SEPTEMBER 1979 MDC G7699

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GENERALIZED ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM COMPUTER PROGRAM (G189A) CONFIGURATION CONTROL

PHASE III FINAL REPORT

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY

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FOREWORD

The work described in this report was performed by the Biotechnology Department of the Vehicle, Energy and Biotechnology Subdivision, Engineering Division, McDonnell Douglas Astronautics Company - Huntington Beach, California. Mr. J. R. Jaax of the Crew Systems Division, National Aeronautics and Space Administration, Johnson Space Center, Houston, Texas, was the contract monitor. S. W. Nicol was the project manager for McDonnell Douglas at Huntington Beach. The G189A computer program configuration control effort was prepared on-site at NASA/JSC by R. E. McEnulty.

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SUMMARY

This final report documents the work performed during Phase III of contract NAS9-14877, Generalized Environmental Control and Life Support System Computer Program (G189A) Configuration Control. Phase III of this contract covers the period from 1 December 1977 to 30 September 1978. During this period the following items of significance were accomplished:

1. The G189A simulation of the Shuttle Orbiter ECLSS was upgraded in the following areas:

   (a) The Payload Loop of the Shuttle Simulation was completely recoded, checked out, and reflects the latest known configuration.

   (b) The Shuttle simulation water and freon loop initialization logic was simplified to permit easier program input for the user.

   (c) The G189A simulation was modified to accept the WASP subroutine, which is a subroutine to evaluate thermal properties of water and freon.

   (d) The 1108 operating system was updated by LEC, which required G189A modifications for compatibility.

   (e) The Shuttle simulation was modified to permit failure cases which simulate zero component flow values.

   (f) The Shuttle SEPS version was modified and secure files were setup on both the 1108 and 1110 systems to permit simulation runs to be made from remote terminals.

1.0 INTRODUCTION

The G189 Generalized Environmental Control and LIfe Support System Computer was initially conceived and developed by MDAC-Huntington Beach in 1964. An initial version of the program was delivered to NASA/JSC in 1965 under contract NAS9-4090. Since 1965 a number of program additions, revisions, and new developments have occurred as a result of in-house work and subsequent NASA contracts. The Crew Systems Division (CSD) of NASA/JSC has been instrumental in developing this program into a valuable ECLSS simulation analysis tool. This contract, NAS9-14877 - Generalized Environmental Control and Life Support System Computer Program (G189A) Configuration Control, provides NASA/JSC with Houston based personnel who can maintain, update, and utilized the G189A computer program effectively and efficiently. The contract effort also includes: (1) providing instruction and consultation services for others regarding the use and application of the G189A program, (2) developing new subroutines or modifying existing subroutines to provide additional capabilities required for current or new simulations, (3) maintaining and improving existing G189A simulation models developed for Shuttle ECLSS and payload ECLSS analyses, (4) developing new simulation models as required, and (5) supporting special study analyses requested by CSD. This contract continues the effort begun in April 1973 under contract NAS9-13404. The following section describes in detail the progress made under the various tasks described in the Phase III portion of contract NAS9-14877.

2.0 REPORT OF PHASE III PROGRESS

The Phase III progress on tasks 1-10 as described in contract NAS9-14877 is reported below.

2.1 Task 1 - Formulate Master Programs

G189A EXEC8 Master Programs were maintained and updated during this contract period according to the method described in paragraph 2.1 of Reference 12. The master program can be accessed by using either a combination master program library tape or a system secure file (G189A) which contains all program elements. The simulation can be run by submitting batch jobs directly or can be remote started via a terminal. Secure files RUN, RUN1 and RUN2 exist on both the 1108 and 1110 computer systems. These files contain card images of G189A simulation decks and are used to remote start simulation runs from a remote terminal. The multiple files existing on each system permits more than one simulation case to be in the system at the same time.

2.2 Task 2, Maintain Tape Library

Six EXEC8 G189 master program librarys were generated this contract year.

Data tapes, post plotting plot tapes and Table 1 summary table tapes were made and saved as required. Table 1 shows the present tape status.

2.3 Task 3, Provide Recommendations

Contract has been maintained between J. P. Kenney, LEC; Joan Meza, LEC; John Granahan, HSD; and Stuart Nicol, MDAC-Huntington Beach during this report period to provide them with recommendations regarding the use of master program library tapes, the use of simulation model tapes, the modification of program subroutines to perform specific tasks, and peculiarities and limitations of selected subroutines. These personnel were the only identified active users of the G189A program during this contract period.

