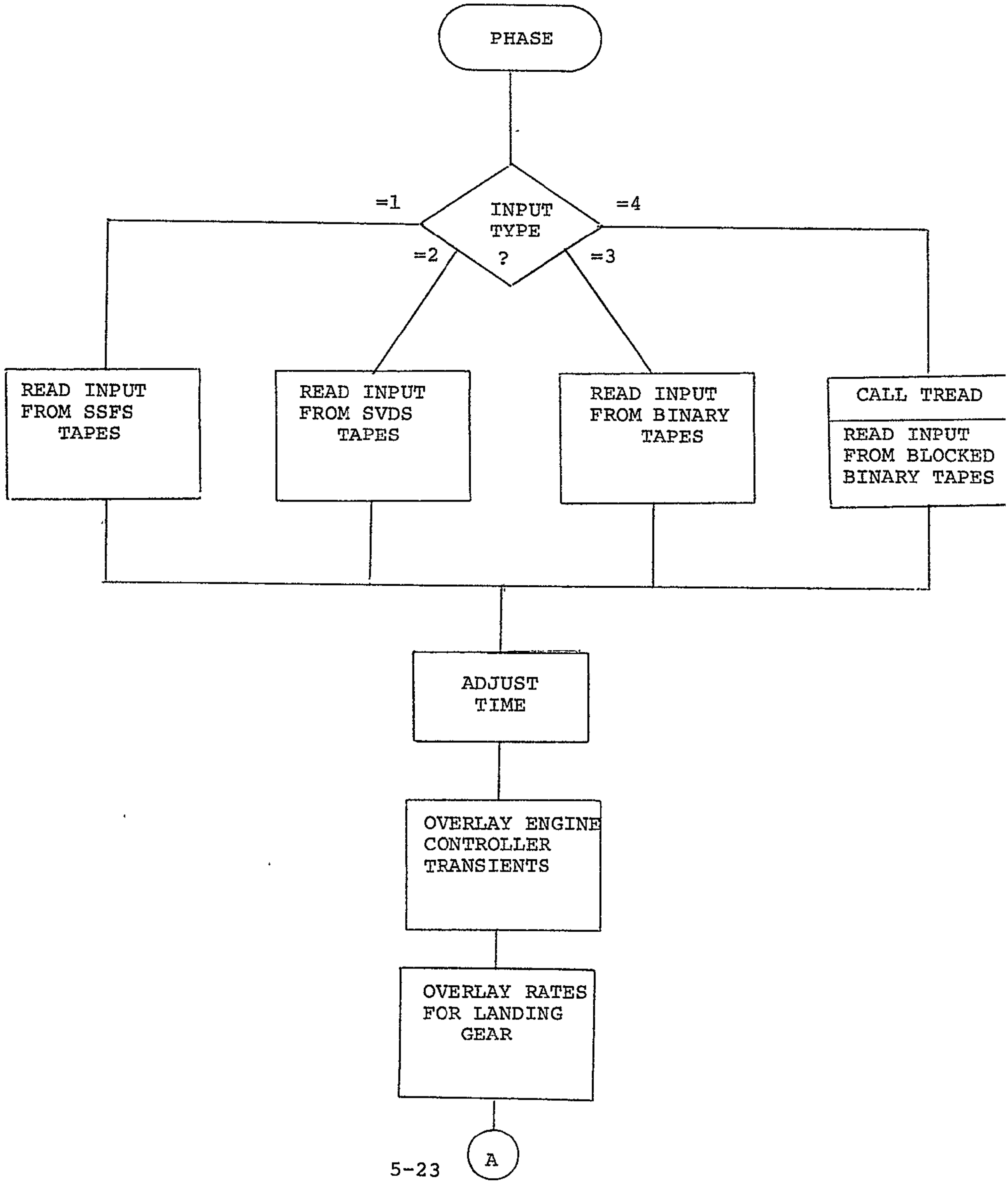
ϕ = Rudder/Speed Brake FRL deflection angle

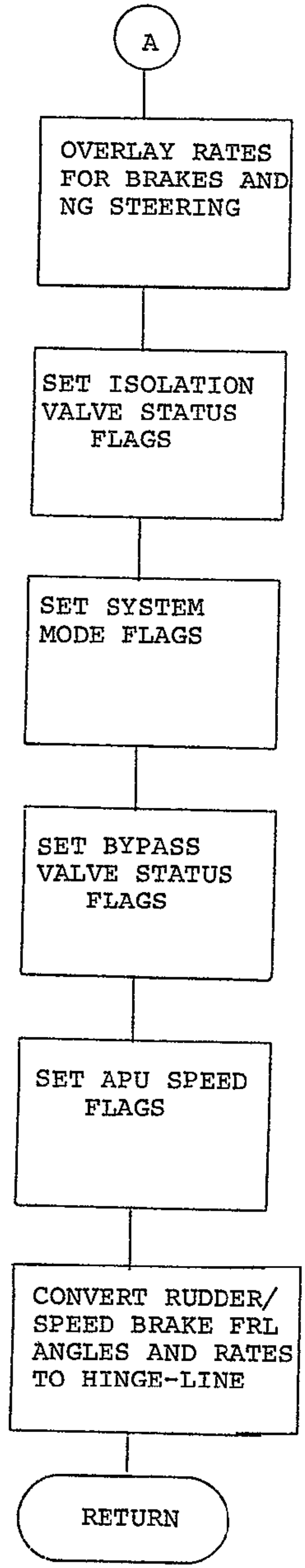
$\dot{\theta}$ = Rudder/Speed Brake hingeline angular rate

$\dot{\phi}$ = Rudder/Speed Brake FRL angular rate

α = Rudder/Speed Brake hingeline angle with orbiter -Z axis = 34.83°

The Rudder Speed Brake conversion equations were derived by Jim Walker/MDAC.


PHASE
INPUT TYPE ?
=1
=2
=3
=4
READ INPUT FROM SSFS TAPES
READ INPUT FROM SVDS TAPES
READ INPUT FROM BINARY TAPES
CALL TREAD
READ INPUT FROM BLOCKED BINARY TAPES
ADJUST TIME
OVERLAY ENGINE CONTROLLER TRANSIENTS
OVERLAY RATES FOR LANDING GEAR
A


A
OVERLAY RATES FOR BRAKES AND NG STEERING
SET ISOLATION VALVE STATUS FLAGS
SET SYSTEM MODE FLAGS
SET BYPASS VALVE STATUS FLAGS
SET APU SPEED FLAGS
CONVERT RUDDER/ SPEED BRAKE FRL ANGLES AND RATES TO HINGE-LINE
RETURN

SUBROUTINE POWER

Identification

Name/Title	-	POWER
Author/Date	-	E. Taylor/October 1975
Organization/Installation	-	LEC for MPAD-JSC
Machine Identification	-	Univac 1108
Source Language	-	FORTRAN V

Purpose

Subroutine POWER computes the power requirements and tests system flow rates against pump capacities.

Usage

Calling Sequence

CALL POWER

Data In/Out

Variables in labeled common are listed in Appendix A

Block Name	Input	Output
/TARRY/	T(1000)	
/TIMES/	NOL	
/LMMTRX/	IASGN(NL)	
/RATES/	RATE(NA)	
	ALT	
/NAMES/	IACTNO(NL)	
	NMODE(3)	
	ISPED(2)	
/GRAD/	FLGRAD(NL)	

Block Name	Input	Output
/CONF/	ISYS(3)	
	IAPUSD(3)	
	TP	
	P(3)	
/LKGS/	XPSLKG(NL)	
	XSVLKG(NL)	
/OUTPUT/		FLRT(NL)
		TFLRT(3)
		PWR(3)

Storage

Coding occupies 474_8 (316_{10}) locations. Internal data occupies 326_8 (214_{10}) locations.

Method

Local Variables

Name	Type	Units	Description
			Coefficients for pump efficiency equations for pressurized system:
			100% APU Speed
CF(I,1,1,1),I=1,7	R	-	Flow Rate ≤ 17.5 GPM
CF(I,2,1,1),J=1,5	R	-	Flow Rate > 17.5 GPM
			110% APU Speed
CF(I,1,1,2),I=1,7	R	-	Flow Rate ≤ 17.5 GPM
CF(I,2,1,2),I=1,5	R	-	Flow Rate > 17.5 GPM
			For depressurized system:
			100% APU Speed
CF(I,1,2,1),I=1,4	R	-	Flow Rate ≤ 4 GPM

Name	Type	Units	Description
ISAT(I),I=1,3	I	-	Flag to indicate max flow rate has been exceeded for system
IPPLT	I	-	Unit for power plot tape
NA	I	-	No. of actuators
NL	I	-	No. of loads
PEFF	R	-	Calculated pump efficiency

Model

The fluid flow rate for each load is calculated from the equation

$$Q = \text{MAX}\left[(\dot{\delta} \times \text{QGRAD}), Q_{PS}\right] + Q_{SV}$$

Q = Load fluid flow rate, GPM
$\dot{\delta}$ = Load angular rate, DEG/SEC
QGRAD = Load flow gradient, GPM/DEG/SEC
Q_{PS} = Load power spool leakage, GPM
Q_{SV} = Load servo valve leakage, GPM

The total fluid flow rate per system is found by summing the flow rates of the loads assigned to that system. A warning flag will appear on the printout if the system's maximum flow rate has been exceeded.

The pump shaft horsepower is computed as follows:

$$E = \sum_{i=0}^{6} a_i Q^i$$

$$P = \frac{P \times Q}{1714.0 \times E}$$

Q = System fluid flow rate, GPM

E = Pump efficiency

P = System pressure, PSI

P = System power, HP

If pump efficiency data is not available the following message is printed and the power is set to zero.

No pump efficiency data available. Flow rate = XXX.XX.
APU speed = XXX % . MODE = XXX

Hydraulic pump efficiency in the pressurized mode is based on data from Reference 5. Hydraulic pump efficiency in the depressurized mode is based on data from a Rockwell Hydraulics Intergroup Data Response dated November 6, 1974.

COEFFICIENTS FOR PUMP EFFICIENCY CURVES

Eqn	a_0	a_1	a_2	a_3	a_4	a_5	a_6
1	2.4540855E-3	1.5067633E-1	-2.024895E-2	2.0384553E-3	-1.3318408E-4	4.8642687E-6	-7.429099E-8
2	4.2472454E-1	2.5911321E-2	-6.2899454E-4	7.4287632E-6	-3.5156554E-8	0.0	0.0
3	1.3046033E-3	1.4074945E-1	-1.8112688E-2	1.7790823E-3	-1.1461501E-4	4.1468731E-6	-6.2860823E-8
4	3.9355880E-1	2.7104849E-2	-6.6040811E-4	7.7603971E-6	-3.6055649E-8	0.0	0.0
5	1.727929657E-4	7.431142388E-2	-5.439551964E-3	4.843641759E-4	0.0	0.0	0.0

1) 100% APU Speed, Pressurized System, Flow Rate $\leq$ 17.5 GPM

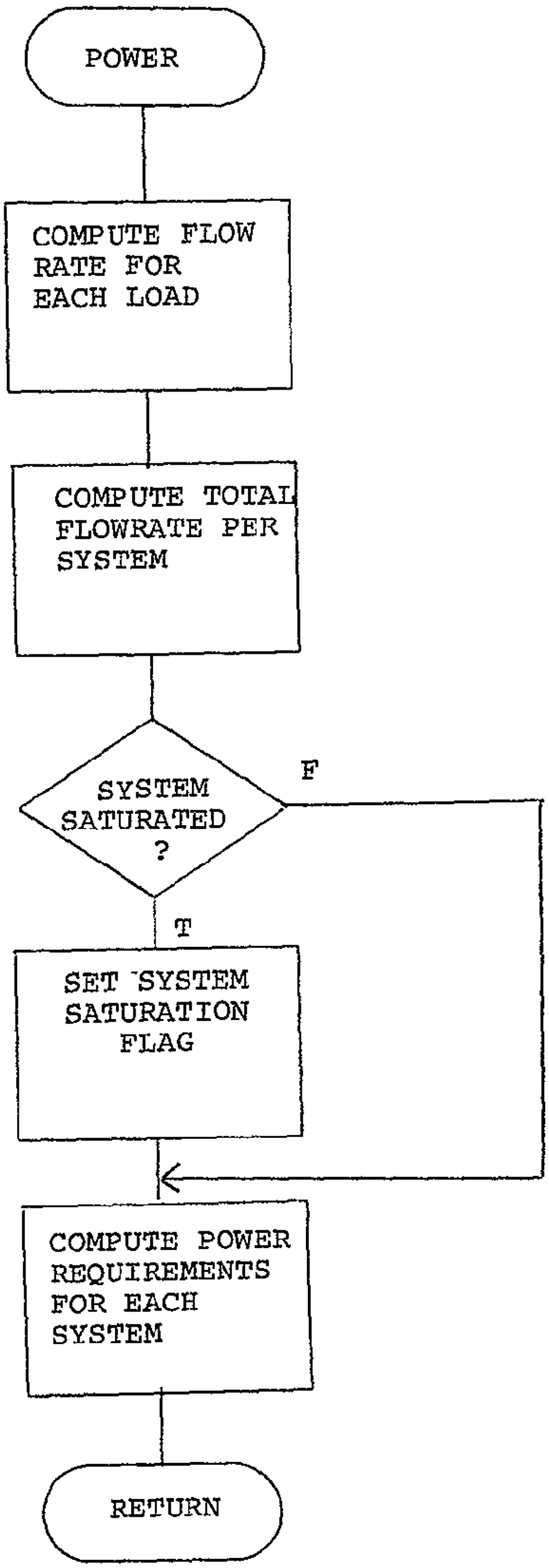
2) 100% APU Speed, Pressurized System, Flow Rate > 17.5 GPM

3) 110% APU Speed, Pressurized System, Flow Rate $\leq$ 17.5 GPM

4) 110% APU Speed, Pressurized System, Flow Rate > 17.5 GPM

5) 100% APU Speed, Depressurized System, Flow Rate $\leq$ 4.0 GPM

FIGURE 9


POWER
COMPUTE FLOW RATE FOR EACH LOAD
COMPUTE TOTAL FLOWRATE PER SYSTEM
SYSTEM SATURATED ?
F
T
SET SYSTEM SATURATION FLAG
COMPUTE POWER REQUIREMENTS FOR EACH SYSTEM
RETURN

SUBROUTINE SAPUM

Identification

Name/Title	-	SAPUM
Author/Date	-	E. Taylor/October 1975
Organization/Installation	-	LEC for MPAD-JSC
Machine Identification	-	Univac 1108
Source Language	-	FORTRAN V

Purpose

Subroutine SAPUM averages the data, computes APU fuel requirements prints the timeline profiles and APU fuel usage summary, and writes the the output data tape.

Usage

Calling Sequence

CALL SAPUM

CALL SUMM

Data In/Out

Variables in labeled common are listed in Appendix A

Block Name	Input	Output
/TARRAY/	T(1000)	
/TIMES/	ISTART	
	ISTOP	
	NOL	
/NAMES/	ISPED(2)	
/LMMTRX/	IPTR(3,3,3)	
/CONF/	ISYS(3)	
	IAPUSD(3)	
	TP	

Block Name	Input	Output
/OUTPUT/	FLRT(NL)	
	TFLRT(3)	
	PWR(3)	
/RATES/	CGLOAD	
	ALT	

Storage

Coding occupies 1170_8 (584_{10}) locations. Internal data occupies 427_8 (279_{10}) locations.

Method

Local Variables

Name	Type	Units	Description
ACOEF(I),I=1,12	R	-	Coefficients for atmospheric pressure equation
ALTKM	R	KM	Altitude
ENUSED	R	HP-HR	Energy used
FRATE1	R	LBS/HR	Fuel usage rate at sea level
FRATE2	R	LBS/HR	Fuel usage rate at space
FREM(I),I=1,3	R	LBS	Fuel remaining
FREQT	R	HRS	Interval specified in input over which to average data
FURATE	R	LBS/HR	Fuel usage rate at altitude
FUSED	R	LBS	Fuel used over interval
IOVER(I),I=1,3	I	-	Flag for no usable fuel remaining
IOTAP	I	-	Unit for plot tape
KSPD(I),I=1,3	I	-	APU speeds at beginning of interval = 1 100% = 2 110%

Name	Type	Units	Description
KSYS	I	-	System configuration code at beginning of interval
NL	I	-	No. of loads
PA	R	PSI	Atmospheric pressure
PRESUR	R	ATM	Atmospheric pressure
SLRTE(I),I=1,5	R	-	Coefficients for equation for fuel usage rate at sea level
SPRTE(I),I=1,5	R	-	Coefficients for equation for fuel usage rate at space
			Last value read or calculated for:
STORE(1)	R	HRS	Time
STORE(I),I=2,38	R	GPM	Flow rates for loads
STORE(I),I=39,41	R	GPM	Flow rates for systems
STORE(I),I=42,44	R	HP	Power requirements
STORE(45)	R	G	Vehicle load
STORE(46)	R	FT	Altitude
TENUSD(1),I=1,3	R	HP-HR	Total energy used
TFUSED(I),I=1,3	R	LBS	Total fuel used
			Weighted average of:
WAVG(1)	R	HRS	Time
WAVG(I),I=2,38	R	GPM	Flow rates for loads
WAVG(I),I=39,41	R	GPM	Flow rates for systems
WAVG(I),I=42,44	R	HP	Power requirements
WAVG(45)	R	G	Vehicle Load
WAVG(46)	R	FT	Altitude
XINT	R	HRS	Interval over which data is averaged
XTP	R	HRS	Time at beginning of interval
YTP	R	HRS	Time at beginning of next interval

Model

The APU fuel requirements are computed as follows

$$\dot{y}_{SL} = \sum_{i=0}^{4} a_i P^i$$

$$\dot{y}_{SP} = \sum_{i=0}^{4} a_i P^i$$

$$P_{ALT} = \frac{14.696}{\left[\sum_{i=0}^{4} a_i (.3048006E-3 \times H)^i\right]^4}$$

$$\dot{y} = \dot{y}_{SP} + (\dot{y}_{SL} - \dot{y}_{SP}) \times \frac{P_{ALT}}{14.696}$$

$$y = \dot{y} \times \Delta t$$

$$y_T = y_T + y$$

$$y_{REM} = y_{LOAD} - y_T$$

The following energy calculations are also performed

$$\varepsilon = P \times \Delta t$$

$$\varepsilon_T = \varepsilon_T + \varepsilon$$

$\dot{y}_{SL}$ = Fuel usage rate at sea level - lbs/hr

$\dot{y}_{SP}$ = Fuel usage rate at space - lbs/hr

$\dot{y}$ = Fuel usage rate at altitude - lbs/hr

p = System horsepower - hp

H = Altitude - ft

P_{ALT} = Atmospheric pressure at altitude - psi

Δt = Time interval - hrs

y = Fuel used - lbs

y_T = Total fuel used - lbs

y_{REM} = Fuel remaining - lbs

y_{LOAD} = Fuel loaded - lbs

ε = Energy - HP-HR

ε_T = Total energy - HP-HR

When no usable fuel remains in a tank the following message is printed.

No usable fuel remaining for system X at XX.XX hrs.

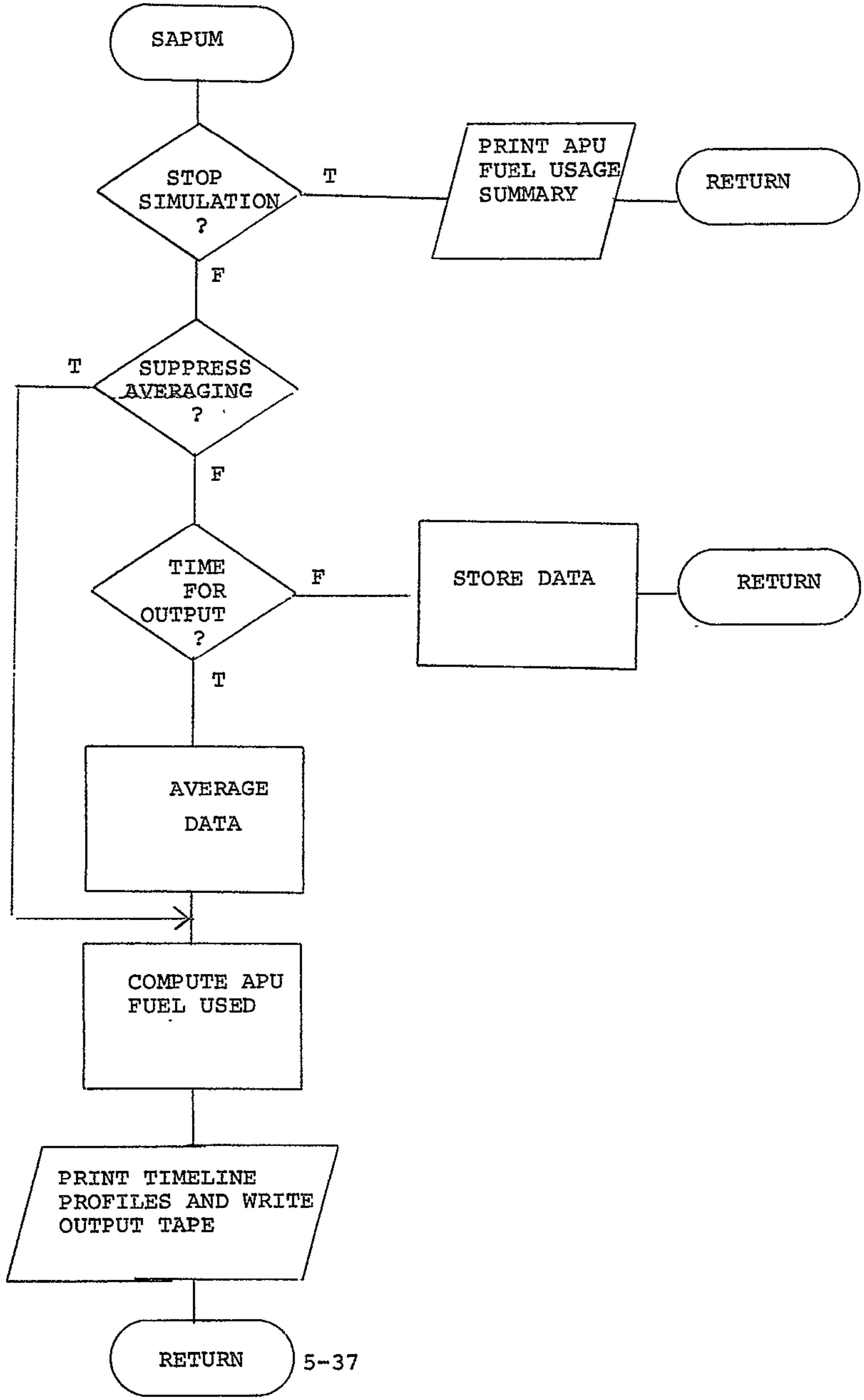
The APU fuel usage rate curves were generated from SFC data in Reference 2. The coefficients for the atmospheric equations can be found in Reference 1.

COEFFICIENTS FOR APU FUEL USAGE

RATE CURVES

	SEA LEVEL	SPACE
a_o	1.552781300 E-1	4.549345422 E-1
a_1	7.942535888 E 0	6.643038955 E 0
a_2	-5.598904841 E-2	-2.576230609 E-2
a_3	5.365529363 E-4	2.244328952 E-4
a_4	-1.714884558 E-6	-6.707555029 E-7

FIGURE 10


SAPUM
STOP SIMULATION ?
T
PRINT APU FUEL USAGE SUMMARY
RETURN
F
SUPPRESS AVERAGING ?
T
F
TIME FOR OUTPUT ?
F
STORE DATA
RETURN
T
AVERAGE DATA
COMPUTE APU FUEL USED
PRINT TIMELINE PROFILES AND WRITE OUTPUT TAPE
RETURN

SUBROUTINE SYSDAT

Identification

Name/Title	-	SYSDAT
Author/Date	-	E. Taylor/October 1975
Organization/Installation	-	LEC for MPAD-JSC
Machine Identification	-	Univac 1108
Source Language	-	FORTRAN V

Purpose

Subroutine SYSDAT stores the systems design data, generates the loss management matrix and prints the hydraulics load data report.

Usage

Calling Sequence

CALL SYSDAT

Data In/Out

Variables of labeled common are listed in Appendix A.

Block Name	Input	Output
/TARRAY/	T(1000)	
/LMMTRX/	LMM(3,NL)	IPTR(3,3,3)
		ICODE(27,NL)
		ISOV(NL)
/NAMES/	NAME(2,NL)	
/LKGS/		PSLKG(NL)
		SVLKG(NL)
/GRAD/		FGRAD(NL,2)

Storage

Coding occupies 414_8 (268_{10}) locations. Internal data occupies 403_8 (259_{10}) locations.

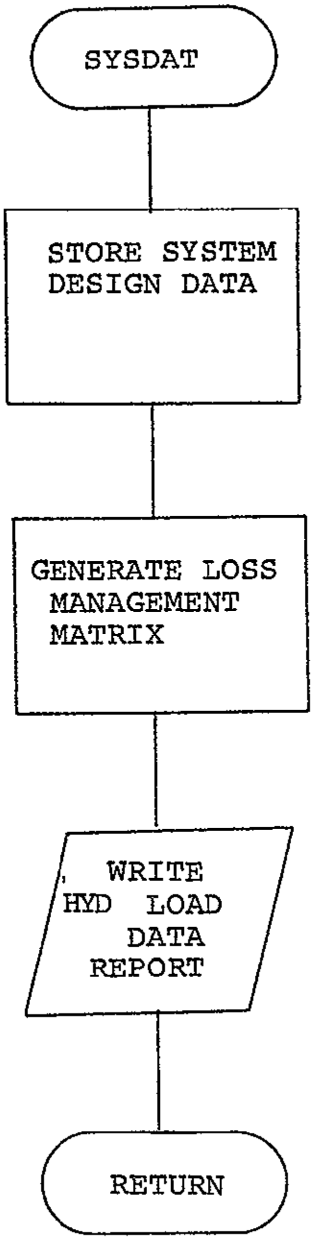
Method

Local Variables

Name	Type	Units	Description
FGCOMM(2,NL)	A	-	Flow gradient comments
ISYS	I	-	System No
MODE	I	-	System mode = 1 pressurized = 2 depressurized = 3 off
NL	I	-	No. of loads

Model

A loss management matrix is generated which contains the system assignment for each load for each combination of system modes. The system assignments are found by checking the active system, first standby system and second standby system of the load for a pressurized system. The first system found to be pressurized is assigned to the load. If none of the systems are pressurized, the procedure is repeated checking for depressurized systems.


SYSDAT
STORE SYSTEM DESIGN DATA
GENERATE LOSS MANAGEMENT MATRIX
WRITE HYD LOAD DATA REPORT
RETURN

SUBROUTINE TITLE

Identification

Name/Title	-	TITLE
Author/Date	-	E. Taylor/October 1975
Organization/Installation	-	LEC for MPAD-JSC
Machine Identification	-	Univac 1108
Source Language	-	FORTRAN V

Purpose

Subroutine TITLE prints the title for the timeline profiles

Usage

Calling Sequence

CALL TITLE

Data In/Out

Variables in labeled common are listed in Appendix A

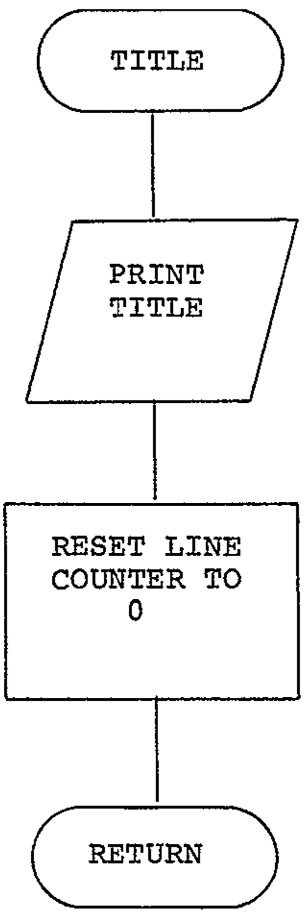
Block Name	Input	Output
/TIMES/		NOL

Storage

Coding occupies 32_8 (26_{10}) locations. Internal data occupies 123_8 (83_{10}) locations.

Method

TITLE prints the title for the timeline profiles and resets the line counter to 0.


TITLE
PRINT TITLE
RESET LINE COUNTER TO 0
RETURN

SUBROUTINE TLINE

Identification

Name/Title	-	TLINE
Author/Date	-	E. Taylor/October 1975
Organization/Installation	-	LEC for MPAD-JSC
Machine Identification	-	Univac 1108
Source Language	-	FORTRAN V

Purpose

Subroutine TLINE reads and processes card inputs.

Usage

Calling Sequence

CALL DLINE

Data In/Out

Variables in labeled common are listed in Appendix A.

Block Name	Input	Output
/CONF/	ISYS(3)	ISYS(3)
	IVALVE(3)	IVALVE(3)
	IAPUSD(3)	IAPUSD(3)
	IBYPV(3)	IBYPV(3)
		TP
/GRAD/	FGRAD(NL,2)	
/NAMES/	ILOAD(NA)	
/RATES/		RATE(NA)
		HM(NA)
		DEF(NA)

Block Name	Input	Output
		CGLOAD
		ALT
/TIMES/		ISTART
		ISTOP
		IEND
/TARRAY/	WRT(NR)	
/TRAJ/	IETP	

Storage

Coding occupies 521_8 (337_{10}) locations. Internal data occupies 73_8 (59_{10}) locations.

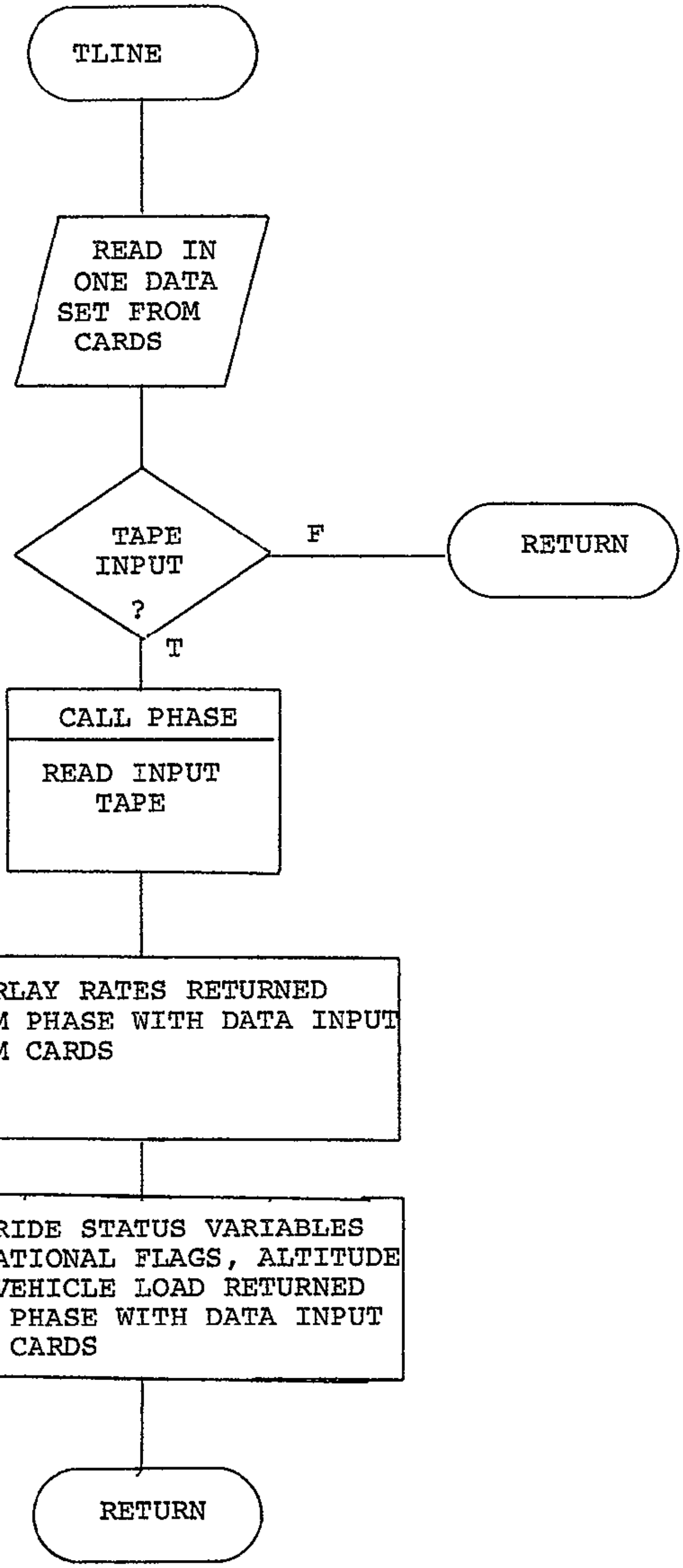
Method

Local Variables

Name	Type	Units	Description
ICARD	I	-	Flag for card input
IR	I	-	Rate flag = 1 Angular = 2 Fluid flow
ISSTRT	I	-	Flag for load design data change
ISTAT	I	-	Read status flag
NA	I	-	Number of actuators
NL	I	-	Number of loads
OWRT(I)	R	DEG/SEC	Angular rates returned from PHASE; I is the actuator no, (I=1,15)
OWRT(I)	R	-	Actuator operational flag returned from PHASE; I is the actuator no, (I=16,23)

Model

The program is initialized by card input before operational control is transferred to tape or card input. If control is transferred to tape input, the operational parameters (time, angular rates, hinge moments, surface deflections, actuator operational flags, altitude, vehicle load, system status variables) are read from tape or overlaid with logic in the PHASE subroutine. Card input will supplement or override this data. Angular rates and fluid flow rates converted to angular rates input from cards are added to the angular rates returned from PHASE. Altitude, vehicle load, actuator operational flags and system status variables input from cards will override the data returned from PHASE. If control is transferred to card input, all operational parameters are defined by card input.


