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An Interactive Preprocessor for the NASA Engine Performance Program

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Abstract

This report describes the Simplified NEPP Automated Preprocessor (SNAP), which is written to aid in the preparation of input data files for the NASA Engine Performance Program (NEPP). Specifically, SNAP is a software package on the Virtual Machine operating system that prompts the NEPP user for input information via a series of menus. The data collected from these menus are assimilated into an input file suitable for the running of NEPP. SNAP acts as a user-friendly preprocessing interface for NEPP. This report serves as an introduction to the SNAP software, a user's manual, a description of the program logic, and a maintenance manual for future modifications to the software.

Introduction

The NASA Engine Performance Program is a very general steady-state thermodynamic cycle analysis code. NEPP is a FORTRAN program that descended from the original Navy/NASA Engine Program, NNEP[1], the Navy/NASA Engine Program with chemical equilibrium analysis, NNEPEQ[2], and the enhanced Navy/NASA Engine Program, NNEP89[3]. This code has been used extensively to predict both the design and off-design performance of a variety of Brayton engine cycle configurations ranging from subsonic turboprops to supersonic variable cycle engines. NEPP's versatility results from the ability of the user to assemble virtually any sequence of components into a complete gas turbine engine model that the code interprets to compute the engine performance characteristics.

One particularly vexing problem in the usage of NEPP concerns the nature of its input requirements. With the exception of component performance and gas property map files, NEPP uses the FORTRAN NAMELIST utility to enter its inputs. One input array contains data that enables the program to connect engine components into a desired configuration. This array describes the type and location of each component in the engine flowpath. Another array is used to describe each component. Each position in this array represents a component specification whose definition is dependent on the component type. A user, therefore, must continually refer to an input manual for the definition of input parameters. This is very tedious and is often prone to errors made by miscounting the elements of the arrays. An example of this input is shown in Table 1.

In 1981, the first attempt was made at developing an input preprocessor to aid in the generation and modification of NEPP input files. This attempt resulted in two programs: KONFIG and REKONFIG[4]. The former allows a user to lay out the components and fill in the component specifications of a new engine while the latter allows a user to modify the component specifications of an existing engine. These programs are written in FORTRAN and are therefore portable to most systems. However, because of the restrictive nature of FORTRAN input, even these programs are rather cumbersome to use. The nature of the display and input varies from machine to machine. In addition, neither code can apply the options in NEPP known as controls, optimizers, and limiters; and REKONFIG does not really reconfigure an engine, but merely redefines the component specifications.

Since the majority of the NEPP users at the NASA Lewis Research Center run the code on the Virtual Machine (VM) operating system[5], a new input preprocessor now exists which takes advantage of the capabilities of this operating system's editor[6] and interpreting language[7]. The Simplified NEPP Automated Preprocessor (SNAP) uses editor macros and interpreter programs to generate customized menus for inputting NEPP data. A disadvantage to this approach is that SNAP's use is thus restricted to the VM operating system. This approach is viewed as an intermediate step before the development of a graphical user interface on a Unix workstation. Such software is currently under development[8].

The philosophy of SNAP is to allow for the more commonplace usage of NEPP by giving users as much help in laying out an engine as possible. To use SNAP, the user works through a series of menu screens. From these menus, the user can input or modify the layout of an engine, add or delete components, modify the specifications of any component, draw the engine layout, check the flowpath logic, create a new NEPP input file, and finally execute NEPP using the newly created input file directly from the SNAP environment.

Program Description

The Input / Output Menu

The Input/Output menu screen, shown in Figure 1, appears upon entering the command *snap*. In this example, the user is presented with, in the VM naming convention, an input file called *TBE INPUT1 A*. This is the file the user last loaded: a turbine bypass engine. SNAP remembers past encounters with each user. This is intended to lessen the number of keystrokes required, presuming the user would most likely work on the same file during the course of a project. This file, if selected, may be the basis for the forthcoming session, which SNAP can modify according to the user's wishes. Appearing immediately below is the name *TBE INPUT2 A*, which is the file the user will presumably have SNAP create at the end of the session. Also appearing in this menu is a safety flag that will prevent the overwriting of *TBE INPUT2 A*, if a file of that name already exists.

Personal function keys now relay commands to the program. There are several possibilities:

-- To modify *TBE INPUT1 A* and create *TBE INPUT2 A*, press the *Proceed* function key 5. Other file names may be entered by overstriking the current names.
-- To configure a completely new engine, press the *Configure New Engine* function key 9. The input file name will be ignored.
-- To edit the input file, press the *Edit Old Input* function key 11.
-- To recover the results of the previous session, press the *Error Recovery* function key 10. This is useful if the user has unintentionally quit SNAP without saving any results and wishes to resume work on the engine at the point of exiting.

The Input/Output menu has error-trapping to guard against proceeding with non-existent files and writing to read-only disks. The output file name may be identical to the input file name. In this case, the file SNAP creates will replace the input file.

The Engine Configuration Menu

The Engine Configuration menu is illustrated in Figures 2 and 3. Shown in Figure 2 is the result of proceeding with our sample input turbine bypass engine, while shown in Figure 3 is the result if the user had chosen to configure a new engine (SNAP always begins the session with an inlet.). In the former case, SNAP has read the file that the user intends to modify (*TBE INPUT1 A*) and feeds the data into the menu for editing. The component names, numbers, and flow stations may be changed at this point. Undefined flow stations are marked by an asterisk. Paging must be used to view engine configurations larger than a single screen.

To add or delete a component, the user makes use of the command area on the left side of the menu. To add a component, the user must type *add* or *a* in the command region. A blank line is formed where data may be entered. Typing *del* or *d* in the command area deletes a component.

A block diagram of the currently configured engine may be obtained by pressing the *Draw Engine* function key 9. An auxiliary menu appears, as shown in Figure 4, where the diagram may be examined and printed, if desired.

To abandon any changes that may have been made to the engine, press the *Quit* function key 3. In the event this key is inadvertently pressed, a message will appear to warn the user of the impending exit. In addition, any system command may be entered in the command area at the bottom of the menu.

The Component Specification Menus

To modify the input specifications of any component, the cursor must be placed anywhere on the line in the Engine Configuration menu of the desired component and the *Select Item* function key 10 must be pressed. A customized menu for that component will appear. This menu lists all of the current inputs for this component and their corresponding definitions. The values of the inputs may be modified by either overstriking them with new values or by typing the specification number and its value in the area at the bottom of the menu. If one of the inputs does not evaluate to a number, an error message is posted and the field is highlighted until the error is corrected. If the component has just been created, SNAP will supply default input specifications for that component. These values may be changed if they do not suit the circumstances for the intended job. This helps eliminate errors caused by failing to set certain input triggers to non-zero values for the normal operation of NEPP. The changes to input specifications may either be saved or ignored upon leaving the component menu. All component menus are illustrated in Figures 5 through 21. Default values for all component specifications are shown.

The Dataset Creation Menu

Once satisfied with the engine configuration and component inputs, the user may proceed to the Dataset Creation menu by pressing the *Proceed* function key 5 in the Engine Configuration menu. Several options (see Figure 22) are available by typing the appropriate character.

Option *A*: Modify NEPP's global input. An auxiliary menu, shown in Figure 23, can change these data. This menu is operated in the same manner as the component specification menus.

Option *B*: Modify off-design cases. The user is sent to an editor containing all of the off-design cases that the original input file may have contained. From there, these off-design cases may be altered for later reattachment to the new input file.

Option *C*: Execute the flowpath logic checking routines. Another auxiliary menu appears (shown in Figure 24) which contains messages concerning the flowpath's viability. Any mistakes made during the engine configuring are flagged here.