2.4 Task 4, Provide Instruction

Consultation services have been provided for the on-site users of the G189A program and telephone communications have been maintained with the off-site users to provide them with information regarding new program features and options, subroutine revisions, and program manual revisions.

2.5 Task 5, Provide Program Modifications

During this report period modifications were made to 16 of the subroutines that are used by all of the library versions, to 6 of the subroutines that are used in the standard library version, and to 23 of the subroutines used for the Shuttle library versions. The modifications made to each subroutine have been documented in the monthly progress reports and are referenced below for each subroutine name/version.

Subroutine NAME/VERSION	Reference Document Reference No. (Section)
ALTCOM	5 (1.4)
ANYHX	6 (1.3)
ARSGAS/S	2 (1.4), 4 (1.4), 5 (1.4), 6 (1.3)
ARSH2Ø/S	2 (1.4), 4 (1.4), 6 (1.3)
ARST/S	4 (1.4)
ATCST/S	4 (1.4)
CABIN/A	2 (1.4), 6 (1.3)
CABIN/S	2 (1.4)
CABINT/A	2 (1.4), 6 (1.3)
CABINT/S	2 (1.4), 6 (1.3)
CASDAT	5 (1.4)
CMAN	5 (1.4)
ECLST/A	1 (1.4)
ECLST/S	1 (1.4), 3 (1.3), 4 (1.4), 5 (1.4)
ELINT/M	3 (1.3), 4 (1.4), 5 (1.4), 6 (1.3)
ELØAD/M	5 (1.4)
FAN	5 (1.4)
FCL/S	1 (1.4), 2 (1.4), 4 (1.4), 5 (1.4)
FLØWØR	1 (1.4)
GASMIX	5 (1.4), 9 (1.3)
GPØLY1/M	1 (1.4), 2 (1.4), 3 (1.3), 4 (1.4), 5 (1.4), 6 (1.3), 9 (1.3)
GPØLY1/Q	1 (1.4), 2 (1.4), 4 (1.4), 5 (1.4), 9 (1.3)
GPØLY2/M	1 (1.4), 2 (1.4), 3 (1.3), 4 (1.4), 5 (1.4), 6 (1.3), 9 (1.3)
GPØLY2/Q	1 (1.4), 2 (1.4), 4 (1.4), 5 (1.4), 9 (1.3)
G189	1 (1.4), 4 (1.4)
HBALNC	5 (1.4)
MAINPL/G	9 (1.3)
PAYLD/S	2 (1.4)
PIPETL	5 (1.4), 9 (1.3)
PRESS	5 (1.4)
PRØP/A	5 (1.4), 6 (1.3)
PRØP/S	5 (1.4), 6 (1.3)
PRTIME	1 (1.4)
QLØAD/M	1 (1.4), 2 (1.4), 3 (1.3), 4 (1.4), 5 (1.4), 6 (1.3), 9 (1.3)

Subroutine NAME/VERSION	Reference Document Reference No. (Section)
QPHAVG/S	4 (1.4), 5 (1.4)
QTAPE/M	5 (1.4)
QTAVG/S	1 (1.4), 2 (1.4), 5 (1.4)
REDDER/S	1 (1.4), 4 (1.4)
RITER/S	1 (1.4), 2 (1.4), 4 (1.4), 5 (1.4)
SEGPRG/A	2 (1.4)
SEGPRG/S	1 (1.4)
SUMTAB	9 (1.3)
TABLRD	4 (1.4)
THERMG	4 (1.4)
UWIN	4 (1.4)
WASP	5 (1.4)

2.6 Task 6, Establish System Schematics

Specific G189A program system configurations are generally prepared for each G189A simulation model. These configurations consist of a master program library tape; a simulation basic case data tape; and, in the case of Shuttle Orbiter ECLSS simulations, special purpose data tapes such as the MPAD power profile profile data tapes, phase averaged heat load and temperature comparison tapes, and post plotting data tapes for post plotting routines. The system configurations currently maintained under this contract are listed in Table 1.

2.7 Task 7, Provide Digital Computer Program Requirements

Program listings of the G189A master program library tapes and EXEC8 secure files as well as card decks for the execution of current simulation models are maintained at NASA/JSC, building 7A, CSE. The master program library tapes, simulation model data tapes, MPAD electrical power profile data tapes, phase averaged comparison data tapes and post-plotting tapes are stored in the NASA/JSC Institutional Data Systems Division (IDSD) magnetic tape library in building 12. The G189A ETC/LSS program manual (Reference 11) updates, prepared during this contract effort, are included as Attachment A of this report.