TLINE
READ IN ONE DATA SET FROM CARDS
TAPE INPUT ?
F
RETURN
T
CALL PHASE
READ INPUT TAPE
OVERLAY RATES RETURNED FROM PHASE WITH DATA INPUT FROM CARDS
OVERRIDE STATUS VARIABLES OPERATIONAL FLAGS, ALTITUDE AND VEHICLE LOAD RETURNED FROM PHASE WITH DATA INPUT FROM CARDS
RETURN

SUBROUTINE TREAD

Identification

Name/Title	-	TREAD
Author/Date	-	D. Wiggins/October 1975
Organization/Installation	-	LEC for MPAD-JSC
Machine Identification	-	Univac 1108
Source Language	-	FORTRAN V

Purpose

Subroutine TREAD reads blocked binary tapes.

Storage

Coding occupies 304_8 (196_{10}) locations. Internal data occupies 1343_8 (739_{10}) locations.

Usage

Calling sequence

CALL TREAD (IFLAG, TUNIT, LGDWN, IWOW)

Arguments

Parameter Name	In/Out	Type	Description
TFLAG	OUT	I	End of tape flag
TUNIT	IN	I	Tape unit
LGDWN	OUT	I	Landing gear down flag
IWOW	OUT	I	Touchdown flag

Data In/Out

Variables in labeled common are listed in Appendix A

Block Name	Input	Output
/TARRAY/		WRT(75)

Error Messages

The following message is written when a tape error occurs

NTRAN error --- status word = X Program assumes end of tape and continues processing.

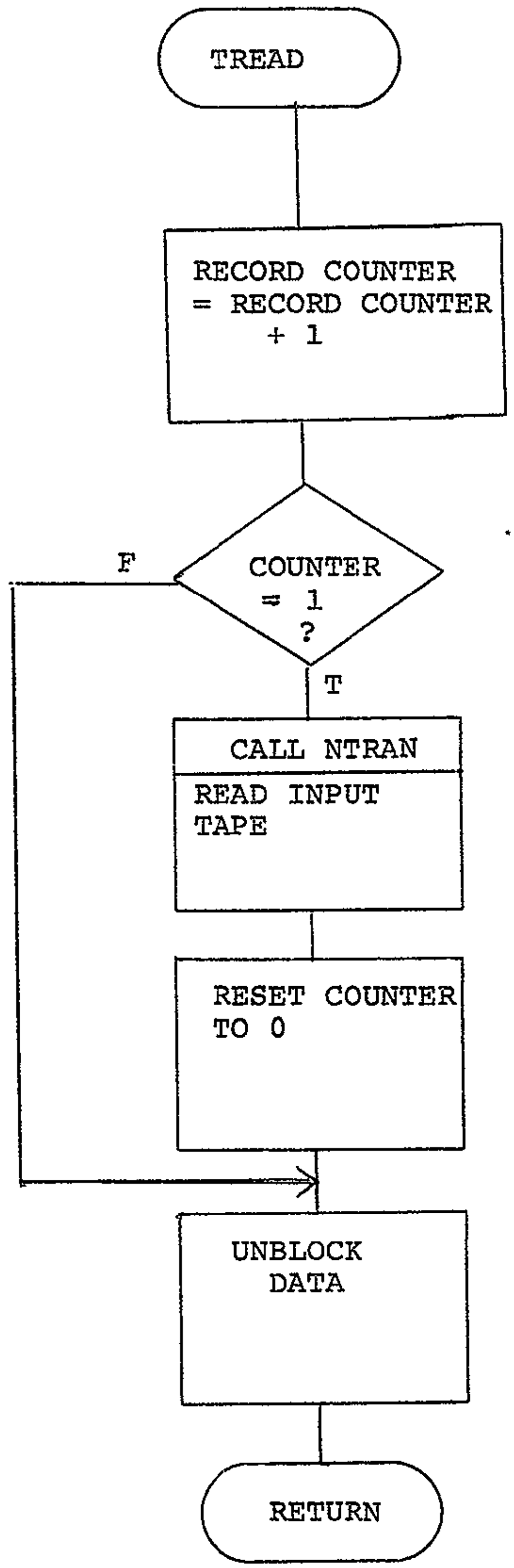
Method

Local Variables

Name	Type	Units	Description
A(I),I=1,32	R	-	Logical record
ASAVE	R	.2 SEC	Last time read from tape
B(I),I=1,640	R	-	Record buffer
DELTA	R	SEC	Delta time
ISKIP	I	-	Bad record flag
ISTAT	I	-	Status return
NN	I	-	Logical record counter
TP	R	SEC	Adjusted time
TSAVE	R	SEC	Last adjusted time
TSTART	R	.2 SEC	First good time

Model

The NTRAN I/O Routines are used to read the input tape. The data is then unblocked and data from one logical record is returned to PHASE. Additional information on NTRAN usage may be found in PARTS 15 and 20 of the CAD Procedures Manual.


TREAD
RECORD COUNTER = RECORD COUNTER + 1
COUNTER = 1 ?
F
T
CALL NTRAN
READ INPUT TAPE
RESET COUNTER TO 0
UNBLOCK DATA
RETURN

5.5 PROGRAM LISTINGS

```
@PDP,FL H.COMMON,H.COMMON
PDPT10 RL70-6 02/06-18:09:31-(0,3)
          PAR    PROC
                 PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MMV=9,MSV=9,MSWV=9
                 *   ,MVCONF=10
                 PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10
                     COMMON/NUMS/NL,NA
          END
          CBL1   PROC
                 COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV
                 INTEGER STVLV
                 COMMON /RATES/RATE(MNA),HM(MNA),DFF(MNA),CGLOAD,ALT,XMACH
                 COMMON /TIMES/ISTART,ISTOP,IEND,NOL,NPTS,NPLTS
                 *      ,IPHASE,IVFLAG,NOL2,TTIME,IUNIT,FREE(2),FRNO(4)
                 *   ,CLNO(4),TPCALL(4),ECTRAN(3),LTYPE,XTFNO,LPHASE,NW
                 *   ,ISTAT,ICARD,LUNIT
                 COMMON /TARRAY/ T(1000),WRT(NR)
                 COMMON /TRAJ/ INDEX(NR),ICTP
                 COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NMODE(3),ISPED(2),ILOAD(MNA),
                 *                IVEH(MNL),ACTNAM(MNA,2)
          END
          CBL2   PROC
                 COMMON /GRAD/FGRAD(MNL,2),FLGRAD(MNL)
                 COMMON /LKGS/PSLKG(MNL),SVLKG(MNL),XPSLKG(MNL),XSVLKG(MNL)
                 *,ALTFLW(MNL)
                 COMMON /LMMTRX/LMM(3,MNL),IPTR(3,3,3),ICODE(3,MNL),IASGN(MNL),
                 *                 MIV(MNL),ISIV(MNL),ISWV(MNL),
                 *                 MVNAM(2,MMV),MVSYS(MMV),MVVEH(MMV),
                 *                 SVNAM(2,MSV) ,           SVVEH(MSV), SVSYS(MSV),
                 *          SWVNAM(2,MSWV),SWSYS(MSWV)                ,SWVVEH(MSWV)
                 *,VCONF(MVCONF),NMV,NSV,NSWV,NVCONF
                 INTEGER VCONF,      SVVEH,               SWVVEH,SVSYS   ,SWSYS
          END
          CBL3   PROC
                 COMMON /OUTPUT/FLRT(MNL),TFLRT(3),PWR(3),ISAT(3),SAT(2)
                 *, IPPLT,IOTAP
                 COMMON /COEFF/ CF(10,2,2,2),
                 *              CRANGE(2,2,2,3)
                 *    ,NPCP
                 DOUBLE PRECISION CF
                 COMMON /PCOMP/ULTPLC(3),ULPRLC(3),TVOL(3),HE(3),
                 *             ULTALT(3),ULTOFT(3,7),PLIM(3)
                 *             ,ULPRFC(3),XFLOW(3,2)
                 COMMON /FUEL/ FLOAD(3),FUNUSE(3),TFUSED(3),FREM(3),TENUSD(3)
                 COMMON /SFCC/ NOCF(MNSPDS,MNEQNS,3),SFC(MNSPDS,MNEQNS,MNOCF,3),
                 *              XALT(MNSPDS,MNEQNS,3),PRALT(MNSPDS,MNEQNS,3),NSPDS,
                 *             NEQNS(MNSPDS),FURATE(3)
                 COMMON/THRST/TALT(MNTEQN),TNOCF(MNTEQN),THRUST(MNTEQN,MTNOCF)
                 *,NTC,TPRESS(MNTEQN),TR(3),PAMB
                 INTEGER TNOCF
          END

END PDP  ERRORS : NONE
```

```
@FOR,S H.MAIN/V6,H.MAIN/V6
FOR S0C3-C2/06/79-18:09:33 (24,)

  MAIN PROGRAM

  STORAGE USED: CODE(1) 000162; DATA(0) 000050; BLANK COMMON(2) 000000

   COMMON BLOCKS:

   0003    NUMS    000002
   0004    CONF    000014
   0005    RATES   000132
   0006    TIMES   000043
   0007    TAPRAY  002106
   0010    TRAJ    000137
   0011    NAMES   000424
   0012    OUTPUT  000073
   0013    COEFF   000271
   0014    PCOMP   000060
   0015    FUEL    000017
   0016    SFCC    001424
   0017    THRST   000106

  EXTERNAL REFERENCES (BLOCK, NAME)

   0020    DBASE
   0021    TLINE
   0022    HINGE
   0023    ACTDAT
   0024    POWER
   0025    SAPUM
   0026    SUMM
   0027    NINTR$
   0030    NWDU$
   0031    NIO2$
   0032    NRDU$
   0033    NIO3$
   0034    NWEF$
   0035    NWNL$
   0036    NSTOP$

  STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

   0000   000035 100F      0000   000036 101F      0000   000025 102F      0001   000106 203G      0001   000124 300L
   0001   000054 5L        0011   000332 ACTNAM    0005   000130 ALT       0013 D 000000 CF        0005   000127 CGLOAD
   0006   000021 CLNO      0000   000015 DB        0005   000072 DEF       0006 R 000031 ECTRAN    0013   000240 ERANGE
   0015   000000 FLOAD     0012   000000 FLRT      0006   000013 FREE      0015   000011 FREM      0006   000015 FRNO
   0015   000003 FUNUSE    0016   001421 FURATE    0014   000011 HF        0005   000035 HP        0000 I 000014 I
   0000 I 000000 IA        0011   000134 IACTNO    0004 I 000003 IAPUSD    0006   000041 ICARD     0006 I 000002 IEND
   0010   000136 IETP      0011   000217 ILOAD     0010   000000 INDEX     0012 I 000072 IOTAP     0006 I 000006 IPHASE
   0012 I 000071 IPPLT     0012   000064 ISAT      0011   000215 ISPED     0006   000000 ISTART    0006 I 000040 ISTAT
   0006 I 000001 ISTOP     0004 I 000000 ISYS      0006   000012 IUNIT     0011   000254 IVEH      0006 I 000007 IVFLAG
   0006   000036 LPHASE    0006   000034 LTYPE     0006   000042 LUNIT     0003   000001 NA        0011   000000 NAME
   0016   001415 NEQNS     0003   000000 NL        0011   000212 NMODE     0016   000000 NOCF      0006 I 000003 NOL
   0006 I 000010 NOL2      0004 I 000007 NOS       0013   000270 NPER      0006 I 000005 NPLTS     0006 I 000004 NPTS
```

```
0016   001414 NSPDS    0017   000074 NTC      0006   000037 NW       C004   000010 P        C017   000105 PAMB
0014   000044 PLIM     0016   001320 PRALT    0012   000061 PWR      C005   000000 RATE     0012   000067 SAT
0016   000074 SFC      0004 I 000013 STVLV    0007 * 000000 T        C017   000000 TALT     0015   000014 TENUSO
0012   000056 TFLRT    0015   000006 TFUSED   0017   000012 THRUST   C017 I 000005 TNOCF    C0C4   000006 TP
0006   000025 TPCALL   0017   000075 TPRESS   0017   000102 TR       C006   000011 TTIME    C014   000006 TVCL
C014   000047 ULPRFC   0014   000003 ULPRLC   0014   000014 ULTALT   C014   000017 ULTOFT   CC14   000000 ULTPLC
C007   001750 WRT      0016   001224 XALT     0014   000052 XFLOW    G005   000131 XMACH    C0C6   000035 XTPNO
```

```
1*          INCLUDE PAR,LIST
1*    PAR   PROC
1*          PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MPV=9,MSV=9,MSWV=9
1*         *   ,MVCONF=10
1*          PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10
1*                 COMMON/NUMS/NL,NA
1*     END
2*          INCLUDE CBL1,LIST
2*    CBL1  PROC
2*          COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV
2*          INTEGER STVLV
2*          COMMON /RATES/RATE(MNA),HM(MNA),DEF(MNA),CGLOAD,ALT,XMACH
2*          COMMON /TIMES/ISTART,ISTOP,IEND,NCL,NPTS,NPLTS
2*         *      ,IPHASE,IVFLAG,NOL2,TTIME,IUNIT,FRFE(2),FRNO(4)
2*         *   ,CLNO(4),TPCALL(4),ECTRAN(3),LTYPE,XTPNO,LPHASE,NW
2*         *   ,ISTAT,ICARD,LUNIT
2*          COMMON /TARRAY/ T(1000),WRT(NR)
2*          COMMON /TRAJ/ INDEX(NR),IFTP
2*          COMMON/NAMES/NAME(2,MNL),TACTNO(MNL),NMODE(3),ISPED(2),ILOAD(MNA)
2*         *                IVEH(MNL),ACTNAM(MNA,2)
2*     END
3*          INCLUDE CBL3,LIST
3*    CBL3  PROC
3*          COMMON /OUTPUT/FLRT(MNL),TFLRT(3),PWR(3),ISAT(3),SAT(2)
3*         *, IPPLT,IOTAP
3*          COMMON /COEFF/ CF(10,2,2,2),
3*         *                ERANGE(2,2,2,3)
3*         *    ,NPCR
3*          DOUBLE PRECISION CF
3*          COMMON /PCOMP/ULTPLC(3),ULPRLC(3),TVOL(3),HE(3),
3*         *              ULTALT(3),ULTOFT(3,7),PLIM(3)
3*         *              ,ULPRFC(3),XFLOW(3,2)
3*          COMMON /FUEL/ FLOAD(3),FUNUSE(3),TFUSED(3),FREM(3),TENUSD(3)
3*          COMMON /SFCC/ NOCF(MNSPDS,MNEQNS,3),SFC(MNSPDS,MNEQNS,MNOCF,3),
3*         *               XALT(MNSPDS,MNEQNS,3),PRALT(MNSPDS,MNEQNS,3),NSPDS,
3*         *              NEQNS(MNSPDS),FURATE(3)
3*          COMMON/THRST/TALT(MNTEQN),TNOCF(MNTEQN),THRUST(MNTEQN,MTNOCF)
3*         *,NTC,TPRESS(MNTEQN),TR(3),PAMB
3*          INTEGER TNOCF
3*     END
4*           DIMENSION IA(12)
5*          NAMELIST/DB/NPTS,NPLTS
6*          DATA (T(I),I=1,NR)/NR*1./
7*          DATA ISYS /3*1/ ,IAPUSD/3*1/,ISTAT/1/
8*          DATA ECTRAN /3*-999999999./
9*          DATA (T(I),I=675,677) /3000.,1000.,0./
```


C-2

```
CO143         DATA T(781)/.9/,T(786)/1./                                                C00001
CO146         DATA (T(I),I=800,811)/3000.,1000.,-.00833333333,.0375,1.0,                C00001
CO146        *     6.5,4*0,1.0,1./                                                      C00001
CO150         NOL=51                                                                    C00001
CO151         NOL2=51                                                                   C00003
CO152         WRITE(15,102)                                                             C00004
CO154   102   FORMAT(' PUT IN RUN ID FOR HEADER ON PRINT FILES')                        C00011
CO155         READ(5,100) IA                                                            C00011
CO160   100   FORMAT(12A6)                                                              C00021
CO161         WRITE(6,101)IA                                                            C00021
CO164         WRITE(7,101)IA                                                            C00031
CO167         WRITE(8,101)IA                                                            C00041
CO172   101   FORMAT(2X,12A6)                                                           C00051
CO172   C                                                                               C00051
CO172   C READ IN DATABASE                                                              C00051
CO172   C                                                                               C00051
CO173         CALL DBASE                                                                C00051
CO173   C                                                                               C00051
CO173   C READ IN TIMELINE INPUT                                                        C00051
CO173   C                                                                               C00051
CO174       5 CALL TLINE                                                                C00054
CO174   C                                                                               C00054
CO174   C                                                                               C00054
CO174   C SET MISSION PHASE AND VEHICLE FLAGS                                           C00054
CO174   C                                                                               C00054
CO175         IPHASE=T(664)+.1                                                          C00055
CO176         IVFLAG=T(996)+.1                                                          C00066
CO177         IF (ISTOP.EQ. 1) GO TO 300                                                C00077
CO177   C                                                                               C00077
CO201         NOS=0                                                                     C00102
CO202         DO 10 I=1,3                                                               C00106
CO205      10 IF (ISYS(I) .EQ. 1) NOS=NOS+1                                             C00106
CO205   C                                                                               C00106
CO205   C CHECK RATES AGAINST HINGE-MOMENT STALL CURVES                                 C00106
CO205   C                                                                               C00106
CO205   C                                                                               C00106
CO210         CALL HINGE                                                                C00115
CO210   C                                                                               C00115
CO210   C  DETERMINE SYSTEM ASSIGNMENTS, POWER SPOOL AND SERVO VALVE LKGS               C00115
CO210   C  AND FLOW GRADIENTS FOR ACTUATORS                                             C00115
CO210   C                                                                               C00115
CO211         CALL ACTDAT                                                               C00117
CO211   C                                                                               C00117
CO211   C  COMPUTE FLOW RATES AND POWER REQUIREMENTS                                    C00117
CO211   C OUTPUT POWER REPORT AND POWER PLOT TAPE                                       C00117
CO211   C                                                                               C00117
CO212         CALL POWER                                                                C00121
CO212   C                                                                               C00121
CO212   C                                                                               C00121
CO212   C AVERAGE DATA AND OUTPUT TAPE                                                  C00121
CO212   C COMPUTE APU FUEL USAGE AND OUTPUT APU PLOT TAPE                               C00121
CO212   C                                                                               C00121
CO213   300 CALL SAPUM                                                                  C00124
CO214         IF (IFND .NE. 1) GO TO 5                                                  C00125
CO216   400 CONTINUE                                                                    C00130
CO216   C IF DATA AVERAGING WAS SUPPRESSED PRINT FINAL FUEL USAGE SUMMARY                C00130
CO217         IF (T(783) .GT. 0) CALL SUMM                                              C00130
```

ORIGINAL PAGE IS OF POOR QUALITY

```
C0221      67*      401    IF (T(762).GT. 0)  END FILE IPPLT                                  C00135
C0223      68*             IF (T(784).GT. 0) END FILE IOTAP                                   C00143
C0225      69*             WRITE(6,DC)                                                        C0C151
C0230      70*             STOP                                                               C00155
C0231      71*             END                                                                C00161
END FOR
```

@FOR,S H.TLINE/V6,H.TLINE/V6
FOR S0E3-02/06/79-18:09:39 (50,)

SUBROUTINE TLINE , ENTRY POINT 000662

STORAGE USED: CODE(1) 000673; DATA(0) 000175; BLANK COMMON(2) 000000

COMMON BLOCKS:

0003	NUMS	000002
0004	CONF	000014
0005	RATES	000132
0006	TIMES	000043
0007	TARRAY	002106
0010	TRAJ	000137
0011	NAMES	000424
0012	GRAD	000212
0013	LKGS	000346
0014	LMMTRX	001141

EXTERNAL REFERENCES (BLOCK, NAME)

0015	SYSDAT
0016	PHASE
0017	NRDU$
0020	NI02$
0021	NI03$
0022	NWDU$
0023	NEPR2$
0024	NERR3$

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001		000005	1L	0001		000641	100L	0000		000130	11F	0000		000121	12F	0001		000135	13L
0001		000141	14L	0001		000016	2L	0001		000205	20L	0001		000322	300G	0001		000402	334G
0001		000411	341G	0001		000444	354G	0001		000537	400G	0001		000544	405G	0001		000555	413G
0001		000024	5L	0001		000275	50L	0001		000314	51L	0001		000333	55L	0001		000356	56L
0000		000120	6F	0001		000363	60L	0001		000360	64L	0001		000311	79L	0001		000437	80L
0001		000107	9L	0001		000533	90L	0001		000477	91L	0000		000133	911F	0000		000124	912F
0000		000137	913F	0001		000502	92L	0001		000507	93L	0001		000634	99L	0011		000332	ACTNAM
0005	R	000130	ALT	0013		000270	ALTFLW	0005	R	000127	CGLOAD	0006		000021	CLNO	0000	R	000035	CMT
0000	R	000047	DATA	0000		000061	DBI	0000		000113	D92	0005	R	000072	DEF	0006		000031	ECTRAN
0012		000000	FCRAD	0012		000134	FLGRAD	0006		000013	FREE	0006		000015	FRNO	0005	R	000035	HK
0000	I	000045	I	0011		000134	IACTNO	0004	I	000003	IAPUSD	0014		000457	IASCN	0006	I	000041	ICARD
0014		000243	ICODE	0000	I	000050	IDATA	0006	I	000002	IEND	0010	I	000136	IETP	0000	I	000056	II
0011	I	000217	ILOAD	0010	I	000000	INDEX	0000		000154	INJP$	0006		000006	IPHASE	0014		000212	IPTR
0000	I	000054	IR	0014		000613	ISIV	0011		000215	ISPED	0000	I	000046	ISSTRT	0006	I	000000	ISTART
0006	I	000040	ISTAT	0006	I	000001	ISTOP	0000	I	000051	ISUB	0014		000671	ISWV	0004	I	000000	ISYS
0006		000012	IUNIT	0011		000254	IVEH	0006		000007	IVFLAG	0000	I	000052	J	0000	I	000053	K
0014		000000	LMH	0006		000036	LPHASE	0006		000034	LTYPE	0006		000042	LUNIT	0000	I	000055	M
0014		000535	MIV	0014		000747	MVNAM	0014		000771	MVSYS	0014		001002	MVVEH	0003	I	000001	NA
0011		000000	NAME	0003		000000	NL	0011		000212	NMODE	0014		001135	NMV	0000	R	000044	NODATA
0006	I	000003	NCL	0006		000010	NOL2	0004		000007	NOS	0006		000005	NPLTS	0006		000004	NPTS

```
0014     001136 NSV       0014     001137 NSWV      0014     001140 NVCONF    0006     000037 NW        0000 R 000000 OWRT
0004     00001C P         0013     00000C PSLKG     0005 R 000000 RATE      0004 I 000013 STVLV     0013    000056 SVLKC
0014     001013 SVNAM     0014 I 001046 SVSYS     0014 I 001035 SVVEH     0014 I 001101 SWSYS     0014    001057 SWVNAM
0014 I 001112 SWVVEH    0007 R 000000 T         0004 R 000006 TP        0006     000025 TPCALL    0006    000011 TTIME
0014 I 001123 VCONF     0007 R 001750 WRT       0005 R 000131 XMACH     0013     000134 XPSLKG    0013    000212 XSVLKG
0006     000035 XTPNO

00101                SUBROUTINE TLINE                                                          000000
00103                INCLUDE PAR,LIST                                                          000000
00103         PAR    PROC                                                                      000000
00104                PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MMV=9,MSV=9,MSWV=9           000000
00104               *   ,MVCONF=10                                                             000000
00105                PARAMETER MNSPOS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10                   000000
00106                    COMMON/NUMS/NL,NA                                                     000000
00106          END                                                                             000000
00107                INCLUDE CBL1,LIST                                                         000000
00107         CBL1   PROC                                                                      000000
00110                COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV                          000000
00111                INTEGER STVLV                                                             000000
00112                COMMON /RATES/RATE(MNA),HM(MNA),DEF(MNA),CGLOAD,ALT,XMACH                 000000
00113                COMMON /TIMES/ISTART,ISTOP,IEND,NCL,NPTS,NPLTS                            000000
00113               *     ,IPHASE,IVFLAG,NOL2,TTIME,IUNIT,FREE(2),FRNO(4)                      000000
00113               *   ,CLNO(4),TPCALL(4),ECTPAN(3),LTYPE,XTPNO,LPHASE,NW                     000000
00113               *   ,ISTAT,ICARD,LUNIT                                                     000000
00114                COMMON /TARRAY/ T(1000),WPT(NR)                                           000000
00115                COMMON /TRAJ/ INDEX(NR),IFTP                                              000000
00116                COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NMODF(3),ISPED(2),ILOAD(MNA),        000000
00116               *                IVEH(MNL),ACTNAM(MNA,2)                                   000000
00116          END                                                                             000000
00117                INCLUDE CBL2,LIST                                                         000000
00117         CBL2   PROC                                                                      000000
00120                COMMON /GRAD/FGRAD(MNL,2),FLGRAD(MNL)                                     000000
00121                COMMON /LKGS/PSLKG(MNL),SVLKG(MNL),XPSLKG(MNL),XSVLKC(MNL)                000000
00121               *,ALTFLW(MNL)                                                              000000
00122                COMMON /LMMTRX/LMM(3,MNL),IPTR(3,3,3),ICODE(3,MNL),IASGN(MNL),            000000
00122               *                MIV(MNL),ISIV(MNL),ISWV(MNL),                             000000
00122               *                MVNAM(2,MMV),MVSYS(MMV),MVVEH(MMV),                       000000
00122               *                SVNAM(2,MSV) ,             SVVEH(MSV), SVSYS(MSV),        000000
00122               *           SWVNAM(2,MSWV),SWSYS(MSWV)                 ,SWVVEH(MSWV)       000000
00122               *,VCONF(MVCONF),NMV,NSV,NSWV,NVCONF                                        000000
00123                INTEGER VCONF,      SVVEH,                 SWVVEH,SVSYS   ,SWSYS          000000
00123          END                                                                             000000
00124                DIMENSION OWRT(MNA)                                                       000000
00125                DIMENSION CMT(7)                                                          000000
00126                REAL NODATA /'NODATA'/                                                    000000
00130                NAMELIST/DB1/   ISTART,ISTOP,IEND,IETP,ISTAT,TP,T(660),T(661)             000000
00131                NAMELIST/DB2/ I                                                           000000
00132                DATA ISYS/3*1/,IAPUSD/3*1/,ISTAT/1/                                       000000
00132         C IF USING CARD INPUT READ RESTART DATA                                          000000
00132         C TEST FOR MISSION STOP TIME                                                     000000
00136                IF (ISTOP .EQ. 0) GO TO 1                                                 000000
00140                ISTART=0                                                                  000001
00141                ISTOP=0                                                                   000002
00142                GO TO 2                                                                   000003
```

```
00143        1 IF( TP      .GT. T(665)) GO TO 99                          000005
00145          IF (ICARD .EQ. 1) GO TO 2                                  000010
00147          IF (ISTART .NE. 0) GO TO 50                                000013
00147  C                                                                  000013
00147  C READ IN T-ARRAY                                                  000013
00147  C                                                                  000013
00151   2      IF (T(999) .EQ. 1.0) ISTART= 0                             000016
00153          ISTP=0                                                     000021
00154          ISSTRT=0                                                   000022
00155        5 READ (5,6,END=100) I                                       000024
00160        6 FORMAT (I3)                                                000032
00161          IF (I .EQ. 999) GO TO 20                                   000032
00163          IF (I .LT. 401 .OR. I .GT. 650) GO TO 9                    000035
00165          IF (T(662) .GT. 2) GO TO 14                                000053
00167          READ(30,12)I,DATA,CMT                                      000057
00174       12 FORMAT (I3,1X,A6,14X,7A6)                                  000071
00175          IF (T(991).EQ.0)WRITE(15,912)I,DATA,CMT                    000071
00203  912     FORMAT(1X,I3,1X,A6,14X,7A6)                                000105
00204          GO TO 13                                                   000105
00205        9 READ (30,11) I,DATA,CMT                                    000107
00212       11 FORMAT (I3,1X,F20.0,7A6)                                   000120
00213          IF (T(991).EQ.0)WRITE(15,911)I,DATA,CMT                    000120
00221  911     FORMAT(1X,I3,1X,F20.10,7A6)                                000135
00222       13 T(I)=DATA                                                  000135
00223          GO TO 5                                                    000137
00224  14      READ(30,11) I,DATA,CMT                                     000141
00231          IF (T(991).EQ.0) WRITE(15,911)I,DATA,CMT                   000152
00237          IDATA=DATA+.1                                              000170
00240          INDEX(I-400)=IDATA                                         000201
00241          GO TO 5                                                    000203
00242  20       READ(30,11)I,DATA,CMT                                     000205
00247          IF(T(991).EQ.0)WRITE(15,911)I,DATA,CMT                     000216
00255          T(I)=DATA                                                  000232
00256  913     FORMAT(1X,I3,/)                                            000235
00257          TP=T(660)                                                  000235
00260          IF (ABS(T(997)-1.0).LE.0.01) T(661)=(T(661)/3600.+T(998))  000237
00262          IF(ABS(T(997)-2.0).LE.0.01) T(661)=(T(661)/3600.+(T(993)/3600.)  000251
00262         *+T(999))                                                   000251
00262  C IF FIRST PASS CALL SYSDAT                                        000251
00262  C IF NEW SYSTEMS DATA HAS BEEN READ IN RECALL SYSDAT               000251
00264          IF ( ISTART .NE. 0) GO TO 50                               000266
00264  C GENERATE LOSS MANAGEMENT MATRIX                                  000266
00264  C                                                                  000266
00266          CALL SYSDAT                                                000270
00267          NOL=51                                                     000272
00267  C                                                                  000272
00270       50 ICARD=0                                                    000275
00271          IF (T(662) .LE. 0) GO TO 51                                000275
00271  C                                                                  000275
00271  C ISTAT=1 READ NEXT TIME FROM TAPE                                 000275
00271  C ISTAT=2 UPDATE WITH DATA FROM TAPE                               000275
00271  C ISTAT=3 DATA HAS BEEN UPDATED WITH RESTART DATA.  READY TO PROCESS  000275
00271  C                                                                  000275
00273          GO TO (55,60,79),ISTAT                                     000300
00274       79 ISTAT=2                                                    000311
00275          GO TO 20                                                   000312
00275  C                                                                  000312
```

```
C SET UP  OWRT ARRAY FOR CARD INPUT
C
   51 ICARD=1
      DO 52 I=1,NA
      OWRT(I)=0.0
      HM(I)= .0
   52 DFF(I)=0.0
      T(665)=T(661)
      ISTAT=1
      GO TO 70
C
C READ NEW DATA FROM TAPE PHASE ROUTINE
C
   55 CALL PHASE
C IF END OF TAPE JUMP TO NEXT RESTART
      IF (ISTP .EQ. 1) GO TO 64
   57 IF (WRT(1) .GE. T(665)) GO TO 99
      IF( WRT(1)-T(661)) 60,58,56
C IF RESTART = NEW TIME ON TAPE READ RESTART DATA AND PROCESS
C WITH NEW DATA FROM TAPE
   58 ISTAT=2
      T(665)=T(661)
      GO TO 2
C IF TIME ON TAPE GT RESTART READ RESTART DATA AND PROCESS
C WITH OLD DATA FROM TAPE
   56 ISTAT=3
   64 CONTINUE
      T(665)=T(661)
      GO TO 2
C UPDATE WITH DATA FROM PHASE
   59 CONTINUE
   60 ISTAT=1
      TP=WRT(1)
      DO 61 I=1,NA
   61 OWRT(I)= WRT(I+1)
      DO 62 I=1,NA
      HM(I)=WRT(I+NA+1)
      ISUB=2*NA + 1
   62 DFF(I)=WRT(I+ISUB)
      ISUB=3*NA + 1
      ALT=WRT(1+ISUB)
      COLOAD=WRT(2+ISUB)
      XMACH=WRT(3+ISUB)
C
C OVERLAY RATES FROM CARD INPUT
C
   60 DO 90 I=1,15
      J=670+(I*2)
      K=J+1
      IR=T(J)+.1
      IR=IR+1
      GO TO (91,92,93),IR
C PROCESS TRANSIENTS WITH NO OVERLAID RATES
   91 RATE(I)=OWRT(I)
      GO TO 90
C PROCESS TRANSIENTS WITH OVERLAID COMMANDED RATES
   92 RATE(I)=T(K)+OWRT(I)
```

```
C0366              GO TO 99                                                L00505
C0366        C PROCESS TRANSIENTS WITH OVERLAID FLUID FLOW RATES             L00505
C0367           93 IF (T(K) .GE. 0) M=1                                      L00507
C0371              IF (T(K) .LT. 0) M=2                                      L00516
C0373              II=ILOAD(I)                                               L00524
C0374           95 RATE(I)=T(K)  + OWRT(I)                                   L00526
C0375           90 CONTINUE                                                  L00537
C0375        C OVERRIDE FROM T-ARRAY                                         L00537
C0377              DO 96 I=16,NA                                             L00537
C0402           96 RATE(I)=OWRT(I)                                           L00537
C0404              DO 97 I=16,NA                                             L00544
C0407           97 IF (ABS(T(I+694)) .GT. 0) RATE(I)=T(I+694)                L00544
C0412              DO 110 I=1,3                                              L00555
C0415              IF (T(I+668) .GT. 0) ISYS(I)=T(I+668)                     L00555
C0417          110 IF (T(I+671) .GT. 0) IAPUSD(I)=T(I+671)                   L00566
C0422              IF (T(678) .GT. 0) ALT=T(678)                             L00602
C0424              IF (T(679) .GT. 0) CGLOAD=T(679)                          L00607
C0424        C SET VALVE STATUS FLAGS BASED ON VALVE CONFIGURATION CODE      L00607
C0426              J=T(680)+.1                                               L00614
C0427              STVLV=VCODE(J)                                            L00626
C0430              RETURN                                                    L00630
C0431           99 ISTOP=1                                                   L00634
C0432              RETURN                                                   L00635
C0433          100 IENS=1                                                    L00641
C0434              ISTOP=1                                                   L00642
C0435              RETURN                                                    L00643
C0436              END                                                       L00672
END FOR
```

```
@FOR,S M.PHASE/V ,M.PHASE/V6
FOR S?03-02/26/7? -1?.39:31 (21,)

   SUBROUTINE PHASE      ENTRY POINT 001231

   STORAGE USED: CODE(1) 001240, DATA(0) 001292; BLANK COMMON(2) 000000

    COMMON BLOCKS:

    0003     NUMS     000002
    0004     CONF     000014
    0005     RATLS    000132
    0006     TIMES    000047
    0007     TARRAY   002126
    0010     TRAJ     000137
    0011     NAMES    000424

   EXTERNAL REFERENCES (BLOCK, NAME)

    0012     SUMN
    0013     COS
    0014     SIN
    0015     NLRP2?
    0016     NPBU$
    0017     NIO3$
    0020     NIO2$
    0021     NWDU$
    0022     NIO1$
    0023     TAN
    0024     ATAN
    0025     NERR3$

   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)
```