Option *D*: Edit the new input dataset. Upon creation of the new input dataset (See options *F* and *G*), users may wish to examine or edit the product of their efforts. The new dataset must be created prior to exercising this option.

Option *E*: Run NEPP using the new dataset. When this option is selected, the NEPP execution menu appears, as shown in Figure 25. The input file used here is the file just created by SNAP while all other data concerning the run (i.e., performance maps, thermodynamic data, execution mode, and library object files) are those used during the previous NEPP run. The new dataset must be created prior to exercising this option.

Option *F*: Create the new dataset. This option instructs SNAP to collect all of the information the user provided in the Engine Configuration menu, the Component Specification menus, and the Global Input menu and to formulate the new NEPP input file. This file is identified by the name provided in the Input/Output menu.

Option *G*: Create the new dataset and attach off-design cases (Default). This option is the same as option *F* above, except that any off-design cases that may have been included in the original input file and modified via option *B* are appended to the new data file. This is the default option; if the user presses the *enter* key without specifying any input character, this option will be performed. Pressing the *Proceed* function key 5 also results in the execution of this option.

Two other options that are not listed in the menu text due to space limitations are also available. They are options *H* and *I*, which perform the same functions as *F* and *G*, respectively, except that a numerical format (rather than a character format) is used to specify the component names. This method is necessary to use the NAMELIST option on some compilers that do not recognize quoted or Hollerith strings in integer arrays.

The user may exit the SNAP environment by pressing the *Quit* function key 3; or, if the user is unhappy with the engine configuration SNAP has created, the *Previous Menu* function key 7 may be pressed. This sends the user back into the Engine Configuration menu where more modifications may be made.

To facilitate future maintenance of SNAP, flowcharts of the software are provided in Figures 26 through 30.

Concluding Remarks

The SNAP software is written to handle most problems frequently encountered by NEPP users. There are, however, several areas in which SNAP has limitations. SNAP cannot handle the complexities of a NEPP feature known as multi-mode engines. If a multi-mode engine is fed into SNAP, a warning message is displayed and the program is aborted. The SNAP software also may only be run on machines using the VM operating system. In addition, any off-design cases the user may wish to include are not "intelligently" modifiable; that is, the SNAP software cannot manipulate the component specification identifiers of the off-design data at the same level of sophistication as it can the design case data. Any modification to off-design data must be made at a rudimentary level through Option B in the Dataset Creation menu.

SNAP is intended to fill an intermediate software niche between its KONFIG and REKONFIG ancestors and a future full-function, Unix workstation, graphical user interface. This software, currently under development[8], takes advantage of the graphics quality and speed provided by these machines. Unlike SNAP, a menu-driven input preprocessor, it is an event-driven user interface. SNAP, however, is an effective and user-friendly input preprocessor and error-trapping device for NEPP that significantly improves upon its predecessors.

Acknowledgments

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References

1. Fishbach, L.H.; and Caddy, M.J.: *NNEP: The Navy/NASA Engine Program.* NASA TMX 71857, 1975.
2. Fishbach, L.H.; and Gordon, S.: *NNEPEQ: Chemical Version of the Navy/NASA Engine Program.* NASA TM 199851, 1988.
3. Plencner, R.M.; and Snyder, C.A.: *The Navy/NASA Engine Program (NNEP89) -- A User's Manual.* NASA TM 105186, 1991.
4. Fishbach, L.H.: *KONFIG and REKONFIG -- Two Interactive Preprocessing Programs to the Navy/NASA Engine Program (NNEP).* NASA TM 82636, 1981.
5. International Business Machines Corporation: *Virtual Machine/System Product: Introduction.* IBM Publication GC19-6200, 1984.
6. International Business Machines Corporation: *Virtual Machine/System Product: System Product Editor User's Guide.* IBM Publication SC24-5220, 1984.
7. International Business Machines Corporation: *Virtual Machine/System Product: System Product Interpreter User's Guide.* IBM Publication SC24-5238, 1984.
8. Curlett, B.P.; and Ryall, K.: *A Graphical User Interface for Engine Cycle Analysis.* NASA TM 105696, 1992.

```
----- NASA MACH 2.4 TURBINE BYPASS ENGINE:  TBE INPUT1 A-----
&D
NCOMP=10,NOSTAT=12,DRAW=T,NCODE=1,LONG=F,AMAC=F,MAPLOT=F,
ITERM=0,DOUTHD=F,MAXNIT=100,INST=0,AMINDS=2.4,ACAPT=24.00,
BOAT=F,SPILL=F, &END
&D MODE=1,
KONFIG(1,1)='INLT',1,0,2,0,SPEC(1,1)=4*0,2.4,.930,0,0,55000,0,0,
0,0,504,
KONFIG(1,2)='COMP',2,0,3,10,SPEC(1,2)=1.1674,.16,1,1703,1,1704,1,
1705,1,0,0,.8607,12.0,0.8114,
KONFIG(1,3)='DUCT',3,0,12,11,SPEC(1,3)=0,0,0,0,0,0,0,0,.000001,0,
KONFIG(1,4)='DUCT',12,0,4,13,SPEC(1,4)=0,0,0,0,0,0,0,0,.0035,0,
KONFIG(1,5)='DUCT',4,0,5,0,SPEC(1,5)=.05,.12,0,3360,1.00,18580,
0,0,0,.020,0,1,
KONFIG(1,6)='TURB',5,10,14,0,SPEC(1,6)=2,1,1,5112,1,5113,1,1,
.83,1,.92,100,1,
KONFIG(1,7)='DUCT',14,0,6,0,SPEC(1,7)=0,.40,0,0,0,0,0,1,0,0,
KONFIG(1,8)='DUCT',6,11,7,0,SPEC(1,8)=0,0,0,0,0,0,0,1,0,0,
KONFIG(1,9)='DUCT',7,0,8,0,SPEC(1,9)=.000,0,0,0,1,18400,
KONFIG(1,10)='NOZZ',8,0,9,0,SPEC(1,10)=0,1,0,0,.985,1,1,0,1,
KONFIG(1,11)='SHFT',2,6,12,0,SPEC(1,11)=1.0310,1,1,1,1,1,1,1,1,
KONFIG(1,12)='LOAD',SPEC(1,12)=-200,
KONFIG(1,13)='CNTL',SPCNTL(1,13)=1,2,'STAP',8,2,0,0,
KONFIG(1,14)='CNTL',SPCNTL(1,14)=1,6,'STAP',8,5,0,0,
KONFIG(1,15)='CNTL',SPCNTL(1,15)=1,11,'DOUT',8,11,0,0,
KONFIG(1,16)='CNTL',SPCNTL(1,16)=9,3,'DOUT',5,2,20,0,
KONFIG(1,17)='CNTL',SPCNTL(1,17)=4,5,'PERF',4,0,80000,0,100,3360,
KONFIG(1,18)='CNTL',SPCNTL(1,18)=9,3,'STAP',1,11,0.000001,0,
KONFIG(1,19)='CNTL',SPCNTL(1,19)=9,4,'STAP',1,13,1,1,
KONFIG(1,20)='CNTL',SPCNTL(1,20)=3,28,'DOUT',7,7,.500,0,
KONFIG(1,21)='CNTL',SPCNTL(1,21)=13,2,'STAP',3,3,1760.,1,
KONFIG(1,26)='SKED',7,7,7,0,SPEC(1,26)=1,1,1,1110,17,1,13,1,
KONFIG(1,27)='SKED',1,1,0,0,SPEC(1,27)=1,6,1,7070,25,1,
KONFIG(1,28)='SKED',1,1,0,0,SPEC(1,28)=1,14,1,7140,25,1,
KONFIG(1,29)='CNTL',SPCNTL(1,29)=1,2,'DOUT',5,2,20.,1,
KONFIG(1,30)='CNTL',SPCNTL(1,30)=8,10,'DOUT',4,10,1300,0,
&END
```