2.8 Task 8, Support Special Analyses

The following special study analyses were supported during this contract period by generating input data, developing special logic and making the runs:

Steady state and transient math models of the Lockheed Electronics Company Vapor Compression Distillation Subsystem were received during this contract period. Both models were installed and checked out in BHSIC on the NASA-JSC Comshare system. New efficiency curves for the VCD unit were generated using the transient model. A series of requested VCD pretest prediction runs were made using the steady state model and the new efficiency data. A G189A component subroutine simulation of the steady state model was generated and is operational.

2.9 Task 9, Provide Monthly Progress Report

Nine monthly Progress Reports (References 1-9) were provided under this contract effort.

2.10 Task 10, Furnish Final Report

This document is furnished to satisfy the requirements of Task 10.

3.0 CONCLUSIONS AND RECOMMENDATIONS

The G189A program configuration control contract has proved to be an efficient method of organizing and controlling the use and modification of the G189A program and the G189A simulation models. The program users have been identified and communications have been maintained with these users to provide consultation, determine program errors and deficiencies, identify new requirements, and define system configurations to be used for specific problem solutions. This effort has resulted in the orderly development of the G189A program and has established a central authority who can assess proposed program changes and their effects upon the program's generalized applications. Specific simulation model requirements are accommodated by creating special versions of the standard G189A master program library (Section 2.1). As these modifications are checked out and used and if they are determined to be applicable to other simulations or to the standard master program library their solutions are prepared as generalized logic blocks which can be added to other library versions and/or to the standard library version.

The G189A Shuttle Orbiter ECLSS simulation models developed under Phase II of the previous contract (Reference 10) were modified and upgraded to provide the new simulation model configurations required for the studies supported under this contract (Section 2.8). A simulation model log (Table 1) which identifies the various simulation model configurations developed and their current status has been maintained. This log provides a convenient method of assessing the current G189A Shuttle ECLSS analysis capability.

Since 1975 the G189 ECLSS program has had the capability to read and process the MPAD generated Shuttle Electrical Power System (SEPS) tapes. This has permitted the ECLSS simulation program to compute realistic transient thermal analyses.

The SEPS program was developed by MPAD primarily to perform consumable analyses and although it provides excellent transient data the program requires a large amount of time for data preparation and execution. MPAD began a parallel development effort in 1975 to create a simplified program which would require less time for data preparation and execution, but still yield adequate data for consumable analysis purposes. The Shuttle Electrical and Environmental Requirements (SHEER) computer program was developed for this purpose. Recently MPAD restricted its use of the SEPS program in favor of the SHEER program. Therefore, the G189 ECLSS thermal analysis programs were modified to provide the option of inputting electrical power profile data generated with the SHEER program.

The SHEER program differs from the SPES program in that it computes the average power requirements for each component used within an activity block and groups the power dissipations into predefined ECLSS heat load locations while the SEPS program computes instantaneous power data for each component and the user is free to group the component power dissipations to match his program requirements. The SHEER programs activity block averaging and component grouping techniques have been compared with the SEPS instantaneous power data to verify the fidelity of the SHEER ECLSS simulation.

The comparison was made using the ØFT2 mission as a test case. The following conclusions were made from the study.

(1) For mission phases that show data out of tolerance, the SHEER analysis is more pessimistic and therefore the SHEER analysis is considered more conservative.

(2) The study of key parameters over the complete mission shows that the maximum difference between SHEER and SEPS key parameters is 3%.

(3) The SHEER analysis for the ØFT2 mission was acceptable for an overall mission assessment purpose.

(4) Tables 1 and 2 of Reference 13 can be used to estimate possible errors for other missions.

The G189A Shuttle simulation models have proven to be a cost effective method of studying overall ECLSS performance under a variety of conditions. Problem areas can be quickly identified and determinations can be made as to the necessity of performing additional analyses requiring the use of the detailed thermal analyzer models which are prepared and maintained by RI. The ease and speed with which special ECLSS reconfigurations, failure modes, and/or boundary conditions can be incorporated in the various modesl has been thoroughly demonstrated. The present set of G189A Shuttle Orbiter ECLSS simulation models provides a varied data base which can easily be upgraded and/or modified to accept hardware development and acceptance test data as they become available.