0001		000131	10L	0001		000411	102L	0001		000170	12L	0001		000002	136G	0001		000214	15L
0001		000227	16L	0001		000133	161G	0001		000377	17L	0001		000400	19L	0001		000532	185L
0001		001556	176L	0001		000577	183L	0001		000612	190L	0001		000232	20L	0001		000505	200L
0001		000625	201L	0001		000175	204G	0001		000355	21L	0001		000202	211G	0001		000205	214G
0001		000667	225L	0001		000702	220L	0001		000242	237G	0001		000254	247G	0001		000275	257G
0001		000276	264G	0001		000303	271G	0001		000306	274G	0001		000702	302L	0001		000717	303L
0001		000761	305L	0001		001103	307L	0001		001111	309L	0001		000727	310L	0001		000712	312L
0001		001144	320L	0001		000351	321G	0001		000357	326G	0001		000404	346G	0001		000416	356G
0001		000426	364G	0001		001002	405L	0001		000541	425G	0001		000433	45L	0001		000663	456G
0000		000522	46F	0001		002677	466G	0001		000714	476G	0001		000252	50L	0001		000460	500L
0001		000467	501L	0001		000452	502L	0000		000533	503F	0001		000731	525G	0001		000756	516G
0001		001016	526F	0001		001105	546G	0001		001126	557G	0001		001164	572G	0001		000716	65L
0001		000371	66L	0001		000037	70L	0000		000476	900F	0000		000527	910F	0001		000332	ACTLAM
[illegible]	R	[illegible]	ALPHA	[illegible]	R	000445	ALRAD	0005		000137	ALT	0005		000127	COLOAD	0006		000021	CLNC
0000	R	000446	COSAL	0000	R	000467	COSPH	0000		000471	CR	0005		000072	DEF	0000	R	000034	CP
0000	R	002044	DUM	0000	R	000456	DUM1	0000	R	000457	DUM2	0006	R	000031	DCTRAN	0000	R	000000	EOF
0006		000013	[illegible]	0006		000015	FRNO	0005		000035	HM	0000	I	000444	I	0011		000134	IACTIO
0004	I	000003	IAFUSD	0006		000041	ICARL	0006	I	000460	IP	0000	I	000455	IDUM	0006		[illegible]	[illegible]
0010	I	000170	IETP	0011		000217	ILOAD	0010	I	000000	INDEX	0000		001156	[illegible]	0006	I	[illegible]	[illegible]

```
C000 I 000453 IS          0011   000215 ISPED     0006   000000 ISTART    C006   000040 ISTAT     C0C6   000001 ISTOP
C010 I 000464 ISUP        0000 I 000536 ISYM      0004 I 000000 ISYS      C000 I 000450 ITYPE     0006 I 000012 IUNIT
C011   000254 IVEH        0006   000007 IVFLAG    0000 I 000454 J         C006 I 000036 LPHASE    0006 I 000034 LTYPE
C006 I 000042 LUNIT       0000 I 000001 NA        0011   000000 NAME      C003   000000 NL        0011   000212 NMODE
0000 R 000503 NODATA      0006   000003 NOL       0006   000010 NOL2      C004   000007 NOS       C0C6   000005 NPLTS
C006   000004 NPTS        0006 I 000037 NW        0004   000010 P         C000 R 000466 PHI       0000 R 000452 PHSTRT
0000 R 000002 PI          0005   000000 RATE      0000 R 000447 SINAL     C004 I 000013 STVLV     0000 R 000536 SYM
0007 R 000000 T           000C   000536 TDUM      0000 R 000004 THROTL    C000 R 000465 TLGOWN    0004 R 000006 TP
C006   000025 TPCALL      000C R 000451 TPNO      0006 R 000011 TTIME     C000 R 000461 T804      0000 R 000462 T805
0000 R 000463 T811        0007 R 001750 WPT       0005   000131 XMACH     C000 R 000007 XPOS      C000 R 000470 XTIME
C006 R 000035 XTPNO       000C D 000534 XXDP

C0101      1*              SUBROUTINE PHASE                                                     000000
C0103      2*              INCLUDE PAR,LIST                                                     000000
C0103      2*     PAR      PROC                                                                 000000
C0104      2*              PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MMV=9,MSV=9,MSWV=9     000000
C0104      2*            *   ,MVCONF=10                                                         000000
C0105      2*              PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10              000000
C0106      2*                  COMMON/NUMS/NL,NA                                                000000
C0106      2*      END                                                                          000000
C0107      3*              INCLUDE CBL1,LIST                                                    000000
C0107      3*     CBL1     PROC                                                                 000000
C0110      3*              COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV                     000000
C0111      3*              INTEGER STVLV                                                        000000
C0112      3*              COMMON /RATES/RATE(MNA),HM(MNA),DEF(MNA),CGLOAD,ALT,XMACH            000000
C0113      3*              COMMON /TIMES/ISTART,ISTOP,IEND,NCL,NPTS,NPLTS                       000000
C0113      3*            *     ,IPHASE,IVFLAG,NOL2,TTIME,IUNIT,FREC(2),FRNO(4)                  000000
C0113      3*            *   ,CLNO(4),TPCALL(4),ECTRAN(3),LTYPE,XTPNO,LPHASE,NW                 000000
C0113      3*            *   ,ISTAT,ICARD,LUNIT                                                 000000
C0114      3*              COMMON /TARRAY/ T(1000),WPT(NR)                                      000000
C0115      3*              COMMON /TRAJ/ INDEX(NR),IETP                                         000000
C0116      3*              COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NMODE(3),ISPED(2),ILOAD(MNA),   000000
C0116      3*            *                 IVEH(MNL),ACTNAM(MNA,2)                              000000
C0116      3*      END                                                                          000000
C0117      4*              DIMENSION DP(2)                                                      000000
C0120      5*              DOUBLE PRECISION XXDP                                                000000
C0121      6*              EQUIVALENCE (XXDP,DP)                                                000000
C0122      7*              DATA EOF /'EOF'/,ALPHA/34.83/,PI/3.1417/                             000000
C0126      8*              EQUIVALENCE (SYM(1),ISYM(1))                                         000000
C0127      9*              EQUIVALENCE (SYM(1),TDUM(1))                                         000000
C0130     10*              REAL NODATA/'NODATA'/                                                000000
C0132     11*              DIMENSION THROTL(3),XPOS(MNA)                                        000000
C0133     12*              DIMENSION DUM(256),ISYM(256),SYM(256),TDUM(222)                      000000
C0134     13*              NAMELIST/D9/DUM                                                      000000
C0135     14*              DO 2 I=1,NR                                                          000002
C0140     15*            2 WRT(I)=0.0                                                           000002
C0142     16*              ALRAD=ALPHA*2.*PI/360.                                               000007
C0143     17*              COSAL=COS(ALRAD)                                                     000010
C0144     18*              SINAL=SIN(ALRAD)                                                     000014
C0145     19*              IETP=0                                                               000020
C0146     20*              ITYPE=T(662) + .1                                                    000021
C0147     21*              NW=T(225)+.1                                                         000032
C0150     22*              IUNIT=T(663)+.1                                                      000043
C0151     23*              TPNO=T(663)                                                          000054
```

ORIGINAL PAGE IS OF POOR QUALITY

```
C0152         IPHASF=T(664) + .1                                        L00056
C0153         IF (IPHASE .NE. LPHASE) PHSTRT=T(660)                     000067
C0155         IF (LTYPE .EQ. ITYPE .AND. LUNIT .EQ. IUNIT)              000074
C0155        *               GO TO (20,70,100),ITYPE                    L00074
C0157         GO TO (10,50,100) ,ITYPE                                  C00120
C0157   C                                                               L00120
C0157   C ROUTINE TO READ OUTPUT TAPE FROM SSFS                         C00120
C0157   C                                                               L00120
C0160      10 DO 5 I=1,256                                              L00133
C0163       5 ISYM(I)=0                                                 L00133
C0165         READ (IUNIT) ISYM                                         C00134
C0170         IS=ISYM(256)                                              L00143
C0170   C THE 256TH WORD OF THE FIRST RECORD WILL CONTAIN               L00143
C0170   C SSFS MOD 4.02            N+1                                  C00143
C0170   C SSFS MOD 4.03,5          N                                    C00143
C0170   C                                   WHERE N=NO OF VARIABLES LISTED ON TAPE   L00143
C0171         IF (IS .EQ. ISYM(IS+1)) GO TO 12                          L00146
C0173         IS=IS-1                                                   C00150
C0174         IF (IS .EQ. ISYM(IS+1)) GO TO 12                          L00154
C0176         WRITE (6,900) IUNIT                                       L00156
C0201     900 FORMAT (1X,'INPUT UNIT ',I3,' IS NOT IN SSFS FORMAT')     C00164
C0202         RETURN                                                    L00164
C0203      12 DO 13 I=1,NR                                              L00170
C0206      13 INDEX(I)=0                                                L00175
C0210         DO 16 I=1,NR                                              L00205
C0213         DO 15 J=1,IS                                              C00205
C0216         IF (T(400+I) .NE.  SYM(J)) GO TO 15                       L00205
C0220         INDEX(I)=J                                                C00210
C0221         GO TO 16                                                  L00212
C0222      15 CONTINUE                                                  L00215
C0224         IF (T(400+I) .EQ. 0) GO TO 16                             L00215
C0226         WRITE (15,910) I,T(400+I)                                 L00217
C0232     910 FORMAT (1X,'NO MATCH WAS FOUND FOR DATA NO ',I3,' WITH',  L00232
C0232        *        ' SYMBOLIC NAME ',A6,//)                          C00232
C0233      16 CONTINUE                                                  L00232
C0235      20 READ (IUNIT,END=45)     (DUM(I),I=1,IS)                   C00232
C0243         IF (DUM(1) .EQ. EOF) GO TO 45                             000245
C0245         GO TO 21                                                  L00250
C0245   C                                                               L00250
C0245   C ROUTINE TO READ OUTPUT TAPE FROM SVDS                         L00250
C0245   C                                                               C00250
C0246      50 DO 51 I=1,256                                             L00254
C0251      51 ISYM(I) =0                                                L00254
C0253         READ(IUNIT)IDUM,IS,(SYM(I),I=1,IS)                        L00255
C0263         DO 64 I=1,NR                                              C00276
C0266      64 INDEX(I)=0                                                C00276
C0270         DO 66 I=1,NR                                              C00306
C0273         DO 65 J=1,IS                                              C00306
C0276         IF (T(400+I) .NE. SYM(J)) GO TO 65                        L00306
C0300         INDEX(I)=J+2                                              C00311
C0301         GO TO 66                                                  C00314
C0302      65 CONTINUE                                                  L00317
C0304         IF (T(400+I) .EQ. 0) GO TO 66                             C00317
C0306         WRITE(15,910) I,T(400+I)                                  L00321
C0312      66 CONTINUE                                                  C00333
C0314         IS=IS+2                                                   C00333
C0315   70    READ(IUNIT,END=45)DUM1,DUM2,(DUM(I),I=3,IS)               C00337
```

```
C
C LOAD DATA INTO WRT ARRAY
C
   21 DO 18 I=1,NR
      ID=INDEX(I)
      IF (ID .EQ. 0) GO TO 17
      WRT(I)   =DUM(ID)
      IF (T(200+I).LE. 0) GO TO 18
      DP(1)=DUM(ID)
      DP(2)=DUM(ID+1)
      WRT(I)=XXPP
      GO TO 18
   17 WRT(I)   =0.0
   18 CONTINUE
      DO 19  I=1,NR
      WRT(I)=WRT(I)*T(I)
19    CONTINUE
      GO TO 200
105   CONTINUE
C
C ROUTINE TO READ BINARY TAPE
  100 DO 101 I=1,NR
  101 WRT(I)=0.0
      READ(IUNIT,END=45)(DUM(I),I=1,NW)
      GO TO 21
C
C
C END OF TAPE (FILE) HAS BEEN REACHED
C
   45 IETP=1
      WRITE(15,46)IUNIT
46    FORMAT(' END OF FILE ON UNIT ',I6,//)
      WRITE(15,503)WRT(1),T(665)
503   FORMAT( )
502   IF (T(781) .EQ. 1.0) GO TO 500
      IF (T(783) .EQ. 1.0) GO TO 501
500   IF (T(999) .EQ. 0.0) CALL SUMM
      RETURN
501   IF (T(999) .EQ. 0.0) RETURN
      TTIME=TTIME+T(665)-TP
      CALL SUMM
      RETURN
C
C ADJUST TIME
C
  200 T804 = T(804)/3600.
      T805 = T(805)/3600.
      T811 = T(811)/3600.
      WRT(1)=WRT(1) + PHSTRT  + T(659)
C
C OVERLAY ENGINE CONTROLLER TRANSIENTS.
C
      GO TO (185,185,185),ITYPE
  185 DO 190 I=1,3
C SET THROTL TO INITIAL THROTTLE SETTING
      ISUB=(NWA+3)
      IF (THROTL(I) .EQ. 0) THROTL(I)=WRT(I+ISUB)
```

```
C0432      IF (ABS(THROTL(I) - WRT(I+ISUB)) .LE. 0.0001) GO TO 188           C00553
C0434      THROTL(I)=WRT(I+ISUB)                                              C00562
C0435      ECTRAN(I)=WRT(1)                                                   C00564
C0436  186 WRT(I*3+1) = T(810)                                                C00567
C0437      GO TO 190                                                          C00570
C0440  188 IF (WRT(1) .GE. ECTRAN(I) .AND. WRT(1) .LE. ECTRAN(I)              C00572
C0440     *    + T(11      ) GO TO 186                                        C00572
C0442      WRT(I*3+1)=0.0                                                     C00610
C0443  190 CONTINUE                                                           C00614
C0443 C                                                                       C00614
C0443 C OVERLAY RATES FOR LANDING GEAR                                        C00614
C0443 C                                                                       C00614
C0445  191 GO TO (201,201,201),ITYPE                                          C00614
C0446  201 ISUB=(3*NA+1)                                                      C00625
C0447      IF (IPHASE .NE. 6 .OR. WRT(1+ISUB).GT. T(801)) GO TO 300           C00630
C0451  203 IF (TLGDWN .LE. 0) TLGDWN=WRT(1)                                   C00646
C0453      IF (WRT(1) .GT. TLGDWN + T804  ) GO TO 225                         C00653
C0453 C ADD UPLOCK TRANSIENT                                                  C00653
C0455      DO 220 I=19,21,2                                                   C00663
C0460  220 WRT(I+1) = 1.0                                                     C00663
C0462      GO TO 230                                                          C00665
C0462 C ADD STRUT TRANSIENT                                                   C00665
C0463  225 IF (WRT(1) .GT. TLGDWN + T804   + T805  ) GO TO 230                C00667
C0465      DO 226 I=20,22,2                                                   C00677
C0470  226 WRT(I+1) = 1.0                                                     C00677
C0472  230 CONTINUE                                                           C00702
C0472 C                                                                       C00702
C0473 300   CONTINUE                                                          C00702
C0473 C                                                                       C00702
C0473 C SET SYSTEM MODE FLAGS                                                 C00702
C0473 C                                                                       C00702
C0474  313 GO TO (312,312,303),ITYPE                                          C00702
C0475  312 DO 311 I=1,3                                                       C00714
C0500  311 ISYS(I)=1                                                          C00714
C0502  303 CONTINUE                                                           C00717
C0502 C                                                                       C00717
C0502 C SET APU SPEED FLAGS                                                   C00717
C0502 C                                                                       C00717
C0503  314 GO TO (310,310,310),ITYPE                                          C00717
C0504  310 DO 301 I=1,3                                                       C00731
C0507  301 IAPUSD(I)=1                                                        C00731
C0511      IF (IPHASE .NE. 2) GO TO 305                                       C00733
C0513      IF (WRT(1) .LE. T(802) .OR. WRT(1) .GT. T(803)) GO TO 305          C00736
C0515      DO 302 I=1,3                                                       C00756
C0520  302 IAPUSD(I)=2                                                        C00756
C0520 C                                                                       C00756
C0520 C CONVERT FRL ANGLES AND RATES TO HINGE-LINE                            C00756
C0520 C                                                                       C00756
C0522  305 CONTINUE                                                           C00761
C0523 404   J=T(994)+.1                                                       C00761
C0524      GO TO (405,307,309),J                                              C00771
C0525  405 DO 306 I=10,11                                                     C01002
C0530      ISUB=(3*NA+1)                                                      C01016
C0531      PHI=WRT(I+ISUB)*2.*PI/360.                                         C01022
C0532      IF (I .EQ. 11) PHI=PHI/2.                                          C01030
C0534      COSPH=COS(PHI)                                                     C01036
C0535      WRT(I+ISUB)=ATAN(TAN(PHI)/COSAL)                                   C01042
```

```
C0536            WRT(I+ISUB)=WRT(I+ISUB)*360./(2.*PI)                                      C01054
C0537            WRT(I+1)=WRT(I+1)*COSAL/(1.D-(COSPH**2)*(SINAL**2))                       C01057
C0540        306 CONTINUE                                                                  C01071
C0542            IF (I .EQ. 11) WRT(I+ISUB)=WRT(I+ISUB)*2.                                 C01071
C0544            GO TO 309                                                                 C01101
C0545        307 DO 309 I=10,11                                                            C01105
C0550        309 WRT(I+1)=WRT(I+1)/COSAL                                                   C01105
C0550      C                                                                               C01105
C0550      C COMPUTE ELEVON RATES FROM POSITIONS                                           C01105
C0550      C                                                                               C01105
C0552      309   IF (T(992).LE. 0.001) GO TO 320                                           C01111
C0554            IF (IUNIT .NE. LUNIT) GO TO 320                                           C01114
C0556            DO 315 I=12,15                                                            C01126
C0561            ISUB=2*NA+1                                                               C01126
C0562      315   WRT(I+1)=((WRT(I+ISUB)-XPOS(I))/(XTIME-WRT(1)))                           C01132
C0562           *    /360.                                                                 C01132
C0564        320 LTYPE=ITYPE                                                               C01144
C0565            XTPNO=TPNO                                                                C01145
C0566            LPHASE=IPHASE                                                             C01147
C0567            LUNIT=IUNIT                                                               C01151
C0570            XTIME=WRT(1)                                                              C01153
C0570      C SET XPOS TO INITIAL ELEVON POSITIONS                                          C01153
C0571            DO 316 I=12,15                                                            C01164
C0574            ISUB=2*NA+1                                                               C01164
C0575      316   XPOS(I)=WRT(I+ISUB)                                                       C01166
C0577            IF(WRT(1).GE.T(665) .AND. T(999).EQ. 1.0) GO TO 502                       C01174
C0601            RETURN                                                                    C01211
C0602            END                                                                       C01242
END FOR
```

```
@FOR,S H.ACTDAT/V6,H.ACTDAT/V6
FOR S9L3-02/06/79-16:09:58 (4,)

  SUBROUTINE ACTDAT     ENTRY POINT 000560

  STORAGE USED: CODE(1) 000572; DATA(0) 000061; BLANK COMMON(2) 000000

   COMMON BLOCKS:

   0003    NUMS     000002
   0004    CONF     000014
   0005    RATES    000132
   0006    TIMES    000043
   0007    TAPRAY   002156
   0010    TRAJ     000157
   0011    NAMES    000424
   0012    GRAD     000212
   0013    LKGS     000346
   0014    LNMTRX   001141

  EXTERNAL REFERENCES (BLOCK, NAME)

   0015    NERR2$
   0016    XPRR
   0017    NERR3$

  STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

   0001   000227 10L      0001   000432 124L     0001   000441 130L     0001   000034 135G     0001   000376 136L
   0001   000403 137L     0001   000401 138L     0001   000444 139L     0001   000445 140L     0001   000045 143G
   0001   000460 147L     0001   000461 148L     0001   000477 149L     0001   000500 150L     0001   000062 153G
   0001   000520 159L     0001   000067 160G     0001   000521 160L     0001   000536 169L     0001   000537 170L
   0001   000133 2CLG     0001   000234 226G     0001   000304 244G     0001   000124 252C     0001   000370 272C
   0001   000407 307G     0001   000463 342G     0001   000504 357G     0001   000525 374C     0001   000127 450L
   0001   000173 480L     0001   000251 70L      0001   000275 75L      0001   000361 79L      0001   000363 80L
   0001   000065 9L       0001   000277 90L      0011   000332 ACTNAM   0005   000130 ALT      0013 R 000270 ALTFLW
   0005   000127 CCLOAD   0006   000021 CLNO     0000   000021 DP2      0005   000072 DEF      0006   000031 ECTRAN
   0012 R 000000 FGRAD    0012 R 000134 FLGRAD   0006   000013 FREE     0006   000015 FRNO     0005   000035 HM
   0000 I 000004 I        0000 I 000014 IA       0011 I 000134 IACTNO   0004   000003 IAPUSD   0014 I 000457 IASCN
   0000 I 000015 IA1      0006   000041 ICARD    0014 I 000245 ICODE    0006   000002 IEND     0010   000136 IETP
   0000 I 000006 IFLD     0011   000217 ILOAD    0010   000000 INDEX    0000   000034 INJP$    0006   000006 IPHASE
   0000 I 000011 IPOINT   0014 I 000212 IPTR     0014 I 000613 ISIV     0011   000215 ISPFD    0006   000000 ISTART
   0006   000040 ISTAT    0006   000071 ISTOP    0014 I 000671 ISWV     0004 I 000000 ISYS     0006   000012 IUNIT
   0011 I 000254 IVEH     0006 I 000007 IVFLAG   0000 I 000005 J        0000 I 000012 JJ       0000 I 000000 JSYS
   0000 I 000007 K        0000 I 000013 KK       0000 I 000016 KM       0000 I 000010 L        0014   000000 LMM
   0006   000036 LPHASE   0006   000034 LTYPE    0006   000042 LUNIT    0014 I 000535 MIV      0014   000747 MVNAM
   0014 I 000771 MVSYS    0014 I 001002 MVVEH    0003 I 000001 NA       0011   000000 NAME     0003 I 000000 NL
   0011   000012 NMODL    0014 I 001135 NAV      0006   000003 NOL      0006   000010 NOL2     0004 I 000007 NOS
   0006   000005 NPLTS    0005   000034 NPTS     0014 I 001136 NSV      0014 I 001137 NSWV     0014   001140 NVCONF
   0006   000037 NV       0004 R 000010 P        0000 R 000003 PIN      0013 R 000000 PSLKG    0005 R 000000 RATE
   0000 R 000020 RATNOS   0004 I 000013 STVLV    0013 R 000056 SVLKG    0014   001013 SVNAM    0014 I 001046 SVSYS
   0014 I 001035 SVVEH    0014 I 001151 SWSYS    0014   001057 SWVNAM   0014 I 001112 SWVVEH   0007 R 000000 T
   0004   000000 TI       0005   000025 TPCALL   0006   000311 TTIME    0014 I 001123 VCONF    0007   001750 WRT
```

```
0005    000131 XMACH      0000 F 000017 XNOS       0013 R 000134 XPSLKG    0013 R 000212 XSVLKG     0006    000C35 XTPNC

C0101    1*          COMPILER (FLD=ABS)                                                              000011
C0103    2*          SUBROUTINE ACTDAT                                                               000011
C0105    3*          INCLUDE PRP,LIST                                                                000011
C0105    3*    PAR   PROC                                                                            000011
C0106    3*          PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MMV=9,MSV=9,MSWV=9                 000011
C0106    3*        *   ,MVCONF=10                                                                    000011
C0107    3*          PARAMETER MNSPDS=4,MNCONS=5,MNOCF=10,MNTEQN=5,MTNOCF=10                         000011
C0110    3*              COMMON/NUMS/NL,NA                                                           000011
C0110    3*     END                                                                                  000011
C0111    4*          INCLUDE CBL1,LIST                                                               000011
C0111    4*    CBL1  PROC                                                                            000011
C0112    4*          COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV                                000011
C0113    4*          INTEGER STVLV                                                                   000011
C0114    4*          COMMON /RATES/RATE(MNA),HM(MNA),DEF(MNA),CGLOAD,ALT,XMACH                       000011
C0115    4*          COMMON /TIMES/ISTART,ISTOP,IEND,NCL,NPTS,NPLTS                                  000011
C0115    4*        *   ,IPHASE,IVFLAG,NOL2,TTIME,IUNIT,FREE(2),FRNO(4)                               000011
C0115    4*        *   ,CLNO(4),TPCALL(4),ECTRAN(3),LTYPE,XTPNO,LPHASE,NW                            000011
C0115    4*        *   ,ISTAT,ICARD,LUNIT                                                            000011
C0116    4*          COMMON /TFRRAY/ T(1000),WPT(NR)                                                 000011
C0117    4*          COMMON /TRAJ/ INDEX(NR),IFTP                                                    000011
C0120    4*          COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NMODE(3),ISPED(2),ILOAD(MNA),               000011
C0120    4*        *                IVEH(MNL),ACTNAM(MNA,2)                                          000011
C0120    4*     END                                                                                  000011
C0121    5*          INCLUDE CBL2,LIST                                                               000011
C0121    5*    CBL2  PROC                                                                            000011
C0122    5*          COMMON /GRAD/FGRAD(MNL,2),FLGRAD(MNL)                                           000011
C0123    5*          COMMON /LKGS/PSLKG(MNL),SVLKG(MNL),XPSLKG(MNL),XSVLKG(MNL)                      000011
C0123    5*        *,ALTFLW(MNL)                                                                     000011
C0124    5*          COMMON /LMMTRX/LMM(3,MNL),IPTR(3,3,3),ICODE(3,MNL),IASGN(MNL),                   000011
C0124    5*        *                PIV(MNL),ISIV(MNL),ISWV(MNL),                                    000011
C0124    5*        *                MVNAM(2,MMV),MVSYS(MMV),MVVEH(MMV),                              000011
C0124    5*        *                SVNAM(2,MSV) ,            SVVEH(MSV), SVSYS(MSV),                000011
C0124    5*        *          SWVNAM(2,MSWV),SWSYS(MSWV)               ,SWVVEH(MSWV)                 000011
C0124    5*        *,VCONF(MVCONF),NMV,NSV,NSWV,NVCONF                                               000011
C0125    5*          INTEGER VCONF,      SVVEH,              SWVVEH,SVSYS   ,SWSYS                   000011
C0125    5*     END                                                                                  000011
C0126    6*          NAMELIST/PP2/ IASGN                                                             000011
C0127    7*          DIMENSION JSYS(3)                                                               000016
C0130    8*          DEFINE IPT(I,J,K)=IPTR(I,J,K)                                                   000016
C0131    9*          DATA PIN/3000./                                                                 000016
C0133   10*          IVFLAG=T(996)+.1                                                                000016
C0133   11*    C                                                                                     000016
C0133   12*    C DETERMINE SYSTEM PRESSURE                                                           000016
C0133   13*    C                                                                                     000016
C0134   14*          DO    5 I=1,3                                                                   000027
C0137   15*          J=ISYS(I)                                                                       000034
C0140   16*        5 P(I)=T(674+J)                                                                   000036
C0140   17*    C                                                                                     000036
C0140   18*    C DETERMINE SYSTEM ASSIGNMENTS FOR LOADS                                              000036
C0140   19*    C                                                                                     000036
C0142   20*          DO 10 I=1,NL                                                                    000045
C0142   21*    C CHECK TO SEE IF LOAD IS ON VEHICLE                                                  000045
```

```
      IFLD=36-IVFLAG
      IF (FLD(IFLD,1,IVEH( I)) .EQ. 1) GO TO 9
      IASGN(I)=0
      GO TO 10
    9 DO 410 J=1,3
  410 JSYS(J)=ISYS(J)
C CHECK MAIN ISOLATION VALVES
      DO 450 J=1,NMV
C CHECK TO SEE IF VALVE IS ON VEHICLE
      IFLD=36-IVFLAG
      IF (FLD(IFLD,1,MVVEH(J)) .EQ. 0) GO TO 450
C CHECK TO SEE IF LOAD IS DOWNSTREAM OF VALVE
      IFLD=36-J
      IF (FLD(IFLD,1,MIV(I)) .EQ. 0) GO TO 450
C CHECK STATUS OF VALVE
      K=J-1
      IF (FLD(K,1,STVLV) .EQ. 0) GO TO 450
      K=MVSYS(J)
      JSYS(K)=3
  450 CONTINUE
C CHECK SECONDARY VALVES
      DO 480 J=1,NSV
C CHECK TO SEE IF VALVE IS ON VEHICLE
      IFLD=36-IVFLAG
      IF (FLD(IFLD,1,SVVEH(J)) .EQ. 0) GO TO 480
C CHECK TO SEE IF LOAD IS DOWNSTREAM OF VALVE
      IFLD=36-J
      IF (FLD(IFLD,1,ISIV(I)) .EQ. 0) GO TO 480
C CHECK STATUS OF VALVE
      K=J-1+12
      IF (FLD(K,1,STVLV) .EQ. 0) GO TO 480
      L=SVSYS(J)
      JSYS(L)=3
  480 CONTINUE
      IPOINT  =IPT(JSYS(1),JSYS(2),JSYS(3))
      JJ=(IPOINT-1)/18
      KK=((IPOINT-(JJ*18))-1)*2
      IASGN(I)=FLD(KK,2,ICODE(JJ+1,I))
   10 CONTINUE
C
C DETERMINE THE POWER SPOOL AND SERVO VALVE LEAKAGES FOR EACH LOAD
C
      DO 90 I=1,NL
      IA=IASGN(I)
      IA1=IA+1
      GO TO (75,70,70,70),IA1
   70 XSVLKG(I)=SVLKG(I)  * (P(IA)/PIN)**.5
      XPSLKG(I)=PSLKG(I)  * (P(IA)/PIN)**.5
      GO TO 90
   75 XPSLKG(I)=0.0
      XSVLKG(I)=0.0
   90 CONTINUE
  300 CONTINUE
C
C CHECK FOR SWITCHING VALVES
C
      DO 20 I=1,NL
```

```
CO246          IA=IADG(I)                                                    COO304
CO247          IF (IA .EQ. 0) GO TO 80                                       COO305
CO251          DO 79 J=1,NSWV                                                COO307
CO251    C CHECK TO SEE IF VALVE IS ON VEHICLE                               COO307
CO254          IFLD=36-IVFLAG                                                COO324
CO255          IF (FLD(IFLD,1,SWVVEH(J)) .EQ. 0) GO TO 79                    COO326
CO255    C CHECK TO SEE IF LOAD IS DOWNSTREAM OF VALVE                       COO326
CO257          IFLD=36-J                                                     COO334
CO260          IF (FLD(IFLD,1,ISNV(I)) .EQ. 0) GO TO 79                      COO337
CO260    C CHECK STATUS OF VALVE                                             COO337
CO262          K=J-1+24                                                      COO345
CO263          IF (FLD(K,1,STVLV) .EQ. 1) XSVLKG(I)=ALTFLW(I)*(P(IA)/PIN)**.5 COO350
CO265       79 CONTINUE                                                      COO370
CO267       80 CONTINUE                                                      COO370
CO267    C                                                                   COO370
CO267    C SET RATES TO A DISCREET FOR LOADS FOR WHICH ONLY AVERAGED         COO370
CO267    C FLOW DATA IS AVAILABLE                                            COO370
CO267    C                                                                   COO370
CO271          DO 137 J=16,NA                                                COO370
CO274          IF (RATE(J)) 136,135,138                                      COO370
CO277      135 RATE(J)=0.0                                                   COO373
CO300          GO TO 137                                                     COO374
CO301      136 RATE(J)=-1.0                                                  COO376
CO302          GO TO 137                                                     COO377
CO303      138 RATE(J) = 1.0                                                 COO401
CO304      137 CONTINUE                                                      COO407
CO304    C                                                                   COO407
CO304    C  DETERMINE FLOW GRADIENT FOR EACH LOAD                            COO407
CO304    C                                                                   COO407
CO306          DO 140 I=1,NL                                                 COO407
CO311          J=IACTNO(I)                                                   COO407
CO312          IF (J .EQ. 0) GO TO 139                                       COO410
CO314          K=IASGN(I)                                                    COO412
CO315          IF (K .EQ. 0) GO TO 139                                       COO414
CO317          KM=ISYS(K)                                                    COO416
CO320          GO TO (124,124,139),KM                                        COO421
CO321      124 IF  (RATE(J)) 125,130,130                                     COO432
CO324      125 FLGRAD(I)=FGRAD(I,2)                                          COO435
CO325          GO TO 140                                                     COO437
CO326      130 FLGRAD(I)=FGRAD(I,1)                                          COO441
CO327          GO TO 140                                                     COO442
CO330      139 FLGRAD(I)=0.0                                                 COO444
CO331      140 CONTINUE                                                      COO446
CO331    C ADJUST FLOW GRADIENTS FOR RUDDER, SPEED BRAKE AND BODY FLAP       COO446
CO333          IF (NOS .EQ. 0) GO TO 147                                     COO446
CO335          XNOS=NOS                                                      COO450
CO336          RATNOS=3.0/XNOS                                               COO453
CO337          GO TO 148                                                     COO456
CO340      147 RATNOS=0.0                                                    COO460
CO341      148 DO 150 I=10,12                                                COO463
CO344          K=IASGN(I)                                                    COO463
CO345          IF (K .EQ. 0) GO TO 149                                       COO464
CO347          IF (ISYS(K  ) .NE. 1) GO TO 149                               COO466
CO351          FLGRAD(I)=FLGRAD(I)*RATNOS                                    COO472
CO352          GO TO 150                                                     COO475
CO353      149 FLGRAD(I)=0.0                                                 COO477
CO354      150 CONTINUE                                                      COO504
```

```
00356         DO 160 I=14,16                                  C005C4
00361         K=IASGN(I)                                      C00504
00362         IF (K .EQ. 0) GO TO 159                         C00505
00364         IF (ISYS(K    ) .NE. 1) GO TO 159                 C00507
00366         FLGRAD(I)=FLGRAD(I)*RATNOS                      C00513
00367         GO TO 160                                       C00516
00370     159 FLGRAD(I)=0.0                                   C00520
00371     160 CONTINUE                                        C00525
00373         DO 170 I=22,24                                  C00525
00376         K=IASGN(I)                                      C00525
00377         IF (K .EQ. 0 ) GO TO 169                        C00526
00401         IF (ISYS(K    ) .NE. 1) GO TO 169               C00530
00403         GO TO 170                                       C00534
00404     169 FLGRAD(I)=0.0                                   C00536
00405     170 CONTINUE                                        C00540
00407     240 CONTINUE                                        C00540
00410         RETURN                                          C00540
00411         END                                             C00571
END FOR
```

```
@FOR,S H.SYSDAT/V6,H.SYSDAT/V6
FOR S0E3-02/06/79-18:10:11 (59,)
```