Table 1: Sample NEPP Input File

```
snap
------------------------- SNAP Execution Menu --------------------------

          Simplified NEPP Automated Preprocessor  (Version 2.0)

Purpose:

     This program will reconfigure an existing NEPP input dataset or configure
     a new input dataset according to user specifications.  All data are taken
     from the following series of menus.

File Information:

Input >  Filename: TBE        Filetype: INPUT1       Filemode: A
Output>  Filename: TBE        Filetype: INPUT2       Filemode: A

Overwrite Previous Output? (Y/N): Y

PF KEYS:  1= Help (SNAP)           3= Quit SNAP          5= Proceed
          9= Configure New Engine  10= Error Recovery    11= Edit Old Input
```

Figure 1: Input/Output Menu

snap

NEPP Engine Configuration
File: TBE INPUT1 A

Add/ Del	Component Number	Component Name	Upstream Flowstation (Primary)	Upstream Flowstation (Secondary)	Downstream Flowstation (Primary)	Downstream Flowstation (Secondary)
=====	1	INLT	1	**	2	**
=====	2	COMP	2	**	3	10
=====	3	DUCT	3	**	12	11
=====	4	DUCT	12	**	4	13
=====	5	DUCT	4	**	5	**
=====	6	TURB	5	10	14	**
=====	7	DUCT	14	**	6	**
=====	8	DUCT	6	11	7	**
=====	9	DUCT	7	**	8	**
=====	10	NOZZ	8	**	9	**
=====	11	SHFT	2	6	12	**
=====	12	LOAD	**	**	**	**
=====	13	CNTL	**	**	**	**
=====	14	CNTL	**	**	**	**

PFKEYS: 1= Help 2= Update 3= Quit (No Changes) 4= Tab 5= Proceed (Update)
6= Auto Controls 7= Backward 8= Forward 9= Draw Engine 10= Select Item
====>