The following recommendations are made with regard to desired improvements for the G189A program and the Shuttle simulation models.

(1) A new subroutine should be developed that allows a component's K array data to be printed out. (The G189A library currently contains subroutines which print out component A, B, R, and V array data.) This routine would be useful for model debugging.

(2) The HSC CO_2 scrubber should be incorporated into the G189A simulation.

(3) Simulation capability using interactive CRT terminals should be expanded.

4.0 REFERENCES

1. Twenty-Third Monthly Progress Report, Generalized Environmental Control and Life Support System Computer Program (G189A) Configuration Control, Contract NAS9-14877, December 1977.

2. Twenty-Fourth Monthly Progress Report, G189A Configuration Control, NAS9-14877, January 1978.

3. Twenty-Fifth Monthly Progress Report, G189A Configuration Control, NAS9-14877, February 1978.

4. Twenty-Sixth Monthly Progress Report, G189A Configuration Control, NAS9-14877, March 1978.

5. Twenty-Seventh Monthly Progress REport, G189A Configuration Control, NAS9-14877, April 1978.

6. Twenty-Eighth Monthly Progress REport, G189A Configuration Control, NAS9-14877, May 1978.

7. Twenty-Ninth Monthly Progress Report, G189A Configuration Control, NAS9-14877, June 1978.

8. Thirtieth Monthly Progress Report, G189A Configuration Control, NAS9-14877, July 1978.

9. Thirty-First Monthly Progress Report, G189A Configuration Control, NAS9-14877, August 1978.

10. Phase II Final Report - Generalized Environmental Control and Life Support System Computer Program (G189A) Configuration Control, MDAC Report No. MDC 7254, November 1977.

11. G189A Generalized Environmental/Thermal Control and Life Support Systems Program - Program Manual, R. L. Blakely, et. al., MDAC Report No. MDC-G2444, September 1971.

12. Exhibit B - Request for Proposal 9-BC 73-27-6-M8P, NASA/JSC, 21 October 1975.

13. Comparison of OFT-2 ECLSS Thermal Analysis Results Obtained Using Two Different Types of Electrical Power Profile Input Data (SHEER and SEPS), Holden KA, MDTSCO-E-902-1.2-TM-B0709-15. September 1977.

TABLE 1 - SHUTTLE ORBITER ECLSS MODELS

		MASTER PROGRAM LIBRARY			SIMUL	
Item No.	Simulation Model Description	Tape No.	Oper. Date	Drop Date	Tape No.	Ope Dat
1	OFT1 8 PSIA CABIN	X09163 X07563	4-10-78		X23606	4-1
2	OFT1 (New data base)	X20909 X19734	4-26-78		X11054	5-1
3	4 Man OFT1 Descent 14.5 PSIA	X20909 X19734	4-26-78		X01568	6-1
4	4 Man OFT1 Descent 8 PSIA	X20909 X19734	4-26-78		X18272	6-2
5	4 Man OFT1 Descent 10 PSIA	X20909 X19734	4-26-78		X04675	6-2
6	4 Man OFT1 Descent 12 PSIA	X20909 X19734	4-26-78		X20674	7-1
7	7 Man S/L II Descent 14.7 PSIA	X20909 X19734	4-26-78		X10911	7-8
8	7 Man S/L II Descent 8 PSIA	X20909 X19734	4-26-78		X10289	7-1
9	7 Man S/L II Descent 10 PSIA	X20909 X19734	4-26-78		X20012	7-1
10	7 Man S/L II Descent 12 PSIA	X20909 X19734	4-26-78		X18056	7-2

FOLDOUT FRAME 3

LE 1 - SHUTTLE ORBITER ECLSS MODELS

PROGRAM LIBRARY		SIMULATION DATA			SEPS POWER DATA		
per. ate	Drop Date	Tape No.	Oper. Date	Drop Date	Tape No.	Oper. Date	Drop Date
-10-78		X23606	4-10-78		X00180		
-26-78		X11054	5-1-78		X06465		
-26-78		X01568	6-19-78		X06465		
-26-78		X18272	6-22-78		X06465		
-26-78		X04675	6-26-78		X06465		
-26-78		X20674	7-12-78		X06465		
-26-78		X10911	7-8-78		X19813		
-26-78		X10289	7-13-78		X19813		
-26-78		X20012	7-19-78		X19813		
-26-78		X18056	7-24-78		X19813		