SUBROUTINE SYSDAT   ENTRY POINT 001511

STORAGE USED: CODE(1) 001524; DATA(0) 001434; BLANK COMMON(2) 000000

COMMON BLOCKS:

0003	NUMS	000002
0004	CONF	000014
0005	RATES	000132
0006	TIMES	000043
0007	TARRAY	002106
0010	TRAJ	000137
0011	NAMES	000424
0012	GRAD	000212
0013	LKGS	000346
0014	LMMTRX	001141
0015	OUTPUT	000073
0016	COEFF	000271
0017	FCOMP	000060
0020	FUEL	000317
0021	SFCC	001424
0022	THRST	000106

EXTERNAL REFERENCES (BLOCK, NAME)

0023	TANK
0024	NWDU$
0025	NIO1$
0026	NIO2$
0027	NERR2$
0030	NIO3$
0031	NERR3$

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000	000363	1000F	0001	000247	1001L	0001	001423	1006G	0000	000316	101F	0000	000521	1010F
0000	000516	1011F	0001	000360	1012L	0000	000540	1016F	0000	000560	1017F	0001	001450	1017G
0000	000347	102F	0000	000564	1050F	0000	000676	1060F	0000	000706	1070F	0000	000713	1090F
0000	000752	1091F	0000	001004	1110F	0001	000001	15L	0001	000145	20L	0000	000356	200F
0000	001114	2000F	0000	001123	2010F	0000	001132	2011F	0000	001143	2025F	0000	001150	2030F
0000	001160	2040F	0000	001166	2045F	0001	000025	205G	0001	000150	21L	0001	000043	217G
0001	000153	22L	0001	000046	222G	0001	000057	225G	0001	000073	232G	0001	000102	235G
0001	000130	240G	0001	000227	277G	0001	000155	30L	0000	001175	3000F	0000	001206	3010F
0000	001235	3015F	0000	001240	3020F	0000	001243	3025F	0000	001246	3046F	0000	001251	3047F
0000	001254	3048F	0001	000303	322G	0001	000315	330G	0001	000321	334G	0001	000160	35L
0001	000405	374G	0001	000407	377G	0001	000163	40L	0001	000424	407G	0000	001325	4085F
0000	001257	4110F	0001	000524	422G	0001	000575	444G	0001	000617	452G	0001	000625	456G
0001	000643	471G	0001	000646	474G	0001	000667	477G	0001	000734	514G	0001	000763	532G
0001	00100[illegible]	540G	0001	001006	543G	0001	001042	556G	0001	001106	604G	0001	001115	611G
0001	001143	630G	0001	001152	635G	0001	001200	6[illegible]4G	0001	001207	661G	0001	001233	676G

```
0001     000631 70L        0001     001247 705G       0001     001263 714G       0001     001300 725G       0001     001303 730G
0001     001321 736G       0001     001337 744G       0001     001362 754G       0001     001374 763G       0001     001406 772G
0000     001661 85F        0001     000743 90L        0001     001061 95L        0011 R   000332 ACTNAM     0005     000130 ALT
0013 R   000270 ALTFLW     0016 D   000000 CF         0005     000127 CGLOAD     0006     000021 CLNO       0000     000311 DB
0005     000072 DEF        0006     000031 ECTRAN     0016 R   000240 ERANGE     0000 R   000000 FGCOMM     0012 R   000000 FGRAD
0012     000134 FLGRAD     0020 R   000070 FLOAD      0015     000000 FLRT       0006     000013 FREE       0020     000011 FREM
0006     000015 FFNO       0020 R   000003 FUNUSE     0021     001431 FURATE     0017 R   000011 HE         0005     000035 HM
0000 I   000266 I          0011 I   000134 IACTNO     0000 I   000303 IAPU       0004     000003 IAPUSD     0014     000457 IASCN
0006     000241 ICARD      0014 I   000245 ICODE      0006     000002 IEND       0010     000136 IETP       0011 I   000217 ILCAD
0010     000000 INDEX      0000     001372 INJP$      0015     000072 IOTAP      0006     000006 IPHASE     0015     000071 IPPLT
0014 I   000012 IPTR       0000 I   000302 IS         0015     000064 ISAT       0000 I   000232 ISET       0014 I   000613 ISIV
0011 I   000215 ISPED      0000 I   000276 ISSS       0006     000000 ISTART     0006     000040 ISTAT      0006     000001 ISTOP
0014 I   000671 ISWV       0004     000000 ISYS       0000 I   000154 ITEMP      0006     000012 IUNIT      0011 I   000254 IVEH
0006     000007 IVFLAG     0000 I   000270 I1         0000 I   000267 I2         0000 I   000265 J          0000 I   000277 JJ
0000 I   000243 JSET       0000 I   000272 K          0000 I   000300 KK         0000 I   000254 KSET       0000 I   000273 L
0000 I   000275 LL         0014 I   000000 LMM        0006     000036 LPHASE     0006     000034 LTYPE      0006     000042 LUNIT
0000 I   000301 LX         0000 I   000271 M          0014 I   000535 MIV        0000 I   000274 MODE       0014 I   000747 MVNAM
0014 I   000771 MVSYS      0014 I   001002 MVVEH      0003 I   000001 NA         0011 I   000000 NAME       0021 I   001415 NEQNS
0003 I   000002 NL         0011 I   000212 NMODE      0014 I   001135 NMV        0021 I   000000 NOCF       0000 I   000304 NOCFP
0000 I   000305 NOCFI      0005     000003 NOL        0006     000010 NOL2       0004     000007 NOS        0016     000270 NPER
0006     000005 NPLTS      0006     000004 NPTS       0021     001414 NSPDS      0014 I   001136 NSV        0014 I   001137 NSWV
0022 I   000074 NTC        0014 I   001140 NVCONF     0006     000037 NW         0004     000010 P          0022     000105 PAMB
0000 R   000134 PHNAME     0017 R   000044 PLIM       0021 R   001320 PRALT      0013 R   000000 PSLKG      0015     000061 PWR
0005     000000 RATE       0015     000067 SAT        0021 R   000074 SFC        0000 R   000152 SFCALT     0004 I   000013 STVLV
0013 R   000056 SVLKG      0014 R   001013 SVNAM      0014 I   001046 SVSYS      0014 I   001035 SVVEH      0014 I   001101 SWSYS
0014 R   001557 SWVNAM     0014 I   001112 SWVVEH     0007     000000 T          0022 R   000000 TALT       0020     000014 TENUSD
0015     000056 TFLRT      0020     000006 TFUSED     0022 R   000012 THRUST     0022 I   000005 TNOCF      0004     000006 TP
0006     000025 TPCALL     0022 R   000075 TPRESS     0022 R   000102 TR         0006     000011 TTIME      0017 R   000006 TVCL
0017 R   000047 ULPRFC     0017 R   000003 ULPRLC     0017 R   000014 ULTALT     0017 R   000017 ULTOFT     0017 R   000000 ULTFLC
0014 I   001123 VCONF      0007     001750 WRT        0021 R   001224 XALT       0017 R   000052 XFLOW      0005     000131 XMACH
0013     000134 XPSLKG     0013     000212 XSVLKG     0006     000035 XTPNO
```

```
00101      1*            COMPILER (FLD=ABS)                                                          000000
00103      2*            SUBROUTINE SYSDAT                                                           000000
00105      3*            INCLUDE PAR,LIST                                                            000000
00105      3*    PAR     PROC                                                                        000000
00106      3*            PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MMV=9,MSV=9,MSWV=9             000000
00106      3*          *    ,MVCONF=10                                                               000000
00107      3*            PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10                     000000
00110      3*                COMMON/NUMS/NL,NA                                                       000000
00110      3*     END                                                                                000000
00111      4*            INCLUDE CBL1,LIST                                                           000000
00111      4*    CBL1    PROC                                                                        000000
00112      4*            COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV                            000000
00113      4*            INTEGER STVLV                                                               000000
00114      4*            COMMON /RATES/RATE(MNA),HM(MNA),DEF(MNA),CGLOAD,ALT,XMACH                   000000
00115      4*            COMMON /TIMES/ISTART,ISTOP,IEND,NOL,NPTS,NPLTS                              000000
00115      4*          *     ,IPHASE,IVFLAG,NOL2,TTIME,IUNIT,FREE(2),FRNO(4)                         000000
00115      4*          *    ,CLNO(4),TPCALL(4),ECTRAN(3),LTYPE,XTPNO,LPHASE,NW                       000000
00115      4*          *    ,ISTAT,ICARD,LUNIT                                                       000000
00116      4*            COMMON /TARRAY/ T(1000),WPT(NR)                                             000000
00117      4*            COMMON /TRAJ/ INDEX(NR),IETP                                                000000
00120      4*            COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NMODE(3),ISPED(2),ILOAD(MNA),          000000
00120      4*          *            IVEH(MNL),ACTNAM(MNA,2)                                          000000
```

```
      END
         INCLUDE CBL2,LIST
CBL2     PROC
         COMMON /GRAD/FGRAD(MNL,2),FLGRAD(MNL)
         COMMON /LKGS/PSLKG(MNL),SVLKG(MNL),XPSLKG(MNL),XSVLKC(MNL)
        *,ALTFLW(MNL)
         COMMON /LMMTRX/LMM(3,MNL),IPTR(3,3,3),ICODE(3,MNL),IASGN(MNL),
        *                MIV(MNL),ISIV(MNL),ISWV(MNL),
        *                MVNAM(2,MMV),MVSYS(MMV),MVVEH(MMV),
        *                SVNAM(2,MSV) ,            SVVEH(MSV), SVSYS(MSV),
        *          SWVNAM(2,MSWV),SWSYS(MSWV)               ,SWVVEH(MSWV)
        *,VCONF(MVCONF),NMV,NSV,NSWV,NVCONF
         INTEGER VCONF,       SVVEH,              SWVVEH,SVSYS   ,SWSYS
      END
         INCLUDE CBL3,LIST
CBL3     PROC
         COMMON /OUTPUT/FLRT(MNL),TFLRT(3),PWR(3),ISAT(3),SAT(2)
        *, IPPLT,IOTAP
         COMMON /COEFF/ CF(10,2,2,2),
        *               ERANGE(2,2,2,3)
        *     ,NPFR
         DOUBLE PRECISION CF
         COMMON /PCOMP/ULTPLC(3),ULPRLC(3),TVOL(3),HE(3),
        *              ULTALT(3),ULTOFT(3,7),PLIM(3)
        *              ,ULPRFC(3),XFLOW(3,2)
         COMMON /FUEL/ FLOAD(3),FUNUSE(3),TFUSED(3),FREM(3),TENUSD(3)
         COMMON /SFCC/ NOCF(MNSPDS,MNEQNS,3),SFC(MNSPDS,MNEQNS,MNOCF,3),
        *               XALT(MNSPDS,MNEQNS,3),PRALT(MNSPDS,MNEQNS,3),NSPDS,
        *              NEQNS(MNSPDS),FURATE(3)
         COMMON/THRST/TALT(MNTEQN),TNOCF(MNTEQN),THRUST(MNTEQN,MTNOCF)
        *,NTC,TPRESS(MNTEQN),TR(3),PAMB
         INTEGER TNOCF
      END
         DIMENSION FGCOMM(2,MNL) ,PHNAME(2,7),SFCALT(2)
         DIMENSION ITEMP(MNL)
         DIMENSION ISET(MMV),JSET(MSV),KSET(MSWV)
         NAMELIST/IB/NOCF
         DATA FGCOMM/92*'        '/
         DATA (FGCOMM(1,J),J=14,16)/3*'OPEN'/
         DATA (FGCOMM(2,J),J=14,16) /3*'CLOSE'/
         DATA (FGCOMM(1,J),J=22,24)/3*'LOWER'/
         DATA (FGCOMM(2,J),J=22,24) /3*'RAISE'/
         DATA (PHNAME(I,1),I=1,2)/'PRELAUNCH'/
         DATA (PHNAME(I,2),I=1,2)/'ASCENT   '/
         DATA (PHNAME(I,3),I=1,2)/'         '/
         DATA (PHNAME(I,4),I=1,2)/'ON-ORB CKOUT'/
         DATA (PHNAME(I,5),I=1,2)/'         '/
         DATA (PHNAME(I,6),I=1,2)/'DESCENT'/
         DATA (PHNAME(I,7),I=1,2)/'ROLLOUT'/
         DATA SFCALT/'SL','SP'/
C LOSS MANAGEMENT MATRIX
C GENERATES AN HYD LOAD SYSTEM ASSIGNMENT MATRIX ICODE
C ICODE(POINTER,HYD LOAD)=SYS TO WHICH THE HYD LOAD IS ASSIGNED
C POINTER=IPTR(SYS 1 MODE,SYS 2 MODE,SYS 3 MODE)
C        WHERE SYS MODE = 1 : PRESSURIZED MODE
C              SYS MODE = 2 : DEPRESSURIZED MODE
C              SYS MODE = 3 : OFF
```

```
00173        C                                                                        000000
00175              CONTINUE                                                           000000
00176              I2=0                                                               000000
00177           15 I1=I2+1                                                            000001
00200              I2=I1+36                                                           000003
00201              IF (I2 .GT. NL) I2=NL                                              000005
00203            2 WRITE (6,101) (I,I=I1,I2)                                          000013
00211          101 FORMAT(1H1,51X,'**** LOSS MANAGEMENT MATRIX ****',//,              000032
00211             *' SYS  SYS  SYS  SYS',35X,'SYSTEM ASSIGNMENTS FOR HYD LOAD NO',/,  000032
00211             *' CONF  1     2     3 ',37I3,/,                                    000032
00211             *)                                                                  000032
00212              WRITE(6,102)                                                       000032
00214          102 FORMAT (                                                           000037
00214             *' CODE MODE MODE MODE',/,1X,131(1H*))                              000037
00215              M=0                                                                000037
00216              DO 50 I=1,3                                                        000046
00221              DO 50 J=1,3                                                        000046
00224              DO 50 K=1,3                                                        000057
00227              M=M+1                                                              000057
00230              IPTR(I,J,K)=M                                                      000065
00231              DO 45 L=I1,I2                                                      000073
00234              DO 35 MODE=1,2                                                     000102
00237              DO 30 LL=1,3                                                       000130
00242              ISSS=LMM(LL,L)                                                     000130
00243              IF (ISSS .EQ. 0) GO TO 35                                          000132
00245              GO TO (20,21,22),ISSS                                              000134
00246           20 IF (I .EQ. MODE) GO TO 40                                          000145
00250              GO TO 30                                                           000146
00251           21 IF (J .EQ. MODE) GO TO 40                                          000150
00253              GO TO 30                                                           000151
00254           22 IF (K .EQ. MODE) GO TO 40                                          000153
00256           30 CONTINUE                                                           000161
00260           35 CONTINUE                                                           000161
00262              ISSS=0                                                             000161
00263           40 JJ=(M-1)/18                                                        000163
00264              KK=((M-(JJ*18))-1)*2                                               000164
00265              FLD(KK,2,ICODE(JJ+1,L))=ISSS                                       000171
00266              ITEMP(L)=ISSS                                                      000207
00267           45 CONTINUE                                                           000213
00271              WRITE(6,200)M,NMODE(I),NMODE(J),NMODE(K),(ITEMP(LX),LX=I1,I2)      000213
00303          200 FORMAT (1X,/,1X,I4,3(2X,A3),I2,36I3)                               000241
00304           50 CONTINUE                                                           000241
00310              IF (I2 .LT. NL) GO TO 15                                           000241
00310        C                                                                        000241
00310        C  WRITE OUT HYD LOAD DATA REPORT                                        000241
00310        C                                                                        000241
00312              CONTINUE                                                           000245
00313              I=0                                                                000245
00314         1001 K=0                                                                000247
00315              I1=I+1                                                             000247
00316              WRITE(6,1000)                                                      000254
00320         1000 FORMAT(1H1,51X,'**** HYD LOAD DATA ****',//,' NO ',                000262
00320             *'LOAD NAME      ACT  SI  S2  FLOW GRAD      POWER  SERVO  ALT   ACT  000262
00320             *  VEH   MAIN   SEC    SWITCH',/,4X,                                000262
00320             *'                           (GPM/DEG/SEC)   SPOOL  VALVE  FLOW  NO   000262
00320             *  CODE  ISOL   ISOL   VALVE ',/,4X,                                000262
00320             *'                                           LKG @  LKG @  (GPM)      000262
```

```
     *         VALVE  VALVE  CODE   ',/,4X,         3000    3000
     *'
     *         CODE   CODE          ',/,4X,         PSI     PSI
     *'
     * ' ,1X,/,131(1H*))
      DO 1015 I=II,NL
      K=K+2
      WRITE (6,1010) I         ,(NAME(J,I),J=1,2),(LMM(J,I),J=1,3),
     *                    FGRAD(I,1),
     * FGCOMM(1,I),PSLKG(I),SVLKG(I),ALTFLW(I),IACTNO(I),IVEH(I),
     * MIV(I),ISIV(I),ISWV(I)
      IF (ABS(FGRAD(I,2)-FGRAD(I,1)) .LE. 0.00001) GO TO 1012
      K=K+1
      WRITE (6,1011) FGRAD(I,2),FGCOMM(2,I)
 1011 FORMAT (31X,F6.3,1X,A6)
 1010 FORMAT (/,1X,I3,1X,2A6,3I4,2X,F6.3,1X,A6,1X,F6.3,1X,F6.3,1X,F6.3,
     * 1X,I3,2X,I3,2X,I5,2X,I5,2X,I5)
 1012 IF (K.GT. 44) GO TO 1001
 1015 CONTINUE
C WRITE OUT HYDRAULIC FUNCTION DATA
C
      WRITE(6,1016)
 1016 FORMAT(1H1,20X'**** HYDRAULIC FUNCTION DATA ****',//,
     *T12,'FUNCTION',T25,'LOAD NO',//,
     *132(1H*)//)
      WRITE(6,1017)(I,(ACTNAM(I,J),J=1,2),ILOAD(I),I=1,MA)
 1017 FORMAT (1X,I5,T10,2A6,5X,I5)
C
C DETERMINE LOADING CONDITIONS FOR APU TANKS
C
 59   DO 60 I=1,3
      IF (HE(I) .EQ. 0.0) CALL TANK(ULTPLC(I),FLOAD(I),TVOL(I),
     *    ULPRLC(I),HE(I),1)
      IF (ULPRLC(I) .EQ. 0.0) CALL TANK(ULTPLC(I),FLOAD(I),TVOL(I),
     *    ULPRLC(I),HE(I),2)
       ULPRFC(I)=ULPRLC(I)
 60   CONTINUE
C
C WRITE OUT APU DATA
C
      WRITE(6,1050) (I,I=1,3),XFLOW,ULTPLC,ULPRLC,TVOL,HE,FLOAD,
     *        FUNUSE,PLIM
 1050 FORMAT (1H1,20X,'**** SYSTEM DATA ****',//,
     *T36,3('   APU/HYD'),/,
     *T36,3('   SYS',I2,2X),//,
     *' MAX FLOW RATE AT 100% SPEED,GPM',T36,3F10.3,/,
     *' MAX FLOW RATE AT 112% SPEED,GPM',T36,3F10.3,/,
     *' ULLAGE TEMP,LC,F',T36,3F10.3,/,
     *' ULLAGE PRESS,LC,PSIA',T36,3F10.3,/,
     *' TANK VOLUME,FT**3',T36,3F10.3,/,
     *' HELIUM,LBM',T36,3F10.3,/,
     *' INITIAL FUEL LOAD,LBM',T36,3F10.3,/,
     *' UNUSABLE FUEL,LBM',T36,3F10.3,/,
     *' LOWER PRESS LIM,PSIA',T36,3F10.3)
      WRITE (6,1060)ULTALT
 1060 FORMAT (' ULLAGE TEMP,FC,F',/,
     *   ' -ALT',T36,3F10.3)
```

```
      DO 70 I=1,7
      IF (ULTOFT(1,I) .EQ. 0.0) GO TO 70
      WRITE(6,1070) (PHNAME(J,I),J=1,2),(ULTOFT(J,I),J=1,3)
 1070 FORMAT (' -OFT-',2A6,T36,3F10.3)
 70   CONTINUE
C
C WRITE OUT PUMP EFFICIENCY EQUATIONS
C
      WRITE(6,1090)
 1090 FORMAT (1H1,50X,'**** PUMP EFFICIENCY CURVES ****',//,
     *' SYSTEM    APU     FLOW RATE LIMITS,GPM ',T54,
     :'EFF= F(FLOW RATE,GPM)',//,
     *' MODE   SPEED     LOWER          UPPER ',/,132(1H*),//)
      DO 90 IS=1,2
      DO 90 IAPU=1,2
      DO 90 K=1,2
      NOCFP=ERANGE(IS,IAPU,K,3)
      NOCF1=NOCFP-1
      IF (NOCFP .EQ. 0) GO TO 90
      WRITE(6,1091) NMODE(IS),ISPED(IAPU),ERANGE(IS,IAPU,K,1),
     *ERANGE(IS,IAPU,K,2),CF(1,K,IS,IAPU),(CF(J+1,K,IS,IAPU),J,
     *   J=1,NOCF1)
 1091 FORMAT (//,3X,A3,4X,I3,'%',3X,F6.2,8X,F6.2,
     *'   EFF = ',D12.6,' * X ** 0 + ',
     *          2(D12.6, ' * X **',I2, ' + '),//,
     *3(45X,3(D12.6,' * X **',I2,' + '),//))
 90   CONTINUE
C
C WRITE OUT FUEL RATE EQUATIONS
C
      WRITE(6,1110)
 1110 FORMAT(1H1,50X,'**** FUEL CONSUMPTION RATE CURVES ',
     *'****',//,
     *T3,'APU',T10,'EQN',T16,'APU',T22,'ALTITUDE',T33,'AMB',T45,
     *'FCR,LBM/HR = F(HYD PUMP SHAFT POWER,HP)',/,
     *' SPEED',T10,' NO',T16,' NO',T24,'(FT)',T33,'PRESS',/,
     *T33,'(PSIA)',/,
     *132(1H*),/)
      DO 100 I=1,2
      J=NECNS(I)
      IF (J .EQ. 0) GO TO 95
      DO 91 K=1,J
      DO 91 KK=1,3
      L=NOCF(I,K,KK)-1
      WRITE(6,85)ISPED(I),K,KK,XALT(I,K,KK),PRALT(I,K,KK),SFC(I,K,1,KK),
     *(SFC(I,K,M+1,KK),M,M=1,L)
  85  FORMAT (//2X,I3,'%',3X,I3,3X,I3,3X,F8.0,3X,F6.2,6X,'FCR = ',
     *D12.6,' * X ** 0 + ',
     *2(D12.6,' * X **',I2,' + '),//,
     *3(45X,3(D12.6,' * X **',I2,' + '),//))
 91   CONTINUE
 95   CONTINUE
 100  CONTINUE
C WRITE OUT VALVE DATA
C
      WRITE (6,2000)
 2000 FORMAT(1H1,55X,'**** VALVE DATA ****',//)
```

```
      WRITE (6,2010)
 2010 FORMAT(1X,'**** MAIN ISOLATION VALVES',//)
      WRITE(6,2011)
 2011 FORMAT (
     *'  NO  NAME              HYD SYS  VEH CODE',/,132(1H*))
      DO 2020 I=1,NMV
      WRITE (6,2025) I,(MVNAM(J,I),J=1,2),MVSYS(I),MVVEH(I)
 2025 FORMAT(2X,I2,2X,2A6,4X,I2,8X,I2,/)
 2020 CONTINUE
      WRITE (6,2030)
 2030 FORMAT (//,1X,'**** SECONDARY ISOLATION VALVES',//)
      WRITE(6,2011)
      DO 2041 I=1,NSV
      WRITE(6,2025)I,(SVNAM(L,I),L=1,2),SVSYS(I),SVVEH(I)
 2040  FORMAT (/,2X,I2,2X,2A6,5X,I4,    5X,I4,3X,12I3)
 2041 CONTINUE
      WRITE (6,2045)
 2045 FORMAT (//,1X,'**** SWITCH VALVES ****',//)
      WRITE(6,2011)
      DO 2051 I=1,NSWV
      WRITE (6,2025)I,(SWVNAM(L,I),L=1,2),SWSYS(I),SWVVEH(I)
 2051 CONTINUE
C
C WRITE OUT VALVE CONFIGURATIONS
C
      WRITE (6,3000)
 3000 FORMAT (1H1,48X,'**** VALVE CONFIGURATION DATA ****',//)
      WRITE (6,3010) (I,I=1,NMV)
 3010 FORMAT (1X,'VALVE',T15,'MAIN ISOLATION VALVES',T58,
     *       'SEC ISOLATION VALVES',T93,'SWITCHING VALVES',/,
     *       1X,'CONF',/,1X,'CODE',T22,12I3)
      WRITE (6,3015) (I,I=1,NSV)
 3015 FORMAT (1H+,T58,12I3)
      WRITE (6,3020) (I,I=1,NSWV)
 3020 FORMAT (1H+,T94,12I3)
      WRITE (6,3025)
 3025 FORMAT (1X,131(1H*))
      DO 3050 I=1,NVCONF
      DO 3030 J=1,NMV
      K=J-1
 3030 ISET(J)=FLD(K,1,VCONF(I)) + 1
      DO 3035 J=1,NSV
      K=J-1+12
 3035 JSET(J)=FLD(K,1,VCONF(I)) + 1
      DO 3040 J=1,NSWV
      K=J-1+24
 3040 KSET(J)=FLD(K,1,VCONF(I)) + 1
      WRITE (6,3046) I,(ISET(J),J=1,NMV)
 3046  FORMAT (/,2X,I3,T22,12I3)
      WRITE (6,3047) (JSET(J),J=1,NSV)
 3047 FORMAT (1H+,T58,12I3)
      WRITE (6,3048) (KSET(J),J=1,NSWV)
 3048 FORMAT (1H+,T94,12I3)
 3050 CONTINUE
      CONTINUE
C
C WRITE OUT APU EXHAUST THRUST CURVES
```

```
01001          C                                                          C01413
01002                WRITE(6,4110)                                        C01413
01004          4110  FORMAT(1H1,45X,'**** APU AVERAGE EXHAUST THRUST',    C01423
01004               *' CURVES ****',//,                                   C01423
01004               *T10,'CON',T16,'ALTITUDE',T27,'AMB',T39,              C01423
01004               *'THRUST,LBF = F(HYD PUMP SHAFT POWER,HP)',/,         C01423
01004               *T10,'NO',T18,'(FT)',T27,'PRESS',/,                   C01423
01004               *T27,'(PSIA)',/,                                      C01423
01004               *132(1H*),/)                                          C01423
01005                DO 4120 I=1,NTC                                      C01423
0101C                K=TNOCF(I)-1                                         C01426
01011                WRITE(6,4085)I,TALT(I),TPRESS(I),THRUST(I,1),        C01431
01011               *(THRUST(I,J+1),J,J=1,K)                              C01431
01024          4085  FORMAT(//T10,I3,3X,F8.0,3X,F6.2,6X,'THRUST = ',      C01460
01024               *D12.6,' * X ** 0 + ',                                C01460
01024               *2(D12.6,' * X **',I2,' + '),//,                      C01460
01024               *3(47X,3(D12.6,' * X **',I2,' + '),//))               C01460
01025          4120  CONTINUE                                             C01460
01027                RETURN                                               C01460
0102C                END                                                  C01533
END FOR
```

```
@FOR,S H.HINGE/V6,H.HINGE/V6
FOR S0E3-02/06/79-18.10:20 (4,)

   SUBROUTINE HINGE      ENTRY POINT 001126

   STORAGE USED: CODE(1) 001135; DATA(0) 000265; BLANK COMMON(2) 000000

    COMMON BLOCKS:

    0003    NUMS    000002
    0004    CONF    000014
    0005    RATES   000132
    0006    TIMES   000043
    0007    TARRAY  002156
    0010    TRAJ    000137
    0011    NAMES   000424
    0012    CRAD    000212
    0013    LKGS    000346
    0014    LMMTRX  001141

   EXTERNAL REFERENCES (BLOCK, NAME)

    0015    COS
    0016    NWDU$
    0017    NIO1$
    0020    NIO2$
    0021    SQRT
    0022    NERR2$
    0023    NERR3$

   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0000    000045 13F        0001    000002 133G       0001    000115 14L        0000    000014 15F        0001    000066 155C
    0001    000105 166G       0000    000101 19F        0001    000174 20L        0001    000145 204G       0000    000130 21F
    0001    000164 215G       0001    000200 227G       0001    000264 251G       0001    000303 262C       0001    000343 276C
    0001    000362 307G       0001    000313 35L        0001    000623 353G       0001    000642 364G       0001    000372 40L
    0001    000746 413G       0001    000765 424G       0001    001061 452G       0001    001100 463G       0001    000431 50L
    0001    000441 51L        0001    000460 52L        0001    000477 53L        0001    000516 55L        0001    000526 56L
    0001    000545 57L        0001    000564 58L        0001    000602 59L        0001    000652 60L        0001    000700 75L
    0001    000710 76L        0001    000720 77L        0001    000727 79L        0001    000775 80L        0001    001013 85L
    0001    001023 86L        0001    001033 87L        0001    001042 89L        0001    001112 90L        0011 R  000332 ACTNAM
    0005    000130 ALT        0013    000270 ALTFLW     0005    000127 CGLOAD     0006    000021 CLNO       0005 R  000072 DEF
    0006    000031 ECTRAN     0012    000000 FGRAD      0012    000134 FLGRAD     0006    000013 FREE       0006    000015 FRNC
    0005 R  000035 HM         0000 I  000003 I          0011    000134 IACTNO     0004    000003 IAPUSD     0014 I  000457 IASCN
    0006    000041 ICARD      0014    000745 ICODE      0006    000002 IEND       0010    000136 IETP       0011 I  000217 ILOAD
    0010    000000 INDEX      0000    000251 INJP$      0006    000006 IPHASE     0014    000212 IPTR       0014    000613 ISIV
    0011    000211 ISEED      0006    000000 ISTART     0006    000040 ISTAT      0006    000001 ISTOP      0014    000671 ISWV
    0004    000000 ISYS       0006    000012 IUNIT      0011    000254 IVEH       0006    000007 IVFLAG     0000 I  000005 J
    0000 I  000004 L          0014    000000 LVM        0000 I  000013 LOAD       0006    000036 LPHASE     0006    000034 LTYPE
    0006    000042 LUNIT      0014    000535 MIV        0014    000747 MVNAM      0014    000771 MVSYS      0014    001002 MVVEH
    0003    000001 NA         0011    000000 NAME       0003    000000 NL         0011    000212 NMODE      0014    001135 NMV
    0000 R  000000 NODATA     0006 I  000003 NOL        0006    000010 NOL2       0004 I  000007 NOS        0006    000005 NPLTS
    0006    000004 NPTS       0014    001136 NSV        0014    001137 NSWV       0014    001140 NVCONF     0006    000037 NW
```

```
0004 R 000016 P          0000 P 000002 PI        0013   000000 PSLKG    0000 R 000010 RAD     0005 R 000000 RATE
0000 R 000012 RAIMAX     0000 R 000207 SHM       0000 R 000006 SRAT     0000 R 000011 STLHM   0004 I 000013 STVLV
0013   000026 SVLKG      0014   001013 SVNAM     0014 I 001046 SVSYS    0014 I 001035 SVVEH   0014 I 001101 SWSYS
0014   001057 SWVNAM     0014 I 001112 SWVVEH    0007   000000 T        0004 R 000006 TP      0006   000025 TPCALL
0006   000011 TTIME      0000 R 000001 T6        0014 I 001123 VCONF    0007   001750 WRT     0005   000131 XMACH
0013   000134 XPSLKG     0013   000212 XSVLKG    0006   000035 XTPNO
```

```
              SUBROUTINE HINGE
              INCLUDE PAR,LIST
      PAR     PROC
              PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MMV=9,MSV=9,MSWV=9
            *   ,MVCONF=10
              PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10
                 COMMON/NUMS/NL,NA
       END
              INCLUDE CBL1,LIST
      CBL1    PROC
              COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV
              INTEGER STVLV
              COMMON /RATES/RATE(MNA),HM(MNA),DEF(MNA),CGLOAD,ALT,XMACH
              COMMON /TIMES/ISTART,ISTOP,TEND,NCL,NPTS,NPLTS
            *     ,IPHASE,IVFLAG,MOL2,TTIME,IUNIT,FREF(2),FRNO(4)
            *   ,CLNO(4),TPCALL(4),ECTRAN(3),LTYPE,XTPNO,LPHASE,NW
            *   ,ISTAT,ICARD,LUNIT
              COMMON /TARRAY/ T(1200),WRT(NR)
              COMMON /TRAJ/ INDEX(NR),IETP
              COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NMODE(3),ISPED(2),ILOAD(MNA),
            *                 IVEH(MNL),ACTNAM(MNA,2)
       END
              INCLUDE CBL2,LIST
      CBL2    PROC
              COMMON /GRAD/FGRAD(MNL,2),FLGRAD(MNL)
              COMMON /LKGS/PSLKG(MNL),SVLKG(MNL),XPSLKG(MNL),XSVLKG(MNL)
            *,ALTFLW(MNL)
              COMMON /LMMTRX/LMM(3,MNL),IPTR(3,3,3),ICODE(3,MNL),IASGN(MNL),
            *                 MIV(MNL),ISIV(MNL),ISWV(MNL),
            *                 MVNAM(2,MMV),MVSYS(MMV),MVVEH(MMV),
            *                 SVNAM(2,MSV)  ,          SVVEH(MSV), SVSYS(MSV),
            *          SWVNAM(2,MSWV),SWSYS(MSWV)            ,SWVVEH(MSWV)
            *,VCONF(MVCONF),NMV,NSV,NSWV,NVCONF
              INTEGER VCONF,      SVVEH,              SWVVEH,SVSYS   ,SWSYS
       END
              REAL NODATA/'NODATA'/
              DATA T6/1.0E6/
              DATA PI/3.1417/
      C CHECK INBOARD ELEVONS
              DO 20 I=13,15,2
              L=ILOAD(I)
              J=IASGN(L)
         12   IF (J .EQ. 0) GO TO 20
              SRAT=1
              SHM=1
              IF (SIGN(SHM,HM(I)) .EQ. SIGN(SRAT,RATE(I))) GO TO 20
              RAD=1.311*(-7.42-DEF(I))
```