SNAP Engine Layout Menu

Figure 2: Engine Configuration Menu for an Existing Engine

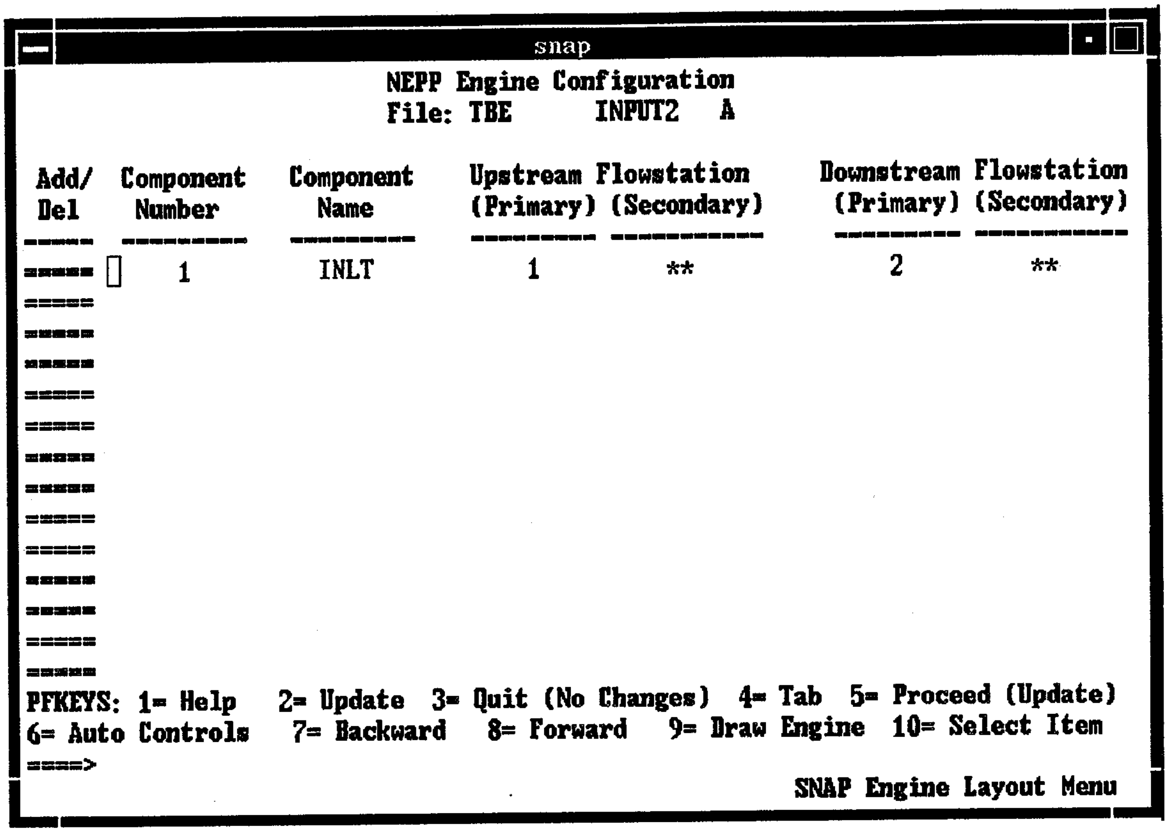

Figure 3: Engine Configuration Menu for a New Engine

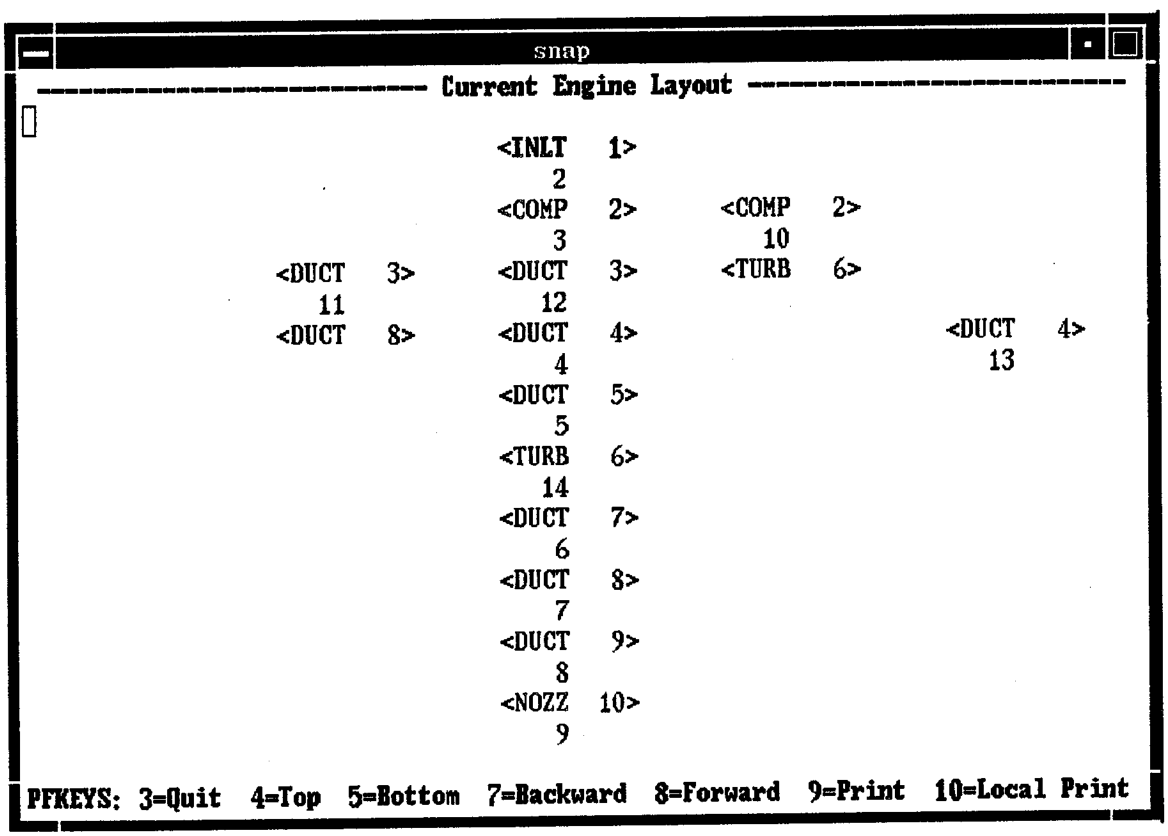

Figure 4: Engine Diagram Screen

------------------------ INLET Reconfiguration Menu ------------------------

Spec	Value	Specification Description
1	100.0000000	Inlet Airflow (lb/s)
2	0.000000000	Freestream Static Temperature (R) (Used if Spec 9 < 0)
3	0.000000000	Freestream Static Pressure (psia) (Used if Spec 9 < 0)
4	0.000000000	Inlet Drag Table Number (if blank, drag is computed)
5	0.000000000	Inlet Mach Number
6	0.950000000	Inlet Recovery or Table Number (if zero, Mil Spec is used)
7	0.000000000	Maximum Flow Allowed in Recovery Table (If Spec 6 is used)
8	0.000000000	Scale Factor on Recovery Table Flow (If Spec 6 is used)
9	0.000000000	Geometric Altitude (ft) (Used if Spec 2 and Spec 3 are 0)
10	0.000000000	Undefined
11	0.000000000	If Spec 11 is Non-Zero, Spec 9 is Geopotential Altitude
12	0.000000000	Temperature to be Added to That of Standard Atmosphere (R)
13	0.000000000	Undefined
14	0.000000000	Corrected Flow at Inlet Exit (Overrides Spec 1 and Spec 15)
15	0.000000000	Corrected Flow at Inlet Entrance (Overrides Spec 1)

Spec Number: [ ]   Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help   3=Quit (No Changes to INLT)   5=Proceed (Update INLT)

Figure 5: Inlet Reconfiguration Menu

snap

------------------------ DUCT Reconfiguration Menu ------------------------

Spec	Value	Specification Description
1	0.000000000	Total Pressure Drop (Delta P over P) or Table Number
2	0.000000000	Design Mach Number (Optional. If input, Spec 7 calculated)
3	0.000000000	Additional Pressure Drop Over Burner Referred Flow Squared
4	0.000000000	If Burner, Exit Temp (R); if Duct, Blank; if Negative, f/a
5	0.000000000	Burner Efficiency or Table Number; if Duct, blank
6	0.000000000	Fuel Heating Value (BTU/lb) or Table Number; if Duct, Blank
7	0.000000000	Cross Sectional Area of Duct or Burner (in2)
8	0.000000000	Entrance Bleed Flow to Total Flow Ratio (Duct only)
9	0.000000000	Exit Bleed Flow to Total Flow Ratio
10	0.000000000	Fraction of Air not Heated
11	0.000000000	(For ICEC=1) If 0, Find Lean f/a; if 1, Stoich; if 2, Rich
12	0.000000000	If 1, Calculate Emissions Index
13	0.000000000	If > 0, Set Spec 4 to TJM1+1 if Spec 4 < TJM1
14	0.000000000	Undefined
15	0.000000000	Undefined

Spec Number: [ ]   Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help   3=Quit (No Changes to DUCT)   5=Proceed (Update DUCT)

Figure 6: Duct Reconfiguration Menu

snap

------------------ WATER INJECTOR Reconfiguration Menu ----------------------

Spec	Value	Specification Description
1	0.000000000	Water to Air Mass Flow Ratio
2	0.800000000	Fraction of Water Vaporized
3	0.000000000	Total Pressure Drop (Delta P Over P)
4	1.000000000	Saturation Switch (If zero, use Spec 1; if 1, saturated)
5	0.000000000	Undefined
6	0.000000000	Undefined
7	0.000000000	Undefined
8	0.000000000	Undefined
9	0.000000000	Undefined
10	0.000000000	Undefined
11	0.000000000	Undefined
12	0.000000000	Undefined
13	0.000000000	Undefined
14	0.000000000	Undefined
15	0.000000000	Undefined

Spec Number: [ ]   Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help   3=Quit (No Changes to WINJ)   5=Proceed (Update WINJ)

Figure 7: Water Injector Reconfiguration Menu

snap

----------------- GAS GENERATOR Reconfiguration Menu ----------------------

Spec	Value	Specification Description
1	1800.000000	Exit Temperature (R)
2	1.000000000	Fuel/Oxidant Mass Ratio (Default 0.3)
3	588.0000000	Generator Pressure (psia)
4	5.000000000	Fuel Flow Rate (lb/s) (If used, define Spec 1 or 2)
5	0.000000000	Oxidant Flow Rate (lb/s) (If used, define Spec 1, 2 or 4)
6	0.000000000	Fraction of Fuel not Included in SFC Calculations
7	0.000000000	Fraction of Oxidant not Included in SFC Calculations
8	0.000000000	Undefined
9	0.000000000	Undefined
10	0.000000000	Undefined
11	0.000000000	Undefined
12	0.000000000	Undefined
13	0.000000000	Undefined
14	0.000000000	Undefined
15	0.000000000	Undefined

Spec Number: [ ]   Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help   3=Quit (No Changes to GASG)   5=Proceed (Update GASG)

Figure 8: Gas Generator Reconfiguration Menu

COMPRESSOR Reconfiguration Menu

Spec	Value	Specification Description
1	1.300000000	R Value Used to Read Tables
2	0.000000000	Compressor Bleed Flow to Total Flow Ratio
3	1.000000000	Scale Factor on Corrected Speed
4	1004.000000	Corrected Weight Flow or Table Number
5	1.000000000	Scale Factor on Corrected Weight Flow
6	1005.000000	Compressor Adiabatic Efficiency or Table Number
7	1.000000000	Scale Factor on Adiabatic Efficiency
8	1006.000000	Compressor Pressure Ratio or Table Number
9	1.000000000	Scale Factor on Pressure Ratio
10	0.000000000	Third Dimensional Argument Value on Map
11	0.000000000	Fractional Bleed Horsepower Loss Due to Interstage Bleed
12	0.850000000	Desired Adiabatic Efficiency at Design Point
13	5.000000000	Desired Pressure Ratio at Design R and Corrected Speed
14	0.985000000	Corrected Speed for Design Point on Maps
15	0.000000000	Undefined

Spec Number: [ ] Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help 3=Quit (No Changes to COMP) 5=Proceed (Update COMP)

Figure 9: Compressor Reconfiguration Menu

snap

TURBINE Reconfiguration Menu

Spec	Value	Specification Description
1	3.500000000	Pressure Ratio at Design Point on Maps
2	0.000000000	Total Bleed In to Total Bleed Available Ratio
3	1.000000000	Scale Factor on Corrected Speed
4	1007.000000	Corrected Weight Flow or Table Number
5	1.000000000	Scale Factor on Corrected Weight Flow
6	1008.000000	Turbine Adiabatic Efficiency or Table Number
7	1.000000000	Scale Factor on Adiabatic Efficiency
8	1.000000000	Scale Factor on Pressure Ratio
9	0.000000000	Turbine Entrance Bleed Flow to Total Bleed Flow Ratio
10	1.000000000	Third Dimensional Argument Value on Map
11	0.900000000	Desired Adiabatic Efficiency at Design Point
12	5000.000000	Corrected Speed at Design Point on Map
13	1.000000000	Turbine Horsepower Split
14	0.000000000	(For CALBLD=T) Factor for Cooling Type per NASA TM 81453
15	0.000000000	(For CALBLD=T) Number of Turbine Stages