Reference Location	Description	Data Type
69	Maximum fan motor efficiency (dimensionless)	I(R) if NSTR(3) = 2
70	Ratio of shaft power to maximum shaft power (dimensionless)	0
71	Fraction of maximum motor efficiency (dimensionless)	0
72	Total electrical input power (watts	I(R) if NSTR(3) = 0
73	Fan power dissipated by compression of gas (watts)	0
74	Power dissipated as heat in fan motor (watts)	0
75	Fan head rise (ft)	0
76	Volumetric flow (cfm)	0
77	Fan power due to adiabatic compression of gas (watts)	0
78	Thermal conductance, UA, between fan assembly and gas stream (BTU/HR°F)	I(R)
79	Fan aerodynamic efficiency	I(R) if NSTR(4) = 0
80	Fan pressure rise corresponding to flow R(1) (psi)	I(R) if NSTR(2) = 0
81	Fan pressure rise from previous subroutine pass; corresponding to flow R(66) (psi)	0
82	Associated gas circuit pressure drop with flow equal to R(1) (psi)	I(R) if NSTR(2) = 1
83	Associated gas circuit pressure drop with flow equal to R(66) (psi)	0
84	Fan on/off flag: 0.0 = fan off 1.1 = fan on	I(R)
85	Fan motor efficiency (dimensionless)	0 when NSTR(3) = 2
86	Unused	
87	Decimal fraction limit for changes in R(1) when subroutine is estimating flows which will balance gas circuit pressure drop with fan head rise. (dimensionless)	I(0), only applies when NSTR(2) = 1

2.3 Heat Loss V-Array Data

Reference Location	Description	Data Type
51	Avg. internal module temperature (°F)	I(R), 0
52	Effective summed conductance to ambient (Btu/nr-°F)	0
53	Component total ambient heat loss (Btu/hr)	0
54	Ambient gas temperture (°F)	I(R)
55	Thermal conductance between surface of insulation and ambient gas (Btu/hr-PF)	I(R)
56	Convective heat loss to ambient gas (Btu/hr)	0
57	Ambient radiation wall temperature (°F)	I(R)
58	Thermal radiation A factor from surface of insulation to ambient wall (ft^2)	I(R)
59	Radiative heat lo-s to ambient wall (Btu/hr)	0
60	Structure temperature for heat shorts (°F)	I(R)
61	Thermal conductance between module and structure temperature (Btu/hr-°F)	I(R)
62	Conductive heat loss to structure (Btu/hr)	0
63	Insulation surface temperature (°F)	0
64	Conductance between module and outer surface of insulation (Btu/hr-°F) (If R(64) = 0, there is no insulation)	I(R)

2.4 Steady State K-Array Data

Reference Location	Description	Data Type
16	Component number of alternate component (If zero program assumes no active cooling.)	I(R)

2.5 Steady State/Transient V-Array Data

Reference Location	Description	Data Type
65	Removal rate of CO_2 (lb/hr)	0
66	Transfer rate of CO_2 (lb/hr-amp-cell)	I(R)
67	Desired module temperature (°F)	I(R)
68	Heater turnoff temperature (°F)	I(R)

The user, therefore, will set the outlet flow from the tank equal to a desired value in a GPØLY1 statement in most simulations. If the total flow is specified in GPØLY1 during component solution as R(1), then the individual constituent flows will be determined by the routine from the known concentrations in the tank. If the total outlet flow, R(1), is not specified in GPØLY1 during the component's solutions but is calculated during another component's solution or in GPØLY2, then the individual constituent flows must be calculated and loaded in the component's proper V array locations. The outlet flow could be keyed to demand schedules, evaluated from orifice equations, or determined by control logic.

2.2 Instruction Options

NSTR(1): Calculation of outlet flow during Steady State

= 0 In steady state calculations the outlet flow is seq equal to the inlet flow despite any coding in GPØLY1. In transient, the GPØLY1 coding will be executed.

= 1 The outlet flow is determined by a GPØLY1 statement or the previous value if no GPØLY1 statement changes it.

NSTR(2): Steady State Heat Balance

= 0 In steady state, tank fluid temperature is equal to temperature of inflowing stream.

= 1 The tank fluid temperature is specified in R(70) and the heating or cooling load required to offset ambient heat losses and fluid expansion is calculated for steady state operation.

= 2 The tank fluid temperature is calculated by iteration on the steady state heat balance.

NSTR(3): Transient Heat Balance

= 0 Skip the transient heat balance and proceed according to NSTR(2)

= 1 Perform transient heat balance.