ORIGINAL PAGE IS OF POOR QUALITY

```
      RAD=RAD*2.*PI/360.
      STLHM=(P(J)/2900.)*0.956E6*COS(RAD)
      IF (ABS(HM(I)) .LE. ABS(STLHM)) GO TO 14
      WRITE (6,13) HM(I),(ACTNAM(I,J),J=1,2),STLHM,TP
      WRITE (15,15) HM(I),(ACTNAM(I,J),J=1,2),STLHM,TP
   15 FORMAT (' HINGE MOMENT LOAD ',F20.10,' IN-LBS ON ',2A6,/,
     *       ' IS GREATER THAN ITS STALL HINGE MOMENT',F20.10,' IN-LBS',
     *        / ,' AT TIME= ',F12.7,' HRS')
   13 FORMAT (1H1,20(/),1X,'HINGE MOMENT LOAD ',F20.10,' IN-LBS ON ',
     *        2A6,' IS GREATER THAN ITS STALL HINGE MOMENT ',F20.10,
     *        ' IN-LBS',//,' AT TIME= ',F12.7,' HRS',/,1H1)
      GO TO 20
   14 RATMAX=32.97*SQRT(1.0-ABS(HM(I)/STLHM))
      IF (ABS(RATE(I)).LE.      RATMAX ) GO TO 20
C
      WRITE(6,19) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP
      WRITE (15,21) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP
C
   20 CONTINUE
C CHECK OUTBOARD ELEVONS
      DO 40 I=12,14,2
      L=ILOAD(I)
      J=IASGN(L)
   32 IF ( J .EQ. 0) GO TO 40
      SRAT=1
      SHM=1
      IF (SIGN(SHM,HM(I)) .EQ. SIGN(SRAT,RATE(I))) GO TO 40
      RAD=.955*(-8.6-DEF(I))
      RAD=RAD*2.*PI/360.
      STLHM=(P(J)/2900.)*0.4595E6*COS(RAD)
      IF (ABS(HM(I)) .LE. ABS(STLHM)) GO TO 35
      WRITE (6,13) HM(I),(ACTNAM(I,J),J=1,2),STLHM,TP
      WRITE (15,15)HM(I),(ACTNAM(I,J),J=1,2),STLHM,TP
      GO TO 40
   35 RATMAX=33.11 * SQRT(1.0-ABS(HM(I)/STLHM))
      IF (ABS(RATE(I)) .LE.      RATMAX ) GO TO 40
C
      WRITE(6,19) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP
      WRITE (15,21) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP
C
   40 CONTINUE
C CHECK BODY FLAP
      I=16
      SHM=1
      SRAT=1
      LOAD=1
      IF (SIGN(SHM,HM(I)) .EQ. SIGN(SRAT,RATE(I)))  LOAD=2
C LOAD=1 : OPPOSING LOAD
C LOAD=2 : AIDING LOAD
      IF (NOS .EQ. 0) GO TO 90
      GO TO (50,55),LOAD
   50 GO TO (51,52,53),NOS
   51 RATMAX=(-.1285543+SQRT(.0165232+(9.0381008*(1.3856317-
     *      ABS(HM(I)/T6)))))/
     *          4.5190504
      GO TO 54
   52 RATMAX=(-.1283966+SQRT(.0164856+(2.0565236*(1.3981675-
```

```
      *     ABS(HM(I)/T6)))))/
      *        1.0292618
       GO TO 59
   53 RATMAX=(-.09493478+SQRT(.0090125+(.9216732*(1.4121217-
      *     ABS(HM(I)/T6)))))/
      *        .4608366
       GO TO 59
   55 GO TO (56,57,58),NOS
   56 RATMAX=(1.4058356+SQRT(1.9763737-(4.1202264*(.4793893-
      *     ABS(HM(I)/T6)))))/
      *     2.0601132
       GO TO 59
   57 RATMAX=(.7925523+SQRT(.6281391-(1.1173654*(.56156701-
      *     ABS(HM(I)/T6)))))/
      *        .558677
       GO TO 59
   58 RATMAX=(.56952632+SQRT(.3243598-(.5227108*(.62047078-
      *     ABS(HM(I)/T6)))))/
      *        .2613554
   59 RATMAX=13.0
       IF (ABS(RATE(I)) .LE.      RATMAX)  GO TO 60
C
       WRITE(6,19) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP
       WRITE (15,21) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP
C
   60 CONTINUE
C
C CHECK RUDDER
C
       I=10
       SHM=1
       SRAT=1
       IF (SIGN(SHM,HM(I)) .EQ. SIGN(SRAT,RATE(I))) GO TO 80
       GO TO (75,76,77),NOS
   75 RATMAX=(-35.588235*ABS(HM(I)/T6))   + 27.047058
       GO TO 79
   76 RATMAX=(-71.17647*ABS(HM(I)/T6))+54.094117
       GO TO 79
   77 RATMAX=(-106.7647*ABS(HM(I)/T6))    + 81.141174
   79 IF (ABS(RATE(I)) .LE. RATMAX) GO TO 80
C
       WRITE(6,19) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP
       WRITE (15,21) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP
C
   80 CONTINUE
C
C CHECK SPEED BRAKE
C
       I=11
       IF (RATE(I))   90,90,84
   84 GO TO (85,86,87),NOS
   85 RATMAX=(-11.296296*ABS(HM(I)/T6))+26.207306
       GO TO 89
   86 RATMAX=(-22.592592 * ABS(HM(I)/T6)) + 52.414813
       GO TO 89
   87 RATMAX=(-33.88888*ABS(HM(I)/T6)) + 78.622218
   89 IF (ABS(RATE(I)) .LE. RATMAX) GO TO 90
```

5-84

ORIGINAL PAGE IS
OF POOR QUALITY

```
C0446         C                                                                              C01042
C0450              WRITE(6,19) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP                         C01046
C0461              WRITE (15,21) (ACTNAM(I,J),J=1,2),RATE(I),RATMAX,TP                       C01070
C0472           19 FORMAT (1H1,20(/),1X,2A6,' ANGULAR RATE INPUT ',F6.3,' DEG/SEC EXC        C01107
C0472             *EEDS MAXIMUM ALLOWABLE RATE ',F6.3,' DEG/SEC AT ',F12.7,' HRS',/,         C01107
C0472             *1H1)                                                                      C01107
C0473           21 FORMAT (1X,2A6,' ANGULAR RATE INPUT ',F6.3,' DEG/SEC',/,                  C01107
C0473             *        ' EXCEEDS MAXIMUM ALLOWABLE RATE ',F6.3,' DEC/SEC',/,             C01107
C0473             *        ' AT ',F12.7,' HRS')                                              C01107
C0474              NOL=51                                                                    C01107
C0474         C                                                                              C01107
C0475           90 CONTINUE                                                                  C01112
C0476              RETURN                                                                    C01112
C0477              END                                                                       C01134
END FOR
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
@FOR,S H.POWER/V6,H.POWER/V6
FOR S0E0-02/06/75-18:10:30 (2,)

SUBROUTINE POWER     ENTRY POINT 000543

STORAGE USED: CODE(1) 000565; DATA(0) 000175; BLANK COMMON(2) 000000

COMMON BLOCKS:

0003    NUMS     000002
0004    CONF     000014
0005    RATES    000122
0006    TIMES    000043
0007    TARRAY   000166
0010    TRAJ     000107
0011    NAMES    000424
0012    GRAD     000212
0013    LKGS     000746
0014    LPMTRX   001141
0015    OUTPUT   000073
0016    COEFF    000271
0017    ECOMP    000000
0020    FUEL     000017
0021    SFCC     001424
0022    THRST    000106

EXTERNAL REFERENCES (BLOCK, NAME)

0023    TITLE
0024    PRESUR
0025    TCOMP
0026    XPO1
0027    NWDU$
0030    NIO1$
0031    NIO2$
0032    NWBU$
0033    NIO3$
0034    NESP$
0035    NWEF$
0036    NERR3$

STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001      000046  120L      0000      000037  132F      0000      000074  133F      0001      000301  134L      0001      000277  135L
0001      000234  136L      0001      000311  140L      0001      000005  142G      0001      000032  157G      0001      000036  164G
0001      000052  175G      0001      000076  206G      0000      000117  211F      0001      000122  221G      0001      000211  273G
0001      000024  81L       0001      000444  87L       0001      000462  89L       0001      000507  96L       0011      000332  ACTNAM
0005 R    000130  ALT       0013      000270  ALTFLW    0016 C    000000  CF        0005      000127  CGLOAD    0016      000021  CLNO
0000      000024  DPUG      0005      000072  DEF       0006      000071  CCTRAN    0016 R    000240  FRANGE    0012      000000  FCRAD
0012 R    000134  FLCRAD    0020      000000  FLOAD     0015 R    000000  FLRT      0006      000013  FPEF      0020      000011  FREM
0006      000015  FRNO      0020      000003  FUNUSE    0021      001421  FURATE    0017      000011  FC        0005      000035  HM
0000 I    000002  I         0011 I    000134  IACTNO    0000 I    000006  IAPU      0004 I    000003  IAPUSD    0014 I    000457  IASCN
0006      000041  ICARD     0014      000245  ICODE     0000 I    000015  ICONF     0006      000002  ICAR      0010      000136  IFTP
```

```
C011     C00217 ILOAD      0000 I 000012 IMODE1     0000 I 000013 IMODE2     C000 I 0CC014 IMODE3     0010   000C00 INDEX
C00C     CC0145 INJPS      0015   000C72 IOTAP      0006   000006 IPHASE     C015 I 0CC071 IPPLT      0014 I 000212 IPTR
C000 I   C00005 IS         0015 I 000064 ISAT       0014   0C0613 ISIV       C011 I 000215 ISPED      CC00 I C00C16 ISPED1
C000 I   C00017 ISPED2     0000 I 000020 ISPED3     0006   000000 ISTART     C006   0CC040 ISTAT      C0C6   000C01 ISTOP
0000 I   C00C21 IST1       0000 I 000022 IST2       0000 I 000023 IST3       C014   C00671 ISWV       0CC4 I 000C00 ISYS
C006     L00C12 IUNIT      0011   000254 IVEH       0006   C0C0C7 IVFLAG     C000 I 0C0004 J          CCL0 I 000C07 K
C00C I   C0001C KK         C000 I 000003 L          C014   CCC000 LMM        C006   0C0036 LPHASE     C0L6   0C0C34 LTYPE
C006     C00C42 LUNIT      0014   000535 MIV        CC14   00C747 MVNAM      C014   CCC771 MVSYS      CC14   CC1C02 MVVEH
CC03     CC0001 NA         0011   000000 NAME       CC21   001415 NEQNS      C003 I 0C0C00 NL         CC11 I 000012 NMCDF
C014     CC113C NMV        0000 I 0CCC11 NOC        0001   CCC007 NOCF       C006 I 000003 NOL        CCC6   CCCC1C NOL2
0004     C00007 NOS        0016 I 000276 NPER       C0C6 I 000C05 NPLTS      C006   000004 NPTS       CC21   0C1414 NSPDS
C014     C0113C NSV        0014   0C1137 NSWV       C022   CCC074 NTC        C014   0C114C NVCONF     CCC6   CCCC37 NW
C004 R   C00C1C P          0022 R 0C0105 PAMB       C0C0 C 0C0000 PCFF       CC17   000044 PLIM       C021   C0132C PRALT
C024 R   C000CC PRESUR     0013   000000 PSLKG      0015 R 000061 PWR        C005 R 000000 RATE       0015 R 000067 SAT
0021     C00074 SFC        0004 I 000013 STVLV      C013   0CC056 SVLKC      C014   0C1013 SVNAM      CC14 I 0C1C46 SVSYS
C014 I   C01C35 SVVEH      0014 I 001101 SWSYS      C014   CL1057 SWVNAM     C014 I 0C1112 SWVVEH     C0L7 R C0C00C T
0022     C000C0 TALT       0000   000C14 TENUSD     C015 R C0CC56 TFLRT      C020   C0CCC6 TFUSED     CC22   C00C12 THRUST
C022 I   000005 THOCF      0004 R 000006 TP         0006   0C0025 TPCALL     C022   0C0C75 TPRESS     0022 R C00102 TR
C006     C00011 TTIME      0017   00000C TVOL       0017   0C0047 ULPRFC     0017   000C03 ULPRLC     CC17   000C14 ULTALT
0017     C00017 ULTOFT     0017   000000 ULTPLC     0014 I C01123 VCONF      C007   0C1750 WRT        CC21   0C1224 XALT
C017 R   000052 XFLOW      0005   0C0131 XMACH      0013 R 000134 XPSLKG     C013 R 0C0212 XSVLKG     C0L6   000C35 XTPAC
```

```
C0101     1*             SUBROUTINE POWER                                                          C00000
C0103     2*             INCLUDE PAR,LIST                                                          C00000
00103     2*      PAR    PROC                                                                      C00000
C0104     2*             PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MMV=9,MSV=9,MSWV=9           C00000
C0104     2*           *   ,MVCONF=10                                                              C00000
C0105     2*             PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10                   C00000
C0106     2*                 COMMON/NUMS/NL,NA                                                     C00000
C0106     2*       END                                                                             C00000
C0107     3*             INCLUDE CPL1,LIST                                                         C00000
C0107     3*      CPL1   PROC                                                                      C00000
C0110     3*             COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV                          C00000
C0111     3*             INTEGER STVLV                                                             C00000
C0112     3*             COMMON /RATES/RATE(MNA),HM(MNA),DEF(MNA),CGLOAD,ALT,XMACH                 C00000
C0113     3*             COMMON /TIMES/ISTART,ISTOP,IEND,NOL,NPTS,NPLTS                            C00000
C0113     3*           *      ,IPHASE,IVFLAG,NOL2,TTIME,IUNIT,FREE(2),FRNO(4)                      C00000
C0113     3*           *   ,CLNO(4),TPCALL(4),ECTRAN(3),LTYPE,XTPNO,LPHASE,NW                      C00000
C0113     3*           *   ,ISTAT,ICARD,LUNIT                                                      C00000
C0114     3*             COMMON /TARRAY/ T(1200),WRT(NR)                                           C00000
C0115     3*             COMMON /TRAJ/ INDEX(NR),IETP                                              C00000
C0116     3*             COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NMODE(3),ISPED(2),ILOAD(MNA),        C00000
C0116     3*           *                IVEH(MNL),ACTNAM(MNA,2)                                    C00000
C0116     3*       END                                                                             C00000
C0117     4*             INCLUDE CPL2,LIST                                                         C00000
C0117     4*      CPL2   PROC                                                                      C00000
C0120     4*             COMMON /GRAD/FGRAD(MNL,2),FLGRAD(MNL)                                     C00000
C0121     4*             COMMON /LKGS/PSLKG(MNL),SVLKG(MNL),XPSLKG(MNL),XSVLKC(MNL)                C00000
C0121     4*            *,ALTFL.(MNL)                                                              C00000
C0122     4*             COMMON /LMMTRX/LMM(3,MNL),IPTR(3,3,3),ICODE(3,MNL),IASGN(MNL),            C00000
C0122     4*           *                MIV(MNL),ISIV(MNL),ISWV(MNL),                              C00000
C0122     4*           *                MVNAM(2,MMV),MVSYS(MMV),MVVEH(MMV),                        C00000
C0122     4*           *                SVNAM(2,MSV)  ,          SVVEH(MSV), SVSYS(MSV),           C00000
C0122     4*           *            SWVNAM(2,MSWV),SWSYS(MSWV)              ,SWVVEH(MSWV)          C00000
```

```
     *,VCONF(MVCONF),NMV,NSV,NSWV,NVCONF
      INTEGER VCONF,      SVVEH,              SWVVEH,SVSYS   ,SWSYS
 END
      INCLUDE CBL3,LIST
CBL3  PROC
      COMMON /OUTPUT/FLRT(MNL),TFLRT(3),PWR(3),ISAT(3),SAT(2)
     *, IPPLT,ICTAP
      COMMON /COEFF/ CF(10,2,2,2),
     *               ERANGE(2,2,2,3)
     *     ,NPCN
      DOUBLE PRECISION CF
      COMMON /PCOMP/ULTPLC(3),ULPPLC(3),TVOL(3),HE(3),
     *             ULTALT(3),ULTOFT(3,7),PLIM(3)
     *             ,ULPRFC(3),XFLOW(3,2)
      COMMON /FUEL/ FLOAD(3),FUMUSE(3),TFUSED(3),FREM(3),TENUSD(3)
      COMMON /SFCC/ NOCF(MNSPDS,MNEQNS,3),SFC(MNSPDS,MNEQNS,MNOCF,3),
     *              XALT(MNSPDS,MNEQNS,3),PRALT(MNSPDS,MNEQNS,3),NSPDS,
     *             NEQNS(MNSPDS),FURATE(3)
      COMMON/THRST/TALT(MNTEQN),TNOCF(MNTEQN),THRUST(MNTEQN,MTNOCF)
     *,NTC,TPRESS(MNTEQN),TR(3),PAMB
      INTEGER TNOCF
 END
      DOUBLE PRECISION PEFF
      DATA SAT/'      ','******'/
      NAMELIST/FFUC/ FLGRAD,FLRT,RATE
C
C COMPUTE FLOW RATE FOR EACH ACTUATOR
C
      DO 100 I=1,NL
      FLRT(I)=0.0
      L=IACTNO(I)
      IF (L .EQ. 0) GO TO 81
      FLRT(I)=ABS(RATE(L))*FLGRAD(I)
      IF (FLRT(I) .LT. XPSLKG(I)) FLRT(I)=XPSLKG(I)
   81 FLRT(I)=FLRT(I)+XSVLKG(I)
  100 CONTINUE
C
C COMPUTE TOTAL FLOW RATE PER SYSTEM
C
      DO 110 I=1,3
  110 TFLRT(I)=0.0
      DO 120 I=1,NL
      J=IASGN(I)
      IF (J .EQ. 0) GO TO 120
      TFLRT(J)=TFLRT(J)+FLRT(I)
  120 CONTINUE
C CHECK FOR SYSTEM SATURATION
C
      DO 125 I=1,3
      L=IAPUSE(I)
      ISAT(I)=1
      IF (TFLRT(I) .GE. XFLOW(I,L)) ISAT(I)=2
  125 CONTINUE
C
C COMPUTE POWER REQUIREMENTS PER SYSTEM
C
      DO 140 I=1,3
```

```
      IF (TFLRT(I) .EQ. 0) GO TO 135
      IS=ISYS(I)
      IAPU=IAPUSD(I)
      PWR(I)=0.0
      K=0
      IF (IS .EQ. 3) GO TO 135
      DO 127 KK=1,NPER
  127 IF(ERANGE(IS,IAPU,KK,1) .LE. TFLRT(I) .AND. TFLRT(I) .LE.
     *   ERANGE(IS,IAPU,KK,2)) K=KK
      IF (K .EQ. 0) GO TO 136
  129 PEFF=0.000
      NOC=ERANGE(IS,IAPU,K,3)+.1
      DO 130 J=1,NOC
  130 IF (DABS(CF(J,K,IS,IAPU)) .GT. 1.E-30) PEFF=PEFF+(CF(J,K,IS,IAPU)*
     *       TFLRT(I)**(J-1))
      GO TO 134
  136 CONTINUE
      IF (NOL .GT. 49) CALL TITLE
      WRITE (6,133) TFLRT(I),ISPED(IAPU),NMODE(IS)
      WRITE (15,132) TFLRT(I),ISPED(IAPU),NMODE(IS),I,TP
  132 FORMAT (' NO PUMP EFFICIENCY DATA AVAILABLE ',/,
     *     ' FLOW RATE= ',/,F20.10,' GPM',/,
     *       ' APU SPEED= ',I3,'%',/,
     *     ' MODE = ',A4,/,' SYS =',I6,/,' TIME = ',F20.10,' HRS',/)
  133 FORMAT (1X,13(1H*),'NO PUMP EFFICIENCY DATA AVAILABLE. ',
     *'  FLOW RATE=',F10.2,'  APU SPEED=',I3,'%   MODE=',A4)
      NOL=NOL+1
  135 PWR(I)=0.0
      GO TO 140
  134 PWR(I)=TFLRT(I)*P(I)/(1714.*PEFF)
  140 CONTINUE
      NPLTS=NPLTS+1
C
C COMPUTE APU EXHAUST THRUST
C
      PAMB=PRESUR(ALT)
      CALL TCOMP
C
C  WRITE OUTPUT REPORT
C
   82 IF (T(785) .LE. 0) GO TO 87
      IF ( NOL .GT. 49) CALL TITLE
   80 IMODE1=ISYS(1)
      IMODE2=ISYS(2)
      IMODE3=ISYS(3)
      ICONF=IPTR (IMODE1,IMODE2,IMODE3)
      ISPED1=IAPUSD(1)
      ISPED2=IAPUSD(2)
      ISPED3=IAPUSD(3)
      IST1=ITSAT(1)
      IST2=ITSAT(2)
      IST3=ITSAT(3)
      J=T(666)+.1
      WRITE(6,211)TP,ALT,ICONF,J,
     *                        ,ISPED(ISPED1),TFLRT(1),SAT(IST1),
     *    PWR(1),            ISPED(ISPED2),TFLRT(2),SAT(IST2),PWR(2),
     *                  ISPED(ISPED3),TFLRT(3),SAT(IST3),PWR(3)
```

```
00334       211 FORMAT (2X,F10.5,1X,F7.0,1X,I2,'/',I2,1X,3(I3,2X,F6.2,2X,A4,2X,F6.     000440
00334          *2,10X))                                                                 000440
00335           NOL=NOL+1                                                               000440
00336        87 IPPLT=T(782) + .1                                                       000444
00337           IF (IPPLT .EQ. 0) RETURN                                                000454
00337      C                                                                            000454
00337      C WRITE PLOT TAPE FOR POWER REQUIREMENTS                                     000454
00337      C                                                                            000454
00341        88 CONTINUE                                                                000462
00342        89 WRITE (IPPLT,END=96) TP,PWR,TFLRT,TR,FLRT                               000462
00351           RETURN                                                                  000503
00352        96 BACKSPACE IPPLT                                                         000507
00353           END FILE IPPLT                                                          000511
00354           IPPLT=IPPLT+1                                                           000514
00355           GO TO 89                                                                000517
00356           END                                                                     000557
END FOR
```

```
@FOR,S H.SAPUM/VE,H.SAPUM/VE
FOR S0E3-02/06/79-18:10:47 (52,)

   SUBROUTINE SAPUM      ENTRY POINT 001635
              SUPM       ENTRY POINT 001640

   STORAGE USED: CODE(1) 001643; DATA(0) 000555; BLANK COMMON(2) 000000

    COMMON BLOCKS:

    0003     NUMS     000002
    0004     COMF     000014
    0005     RATES    000132
    0006     TIMES    000043
    0007     TAPRAY   002106
    0010     TRAJ     000137
    0011     NAMES    000424
    0012     CRAD     000212
    0013     LKGS     000346
    0014     LMTRX    001141
    0015     OUTPUT   000073
    0016     COEFF    000271
    0017     PCOMP    000060
    0020     FUEL     000017
    0021     SFCC     001424
    0022     THRST    000106

   EXTERNAL REFERENCES (BLOCK, NAME)

    0023     PRESUR
    0024     TANK
    0025     TITLE
    0026     TITLE2
    0027     XPRI
    0030     NWDU$
    0031     NIO2$
    0032     NWBU$
    0033     NIO1$
    0034     NIO3$
    0035     NBSP$
    0036     NWEF$
    0037     NERR2$
    0040     NERR3$

   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001     000306 1019L     0001     000035 156G      0001     000054 164G      0001     000063 171C      0001     000072 176G
    0001     000511 2008L     0001     000535 2010L     0001     000556 2011L     0000     000357 2012F     0001     000124 213G
    0001     000157 236G      0001     000202 242G      0001     000217 250G      0001     000253 262G      0001     000347 302C
    0001     000242 305L      0001     000376 311G      0001     000017 331L      0001     000513 336G      0001     000042 412L
    0001     000152 420L      0001     000167 422L      0001     000200 423L      0001     000730 450C      0001     000756 464F
    0001     000764 470G      0001     001017 50L       0001     000677 502L      0001     000602 503L      0000     000330 505F
    0001     000702 510L      0001     001042 514G      0001     001106 52L       0001     001005 520L      0000     000301 527F
```

```
0000   000343 53F       0001   000376 539L      0001   001071 535G      0001   001125 540L      0001   001137 550L
0000   000366 551F      0000   000436 552F      0001   001145 563G      0001   001177 600L      0001   000302 609L
0001   001207 610L      0000   000464 613F      0001   001213 613G      0001   001360 614L      0001   001457 615L
0001   001537 620L      0001   001551 640L      0001   001400 674G      0001   001434 712G      0001   001475 732C
0001   001563 766G      0001   000431 839L      0001   000432 849L      0000   000256 859F      0000   000501 990F
0011   000332 ACTNAM    0005 P 000130 ALT       0013   000270 ALTFLW    0016 D 000000 CF        0005 R 000127 CCLOAD
0006   000521 CLNO      0000   000246 DRUG      0005   000072 DEF       0000 R 000222 DELTP     0006   000231 ECTRAN
0005 R 000224 EFUSED    0016   000240 ERANGE    0012   000000 FCRAD     0012   000134 FLGRAD    0020 R 000000 FLOAD
0015 R 000000 FLRT      0000 P 000217 FRATE1    0000 R 000221 FRATE2    0006   000013 FREE      0020 R 000011 FREM
0000 R 000201 FREQT     0026   000015 FRNO      0020 R 000003 FUNUSE    0021 R 001421 FURATE    0020 R 000223 FUSED
0017 R 000011 HE        0005   000035 HM        0000 I 000213 I         0011   000134 IACTNO    0004 I 000003 IAPUSD
0014 I 002457 IASGN     0000 I 000231 IA1       0000 I 000232 IA2       0000 I 000233 IA3       0006   000041 ICARD
0014   002245 ICODE     0006   000002 IEND      0010   000136 IETP      0000 I 000245 IK        0011   000217 ILOAD
0010   000000 INDEX     0000   000521 INJPI     0015 I 000072 IOTAP     0000 I 000171 IOVFR     0006 I 000006 IPHASE
0015   000071 IPPLT     0014 I 000217 IPTP      0015 I 000064 ISAT      0014   000613 ISIV      0000 I 000214 ISPD
0011 I 000215 ISPED     0000 I 000236 IST       0006 I 000000 ISTART    0006   000040 ISTAT     0006 I 000001 ISTOP
0000 I 000242 IST1      0000 I 000243 IST2      0000 I 000244 IST3      0014   000671 ISWV      0004 I 000000 ISYS
0000 I 000174 IUNDER    0006   000012 IUNIT     0011   000254 IVEH      0006 I 000007 IVFLAG    0000 I 000205 I1
0000 I 000200 I2        0000 I 000237 I3        0000 I 000204 J         0000 I 000220 K         0000 I 000166 KSPD
0000 I 000210 KSYS      0000 I 000215 KV1       0000 I 000216 KV2       0014   000000 LMM       0006   000036 LPHASE
0006   000034 LTYPE     0006   000042 LUNIT     0014   000535 MIV       0014   000747 MVNAM     0014   000771 MVSYS
0014   001002 MVVEH     0003   000001 NA        0011   000000 NAME      0021 I 001415 NEQNS     0013 I 000000 NL
0011   000012 NMODE     0014   001135 NMV       0021 I 000000 NOCF      0006 I 000003 NOL       0006 I 000010 NOL2
0004   000007 NOS       0016   000079 NPER      0006 I 000005 NPLTS     0006 I 000004 NPTS      0021   001414 NSPDS
0014   001136 NSV       0014   001137 NSWV      0022   000074 NTC       0014   001140 NVCONF    0006   000037 NW
0000 I 000220 N1        0000 I 000227 N2        0000 I 000233 N3        0004 R 000010 P         0022 R 000105 PAMB
0017 R 000044 PLIM      0021 R 001320 PRALT     0023 R 000000 PRESUR    0013   000000 PSLKG     0015 R 000061 PWR
0005   000000 RATE      0015 R 000067 SAT       0021 R 000074 SFC       0009 R 000073 STORE     0004 I 000013 STVLV
0013   000056 SVLKG     0014   001213 SVNAM     0014 I 001046 SVSYS     0014 I 001035 SVVEH     0014 I 001101 SWSYS
0014   001057 SWVNAM    0014 I 001112 SWVVEH    0007 R 000000 T         0022   000000 TALT      0000 R 000225 TEMP
0020 R 000014 TENUSD    0015 P 000056 TFLRT     0020 R 000006 TFUSED    0022   000012 THRUST    0000 R 000240 TLAST
0000 R 000234 TLIN      0022 I 000005 TNOCF     0004 R 000006 TP        0006   000025 TPCALL    0012   000075 TPRESS
0022 R 000132 TR        0000 R 000235 TSEC      0006 R 000011 TTIME     0000 R 000237 TTMIN     0017 R 000006 TVOL
0017 R 000047 ULPRFC    0017   000003 ULPRLC    0017 R 000014 ULTALT    0017 R 000017 ULTOFT    0017   000000 ULTPLC
0014 I 001123 VCONF     0000 P 000000 WAVG      0007   001750 WRT       0021   001224 XALT      0017   000052 XFLOW
0000 R 000212 XINT      0005 R 000131 XMACH     0013   000134 XPSLKG    0000 R 000177 XPWR      0013   000212 XSVLKG
0000 R 000211 XTP       0036   000035 XTPNO     0000 R 000241 YALT      0000 R 000203 YTP
```

```
00101      1*           SUBROUTINE SAPUM                                                          000000
00103      2*           INCLUDE PAR,LIST                                                          000000
00103      2*     PAR   PROC                                                                      000000
00104      2*           PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MHV=9,MSV=9,MSWV=9          000000
00104      2*          *  ,MVCONF=10                                                              000000
00105      2*           PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10                   000000
00106      2*               COMMON/NUMS/NL,NA                                                     000000
00106      2*      END                                                                            000000
00107      3*           INCLUDE CBL1,LIST                                                         000000
00107      3*     CBL1  PROC                                                                      000000
00110      3*           COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV                          000000
00111      3*           INTEGER STVLV                                                             000000
00112      3*           COMMON /RATES/RATE(MNA),HM(MNA),DEF(MNA),CGLOAD,ALT,XMACH                 000000
00113      3*           COMMON /TIMES/ISTART,ISTOP,IEND,NOL,NPTS,NPLTS                            000000
00113      3*          *    ,IPHASE,IVFLAG,NOL2,TTIME,IUNIT,FREE(2),FRNO(4)                       000000
00113      3*          *  ,CLNO(4),TPCALL(4),ECTRAN(3),LTYPE,XTPNO,LPHASE,NW                      000000
```

```
      *    ,ISTAT,ICARD,LUNIT
       COMMON /IARRAY/ T(1000),WPT(NR)
       COMMON /TRAJ/ INDEX(NR),IFTP
       COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NMODE(3),ISPED(2),ILOAD(MNA),
      *               IVEH(MNL),ACTNAM(MNA,2)
 END
       INCLUDE CPL2,LIST
 CPL2  PROC
       COMMON /GRAD/FGRAD(MNL,2),FLGRAD(MNL)
       COMMON /LKCS/PSLKG(MNL),SVLKG(MNL),XPSLKG(MNL),XSVLKG(MNL)
      *,ALTFLW(MNL)
       COMMON /LMMTRX/LMM(3,MNL),IPTR(3,3,3),ICODE(3,MNL),IASGN(MNL),
      *               MIV(MNL),ISIV(MNL),ISWV(MNL),
      *               MVNAM(2,MMV),MVSYS(MMV),MVVEH(MMV),
      *               SVNAM(2,MSV) ,              SVVEH(MSV), SVSYS(MSV),
      *          SWVNAM(2,MSWV),SWSYS(MSWV)                ,SWVVEH(MSWV)
      *,VCONF(MVCONF),NMV,NSV,NSWV,NVCONF
       INTEGER VCONF,       SVVEH,                SWVVEH,SVSYS   ,SWSYS
 END
       INCLUDE CPL3,LIST
 CPL3  PROC
       COMMON /OUTPUT/FLRT(MNL),TFLRT(3),PWR(3),ISAT(3),SAT(2)
      *, IPPLT,IOTAP
       COMMON /COEFF/ CF(10,2,2,2),
      *               ERANGE(2,2,2,3)
      *    ,NPEP
       DOUBLE PRECISION CF
       COMMON /PCOMP/ULTPLC(3),ULPRLC(3),TVOL(3),HE(3),
      *               ULTALT(3),ULTOFT(3,7),PLIM(3)
      *               ,ULPRFC(3),XFLOW(3,2)
       COMMON /FUEL/ FLOAD(3),FUNUSE(3),TFUSED(3),FREM(3),TENUSD(3)
       COMMON /SFCC/ NOCF(MNSPDS,MNEQNS,3),SFC(MNSPDS,MNEQNS,MNOCF,3),
      *               XALT(MNSPDS,MNEQNS,3),PRALT(MNSPDS,MNEQNS,3),NSPDS,
      *               NEQNS(MNSPDS),FURATE(3)
       COMMON/THRST/TALT(MNTEQN),TNOCF(MNTEQN),THRUST(MNTEQN,MTNOCF)
      *,NTC,TERLSS(MNTEQN),TR(3),PAMB
       INTEGER TNOCF
 END
       DIMENSION WAVG(NG)
       DIMENSION STORE(NG),          KSPD(3)
       DIMENSION IOVER(3),IUNDER(3)
       DIMENSION XPWR(3)
       NAMELIST/DBUG/FLRT,WAVG
       FREQT=T(781)/3600.
       IOTAP=T(784)+.1
C
C TEST AVERAGING FLAG
C
       IF (T(783) .GT. 0) GO TO 600
C
C TAKE A WEIGHTED AVERAGE OF DATA OVER GIVEN INTERVAL
  331 IF (ISTART .EQ. 0) GO TO 412
      IF (ISTOP.EQ. 1) GO TO  422
      IF (TP-YTF) 410,420,420
  410 DO 411 J=2,NG
  411 WAVG(J)=WAVG(J)+STORE(J)*(TP-STORE(1))
  412 STORE(1)=TP
```