Spec Number: [ ] Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help 3=Quit (No Changes to TURB) 5=Proceed (Update TURB)

Figure 10: Turbine Reconfiguration Menu

snap

------------------ HEAT EXCHANGER Reconfiguration Menu ----------------------

Spec	Value	Specification Description
1	0.000000000	Main Total Pressure Drop (Delta P over P) or Table Number
2	0.000000000	Secondary Total Pressure Drop (Delta P over P) or Table
3	100.0000000	Guess Value Temperature Rise (R)
4	0.700000000	Effectiveness or Table Number
5	1.000000000	Scale Factor on Effectiveness
6	0.000000000	Undefined
7	0.000000000	Undefined
8	0.000000000	Undefined
9	0.000000000	Undefined
10	0.000000000	Undefined
11	0.000000000	Undefined
12	0.000000000	Undefined
13	0.000000000	Undefined
14	0.000000000	Undefined
15	0.000000000	Undefined

Spec Number: [ ]   Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help   3=Quit (No Changes to HTEX)   5=Proceed (Update HTEX)

Figure 11: Heat Exchanger Reconfiguration Menu

snap

-------------------- SPLITTER Reconfiguration Menu -----------------------

Spec	Value	Specification Description
1	2.000000000	Bypass Ratio
2	0.000000000	Main Stream Total Pressure Drop (Delta P over P)
3	0.000000000	Secondary Stream Total Pressure Drop (Delta P over P)
4	0.000000000	Undefined
5	0.000000000	Undefined
6	0.000000000	Undefined
7	0.000000000	Undefined
8	0.000000000	Undefined
9	0.000000000	Undefined
10	0.000000000	Undefined
11	0.000000000	Undefined
12	0.000000000	Undefined
13	0.000000000	Undefined
14	0.000000000	Undefined
15	0.000000000	Undefined

Spec Number: [ ]   Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help   3=Quit (No Changes to SPLT)   5=Proceed (Update SPLT)

Figure 12: Splitter Reconfiguration Menu

snap

MIXER Reconfiguration Menu

Spec	Value	Specification Description
1	0.000000000	Main Flow Inlet Area Calculated at Design Point (ft2)
2	0.000000000	Secondary Flow Inlet Area Calculated at Design Point (ft2)
3	0.300000000	If > 1, Total to Static Pressure Ratio; If < 1, Design Mach
4	0.950000000	Momentum Coefficient for Mixer Exit Stream
5	1.000000000	If 1, Total Inlet Area Fixed; If 0, Independent Areas
6	0.000000000	If 1, Spec 3 is Min PR or Min Mach Number of Either Stream
7	0.000000000	If 0, Subsonic Mixer; If 1, Supersonic Mixer; If 2, Ejector
8	0.000000000	If 0, Subsonic Solution; If 1, Supersonic Solution
9	0.000000000	If Spec 7 > 0, Design Ejector Primary Mach Number
10	0.000000000	Mixer Area Ratio
11	0.000000000	Injection Angle (Deg)
12	0.000000000	Factor Used to Check for Overexpansion of Ejector
13	0.000000000	Momentum Coefficient of JM1 Stream
14	0.000000000	Momentum Coefficient of JM2 Stream
15	0.000000000	Undefined

Spec Number: [ ] Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help 3=Quit (No Changes to MIXR) 5=Proceed (Update MIXR)

Figure 13: Mixer Reconfiguration Menu

snap

NOZZLE Reconfiguration Menu

Spec	Value	Specification Description
1	0.000000000	Flow Area (in2); Exit for Convergent, Throat for C-D
2	1.000000000	Flow Discharge Coefficient or Table Number
3	0.000000000	Exit Static Pressure (psia) (if Different Than Ambient)
4	0.000000000	Ambient Static Pressure (psia) (If zero see Spec 9)
5	0.990000000	Velocity Coefficient or Table Number
6	0.000000000	Nozzle Switch: if 0, Convergent; if 1, 2, 3; C-D
7	1.000000000	Area Switch: if 0, Fix Throat; if 1, Vary to Match Flow
8	0.000000000	Exit to Throat Area Ratio (for Type 3 Nozzles)
9	1.000000000	If Spec 4 is Zero, Set Spec 9 to Inlet Component Number
10	0.000000000	Divergence Half Angle (Deg) (For Divergence Calculations)
11	0.000000000	Divergent Axial Length (in) (For Divergence Calculations)
12	0.000000000	Nozzle Switch for Divergence Calculations (See Manual)
13	0.000000000	Undefined
14	0.000000000	Undefined
15	0.000000000	Undefined

Spec Number: [ ] Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help 3=Quit (No Changes to NOZZ) 5=Proceed (Update NOZZ)

Figure 14: Nozzle Reconfiguration Menu

snap

LOAD Reconfiguration Menu

Spec	Value	Specification Description
1	0.000000000	Load Horsepower (Negative) or Table Number
2	0.000000000	Propeller Eff or tab. ref. no. (If no propeller, enter 0)
3	0.000000000	Thrust to Specific Horsepower Ratio (Sea Level Static)
4	0.000000000	Design point power loading (SHP/D*D)
5	0.000000000	Design point tip speed, ft/s
6	0.000000000	Undefined
7	0.000000000	Undefined
8	0.000000000	Scaling factor on thrust and efficiency
9	0.000000000	Desired design point propeller efficiency
10	0.000000000	Undefined
11	0.000000000	Undefined
12	0.000000000	Undefined
13	0.000000000	Undefined
14	0.000000000	Undefined
15	0.000000000	Undefined

Spec Number: [ ]   Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help   3=Quit (No Changes to LOAD)   5=Proceed (Update LOAD)

Figure 15: Load Reconfiguration Menu

snap

SHAFT Reconfiguration Menu

Spec	Value	Specification Description
1	1000.000000	Actual Shaft RPM
2	1.000000000	Gear Ratio to First Attachment (Component RPM/Shaft RPM)
3	1.000000000	Gear Ratio to Second Attachment (Component RPM/Shaft RPM)
4	1.000000000	Gear Ratio to Third Attachment (Component RPM/Shaft RPM)
5	1.000000000	Gear Ratio to Fourth Attachment (Component RPM/Shaft RPM)
6	1.000000000	Mechanical Efficiency of First Attachment (HP/Ideal HP)
7	1.000000000	Mechanical Efficiency of Second Attachment (HP/Ideal HP)
8	1.000000000	Mechanical Efficiency of Third Attachment (HP/Ideal HP)
9	1.000000000	Mechanical Efficiency of Fourth Attachment (HP/Ideal HP)
10	0.000000000	Undefined
11	0.000000000	Undefined
12	0.000000000	Undefined
13	0.000000000	Undefined
14	0.000000000	Undefined
15	0.000000000	Undefined

Spec Number: [ ]   Spec Value:

Usage Note: Enter new values above or overstrike values in the second column.
PF KEYS: 1=Help   3=Quit (No Changes to SHFT)   5=Proceed (Update SHFT)