NSTR(4): Initial Mass or Volume in Tank.

= 0 Initial volume R(71), pressure R(72), and temperature R(70) inputs are used to calculate the initial mass

= 1 Mass R(60), pressure R(72), and temperature R(70) inputs are taken as correct data. Volume calculated and used in transient runs.

NSTR(5): The provision for heat rejection/addition through use of secondary flow as heat transport medium. (Subroutine automatically sets NSTR(2) = 2 if NSTR(5) = 0)

2.4 Steady State V-Array Data

Reference Location	Description	Data Type
65	Fluid heating or cooling load in steady state (Btu/hr)	I(0)
66	Tank wall heating or cooling load in steady state (Btu/hr)	I(0)
67	Effective heat transfer conductance (UA) between heating/cooling fluid and the tank wall or fluid (Btu/hr-°F)	I(R) if NSTR(5)>0
68	Maximum weight of liquid in tank. (Full conditions) (lbs)	I(R) if Flow code = 0 or 4
69	Total fluid weight in tank (lb)	I(R)
70	Fluid temperature in tank (°F)	I(R)
71	Fluid volume in tank (ft^3)	I(R) if NSTR(4)=0
72	Fluid pressure in tank (psia)	I(R)
73	Weight of non-condensables in tank (lb)	I(R) if Flow code = 1
74	Weight of condensable vapor (lb)	I(R) if Flow code = 1
75	Weight of condensable liquid (lb)	I(R) if Flow code = 1
76	Non-condensable specific heat in tank (Btu/lb-°F)	0
77	Non-condensable molecular weight (lb)	0
78	Weight of oxygen in tank (lb)	I(R) if Flow code = 2 or 3
79	Weight of diluent in tank (lb)	I(R) if Flow code = 2 or 3

Reference Location	Description	Data Type
80	Weight of CO_2 in tank (lb)	I(R) if Flow code = 2 or 3
81	Weight of trace contaminants in tank (lb)	
82	Weight of special flow type 1 (lb)	
83	Weight of special flow type 2 (lb)	I(R) if Flow code = 3 or 4
84	Weight of special flow type 3 (lb)	
85	Weight of special flow type 4 (lb)	
86	Weight of special flow type 5 (lb)	
87	Weight of special flow type 6 (lb)	
88	Specific heat of fluid in tank (Btu/lb-°R)	0
89	Density of fluid in tank (lb/ft^3)	0
90	Viscosity of fluid (lbm/ft-hr)	0
91	Molecular weight of fluid in tank (lb/lb-mole)	0

2.5 Transient V-Array Data

Reference Location	Description	Data Type
92	Thermal capacitance of tank shell (Btu/°F) (If zero, steady state logic will be used.)	I(R)
93	Thermal conductance between internal fluid and tank wall (Btu/hr-°F) (If R(93) = 0 process will be adiabatic.)	I(R)
94	Maximum allowable temperature change in one internal compute step to avoid instabilities in the heat balances (°F) (Typical value = 5°F)	I(R)
95	External heat load to fluid (Btu/hr)	I(R)
96	External heat load to tank wall (Btu/hr)	I(R) if R(93) = 0
97	Rate of change of mass in tank (lb/hr)	0

2.6 Special Input Feature

It will be noticed that reference locations 69 to 87 contain information analogous to what is contained in the A or B arrays. The difference is that pounds replace pounds/hr and R(71) contains the tank volume instead of a pressure. Ordinarily the user must input data values into most of these locations in order to define the initial contents of the tank.

TABLE 3-1 CASE DATA DEFINITIONS (continued)

Card Name	Card Column	FORTRAN Format	FORTRAN Name	Definition
		I	KPRUN	Pressure drop solution flag, Enter: 0 No pressure drop solution 1 Pressure drop solution
		I	NPASPD	Number of system passes to be performed before pressure drop analysis begins.
		I	KSTEADY	Universal component steady state solution flag. Enter: 0 No Change [Use Component Solution Method Specified by NSTR(16)]. 1 Use Steady State Solutions for All Components
		I	NØLIM	Plot gird limit flag Enter: 0 Accept limits specified on PLØT cards 1 Disregard specified PLØT card limits, calculate limits based on computed data range (This option allows all data to be shown on plots.)
		I	KRUN	Steady State/Transient Run Flag Enter: 0 Steady State only 1 Steady State followed by Transient 2 Transient only 3 Transient followed by Steady State 4 Do not run case, edit data only