ORIGINAL PAGE IS OF POOR QUALITY

```
      DO 413 J=1,NL
  413 STORE(J+1)=FLRT(J)
      DO 414 J=1,7
  414 STORE(J+NL+1)=TFLRT(J)
      DO 415 J=1,3
      STORE(J+NL+10)=TR(J)
  415 STORE(J+NL+4)=PWR(J)
      STORE(   NL+8)=CGLOAD
      STORE(   NL+9)=ALT
      STORE(NL+13)=XMACH
  416 I1=ISYS(1)
      I2=ISYS(2)
      I3=ISYS(3)
      KSYS=IPTR(I1,I2,I3)
      DO 418 J=1,3
  418 KSPD(J)=IAPUSD(J)
  417 IF (ISTART .NE. 0) RETURN
      YTP=TP
      XTP=YTP
      YTP=YTP+FREQT
      TTIME=TTIME + T(665)-TP
      ISTART=1
      RETURN
  420 DO 421 J=2,NG
  421 WAVG(J)=WAVG(J)+STORE(J)*(YTP-STORE(1))
      XINT=FREQT
      GO TO 423
  422 XINT=T(665)-XTP
      IF (XINT  .LE. 0) RETURN
  423 DO 424 J=2,NG
  424 WAVG(J)=WAVG(J)/XINT
C CALCULATE ATMOSPHERIC PRESSURE FOR THE CURRENT ALTITUDE
 530  PAMB=PRESUR(WAVG(NL+9))
C
C COMPUTE FUEL QUANTITIES
C
 1009 DO 2009 I=1,3
C FIND CURVES TO INTERPOLATE BETWEEN
C
      ISPD=KSPD(I)
      J=NEQNS(ISPD)-1
      IF (PAMB .LT. PRALT(ISPD,1,I)) GO TO 309
      KV1=1
      KV2=2
      GO TO 1019
  309 DO 509 I1=1,J
      IF (PRALT(ISPD,I1,I).GE.PAMB.AND.PAMB.GE.PRALT(ISPD,I1+1,I))
     *    GO TO 609
  509 CONTINUE
      KV1=J
      KV2=J+1
      GO TO 1019
  609 KV1=I1
      KV2=I1+1
C FIND FUEL RATES ON CURVES
 1019 J=NPCF(ISPD,KV1,I)
      IF (WAVG(4+NL+I) .LE. 0.00001) GO TO 839
```

```
      FRATE1=0.0
      DO 709 K=1,J
  709 FRATE1=FRATE1+SFC(ISPD,KV1,K,I)*WAVG(4+NL+I)**(K-1)
      J=NOCF(ISPD,KV2,I)
      FRATE2=0.0
      DO 809 K=1,J
  809 FRATE2=FRATE2+SFC(ISPD,KV2,K,I)*WAVG(4+NL+I)**(K-1)
C INTERPOLATE WITH PRESSURE
      DELTP=ABS(PRALT(ISPD,KV1,I)-PRALT(ISPD,KV2,I))
      FURATE(I)=FRATE2+(FRATE1-FRATE2)*((PAMB-PRALT(ISPD,KV2,I))/DELTP)
      GO TO  49
  839 FURATE(I)=0.0
  849 FUSED    =FURATE(I)*XINT
      TFUSED(I)=TFUSED(I)+FUSED
      FREM(I)=FLOAD(I)-TFUSED(I)
      ENUSED=WAVG(4+NL+I)*XINT
      TENUSD(I)=TENUSD(I)+ENUSED
C
C COMPUTE TANK PRESSURE
C
      IF (IVFLAG .EQ. 1) TEMP=ULTALT(I)
      IF (IVFLAG .EQ. 2) TEMP=(ULTOFT(I,IPHASE))
      CALL TANK(TEMP,FREM(I),TVOL(I),ULPRFC(I),HE(I),2)
2009  CONTINUE
C
C  CHECK AGAINST FUEL AND PRESSURE LIMITS
C
2008     DO 2011 I=1,3
      IF (IOVER(I) .EQ. 1) GO TO 2010
      IF (FREM(I) .GT. FUNUSE(I)) GO TO 2010
      WRITE (15,859) I,YTP   ,TFUSED(I)
  859 FORMAT (' NO USABLE FUEL REMAINING FOR SYSTEM ',I3,/,
     *        ' AT TIME = ',F10.6,' HRS',/,
     *        ' FUEL USED = ',F 9.3,' LBS')
      IOVER(I)=1
 2010 CONTINUE
C
      IF (IUNDER(I) .EQ. 1) GO TO 2011
      IF (ULPRFC(I) .GT. PLIM(I)) GO TO 2011
      IUNDER(I)=1
      WRITE(15,527)I,ULPRFC(I),YTP
527   FORMAT(' TANK PRESSURE BELOW ACCEPTABLE LIMITS',/,
     *' APU TANK NO',I3,/,
     *' TANK PRESSURE = ',F7.3,' PSIA',
     *' AT TIME = ',F10.5,' HRS')
2011  CONTINUE
      IF (T(783) .GT. 0) GO TO 610
C
C WRITE OUTPUT TAPE
C
      N1=NL+7
      N2=NL+11
      N3=NL+13
      IF (T(786) .LE. 0) GO TO 502
      IF (T(785) .LE. 0) GO TO 503
  503 IF (NOL .GT. 49) CALL TITLE
      NPTS=NPTS+1
```

```
00403      IA1=KSPD(1)                                                                       000612
00406      IA2=KSPD(2)                                                                       000614
00407      IA3=KSPD(3)                                                                       000616
00410      J=T(666)+.1                                                                       000620
00411      WRITE (6,505) XTP,WAVG(NL+9),KSYS,J,ISPED(IA1),WAVG(NL+2),                        000635
00411     *WAVG(NL+5),FREM(1),ISPED(IA2),WAVG(NL+3),WAVG(NL+6),                              000635
00411     *    FREM(2),ISPED(IA3),WAVG(NL+4),WAVG(NL+7),FREM(3)                              000635
00433      IF (NOL .GT. 49) CALL TITLE                                                       000662
00435      NOL=NOL+1                                                                         000670
00436  505 FORMAT (1X,'*',F10.5,1X,F7.0,1X,I2,'/',I2,1X,3(I3,F6.2,8X,F6.2,2X,                000673
00436     *    2X,F6.2,2X))                                                                  000673
00437      IF (T(765) .LE. 0) GO TO 502                                                      000673
00441  502 IF (IOTAP .LE. 0) GO TO 50                                                        000677
00443  510 TMIN=XTP*60.                                                                      000702
00444      TSEC=XTP*3600.                                                                    000704
00445      WRITE (IOTAP,END=520) XTP,(WAVG(I),I=2,N1),KSYS,KSPD,                             000707
00445     *WAVG(NL+8),WAVG(NL+9),FREM,ULPRFC,TMIN,TSEC,(IASGN(I),I=1,NL)                     000707
00445     *   ,(WAVG(I),I=12,N3),FURATE,PAMB,WAVG(NL+10),TENUSD,(P(I),I=1,3)                 000707
00501      GO TO 50                                                                          001003
00502  520 BACKSPACE IOTAP                                                                   001005
00503      END FILE IOTAP                                                                    001007
00504      IOTAP=IOTAP+1                                                                     001012
00505      GO TO 510                                                                         001015
00505 C                                                                                      001015
00505 C WRITE OUT APU DATA MISSION PROFILES                                                   001015
00505 C                                                                                      001015
00506 50   IF (NOL2 .GT. 49) CALL TITLE2                                                     001017
00510      WRITE(7,53) XTP,PAMB,(FREM(I),FURATE(I),ULPRFC(I),WAVG(I+NL+10)                   001024
00510     *,I=1,3)                                                                           001024
00523 53   FORMAT (2X,F10.5,3X,F6.2,T24,3(1X,F6.2,2X,F6.2,2X,F6.2,                           001050
00523     *2X,F6.2,3X))                                                                      001050
00524      WRITE(8,2012) XTP,WAVG(NL+10),WAVG(NL+8),TENUSD                                   001050
00532 2012 FORMAT (1X,F11.5,3X,F6.2,2X,F5.3,4X,3(F7.3,3X))                                   001063
00533      NOL2=NOL2+1                                                                       001063
00534      DO 51 I=1,NG                                                                      001071
00537   51 WAVG(I)=0.0                                                                       001071
00541      IST=ISTOP+1                                                                       001072
00542      GO TO (52,540,550),IST                                                            001075
00543   52 IF (YTP .EQ. T(665)) GO TO 540                                                    001106
00545      STORE(1)=YTP                                                                      001110
00546      XTP=YTP                                                                           001112
00547      YTP=XTP+FREQT                                                                     001113
00550      IF (YTP .GE. T(665)) YTP=T(665)                                                   001115
00552      GO TO 331                                                                         001123
00553  540 ISTOP=2                                                                           001125
00554      XTP=T(665)                                                                        001127
00555      WAVG(NL+8)=STORE(NL+8)                                                            001131
00556      WAVG(NL+9) = STORE(NL+9)                                                          001133
00557      GO TO 2000                                                                        001135
00560      ENTRY SUMM                                                                        001137
00560 C                                                                                      001137
00560 C PRINT FUEL USAGE SUMMARY                                                             001137
00560 C                                                                                      001137
00561 550  WRITE (15,551) (I,TFUSED(I),FREM(I),TENUSD(I),ULPRFC(I),I=1,3)                    001137
00573 551  FORMAT (21X,'HYD/APU MISSION SUMMARY',//,                                         001156
00573     *12X,'FUEL',7X,'FUEL',9X,'ENERGY',6X,'TANK',/,                                     001156
00573     *12X,'USED',7X,'REM',9X,'(HP-HR)',5X,'PRESS',/,                                    001156
```

```
00573          *12X,'(LBM)',6X,'(LBM)',19X,'(PSIA)',//,                          001156
00573          *3(' SYSTEM',I2,F9.2,2X,F9.2,4X,F9.2,2X,F9.2,/))                  001156
00574           TTMIN=TTIME*60.                                                  001156
00575           WRITE(15,552) TTMIN,NPLTS,NPTS                                   001161
00602    552    FORMAT (' TOTAL APU OPERATION TIME = ',F9.4,' MIN',/,            001171
00602          *' NUMBER OF DATA POINTS INPUT = ',I8,/,                          001171
00602          *' NUMBER OF DATA POINTS OUTPUT =',I8)                            001171
00603           NOL=51                                                           001171
00604           RETURN                                                           001173
00604    C                                                                       001173
00604    C LOGIC FOR NON-AVERAGED DATA                                           001173
00604    C                                                                       001173
00605    600    IF (ISTART .NE. 0) GO TO 640                                     001177
00607           TTIME=TTIME+T(665)-TP                                            001200
00610           ISTART=1                                                         001204
00611      610  TLAST=TP                                                         001207
00612           DO 611 I=1,3                                                     001213
00615           KSPD(I)=IAPUSD(I)                                                001213
00616      611  XPWR(I)=PWR(I)                                                   001214
00620           YALT=ALT                                                         001217
00621           I1=ISYS(1)                                                       001221
00622           I2=ISYS(2)                                                       001223
00623           I3=ISYS(3)                                                       001225
00624           KSYS=IPTR(I1,I2,I3)                                              001227
00625           IA1=IAPUSD(1)                                                    001236
00626           IA2=IAPUSD(2)                                                    001241
00627           IA3=IAPUSD(3)                                                    001244
00630           IST1=ISAT(1)                                                     001247
00631           IST2=ISAT(2)                                                     001252
00632           IST3=ISAT(3)                                                     001255
00633           IF (NOL .GT. 49) CALL TITLE                                      001266
00635           J=T(646)+.1                                                      001274
00636           WRITE(6,613) TP,YALT,KSYS,J,ISPED(IA1),TFLRT(1),SAT(IST1),PWR(1),  001305
00636          *     FREM(1),ISPED(IA2),TFLRT(2),SAT(IST2),PWR(2),FREM(2),       001305
00636          *        ISPED(IA3),TFLRT(3),SAT(IST3),PWR(3),FREM(3)             001305
00663      613  FORMAT (2X,F10.5,1X,F7.0,1X,I2,'/',I2,1X,3(I3,2X,F6.2,2X,A4,     001351
00663          *        2X,F6.2,2X,F6.2,2X))                                     001351
00664           NOL=NOL+1                                                        001351
00665           IF (IOTAP .LE. 0) GO TO 615                                      001354
00667    614    TMIN=TP*60.                                                      001360
00670           TSEC=TP*3600.                                                    001362
00671           WRITE(IOTAP,END=620)TP,(FLRT(IK),IK=1,NL),TFLRT,PWR,KSYS,IAPUSD,   001367
00671          *   COLOAD,YALT,FREM   ,ULPRFC,TMIN,TSEC,(IASCN(IK),IK=1,NL)      001367
00671          *,TR,FURATE,PAMB,XMACH,TENUSD,(P(I),I=1,3)                        001367
00671    C                                                                       001367
00671    C WRITE OUT APU DATA MISSION PROFILES                                   001367
00671    C                                                                       001367
00724    615    IF (NOL2 .GT. 49) CALL TITLE2                                    001457
00726           WRITE(7,52) TP,PAMB,(FREM(I),FURATE(I),ULPRFC(I),TR(I),I=1,3)    001464
00741            WRITE(8,2012) TP,XMACH,COLOAD,TENUSD                            001503
00747           NOL2=NOL2+1                                                      001516
00750           WRITE(15,990) ISTART,TTIME                                       001521
00754     990   FORMAT ( )                                                       001530
00755           IF (T(999) .EQ. 1.0) GO TO 550                                   001530
00757           RETURN                                                           001533
00760      620  BACKSPACE IOTAP                                                  001537
00761           END FILE IOTAP                                                   001541
```

```
C0762          IOTAP=IOTAP+1                        C01544
C0763          GO TO 614                            C01547
C0764     640  XINT=TP-TLAST                        C01551
C0765          DO 641 I=1,3                         C01553
C0770     641  WAVG(4+NL+I) = XPWR(I)               C01563
C0772          WAVG(NL+9)=YALT                      C01565
C0773          GO TO 530                            C01567
C0774          END                                  C01642
END FOR
```

```
@FOR,S H.DBASE/V6,H.DBASE/V6
FOR S9E3-02/06/79-16:11:08 (39,)

   SUBROUTINE DBASE     ENTRY POINT 001406

   STORAGE USED: CODE(1) 001423; DATA(0) 000254; BLANK COMMON(2) 000000

    COMMON BLOCKS:

    0003     NUMS     000002
    0004     CONF     000014
    0005     RATES    000132
    0006     TIMES    000043
    0007     TARRAY   002106
    0010     TRAJ     000137
    0011     NAMES    000424
    0012     GRAD     000212
    0013     LKGS     000346
    0014     LMMTRX   001141
    0015     OUTPUT   000073
    0016     COEFF    000271
    0017     FCOMP    000060
    0020     FUEL     000017
    0021     SFCC     001424
    0022     THRST    000106

   EXTERNAL REFERENCES (BLOCK, NAME)

    0023     PRESUR
    0024     NWDU$
    0025     NIO2$
    0026     NRDU$
    0027     NIO1$
    0030     NIO3$
    0031     NERR2$
    0032     NERR3$

   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001     000615  100L      0001     000610  1009L     0001     000637  110L      0000     000141 '120F      0000     000162  1209F
    0000     000143 '121F      0000     000161  122F      0000     000125  13F       0000     000200  130F      0001     000701  135L
    0000     000203  140F      0000     000135  15F       0001     000337  159L      0001     000055  16L       0001     000723  160L
    0001     000026  165G      0001     000057  17L       0001     000731  170L      0001     000042  176G      0001     000743  180L
    0001     000744  189L      0001     000751  190L      0001     000101  20L       0001     000773  200L      0001     000773  201L
    0000     000171  209F      0000     000145  21F       0000     000207  210F      0001     000433  211L      0001     000464  215L
    0000     000166  219F      0001     000124  22L       0001     000115  226G      0001     000133  23L       0001     000155  24L
    0000     000150  25F       0001     001020  250L      0001     001022  251L      0001     000254  271G      0001     000262  275G
    0001     001047  300L      0001     001051  301L      0001     000303  306G      0001     001076  308L      0000     000174  309F
    0001     001105  310L      0000     000176  319F      0001     000372  346G      0000     000153  35F       0001     000417  359L
    0001     000413  360G      0001     000460  372G      0000     000157  40F       0001     000506  400G      0001     001127  400L
    0001     000514  405G      0001     000525  409L      0001     001127  410L      0000     000211  415F      0001     000530  416G
    0001     001166  417L      0001     001174  420L      0001     000544  421G      0001     000555  430G      0001     000310  44L
    0001     001177  449L      0001     000715  45L       0001     001206  450L      0001     000676  475G      0001     000337  50L
```

```
0001     001230 500L      0001     001333 510L      0001     001342 511L      0001     000725 512G      0001     001364 512L
0001     000740 520G      0001     001010 542G      0001     001037 556G      0001     001066 571G      0001     000005 6L
0001     000554 609L      0001     001144 621G      0001     001303 661G      0001     001326 672G      0001     000574 759L
0001     000603 709L      0011 R   000332 ACTNAM    0005     000130 ALT       0013 R   000270 ALTFLW    0000 R   000111 ALTSUB
0000 R   000034 BLANK     0016 D   000000 CF        0005     000127 CCLOAD    0006     000021 CLNO      0000 R   000001 D
0000     000120 DB2       0005     000072 DEF       0000 R   000056 DUM       0006     000031 ECTRAN    0016 R   000240 ERANCE
0012 R   000000 FGRAC     0012     000134 FLGRAD    0020 R   000000 FLOAD     0015     000000 FLRT      0006     000013 FREE
0020 R   000011 FFCM      0006     000015 FRNO      0020 R   000003 FUNUSE    0021     001421 FURATE    0017 R   000011 HF
0005     000035 HM        0000 I   000074 I         0011 I   000134 IACTNO    0000 I   000104 IAPU      0004     000003 IAPUSD
0014     003457 IASGN     0006     000041 ICARD     0014     000245 ICODE     0000 I   000107 ICUM      0006     000002 IEND
0000 I   000135 IECN      0012     000136 IETP      0011 I   000217 ILOAD     0003 I   000112 IM        0010     000000 INDEX
0000     000226 INJP      0015     000072 IOTAP     0000 I   000113 IP        0006     000006 IPHASE    0015     000071 IPPLT
0014     000212 ITTR      0015     000064 ISAT      0014 I   000613 ISIV      0000 I   000103 ISPD      0011 I   000215 ISPED
0006     000000 ISTART    0006     000040 ISTAT     0006     000001 ISTOP     0014 I   000671 ISWV      0004     000000 ISYS
0006     000012 IUNIT     0011 I   000254 IVEH      0006     000007 IVFLAG    0000 I   000075 J         0000 I   000110 K
0000 I   000100 KNO       0000 I   000114 L         0014 I   000000 LMN       0006     000036 LPHASE    0006     000034 LTYPE
0006     000042 LUNIT     0014 I   000575 MIV       0000 I   000102 MODE      0014 I   000747 MVNAM     0014 I   000771 MVSYS
0014 I   001002 MVVFH     0003 I   000001 NA        0011 I   000000 NAME      0021 I   001415 NEQNS     0003 I   000000 NL
0011 I   000212 MNODE     0014 I   001135 NMV       0021 I   000000 NOCF      0000 I   000101 NOCFPE    0006     000003 NCL
0006     000010 NOL2      0004     000007 NOS       0016 I   000270 NPER      0006     000005 NPLTS     0006     000004 NPTS
0021 I   001414 NSFDS     0014 I   001136 NSV       0014 I   001137 NSWV      0022 I   000074 NTC       0014 I   001140 NVCCNF
0006     000027 NW        0004     000010 P         0022     000105 PAMB      0017 R   000044 PLIM      0021 R   001320 PRALT
0023 R   000000 PRESUR    0013 R   000000 PSLKG     0015     000061 PWR       0005     000000 RATE      0015     000067 SAT
0021 R   000074 SFC       0020 R   000005 SL        0000 R   000006 SP        0000 R   000077 SPEED     0004 I   000013 STVLV
0013 R   000056 SVLKG     0014 F   001013 SVNAM     0014 I   001046 SVSYS     0014 I   001035 SVVFH     0014 I   001101 SWSYS
0014 R   001157 SWVNAM    0014 I   001112 SWVVEH    0007     000000 T         0022 R   000000 TALT      0000 R   000053 TEMF
0020     000014 TENUSD    0015     000056 TFLRT     0020     000006 TFUSCD    0022 R   000012 THRUST    0022 I   000005 TNOCF
0004     000006 TF        0006     000025 TPCALL    0022 R   000075 TPRESS    0022     000102 TR        0006     000011 TTIME
0017 R   000006 TVUL      0017     000047 ULPREC    0017 R   000003 ULPRLC    0017 R   000014 ULTALT    0017 R   000017 ULTCFT
0017 R   000000 ULTPLC    0014 I   001123 VCONF     0000 I   000007 VTEMP     0007     001750 WRT       0021 R   001274 XALT
0000 R   000100 XDUM      0017 R   000052 XFLOW     0005     000131 XMACH     0000 R   000076 XMODE     0000 R   000000 XP
0013     000134 XPSLKG    0013     000212 XSVLKG    0006     000035 XTPNO     0000 R   000002 X100      0000 R   000003 X110
```

```
00101      1*              SUBROUTINE DBASE                                                          000000
00103      2*              INCLUDE PAR,LIST                                                          000000
00103      2*       PAR    PROC                                                                      000000
00104      2*              PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MPV=9,MSV=9,MSWV=9           000000
00104      2*            *   ,MVCONF=10                                                              000000
00105      2*              PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10                   000000
00106      2*                  COMMON /NUMS/NL,NA                                                    000000
00106      2*        END                                                                             000000
00107      3*              INCLUDE CBL1,LIST                                                         000000
00107      3*       CBL1   PROC                                                                      000000
00110      3*              COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV                          000000
00111      3*              INTEGER STVLV                                                             000000
00112      3*              COMMON /RATES/RATE(MNA),HP(MNA),DEF(MNA),CGLOAD,ALT,XMACH                 000000
00113      3*              COMMON /TIMES/ISTART,ISTOP,IEND,NCL,NPTS,NPLTS                            000000
00113      3*            *   ,IPHASE,IVFLAG,NOL2,TTIME,IUNIT,FREE(2),FPNO(4)                         000000
00113      3*            *   ,CLNO(4),TPCALL(4),ECTRAN(3),LTYPE,XTPNO,LPHASE,NW                      000000
00113      3*            *   ,ISTAT,ICARD,LUNIT                                                      000000
00114      3*              COMMON /IARRAY/ T(1000),WRT(NR)                                           000000
00115      3*              COMMON /IPAJ/ INDEX(NP),IETP                                              000000
00116      3*              COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NNODE(3),ISPED(2),ILOAD(MNA),        000000
00116      3*            *               IVEH(MNL),ACTNAM(MNA,2)                                     000000
```

```
 END
      INCLUDE CBL2,LIST
 CBL2 PROC
      COMMON /GRAD/FGRAD(MNL,2),FLGRAD(MNL)
      COMMON /LKGS/PSLKG(MNL),SVLKG(MNL),XPSLKG(MNL),XSVLKG(MNL)
     *,ALTFLW(MNL)
      COMMON /LMMTRX/LMM(3,MNL),IPTR(3,3,3),ICODE(3,MNL),IASGN(MNL),
     *                MIV(MNL),ISIV(MNL),ISWV(MNL),
     *                MVNAM(2,MMV),MVSYS(MMV),MVVEH(MMV),
     *                SVNAM(2,MSV)  ,              SVVEH(MSV), SVSYS(MSV),
     *          SWVNAM(2,MSWV),SWSYS(MSWV)                  ,SWVVEH(MSWV)
     *,VCONF(MVCONF),NMV,NSV,NSWV,NVCONF
      INTEGER VCONF,        SVVEH,                 SWVVEH,SVSYS  ,SWSYS
 END
      INCLUDE CBL3,LIST
 CBL3 PROC
      COMMON /OUTPUT/FLRT(MNL),TFLRT(3),PWR(3),ISAT(3),SAT(2)
     *, IPPLT,IOTAP
      COMMON /COEFF/ CF(10,2,2,2),
     *               ERANGE(2,2,2,3)
     *    ,NPER
      DOUBLE PRECISION CF
      COMMON /PCOMP/ULTPLC(3),ULPRLC(3),TVOL(3),HE(3),
     *             ULTALT(3),ULTOFT(3,7),PLIM(3)
     *             ,ULPRFC(3),XFLOW(3,2)
      COMMON /FUEL/ FLOAD(3),FUMUSE(3),IFUSED(3),FREM(3),TENUSD(3)
      COMMON /SFCC/ NOCF(MNSPDS,MNEQNS,3),SFC(MNSPDS,MNEQNS,MNOCF,3),
     *              XALT(MNSPDS,MNEQNS,3),PRALT(MNSPDS,MNEQNS,3),NSPDS,
     *             NEQNS(MNSPDS),FURATE(3)
      COMMON/THRST/TALT(MNTEQN),TNOCF(MNTEQN),THRUST(MNTEQN,MTNOCF)
     *,NTC,TPRESS(MNTEQN),TR(3),PAMB
      INTEGER TNOCF
 END
      DATA XP/'P '/,D/'D '/,X100/'100'/,X110/'110'/,BLANK/'      '/
      DATA ISPLD/103,113/
      DATA NMODE/'PR','DPR','OFF'/
      DATA SL/'SL'/,SP/'SP'/,NPER/2/
      DIMENSION VTEMP(36)
      INTEGER VTEMP
      DIMENSION TEMP(3),DUM(14)
      NAMELIST/DB2/NOCF
C
C WRITE OUT DATA BASE INFORMATION ECHO
C
      WRITE(6,13)
13    FORMAT (1H1,21X,'**** DATA BASE INFORMATION ****',//)
C READ IN HYD LOAD DATA
C
    6 READ(5,15,END=16)I,(NAME(J,I),J=1,2),FGRAD(I,1),FGRAD(I,2),
     *                  PSLKG(I),SVLKG(I),ALTFLW(I),(LMM(J,I),J=1,3),
     *                  IACTNO(I),IVEH(I),MIV(I),ISIV(I),ISWV(I)
   15 FORMAT (I2,2A6,5F6.0,5I2,3I5)
      GO TO 6
16    NL=I
17    READ(5,120,END=20)DUM
120   FORMAT(13A6,A2)
      WRITE(6,121) DUM
```

```
121    FORMAT(1X,13A6,A2)
       GO TO 17
C
C READ IN HYDRAULIC FUNCTION DATA
C
20     READ(5,21,END=22) I,(ACTNAM(I,J),J=1,2),ILOAD(I)
21     FORMAT(I2,2A6,5X,I5)
       GO TO 20
22     NA=I
       WRITE(6,122)
23     READ(5,120,END=24)DUM
       WRITE(6,121)DUM
       GO TO 23
C
C READ IN PUMP EFFICIENCY DATA
C
   24 READ(5,25,END=44) XMODE,SPEED,KNO,NOCFPE
   25 FORMAT (A2,A3,I2,19X,I2)
      IF (XMODE .EQ.XP) MODE=1
      IF (XMODE .EQ. D) MODE=2
      IF (SPEED .EQ. X100) ISPD=1
      IF (SPEED .EQ. X110) ISPD=2
      ERANGE(MODE,ISPD,KNO,3)=NOCFPE
      READ (20,35)(ERANGE(MODE,ISPD,KNO,J),J=1,2),(CF(J,KNO,MODE,ISPD),
     *             J=1,3)
   35 FORMAT (7X,2F7.0,7X,3G14.0)
      IF (NOCFPE .LE. 3) GO TO 20
      READ (5,40) (CF(J,KNO,MODE,ISPD),J=4,NOCFPE)
   40 FORMAT (5F14.0)
      GO TO 24
   44 WRITE(6,122)
  122 FORMAT (1X)
45     READ(5,120,END=50)DUM
       WRITE(6,121)DUM
       GO TO 45
C
C READ IN SFC DATA
C
50     CONTINUE
  159 READ (5,1209,END=409) ISPD,IAPU,IEQN,XDUM,IDUM
 1209 FORMAT (I3,I1,I2,F11.0,I3)
  219 FORMAT (6X,F11.0,I3)
  209 FORMAT (2I3,F11.0,I3)
      K=6
      IF (IDUM .LT. 6) K=IDUM
      READ (20,309) (DUM(J),J=1,K)
  309 FORMAT (20X,6F10.0)
      K= IDUM
      IF (K .LE. 6) GO TO 359
      READ (5,319) (DUM(J),J=7,K)
  319 FORMAT (6F10.0)
C
C ASSIGN DATA TO PROPER APU, IF NO APU NO IS SPECIFIED, THE DATA
C WILL BE USED FOR ALL 3 APUS
C
  359 J=IAPU + 1
      GO TO (215,211,211,211) ,J
```

```
  211 XALT(ISPD,IEQN,IAPU)=XDUM
      NOCF(ISPD,IEQN,IAPU)=IDUM
      DO 212 I=1,IDUM
  212 SFC(ISPD,IEQN,I,IAPU)=DUM(I)
      GO TO 159
  215 DO 216 J=1,3
      XALT(ISPD,IEQN,J)=XDUM
      NOCF(ISPD,IEQN,J)=IDUM
      DO 217 I=1,IDUM
  217 SFC(ISPD,IEQN,I,J)=DUM(I)
  216 CONTINUE
      GO TO 159
C
C FIND PRESSURE FOR CURVES
C
409   CONTINUE
      DO 809 I=1,MNSPDS
      DO 709 J=1,MNEQNS
      IF (NOCF(I,J,1) .GT. 0) GO TO 609
      NEQNS(I)=J-1
      GO TO 759
  609 DO 610 K=1,3
      ALTSUB=XALT(I,J,K)
610   PRALT(I,J,K)=PRESUR(ALTSUB)
  709 CONTINUE
      NEQNS(I)=MNEQNS
  759 IF (NOCF(I,1,1) .GT. 0)  GO TO 809
      NSPDS=I-1
      GO TO 1009
  809 CONTINUE
      NSPDS=MNSPDS
 1009 CONTINUE
      WRITE(6,122)
100   READ(5,120,END=110)DUM
      WRITE(6,121)DUM
      GO TO 100
C
C READ IN APU DATA
C
110   CONTINUE
      READ(5,130)XFLOW,ULTPLC,ULPRLC,TVOL,HE,FLOAD,
     *         FUNUSE,PLIM
      DO 112 I=1,3
112   FREM(I)=FLOAD(I)
  130 FORMAT (7(35X,3F10.0,/))
C
C READ IN ULLAGE TEMPS FOR DIFFRENT MISSION PHASES
C
  135 READ(5,140,END=189) IM,IP,TEMP
  140 FORMAT (24X,I2,I4,5X,3F10.0)
      GO TO (160,170),IM
160   DO 165 I=1,3
165   ULTALT(I)=TEMP(I)
      GO TO 135
170   DO 175 I=1,3
175   ULTOFT(I,IP)=TEMP(I)
180   GO TO 135
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
  189 WRITE(6,122)
190   READ(5,120,END=200)DUM
      WRITE(6,121)DUM
      GO TO 190
200   CONTINUE
C
C READ IN VALVE DATA
C
  201 READ(5,210,END=250)I,(MVNAM(J,I),J=1,2),MVSYS(I),MVVEH(I)
      GO TO 201
  210 FORMAT (I2,2A6,3I5)
  250 NMV=I
  251 READ(5,210,END=300)I,(SVNAM(J,I),J=1,2),SVSYS(I),          SVVEH(I)
      GO TO 251
  300 NSV=I
  301 READ(5,210,END=308)I,(SWVNAM(J,I),J=1,2),SWSYS(I),
     *                    SWVVEH(I)
      GO TO 301
  308 NSWV=I
      WRITE(6,122)
  310 READ (5,120,END=400)DUM
      WRITE (6,121) DUM
      GO TO 310
  400 CONTINUE
C
C READ IN VALVE CONFIGURATION DATA
C
  410 READ (5,415,END=449) I,VTEMP
  415 FORMAT (I2,1X,36I2)
      DO 420 J=1,36
      K=VTEMP(J) + 1
      GO TO (420,417,417),K
  417 L=J-1
      FLD(L,1,VCONF(I))=K-2
  420 CONTINUE
      GO TO 410
  449 NVCONF=I
      WRITE(6,122)
  450 READ(5,120,END=500) DUN
      WRITE (6,121)DUM
      GO TO 450
C
C READ IN APU EXHAUST THRUST CURVES
C
500   READ(5,209,END=510)IEQN,IDUM,TALT(IEQN),TNOCF(IEQN)
C
C FIND AMBIENT PRESSURE FOR CURVE
C
      ALTSUP=TALT(IEQN)
      TPRESS(IEQN)=PRESUP(ALTSUP)
      K=TNOCF(IEQN)
      IF (TNOCF(IEQN).LT.6) K=TNOCF(IEQN)
      READ(5,209)(THRUST(IEQN,J),J=1,K)
      K=TNOCF(IEQN)
      IF (K .LE. 6) GO TO 500
      READ(5,219)(THRUST(IEQN,J),J=7,K)
      GO TO 500
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
C00677      510   NTC=IEQN                                         C01333
C00700            WRITE(6,122)                                     C01334
C00702      511   READ(5,120,END=512)DUM                           C01342
C00705            WRITE(6,121)DUM                                  C01352
C00710            GO TO 511                                        C01362
C00711      512   RETURN                                           C01364
C00712            END                                              C01422
END FOR
```

```
@FOR,S H.PRESUR,H.PRESUR
FOR SCE3-02/06/79-16:11:35 (1,)

   FUNCTION PRESUR        ENTRY POINT 000034

   STORAGE USED: CODE(1) 000040; DATA(0) 000033; BLANK COMMON(2) 000000

   EXTERNAL REFERENCES (BLOCK, NAME)
    0003    NERR3$

   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)
    0001    000006 111G        0000 R 000001 ACOEF      0000 R 000015 ALTKM      0000 I 000017 I          0000    000025 INJP$
    0000 R 000020 PRATM        0000 R 000000 PRESUR     0000 R 000016 TERM

00101          FUNCTION PRESUR(ALT)                                                  000000
00103          DIMENSION ACOEF(12)                                                   000000
00103   C              THESE ARE COEFFICIENTS FOR COMPUTING ATMOSPHERIC              000000
00103   C              PRESSURE AS A FUNCTION OF ALTITUDE -- SEE U. S. 62            000000
00103   C              ATMOSPHERE SUPPLEMENT PAGE 67.                                000000
00103   C                                                                            000000
00104          DATA ACOEF /  0.25977729  E-19, -0.23418164  E-16,                    000000
00104         X              0.87375907  E-14, -0.17237149  E-11,                    000000
00104         X              0.19653597  E-09, -0.13227456  E-07,                    000000
00104         X              0.53441596  E-06, -0.13252552  E-04,                    000000
00104         X              0.21215722  E-03, -0.74747882  E-03,                    000000
00104         X              0.35333673  E-01,  1.0E0              /                 000000
00104   C                                                                            000000
00104   C           CONVERT ALTITUDE TO METRIC                                       000000
00104   C                                                                            000000
00106          ALTKM = ALT * 0.3048006E-3                                            000000
00106   C              CALCULATE ATMOSPHERIC PRESSURE FOR THE CURRENT                000000
00106   C              ALTITUDE                                                      000000
00106   C                                                                            000000
00107          TERM = 0.0                                                            000002
00107   C                                                                            000002
00110          DO 70 I = 1,12                                                        000006
00113          TERM = ALTKM * TERM + ACOEF(I)                                        000006
00114       70 CONTINUE                                                              000012
00116          PRATM=1.0/(TERM**4)                                                   000012
00116   C                                                                            000012
00116   C           CONVERT PRESSURE FROM ATMOSPHERES TO PSI                         000012
00116   C                                                                            000012
00117          PRESUR = PRATM * 14.696                                               000017
00120          RETURN                                                                000021
00121          END                                                                   000037
END FOR
```