Figure 16: Shaft Reconfiguration Menu

```
snap
---------------------- CONTROL Reconfiguration Menu ----------------------

Vary Airflow of INLT 1 so that Net Thrust  equals 20000.00000
---------------------------------------------------------------------------
Component to be varied is:  1          Dependent variable type is PERF
Independent variable is:    1
Minimum allowable value:               Perf. property sought is:  4
Maximum allowable value:               Desired value is:    20000.00000
                                       Control is: OFF Tolerance= 0

Independent Variables (SPECs)          Dependent variables (PERFs)
-----------------------------          ---------------------------
1  Airflow          10 Fuel/Air         1 Total Airflow    10 Installed TSFC
2  Total Temp       11 ******           2 Gross Thrust     11 Inlet Drag
3  Total Press      12 Delta Temp       3 Fuel Flow        12 Boattail Drag
4  Drag Table       13 ******           4 Net Thrust       13 ******
5  Mach Number      14 Exit Corr Flo    5 TSFC             14 ******
6  Recovery         15 Ent Corr Flow    6 Fnet/Airflow     15 Cooling SPEC
7  Max Table Flow                       7 Inlet Drag
8  Scale Factor                         8 Total SHP
9  Altitude                             9 Installed Fnet

PF KEYS:  1=Help      3=Quit (No Changes to CNTL)      5=Proceed (Update CNTL)
```

Figure 17: Control Reconfiguration Menu

```
snap
---------------- OPTIMAL VARIABLE Reconfiguration Menu -------------------

NC      2          Number of Component Having Independent Variable
TOLOPT 0.0002000   Criteria of Convergence on Dependent Variable
NJOPT  0.0000000   Component Number Containing the Dependent Variable
NVOPT  0.0000000   For NJOPT=0--PERF PROPTY which is Depend. Var.>0Min,<0Max
                   For NJOPT>0--No. of DATOUT for NJOPT Indic Dependent Var.

Spec     Value            Specification Description
----     -----            -------------------------
 1   0.000000000   Blank
 2   0.000000000   Minimum Allowable Value of the Variable
 3   0.000000000   Maximum Allowable Value of the Variable
 4   0.000000000   SPEC of Component NC which is the Independent Variable
 5   0.000000000   Blank
 6   0.000000000   Blank
 7   0.000000000   Blank
 8   0.000000000   Blank
 9   0.000000000   Switch to Turn ON (=1) or OFF (=0) this Variable

                   Spec Number: [ ]    Spec Value:

Usage Note:  Enter new values above or overstrike values in the second column.
PF KEYS:  1=Help      3=Quit (No Changes to OPTV)      5=Proceed (Update OPTV)
```

Figure 18: Optimal Variable Reconfiguration Menu

```
                                  snap
 ---------------- LIMITING VARIABLE Reconfiguration Menu -----------------

 Spec     Value             Specification Description
 ----     -----             -------------------------
  1   0.000000000   Blank
  2   0.000000000   Minimum allowable value
  3   0.000000000   Maximum allowable value
  4   STAP          DOUT or STAP or PERF
  5   1.000000000   The number of the desired DOUT, STAP, or PERF
  6   1.000000000   Component Number or Station Number or Blank
  7   0.000000000   Blank
  8   0.000000000   Blank
  9   0.000000000   Switch to turn ON (=1) or OFF (=0) this limit
 10   0.000000000   Blank
 11   0.000000000   Blank
 12   0.000000000   Blank
 13   0.000000000   Blank
 14   0.000000000   Blank
 15   0.000000000   Blank

                    Spec Number: []    Spec Value:

 Usage Note:  Enter new values above or overstrike values in the second column.
 PF KEYS:  1=Help      3=Quit (No Changes to LIMV)      5=Proceed (Update LIMV)
```

Figure 19: Limiting Variable Reconfiguration Menu

```
                                  snap
 --------------------- SCHEDULE Reconfiguration Menu ---------------------

  NC  1     Component Number with dependent (scheduled) variable
  V1  **    Flow Station or Component Number containing X on the Map
  V2  2     Flow Station or Component Number containing Y on the Map
  V3  **    Flow Station or Component Number containing Z on the Map

 Spec     Value             Specification Description
 ----     -----             -------------------------
  1   0.000000000   0=OFF,  1=ON
  2   0.000000000   Dependent variable (SPEC number of NC)
  3   1.000000000   Scale factor on dependent value (FXYZ)
  4   0.000000000   Table (MAP) number containing FXYZ = f(X, Y, Z)
  5   0.000000000   Definition of X variable (1-8,STAP 11-19,DOUT 21-35,SPEC)
  6   1.000000000   Scale factor on Spec 5
  7   0.000000000   Definition of Y variable on Map
  8   1.000000000   Scale factor on Spec 7
  9   0.000000000   Definition of Z variable on Map
 10   1.000000000   Scale factor on Spec 9

                    Spec Number: []    Spec Value:

 Usage Note:  Enter new values above or overstrike values in the second column.
 PF KEYS:  1=Help      3=Quit (No Changes to SKED)      5=Proceed (Update SKED)
```

Figure 20: Schedule Reconfiguration Menu

```
                                    snap
 --------------- CONDITIONAL CONTROL Reconfiguration Menu ----------------

Activate CNTL 1 when Weight Flow of flow station 1 exceeds 100  --ON--
 --------------------------------------------------------------------------
 Trigger Variable Type is     STAP     CNTL Number to be controlled      1
 Station Property Number is   1        Desired TOL on above CNTL  1
 Flow station is              1
 Trigger value is             100      0=Control is off
                                       1=on when > than trigger value
                                      -1=on when < than trigger value    1
   Trigger Variables (STAPs)
 --------------------------------      0=Do not rest CNTL to original state
 1  Weight Flow                        1=Reset CNTL to original state    0
 2  P Total
 3  T Total                            0=Change CNTL setting only once
 4  f/a                                1=Vary CNTL setting freely        0
 5  Corr Airflow
 6  Mach Number                        0=Do not reset CNTL indep variable
 7  P Static                           1=Reset CNTL independent variable 0
 8  Flow Error
 9  ******

PF KEYS:  1=Help     3=Quit (No Changes to VCNT)     5=Proceed (Update VCNT)
```

Figure 21: Conditional Control Reconfiguration Menu

```
                                    snap
 ---------------------- New Dataset Creation Menu ------------------------

                                  Options
                                  -------

                A       Modify Preliminary Namelist Input
                B       Modify Off-Design Cases (if any)
                C       Verify Flowpath Logic
                D       Edit Your New Dataset
                E       Run NEPP Using New Dataset
                F       Create the New Dataset
                G       Create the New Dataset
                        and Attach any Off-Design Cases (Default)




                        Select Option ==> []

PF KEYS:    1=Help     3=Quit SNAP     5=Proceed     7=Previous menu
```

Figure 22: NEPP Input File Creation Menu

snap

NEPP Global Namelist Input

Value	Name	Default	Value	Name	Default	Value	Name	Default
0	ACAPT	0	**0**	IWT	0	**F**	SPILL	F
0	ACTL	0	**F**	LABEL	F	**0**	SPLDES	0
F	AMAC	F	**T**	LONG	T	**T**	TABLES	T
2.7	AMINDS	2.7	**F**	MAPLOT	F	**530**	TFUEL	530
F	BOAT	F	**50**	MAXNIT	50	**.0002**	TOLOPT	.0002
F	CALBLD	F	**1**	MODESN	1	**1985**	YEARB	1985
0	DEBUG	0	**1**	NCASE	1	**1985**	YEARV	1985
F	DOUTHD	F	**1**	NCODE	1			
F	DRAW	F	**F**	NEWEFF	F			
10000	ELIFE	10000	**0**	NJOPT	0			
0	ENDIT	0	**1**	NMODES	1			
0	ICEC	0	**20**	NUMLIN	20			
F	INLTDS	F	**0**	NVOPT	0			
0	INST	0	**T**	PINPUT	T			
0	ITERM	0	**F**	PLOT	F			
0	ITPRT	0	**T**	PUNT	T			
1	IWAY	1	**1**	SIZINL	1			

Usage Note: Overstrike existing values with your selections.
PF KEYS: 1=Help 3=Quit (No Changes) 5=Proceed (Update)

Figure 23: Global Input Menu

snap

Flowpath Check Messagage Screen

FLOWPATH LOGIC CHECKING MESSAGES:
(IF NO MESSAGES APPEAR BELOW, FLOWPATH IS CORRECT)

PFKEYS: 3=Quit 4=Top 5=Bottom 7=Backward 8=Forward 9=Print 10=Local Print

Figure 24: Flowpath Logic Check Screen

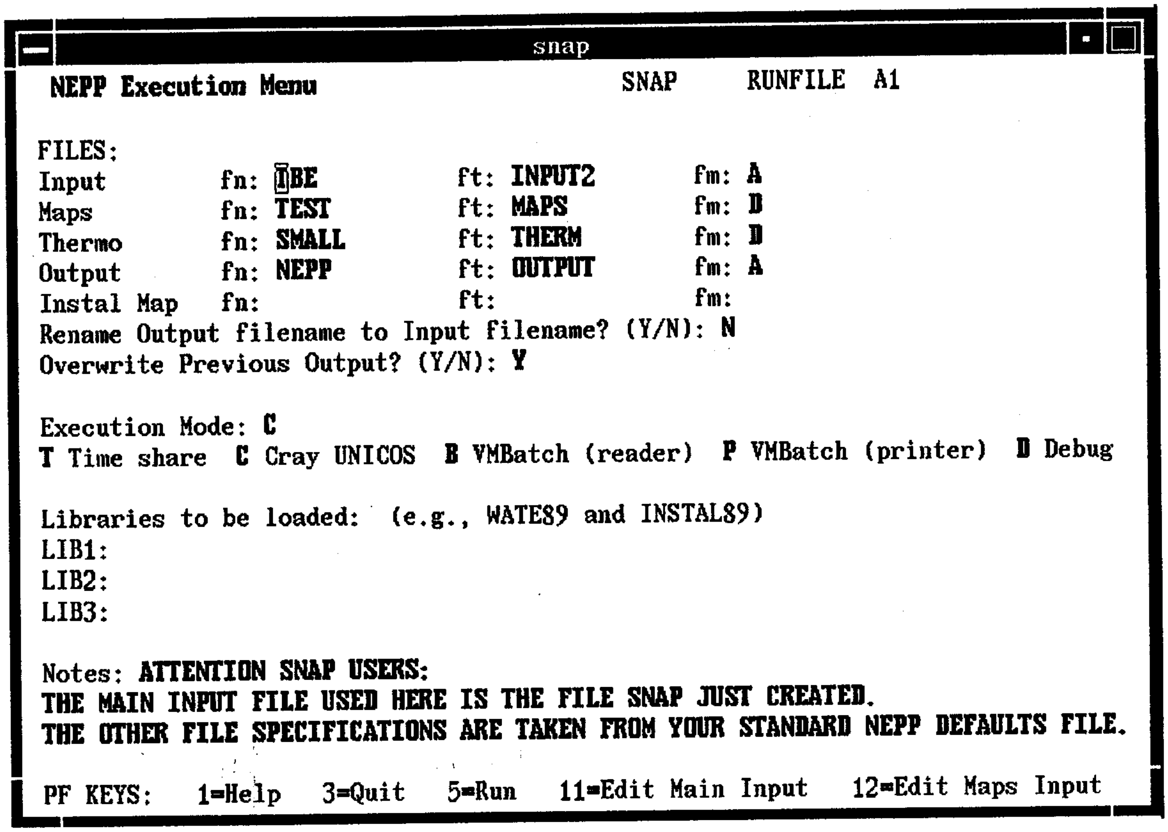