ORIGINAL PAGE IS OF POOR QUALITY

```
@FOR,S H.TANK/V6,H.TANK/V6
FOR S0E3-02/06/79-10:11:39 (3,)

   SUBROUTINE TANK      ENTRY POINT 000046

   STORAGE USED: CODE(1) 000056; DATA(0) 000013; BLANK COMMON(2) 000000

   EXTERNAL REFERENCES (BLOCK, NAME)

    0003     NERR2$
    0004     NERR3$

   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001     000021 10L        0001    000032 20L        0000    000007 INJP$      0000 R 000000 RHE        0000 R 000002 RHOH
    0000 R 000001 TR           0000 R 000003 VUL


00101          SUBROUTINE TANK(T,F,V,P,HE,IFLAG)                                                  000000
00101       C                                                                                     000000
00101       C T=ULLAGE TEMP, F                                                                    000000
00101       C TR=ULLAGE TEMP, R                                                                   000000
00101       C F=HYDRAZINE, LBM                                                                    000000
00101       C V=TANK VOLUME, FT**3                                                                000000
00101       C P=ULLAGE PRESSURE, PSIA.                                                            000000
00101       C HE=HELIUM, LBM                                                                      000000
00101       C RHE=SPECIFIC GAS CONSTANT FOR HELIUM = 2.6990                                       000000
00101       C              VALUE AT P=150 PSIA & T=70 F                                           000000
00101       C IFLAG=1 -- COMPUTE HELIUM                                                           000000
00101       C IFLAG=2 -- COMPUTE PRESSURE                                                         000000
00101       C                                                                                     000000
00103          DATA RHE/2.6990/                                                                   000000
00105       C CONVERT TEMP TO RANKIN                                                              000000
00105          TR=T+459.69                                                                        000000
00105       C COMPUTE HYDRAZINE DENSITY                                                           000000
00106          RHOH=77.484 - 0.0315*TR                                                            000002
00106       C COMPUTE ULLAGE VOLUME                                                               000002
00107          VUL=V-F/RHOH                                                                       000005
00110          GO TO (10,20),IFLAG                                                                000011
00110       C COMPUTE HELIUM MASS                                                                 000011
00111       10 HE=(P*VUL)/(RHE*TR)                                                                000021
00112          RETURN                                                                             000026
00112       C COMPUTE ULLAGE PRESS                                                                000026
00113       20 P=(HE*TR*RHE)/VUL                                                                  000032
00114          RETURN                                                                             000036
00115          END                                                                                000055
END FOR
```

```
@FOR,S H.TCOMP/V6,H.TCOMP/V6
FOR S0E3-02/06/79-18:11:44 (1,)

   SUBROUTINE TCOMP     ENTRY POINT 000213

   STORAGE USED: CODE(1) 000225; DATA(0) 000057; BLANK COMMON(2) 000000

    COMMON BLOCKS:

    0003    NUMS    000002
    0004    OUTPUT  000073
    0005    COEFF   000271
    0006    PCOMP   000065
    0007    FUEL    000017
    0010    SFCC    001424
    0011    THRST   000106

   EXTERNAL REFERENCES (BLOCK, NAME)

    0012    XPRI
    0013    NERR3$

   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000015 122G     0001    000033 133G     0001    000106 153G     0001    000135 162G     0001    000027 708L
    0001    000061 715L     0001    000065 719L     0001    000170 739L     0001    000171 749L     0005 D  000000 CF
    0000    000011 DP       0000 R  000010 DELTP    0005    000240 ERANGE   0007    000000 FLOAD    0004    000000 FLRT
    0007    000011 FREM     0007    000003 FUNUSE   0010    001421 FURATE   0006    000011 HC       0000 I  000004 I
    0000    000036 INJP$    0004    000072 IOTAP    0004    000071 IPPLT    0004    000064 ISAT     0000 I  000006 I1
    0000 I  000005 J        0000 I  000007 K        0000 I  000002 KV1      0000 I  000003 KV2      0003    000001 NA
    0010    001415 NEQNS    0003    000000 NL       0010    000000 NOCF     0005    000270 NPEP     0010    001414 NSPCS
    0011 I  000074 NTC      0011 R  000105 PAMB     0006    000044 PLIM     0010    001320 PRALT    0004 R  000061 PWR
    0004    000067 SAT      0010    000074 SFC      0011    000000 TALT     0007    000014 TENLSD   0004    000056 TFLRT
    0007    000026 TFUSED   0011 R  000012 THRUST   0011 I  000005 TNOCF    0011 R  000075 TPRESS   0011 R  000102 TR
    0000 R  000000 TR1      0000 R  000001 TR2      0006    000006 TVOL     0006    000047 ULPPFC   0006    000003 ULPRLC
    0006    000014 ULTALT   0006    000017 ULTOFT   0006    000000 ULTPLC   0010    001224 XALT     0006    000052 XFLCW


 00101      1*              SUBROUTINE TCOMP                                                   000000
 00103      2*              INCLUDE PAR,LIST                                                   000000
 00103      2*      PAR     PROC                                                               000000
 00104      2*              PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MMV=9,MSV=9,MSWV=9    000000
 00104      2*            * ,MVCONF=10                                                         000000
 00105      2*              PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10            000000
 00106      2*                  COMMON/NUMS/NL,NA                                              000000
 00106      2*       END                                                                       000000
 00107      3*              INCLUDE CBL3,LIST                                                  000000
 00107      3*      CBL3    PROC                                                               000000
 00110      3*              COMMON /OUTPUT/FLRT(MNL),TFLRT(3),PWR(3),ISAT(3),SAT(2)            000000
 00110      3*            *, IPPLT,IOTAP                                                       000000
 00111      3*              COMMON /COEFF/ CF(10,2,2,2),                                       000000
```

```
     *              ERANGE(2,2,2,3)
     *     ,NPER
      DOUBLE PRECISION CF
      COMMON /PCOMP/ULTPLC(3),ULPRLC(3),TVOL(3),HE(3),
     *               ULTALT(3),ULTOFT(3,7),PLIM(3)
     *              ,ULPRFC(3),XFLOW(3,2)
      COMMON /FUEL/ FLOAD(3),FUMUSE(3),TFUSED(3),FREM(3),TENUSD(3)
      COMMON /SFCC/ NOCF(MNSPDS,MNEQNS,3),SFC(MNSPDS,MNEQNS,MNOCF,3),
     *              XALT(MNSPDS,MNEQNS,3),PRALT(MNSPDS,MNEQNS,3),NSPDS,
     *              NEQNS(MNSPDS),FURATE(3)
      COMMON/THRST/TALT(MNTEQN),TNOCF(MNTEQN),THRUST(MNTEQN,MTNOCF)
     *,NTC,TPRESS(MNTEQN),TR(3),PAMB
      INTEGER TNOCF
 END
      NAMELIST/DB/ TR1,TR2,TR,KV1,KV2,PAMB
      DO 800 I=1,3
C
C COMPUTE APU AVERAGE EXHAUST THRUST
C
C FIND CURVES TO INTERPOLATE BETWEEN
      J=NTC-1
      IF (PAMB .LT. TPRESS(1)) GO TO 708
      KV1=1
      KV2=2
      GO TO 719
708   DO 710 I1=1,J
      IF (TPRESS(I1).GE.PAMB .AND. PAMB .GE. TPRESS(I1+1))
     *  GO TO 715
710   CONTINUE
      KV1=J
      KV2=J+1
      GO TO 719
715   KV1=I1
      KV2=I1+1
C FIND THRUST ON CURVES
719   J=TNOCF(KV1)
      IF (PWR(I) .EQ. 0) GO TO 739
      TR1=0.0
      DO 720 K=1,J
720   TR1=TR1 + THRUST(KV1,K)*PWR(I)**(K-1)
      J=TNOCF(KV2)
      TR2=0.0
      DO 721 K=1,J
721   TR2=TR2 + THRUST(KV2,K)*PWR(I)**(K-1)
C INTERPOLATE WITH PRESSURE
      DELTP=ABS(TPRESS(KV1)-TPRESS(KV2))
      TR(I)=TR2+(TR1-TR2)*((PAMB-TPRESS(KV2))/DELTP)
      GO TO 749
739   TR(I)=0.0
749   CONTINUE
800   CONTINUE
      RETURN
      END
END FOR
```

ORIGINAL PAGE IS OF POOR QUALITY

```
@FOR,S H.TITLE/V6,H.TITLE/V6
FOR S9E3-02/06/79-18:11:51 (2,)

   SUBROUTINE TITLE      ENTRY POINT 000067
              TITLE2     ENTRY POINT 000072

   STORAGE USED: CODE(1) 000075; DATA(0) 000246; BLANK COMMON(2) 000000

    COMMON BLOCKS:

    0003    NUMS    000002
    0004    CONF    000014
    0005    RATES   000132
    0006    TIMES   000043
    0007    TARRAY  002156
    0010    TRAJ    000137
    0011    NAMES   000424

   EXTERNAL REFERENCES (BLOCK, NAME)

    0012    NWDU$
    0013    NI01$
    0014    NI02$
    0015    NERR3$

   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000006 121G       0001    000026 133G       0001    000042 142G       0000    000001 200F       0000    000113 300F
    0000    000174 400F       0011    000332 ACTNAM     0005    000130 ALT        0005    000127 CGLOAD     0006    000021 CLNO
    0005    000072 DEF        0006    000031 ECTRAN     0006    000013 FREE       0006    000015 FRNO       0005    000035 HM
    0000 I  000000 I          0011    000134 IACTNO     0004    000003 IAPUSD     0006    000041 ICARD      0006    000002 IENC
    0010    000136 IETP       0011    000217 ILOAD      0010    000000 INDEX      0000    000237 INJP$      0006    000006 IPHASE
    0011    000215 ISPED      0006    000000 ISTART     0006    000040 ISTAT      0006    000001 ISTOP      0004    000000 ISYS
    0006    000012 IUNIT      0011    000254 IVEH       0006    000007 IVFLAG     0006    000036 LPHASE     0006    000034 LTYPE
    0006    000042 LUNIT      0003    000001 NA         0011    000000 NAME       0003    000000 NL         0011    000212 NMODE
    0006 I  000003 NOL        0006 I  000013 NOL2       0004    000007 NOS        0006    000005 NPLTS      0006    000004 NPTS
    0006    000037 NW         0004    000010 P          0005    000000 RATE       0004 I  000013 STVLV      0007    000000 T
    0004    000006 TF         0006    000025 TPCALL     0006    000011 TTIME      0007    001750 WRT        0005    000131 XMACH
    0006    000035 XTPNO


              1*                SUBROUTINE TITLE                                                  000000
              2*                INCLUDE PAR,LIST                                                  000000
              2*        PAR     PROC                                                              000000
              2*                PARAMETER MNA=29,NR=3*MNA+7,MNL=46,NG=MNL+13,MMV=9,MSV=9,MSWV=9   000000
              2*             *   ,MVCOEF=10                                                       000000
              2*                PARAMETER MNSPDS=4,MNEQNS=5,MNOCF=10,MNTEQN=5,MTNOCF=10           000000
              2*                    COMMON/NUMS/NL,NA                                             000000
              2*         END                                                                      000000
              3*                INCLUDE CPL1,LIST                                                 000000
              3*        CPL1    PROC                                                              000000
```

```
CD110        COMMON /CONF/ISYS(3),IAPUSD(3),TP,NOS,P(3),STVLV                          000000
CD111        INTEGER STVLV                                                             000000
CD112        COMMON /RATES/RATE(MNA),HP(MNA),DEF(MNA),CGLOAD,ALT,XMACH                 000000
CD113        COMMON /TIMES/ISTART,ISTOP,IEND,NOL,NPTS,NPLTS                            000000
CD113     *      ,IPHASL,IVFLAG,NOL2,TTIME,IUNIT,FREE(2),FRNO(4)                       000000
CD113     *   ,CLND(4),TPCALL(4),FCTRAN(3),LTYPE,XTPNO,LPHASE,NW                       000000
CD113     *   ,ISTAT,ICARD,LUNIT                                                       000000
CD114        COMMON /IARRAY/ T(1000),WPT(NR)                                           000000
CD115        COMMON /TRAJ/ INDEX(NR),IFTP                                              000000
CD116        COMMON/NAMES/NAME(2,MNL),IACTNO(MNL),NMODE(3),ISPED(2),ILOAD(MNA),        000000
CD116     *                 IVEH(MNL),ACTNAM(MNA,2)                                    000000
CD116   END                                                                            000000
CD117        WRITE (6,200) (I,I=1,3)                                                   000000
CD125    200 FORMAT (1H1,27X,2('SYSTEM ',I1,27X),    'SYSTEM ',I1,//,                  000013
CD125       *4X,'TIME',7X,'ALT ',3X,'SYS/',1X,3('APU  ',1X,'TOTAL',2X,                 000013
CD125       *'MAX ',3X,'SYS  ',3X,'APU  ',2X),/,                                       000013
CD125       *4X,'(HRS)',6X,'(FT)',3X,'VLV ',1X,3('SPEED',1X,'FLOW ',2X,                000013
CD125       *'RATE',3X,'POWER',3X,'FUEL ',2X),/,                                       000013
CD125       *22X,'CONF',1X,3('%      ',1X,'RATE ',2X,                                  000013
CD125       *'WRNG',3X,'RQMTS ',2X,'REM  ',2X),/,                                      000013
CD125       *22X,'CODE ',3('      ',1X,'(GPM)',2X,                                     000013
CD125       *'FLAG',3X,'(HP) ',3X,'(LBS)',2X),/,                                       000013
CD125       *131(1H ))                                                                 000013
CD126        NOL=0                                                                     000013
CD127        RETURN                                                                    000014
CD130        ENTRY TITLE2                                                              000017
CD131        WRITE(7,300) (I,I=1,3)                                                    000017
CD137   300  FORMAT(1H1,55X,' MISSION PROFILES - PART 2',//,T24,                       000033
CD137       *3(11X,'APU NO ',I2,11X),/,3X,'TIME',T16,'AMB',T24,                        000033
CD137       *3(' FUEL     FOR      TANK      EXHAUST  '),/,T16,'PRESS',T24,            000033
CD137       *3(' REF      (LBM/    PRESS     THRUST   '),/,3X,'(HRS)',T16,'(PSIA)',    000033
CD137       *T24,                                                                      000033
CD137       *3(' (LBM)    HR)      (PSIA)   (LBF)     '),/,                            000033
CD137       *132(1H*))                                                                 000033
CD140        WRITE(7,400)(I,I=1,3)                                                     000033
CD146   400  FORMAT (1H1,55X,'MISSION PROFILES - PART 3',///,                          000047
CD146       *3X,'TIME',T16,'MACH',T23,'CGLOAD',T33,3('SYS ',I1,5X),/,                  000047
CD146       *3X,'(HRS)',T16,'NO',T33,3('ENERGY',4X),/,                                 000047
CD146       *T33,3('(HP-HR)',3X),/,132(1H*))                                           000047
CD147        NOL2=0                                                                    000047
CD150        RETURN                                                                    000050
CD151        END                                                                       000074
END FOR
```

```
@ELT,L H.MAPSYM/V6
ELT007 RL71-3 02/06/79 18:11:57 (6,)
000001        002    SEG A
000002        002    IN H.MAIN/V6,H.TLINE/V6,H.NTABS
000003        002    IN H.TANK/V6,H.PRESUR
000004        002    SEG B*
000005        002    IN H.BLASE/V6,H.SYSDAT/V6
000006        002    SEG C*,B
000007        002    IN H.ACTDAT/V6,H.PHASE/V6,H.HINGE/V6,H.POWER/V6,H.SAPUM/V6
000010        002    IN H.TITLE/V6,H.TCOMP/V6

END ELT.

@PACK H,
FURPUR 27R2  RL72-8 02/06/79 18:11:58
END PACK. TEXT=81,TOC=3,SYM=112,REL=75,ABS=2
```

```
@MAP,S H.MAPS/M/V6,H.HYDRA/V6
MAP28R2 RL71-3 02/06/77 18:12:10 (6,)
     1.        SEG A
     2.        IN H.MAIN/V6,H.TLINE/V6,H.NTABS
     3.        IN H.TANK/V6,H.PRFSUR
     4.        SEG B*
     5.        IN H.DPASE/V6,H.SYSDAT/V6
     6.        SEG C*,C
     7.        IN H.ACTLAT/V6,H.PHASE/V6,H.HINGE/V6,H.POWER/V6,H.SAPUM/V6
     8.        IN H.TITLE/V6,H.TCOMP/V6

ADDRESS LIMITS    001000 025375      10494 IBANK WORDS DECIMAL
                  040000 057321       7874 DBANK WORDS DECIMAL
SEGMENT LOAD TABLE       040000 040013
INDIRECT LOAD TABLE      040014 040115
STARTING ADDRESS  010033
```

SEGMENT A		001000 014225		040116 053663
NRWND$/FOR-E3	$(1)	001000 001063	$(2)	040116 040127
NFTV$/FOR-E2	$(1)	001064 001106		
NCNVT$/FOR66	$(1)	001107 001330	$(2)	040130 040224
NBFCC$			$(2)	040225 042452
NFTCH$/FOR-E2	$(1)	001331 001613	$(2)	042453 042466
NBUCV$/FOR-E3	$(1)	001614 001744	$(2)	042467 042544
NCLOS$/FOR-E3	$(1)	001745 002202	$(2)	042545 042572
NSWTC$/FOR69	$(1)	002203 002227		
NWPLK$/FOR66	$(1)	002230 002341		
NPSFL$/FOR-E3	$(1)	002342 002376		
NUPCA$/FOR66	$(1)	002377 002432		
NRELK$/FOR-E2	$(1)	002433 002455		
NININ$/FOR-E3	$(1)	002456 002713	$(2)	042573 042574
NINPT$/FORE3-CORR	$(1)	002714 004310	$(2)	042575 042630
NOTIN$/FOR-E3	$(1)	004311 004605	$(2)	042631 042634
NOUT$/FOR-E3-UPD	$(1)	004606 006321	$(2)	042635 042676
NFMT$/FOR-E3	$(1)	006322 007204	$(2)	042677 042753
NIOER$/FOR-E3	$(1)	007205 007424	$(2)	042754 043123
NFCHK$/FOR-E3	$(1)	007425 010416	$(2)	043124 043274
	$(3)	010417 010417	$(4)	043275 043346
FORCOM$/FORFTN			$(2)	043347 043354
NERCOM$/FOR-TE3	$(1)	010420 010477	$(2)	043355 043370
FORVCOM$/FOR-TE3			$(2)	043371 043400
ERUF/SYS72-6				
NERR$/FOR-E3	$(1)	010500 011041	$(2)	043401 043560
NSTOP$/FORE3-JSC	$(1)	011042 011141	$(2)	043561 043632
NLOUT$/FOR-E3	$(1)	011142 012220	$(2)	043633 043670
NWEF$/FOR-E2	$(1)	012221 012426	$(2)	043671 043710
NTSUF$/FOR-E2	$(1)	012427 012466	$(2)	043711 043711
NIER$/FOR-E3	$(1)	012467 012645	$(2)	043712 044031
NOEUF$/FOR66	$(1)	012646 012706		
NINTP$/FORE3-RLIB	$(1)	012707 012763	$(2)	044032 044047
IDLE/SYS64	$(1)	012764 013072		

```
LMMTRX(COMMONBLOCK)                                                           044050 045210
LKGS(COMMONBLOCK)                                                             045211 045556
GRAD(COMMONBLOCK)                                                             045557 045770
THRST(COMMONBLOCK)                                                            045771 046076
SFCC(COMMONBLOCK)                                                             046077 047522
FUEL(COMMONBLOCK)                                                             047523 047541
PCOMP(COMMONBLOCK)                                                            047542 047621
COEFF(COMMONBLOCK)                                                            047622 050112
OUTPUT(COMMONBLOCK)                                                           050113 050205
NAMES(COMMONBLOCK)                                                            050206 050631
TRAJ(COMMONBLOCK)                                                             050632 050770
TARRAY(COMMONBLOCK)                                                           050771 053076
TIMES(COMMONBLOCK)                                                            053077 053141
RATES(COMMONBLOCK)                                                            053142 053273
CONF(COMMONBLOCK)                                                             053274 053307
NUMS(COMMONBLOCK)                                                             053310 053311
BLANK$COMMON(COMMONBLOCK)
MAIN/V6                          $(1)      013033 013214      $(0)      053312 053361
                                 $(3)      NUMS               $(2)      BLANK$COMMON
                                 $(5)      RATES              $(4)      CONF
                                 $(7)      TARRAY             $(6)      TIMES
                                 $(011)    NAMES              $(010)    TRAJ
                                 $(013)    COEFF              $(012)    OUTPUT
                                 $(015)    FUEL               $(014)    PCOMP
                                 $(017)    THRST              $(016)    SFCC
TLINE/V6                         $(1)      013215 014107      $(0)      053362 053556
                                 $(3)      NUMS               $(2)      BLANK$COMMON
                                 $(5)      RATES              $(4)      CONF
                                 $(7)      TARRAY             $(6)      TIMES
                                 $(011)    NAMES              $(010)    TRAJ
                                 $(013)    LKGS               $(012)    GRAD
                                                              $(014)    LMMTRX
NTAB$                                                         $(2)      053557 053615
TANK/V6                          $(1)      014110 014165      $(0)      053616 053630
                                                              $(2)      BLANK$COMMON
PRESUR                           $(1)      014166 014225      $(0)      053631 053663
                                                              $(2)      BLANK$COMMON

                 SEGMENT B*                 014226 017404       053664 055573
                 FOLLOWS SEGMENT A

DBASE/V6                         $(1)      014226 015650      $(0)      053664 054137
                                 $(3)      NUMS               $(2)      BLANK$COMMON
                                 $(5)      RATES              $(4)      CONF
                                 $(7)      TARRAY             $(6)      TIMES
                                 $(011)    NAMES              $(010)    TRAJ
                                 $(013)    LKGS               $(012)    GRAD
                                 $(015)    OUTPUT             $(014)    LMMTRX
                                 $(017)    PCOMP              $(016)    COEFF
                                 $(021)    SFCC               $(020)    FUEL
                                                              $(022)    THRST
SYSDAT/V6                        $(1)      015651 017404      $(0)      054140 055573
                                 $(3)      NUMS               $(2)      BLANK$COMMON
                                 $(5)      RATES              $(4)      CONF
                                 $(7)      TARRAY             $(6)      TIMES
                                 $(011)    NAMES              $(010)    TRAJ
```

```
                    $(013)  LKGS              $(012)  GRAD
                    $(015)  OUTPUT            $(014)  LMMTRX
                    $(017)  PCOMP             $(016)  COEFF
                    $(021)  SFCC              $(020)  FUEL
                                              $(022)  THRST

          SEGMENT C*          014226 025375     053664 057301
          HAS THE SAME STARTING ADDRESS AS SEGMENT B

NEXP5$/FOR66        $(1)    014226 014313     $(2)    053664 053673
NPKSP$/FOR-E3       $(1)    014314 015047     $(2)    053674 053721
NFOUT$/FOR-E3       $(1)    015050 015467     $(2)    053722 053743
NEXP9$/FOR68        $(1)    015470 015612     $(2)    053744 053764
SQRT$/FOR59         $(1)    015613 015653     $(2)    053765 053776
ATAN$/FOR59         $(1)    015654 016057     $(2)    053777 054030
TANCCTAN$/FOR59     $(1)    016060 016255     $(2)    054031 054051
NFINI$/FOR-E3       $(1)    016256 016703     $(2)    054052 054135
SINCOS$/FOR-E3      $(1)    016704 017040     $(2)    054136 05416C
NEXP6$/FOR-E3       $(1)    017041 017236     $(2)    054161 054232
ACTUAT/V6           $(1)    017237 020030     $(0)    054233 054313
                    $(3)    NUMS              $(2)    BLANK$COMMON
                    $(5)    RATES             $(4)    CONF
                    $(7)    TARRAY            $(6)    TIMES
                    $(011)  NAMES             $(010)  TRAJ
                    $(013)  LKGS              $(012)  GRAD
                                              $(014)  LMMTRX
PHASE/V6            $(1)    020031 021273     $(0)    054314 055515
                    $(3)    NUMS              $(2)    BLANK$COMMON
                    $(5)    RATES             $(4)    CONF
                    $(7)    TARRAY            $(6)    TIMES
                    $(011)  NAMES             $(010)  TRAJ
HINGE/V6            $(1)    021274 022430     $(0)    055516 056002
                    $(3)    NUMS              $(2)    BLANK$COMMON
                    $(5)    RATES             $(4)    CONF
                    $(7)    TARRAY            $(6)    TIMES
                    $(011)  NAMES             $(010)  TRAJ
                    $(013)  LKCS              $(012)  GRAD
                                              $(014)  LMMTRX
POWER/V6            $(1)    022431 023210     $(0)    056003 056177
                    $(3)    NUMS              $(2)    BLANK$COMMON
                    $(5)    RATES             $(4)    CONF
                    $(7)    TARRAY            $(6)    TIMES
                    $(011)  NAMES             $(010)  TRAJ
                    $(013)  LKCS              $(012)  GRAD
                    $(015)  OUTPUT            $(014)  LMMTRX
                    $(017)  PCOMP             $(016)  COEFF
                    $(021)  SFCC              $(020)  FUEL
                                              $(022)  THRST
SAPUM/V6            $(1)    023211 025053     $(0)    056200 056754
                    $(3)    NUMS              $(2)    BLANK$COMMON
                    $(5)    RATES             $(4)    CONF
                    $(7)    TARRAY            $(6)    TIMES
                    $(011)  NAMES             $(010)  TRAJ
                    $(013)  LKGS              $(012)  GRAD
                    $(015)  OUTPUT            $(014)  LMMTRX
                    $(017)  PCOMP             $(016)  COEFF
```

ORIGINAL PAGE IS OF POOR QUALITY

```
                         $(021)   SFCC                 $(020)   FUEL
                                                       $(022)   THRST
TITLE/V6                 $(1)     025054 025150        $(0)     056755 057222
                         $(3)     NUMS                 $(2)     BLANK$COMMON
                         $(5)     RATES                $(4)     CONF
                         $(7)     TARRAY               $(6)     TIMES
                         $(011)   NAMES                $(010)   TPAJ
TCOMP/V6                 $(1)     025151 025375        $(0)     057223 057301
                         $(3)     NUMS                 $(2)     BLANK$COMMON
                         $(5)     COEFF                $(4)     OUTPUT
                         $(7)     FUEL                 $(6)     PCOMP
                         $(011)   THRST                $(010)   SFCC


IBANK DRAWN TO SCALE:     100 WORDS DECIMAL PER DASH

A (5782)
----------------------------------------------------------
                                                          B* (1647)
                                                          ----------------
                                                          C* (4712)
                                                          -----------------------------------------------

DBANK DRAWN TO SCALE:     80 WORDS DECIMAL PER DASH

 A (5990)
 ---------------------------------------------------------------------------
                                                                           B* (968)
                                                                           ------------
                                                                           C* (1806)
                                                                           ----------------------

SYS$*RLIB$. LEVEL 72-8
END MAP

@BRKPT PRINT$
```

5.6 SAMPLE INPUT/OUTPUT

Figure 11 contains a sample input data deck.

Figure 12 contains a sample Hydraulic Load Data Report.

Figure 13 contains a sample timeline profile.

Figure 14 contains a sample APU fuel usage summary.

```
660 -.166667              START PRELAUNCH AT T=-.166667
661 -.001                 RESTART AT T=-.001
662 0.0                   INPUT TYPE = CARDS ONLY
665 .218333               STOP SIMULATICN AT T=.218333
781 1.                    DATA TO BE AVERAGED OVER 1 SEC INTERVALS
999
684 2.                    ADD   ENGINE CONTROLLER FLOW RATES
685 14.                   OF 14 GPM
690 2.
691 14.
696 2.
697 14.
661 -.0007                RESTART AT T=-.0007
999
685 6.                    RESET ENGINE CONTROLLER FLOW RATES
691 6.                    TO 6 GPM
697 6.
661 0.0                   RESTART AT T=0
999
662 1.                    INPUT TYPE = SSFS TAPE
664 2.                    PHASE = ASCENT
251 TIME                  SYMBOLIC NAMES ON SSFS INPUT TAPES
252 GIMPR1
253 GIMYR1
255 GIMPR2
256 GIMYR2
258 GIMPR3
259 GIMYR3
321 ALT
323 THROT1
324 THROT2
325 THROT3
661 0.0001                RESTART AT T=0.0001
999
684 0.                    STOP ADDING ENGINE CONTROLLER FLOW RATES
690 0.
696 0.
661 .135                  RESTART AT T=.135
999
684 2.                    ADD ENGINE CONTROLLER FLOW RATES
685 7.                    OF 7 GPM
690 2.
691 7.
696 2.
697 7.
661 .135416               RESTART AT T=.135416
999
685 13.                   RESET ENGINE CONTROLLER FLOW RATES
691 13.                   TO 13 GPM
697 13.
661 .135555               RESTART AT .135555
999
684 0.                    STOP ADDING ENGINE CONTROLLER FLOW RATES
690 0.
696 0.
661 .218333               RESTART AT T=.218333
999
999                       STOP SIMULATICN
660 162.71777             START ON-ORBIT CKOUT AT T=162.71777
661 162.85110             RESTART AT T=162.85110
```

FIGURE 11

```
665 162.85110              STOP SIMULATION AT T=162.85110
662 3.                     INPUT TYPE = BINARY TAPE
663 4.                     INPUT UNIT = 4
664 4                      PHASE = ON-ORBIT CKOUT
999
999                        STOP SIMULATION
660 163.21777              START ENTRY AT T=163.21777
661 163.8                  RESTART AT T=163.8
662 4.                     INPUT TYPE = BLOCKED BINARY TAPE
663 7.                     INPUT UNIT = 7
664 6.                     PHASE = ENTRY WITH LANDING
665 163.8                  STOP SIMULATION AT T=163.8
999
  EOF
```


FIGURE 11 (continued)

SAMPLE HYDRAULIC LOAD DATA REPORT

ROCKWELL SIZING MISSION - SYS 3 FAIL AT MPS PURGE DATE 111175 PAGE 60

**** HYD LOAD DATA ****

NO	LOAD NAME	ACT	S1	S2	FLOW GPAD (GPM/DEG/SEC)	POWER SPOOL LKG @ 3000 PSI (GPM)	SERVO VALVE LKG @ 3000 PSI (GPM)	ISO - DUMP VALVE	ACT NO	BYPASS VALVE	BYPASS FLOW (GPM)
1	SSME 1 PITCH	1	2	3	3.338	1.200	.300	1	1	0	.00
2	SSME 1 YAW	1	3	2	2.623	1.200	300	1	2	0	.00
3	SSME 1 CNTRL	1	0	0	1.000	.000	.000	1	3	1	.15
4	SSME 2 PITCH	2	1	3	2.623	1.200	.300	1	4	0	.00
5	SSME 2 YAW	2	3	1	2.623	1.200	.300	1	5	0	.00
6	SSME 2 CNTRL	2	0	0	1.000	.000	.000	1	6	2	.15
7	SSME 3 PITCH	3	1	2	2.623	1.200	.300	1	7	0	.00
8	SSME 3 YAW	3	2	1	2.623	1.200	.300	1	8	0	.00
9	SSME 3 CNTRL	3	0	0	1.000	.000	.000	1	9	3	.15
10	RUDDER MTR 1	1	0	0	.685	.193	.000	0	10	0	.00
11	RUDDER MTR 2	2	0	0	.685	.193	.000	0	10	0	.00
12	RUDDER MTR 3	3	0	0	.685	193	.000	0	10	0	-.00
13	RUDDER SERVO	3	2	1	.000	.000	.727	0	10	0	.00
14	SB MTR 1	1	0	0	1.014 OPEN 1.041 CLOSE	.193	.000	0	11	-0	.00
15	SB MTR 2	2	0	0	1.014 OPEN 1.041 CLOSE	.193	.000	0	11	0	.00
16	SB MTR 3	3	0	0	1.014 OPEN 1.041 CLOSE	.193	.000	0	11	0	.00
17	SB SERVO	3	2	1	.000	.000	.727	0	11	0	.00
18	LO ELEVON	3	2	1	.719	127	.727	0	12	0	.00
19	LI ELEVON	2	1	3	1.493	.245	.727	0	13	0	.00
20	RO ELEVON	1	2	3	.719	.127	.727	0	14	0	.00
21	RI ELEVON	3	1	2	1.493	.245	.727	0	15	0	.00

FIGURE 12

SAMPLE TIMELINE PROFILE

ROCKWELL SIZING MISSION - SYS 3 FAIL AT MPS PURGE DATE 111175 PAGE 62

			SYSTEM 1					SYSTEM 2					SYSTEM 3				
TIME (HRS)	ALT (FT)	SYS CONF CODE	APU SPEED %	TOTAL FLOW RATE (GPM)	MAX RATE WRNG FLAG	SYS POWER RQMTS (HP)	APU FUEL REM (LBS)	APU SPEED %	TOTAL FLOW RATE (GPM)	MAX RATE WRNG FLAG	SYS POWER RQMTS (HP)	APU FUEL REM (LBS)	APU SPEED %	TOTAL FLOW RATE (GPM)	MAX RATE WRNG FLAG	SYS POWER RQMTS (HP)	AP FU RE (L
-.16667	0.	1	100	6.24		22.32	295.00	100	6.36		22.54	295.00	100	8.67		26.64	295
-.08333	0.	1	100	6.24		22.32	282.07	100	6.36		22.54	281.97	100	8.67		26.64	279
-.03333	0.	1	100	6.82		23.36	274.32	100	6.58		22.93	274.15	100	8.89		27.04	270
-.03194	0.	1	100	6.82		23.36	274.09	100	6.58		22.93	273.92	100	8.89		27.04	270
-.00833	0.	1	110	6.24		23.32	270.28	110	6.36		23.53	270.17	110	8.67		27.67	266
-.00094	0.	1	110	22.94		53.43	269.09	110	21.65		51.09	268.97	110	23.25		53.99	264
-.00066	0.	1	110	10.44		30.86	269.00	110	9.15		28.53	268.88	110	10.75		31.41	264
-.00038	0.	1	110	14.94		38.95	268.94	110	13.65		36.64	268.83	110	15.25		39.50	264
-.00003	0.	1	110	46.05		96.31	268.85	110	62.42		128.18	268.75	110	64.73		132.86	264
.00000	0.	1	110	46.05		96.31	268.83	110	62.42		128.18	268 72	110	64.73		132.86	264
.00006	126.	1	110	31 63		69.24	268.80	110	51.79		107.34	268.68	110	64.73		132.86	264
.00008	168.	1	110	30.58		67.31	268.79	110	42.61		89.76	268.66	110	44.21		92.80	264
.00014	294.	1	110	30.58		67.31	268.77	110	20 00		48.11	268.63	110	21.60		51.01	264
.00042	882.	1	110	24.58		56.40	268 65	110	14 00		37.28	268.55	110	15.60		40.13	264
.00167	3507.	1	110	16.24		41.26	268.22	110	9.54		29.24	268.24	110	11.14		32.12	264
.00167	3507.	1	110	39.00		82.94	268.22	110	31.45		68 90	268.24	110	33.76		73.15	264
.00194	4074.	1	110	9.49		29.14	268.08	110	9.02		28 30	268.13	110	10.62		31.18	263
.00444	9324.	1	110	35.12		75.68	267.60	110	29 22		64.81	267.66	110	30.82		67.74	263
.00472	9912.	1	110	20.10		48.28	267.47	110	17.94		44.33	267.55	110	19.54		47.26	263
.00500	10: 0.	1	110	20.10		48 28	267.39	110	17.94		44.33	267.48	110	19.*4		47.26	263
.01111	23332.	1	110	11.05		31.94	265.58	110	9.81		29.71	265.80	110	11.84		33.38	261
.01194	25075.	1	110	18.91		46.12	265.41	110	?0.56		49.12	265.64	110	22.60		52.80	261
.01500	31501.	1	110	11.05		31.94	264.56	110	9.81		29.71	264.74	110	11.84		33.38	260
.01667	35025.	1	110	11.05		31.94	264 23	110	9.81		29.71	264.43	110	11.84		33.38	259
.01944	52357.	1	110	15.34		39.66	263.68	110	13.22		35.87	263.91	110	15.25		39.50	259
.02028	57613.	1	110	42.35		89.27	263 48	110	31.05		68.17	263.73	110	32.65		71.12	259
.02083	61054	1	110	14.90		38.89	263.20	110	13.22		35.87	263.52	110	14.82		38.73	258
.03111	125377.	1	110	8.23		26.88	260.81	110	7.97		26.42	261.29	110	9.57		29.29	256
.03500	149717.	1	110	39.02		82.96	260.17	110	56 42		116.31	260.66	110	58.73		120.84	255
.03527	151407.	1	110	19.64		47.44	260 04	110	18.64		45.62	260.49	110	20.24		48.54	255
.03533	151782.	1	110	48.89		101.74	260.02	110	40.81		86.34	260.47	110	43.12		90.71	255
.03611	156662.	1	110	19.45		47.09	259.57	110	21.00		49.92	260.09	110	22.60		52.82	255
.03889	174057.	1	100	7.88		25.24	258.81	100	7.78		25.07	259.28	100	9.38		27.92	254
.18319	400000.	1	100	7.88		25.24	236.43	100	7.78		25.07	237.04	100	9.38		27 92	229
.18333	400000	1	100	55.83		113.36	236 41	100	47.43		97.27	237.02	100	49.74		101.66	229
.18361	400000.	1	100	6.24		22.32	236.23	100	6.36		22.54	236.87	100	8.67		26.64	229
.19583	400000.	3	100	9.71		28.51	234.54	100	11.17		31 11	235 17	100	.00		.00	227
.26667	400000.	27	100	.00		.00	222.24	100	.00		.00	221.82	100	.00		.00	227
.56666	400000.	27	100	.00		.00	222.24	100	.00		.00	221.82	100	.00		.00	227
.56943	400000.	9	100	14 64		37.33	222.24	100	.00		.00	221.82	100	.00		.00	227
.57221	400000.	3	100	6 86		23.43	221 62	100	8.32		26.02	221.82	100	.00		.00	227
.57499	400000.	12	100	.31		7.97	221.22	100	14.64		37.33	221.38	100	.00		.00	227
.57777	400000	3	100	6.86		23.43	221.07	100	8 32		26.02	220.76	100	.00		.00	227

FIGURE ~~13~~

SAMPLE APU FUEL USAGE SUMMARY

ROCKWELL SIZING MISSION - SYS 3 FAIL AT MPS PURGE DATE 111175 PAGE 73

APU FUEL USAGE SUMMARY

	FUEL USED (LBS)	FUEL REMAINING (LBS)
SYSTEM 1	175.3079	119.6921
SYSTEM 2	186.5193	108.4807
SYSTEM 3	67.2938	227.7062

8N FPR 11 NOV 75 23:31: 8

FIGURE 14

6. REFERENCES

1. U. S. Standard Atmosphere, 1962.

2. Shuttle APUs Specific Propellant Consumption Data to be used for the Propellant Tank Sizing and Interconnect Studies. JSC memo, EP4/4 - 74/73, April, 1974.

3. Bald, N. B.: SSFS Plot Output Data Format, SNAIL No. 59, October 16, 1975.

4. Isherwood, J. K.: User's Manual, Generalized Plot Program TRWPLT, TRW 11176-H594-RO-OO, August 1970

5. Rockwell International: Hydraulic Pump Efficiency Data for Power Profile Computer Program. Internal Letter No. 388-202-75-018, February 1975.

6. Rockwell International Space Shuttle Electro-Mechanical Systems Department 388: Space Shuttle Hydraulic System Power Analysis Computer Program. October 25, 1974.

7. TRW: Simplified Auxiliary Power Unit Consumables Model. Memo No. 2533.5-74-22. February 21, 1974.

8. Rockwell International: Requirements/Definition Document, Hydraulics Subsystem. RI SD72-SH-0102-6, July 30, 1975.

9. Rockwell International: Requirements/Definition Document, Auxiliary Power Unit. RI SD72-SH-0104-2, December 5, 1974.

10. Lockheed Electronics, Co.: Program and user information for the Hydraulic/Auxiliary Power Unit (HYDRA) Computer Program, LEC-8323, April 1976

APPENDIX A

COMMON BLOCK DEFINITIONS

Labeled Common Name	Variable Name	Type	Units	Description
CONF	ISYS(I)	I	-	Flag for system operational mode; I is the system number; (I = 1,3) = 1 Pressurized = 2 Depressurized = 3 Off
	IVALVE(I)	I	-	Flag for valve status; I is the valve number; (I=1,3) = 1 Open = 2 Closed
	IAPUSD(I)	I	-	Flag for APU speed; I is the system number; I = 1,3 = 1 100% Speed = 2 110% Speed
	TP	R	HRS	Current time
	NOS	I	-	Number of systems pressurized
	P(I)	R	psi	System pressure; I is the system number; (I = 1,3)
	IBYPV(I)	I	-	Flag for bypass valve status; I is the bypass valve number; (I = 1,3) = 1 Open = 2 Closed
GRAD	FGRAD(I,1)	R	GPM/DEG/SEC	Flow gradient for positive angular rates with three systems pressurized; I is the hydraulic load number; (I = 1,37)

Labeled Common Name	Variable Name	Type	Units	Description
	FGRAD(I,2)	R	GPM/DEG/SEC	Flow gradient for negative angular rates with three systems pressurized; I is the hydraulic load number; (I = 1,37)
	FLGRAD(I)	R	GPM/DEG/SEC	Flow gradient; I is the hydraulic load number; (I = 1,37)
LKGS	PSLKG(I)	R	GPM	Power spool leakage at 3000 psi; I is the hydraulic load number; (I = 1,37)
	SVLKG(I)	R	GPM	Servo valve leakage at 3000 psi; I is the hydraulic load number; (I = 1,37)
	XPSLKG(I)	R	GPM	Power spool leakage; I is the hydraulic load number (I = 1,37)
	XSVLKG(I)	R	GPM	Servo valve leakage; I is the hydraulic load number (I = 1,37)
	BYFLOW(I)	R	GPM	Bypass flow; I is the hydraulic load number (I = 1,37)
LMMTRX	LMM(1,I)	I	-	Active system number; I is the hydraulic load number (I = 1,37)
	LMM(2,I)	I	-	1st standby system number; I is the hydraulic load number (I = 1,37)
	LMM(3,I)	I	-	2nd standby system number; I is the hydraulic load number (I = 1,37)
	IPTR(I,J,K)	I	-	System configuration code; I is the system 1 operational

Labeled Common Name	Variable Name	Type	Units	Description
				mode; J is the system 2 operational mode; K is the system 3 operational mode; (I = 1,3); (J = 1,3); (K = 1,3)
	ICODE(I,J)	I	-	System number; I is the system configuration code; J is the hydraulic load number; (I = 1,27); (J = 1,37)
	ISOV(I)	I	-	Isolation valve number; I is the hydraulic load number; (I = 1,37)
	IASGN(I)	I	-	System number; I is the hydraulic load number; (I = 1,37)
	IBYPSS(I)	I	-	Bypass valve number; I is the hydraulic load number, (I = 1,37)
NAMES	NAME(I,J)	A	-	Symbolic name; J is the hydraulic load number; (I = 1,2); (J = 1,37)
	IACTNO(I)	I	-	Actuator number; I is the hydraulic load number; (I = 1,37)
	NMODE(I)	A	-	Symbolic name; I is the operational mode number; (I = 1,3)
	ISPED(I)	A	%	APU speed ; I is the speed number; (I = 1,2)
	ILOAD(I)	I	-	Hydraulic load number; I is the actuator number; (I = 1,23)

Labeled Common Name	Variable Name	Type	Units	Description
OUTPUT	FLRT(I)	R	GPM	Flow rate; I is the hydraulic load number; (I = 1,37)
	TFLRT(I)	R	GPM	Flow rate; I is the system number; (I = 1,3)
	PWR(I)	R	HP	Horsepower; I is the system number; (I = 1,3)
RATES	RATE(I)	R	DEG/SEC	Angular rate; I is the actuator number; (I = 1,23)
	HM(I)	R	IN-LBS	Hinge moment; I is the actuator number; (I = 1,23)
	DEG(I)	R	DEG	Surface deflection; I is the actuator number; (I = 1,23)
	CGLOAD	R	G	Vehicle load
	ALT	R	FT	Altitude
TARRAY	T(I)	R	-	Definitions of variables stored in the array T can be found in Section 3.1.1 Card Input. The data number is the subscript for the array T.
	WRT(1)	R	HRS	Time
	WRT(I)	R	DEG/SEC	Angular rates; I is the actuator number + 1; (1 = 2,16)
	WRT(I)	R	-	Actuator operational flag; I is the actuator number + 1; (I = 17,24)
	WRT(I)	R	IN-LBS	Hinge-moment; I is the actuator number + 24; (I = 24,47)

Labeled Common Name	Variable Name	Type	Units	Description
	WRT(I)	R	DEG	Surface deflection; I is the actuator number + 47; (I = 48,70)
	WRT(71)	R	FT	Altitude
	WRT(72)	R	G	Vehicle load
	WRT(I)	R	%	Throttle setting; I is the engine number + 72; (I = 73,75)
TIMES	ISTART	I		Start flag
	ISTOP	I		Stop flag
	IEND	I		End of mission flag
	NOL	I		Number of lines printed on page
TRAJ	INDEX(I)	I		Word location for data on SSFS and SVDS tapes; I = 1,75
	IETP	I		End of tape flag

APPENDIX B

SSFS AND SVDS TRAJECTORY TAPE FORMAT

B.1 SVDS INPUT TRAJECTORY TAPE FORMAT AND USAGE

The symbolic names of the parameters contained on the tape and the names included in the timeline array must be identical. Also, the timeline array symbolic names must include the correct parameter numbers associated with that name.

a. The first record on the tape should contain the number of parameters and the symbolic names. The first word on this record must be a dummy word with the second word corresponding to the number of parameters on the tape followed by the symbolic names.

b. The second record should contain the first time point and all parameter values. The first two words of the second record should be dummy words followed by the parameter values corresponding to the symbolic names on the first record.

c. The suceeding records should contain a unique time point and associated parameter values. Again, each record should contain two dummy words at the beginning of the record.

d. @EOF

B.2 SSFS INPUT TRAJECTORY TAPE FORMAT AND USAGE

If the SSFS trajectory is created on a file and then copied to tape, the tape must be copied back to a temporary file with a @COPY,G command. The symbolic names of the parameters contained on the file (tape) and the names included in the timeline array must be identical. Also, timeline array symbolic names must include the correct parameter numbers associated with that name.

a. The first record on the file (tape) must contain the number of parameters and the symbolic names.

b. The second record should contain the first time point and all parameter values associated with this time point.

c. The succeeding records must contain a unique time point and associated parameter values.

d. @EOF