Figure 25: NEPP Execution Menu

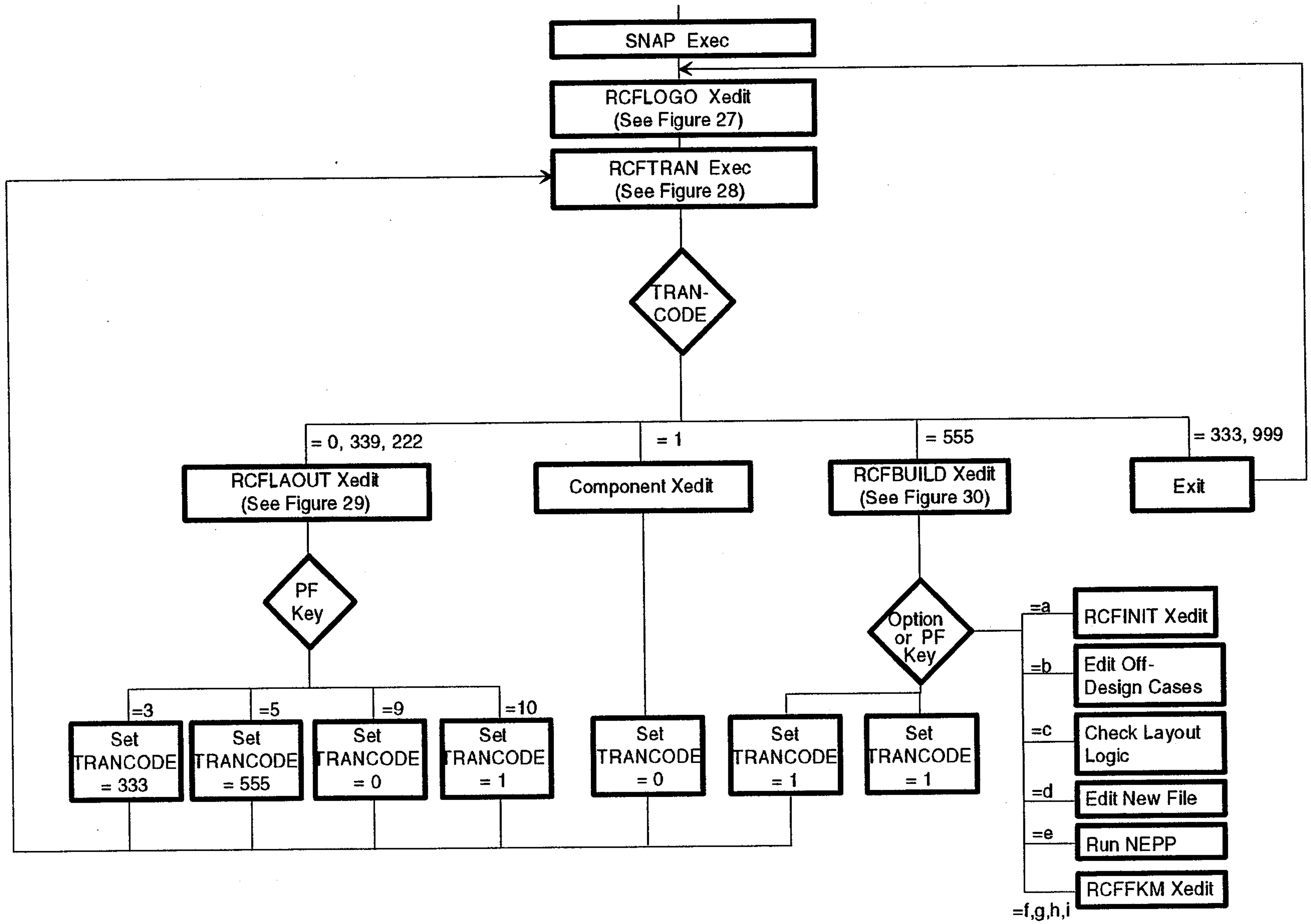

Figure 26: Overall System Flowchart

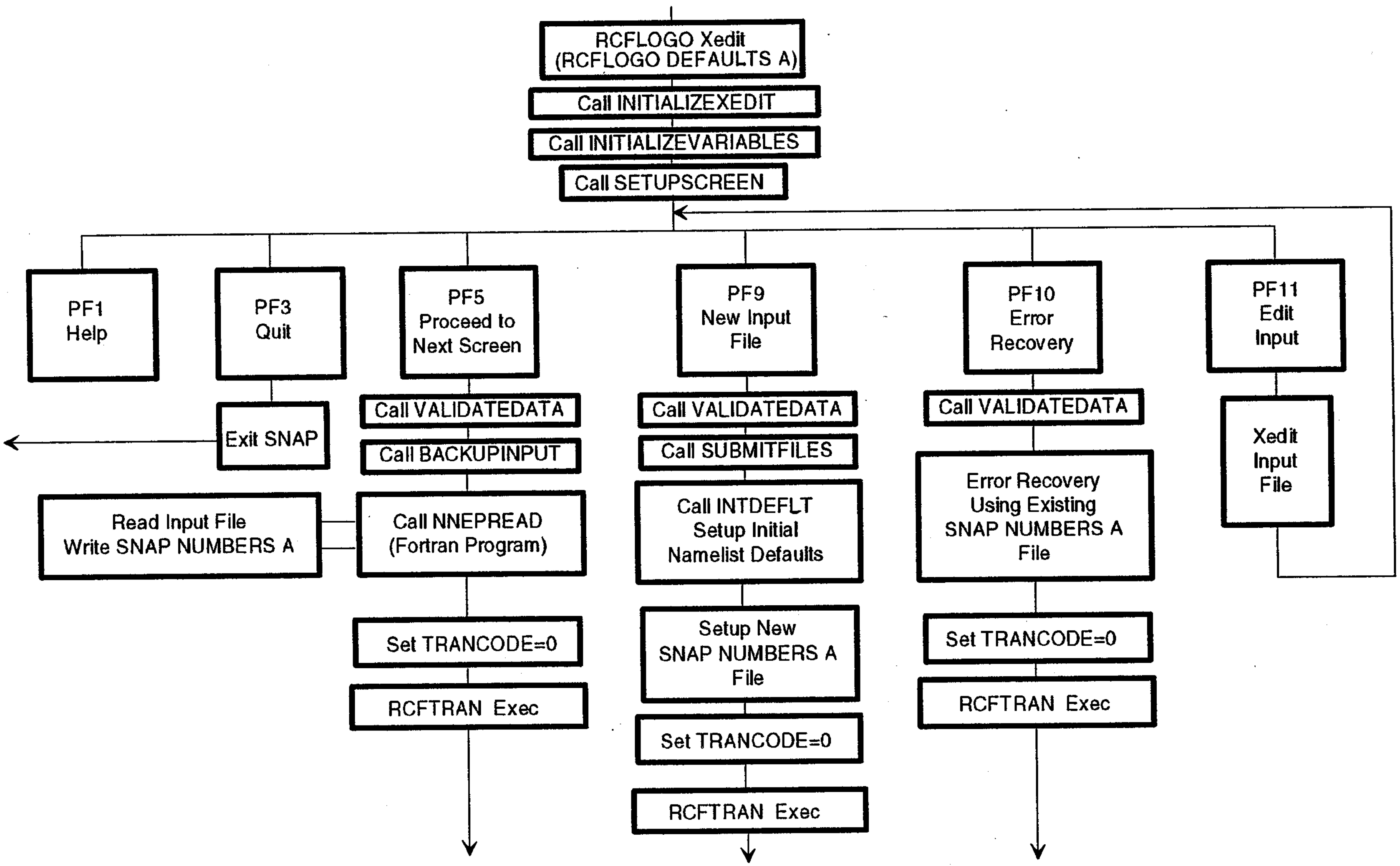

Figure 27: Input/Output Menu Flowchart

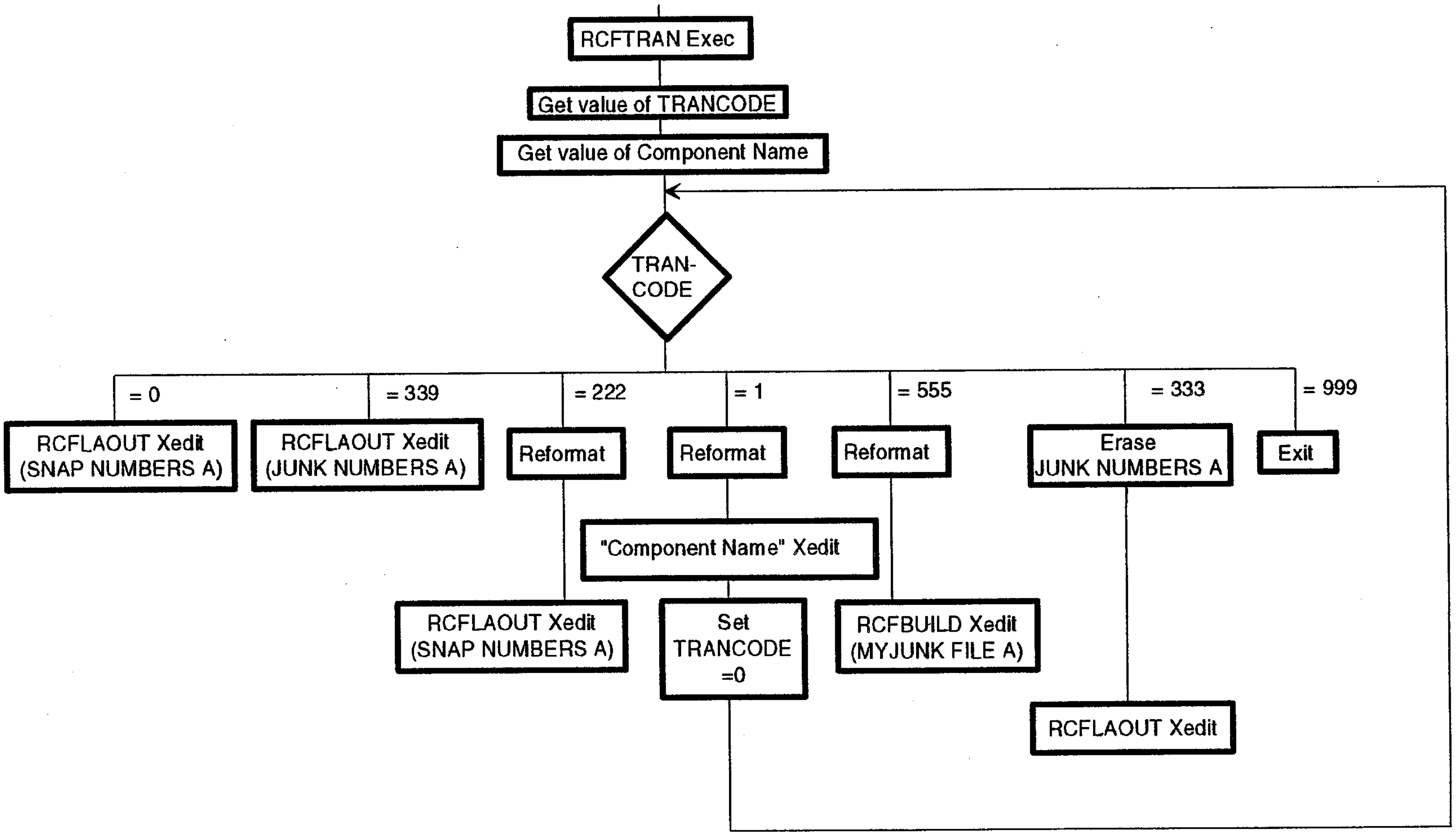

Figure 28: Component Menu Transfer Utility Flowchart

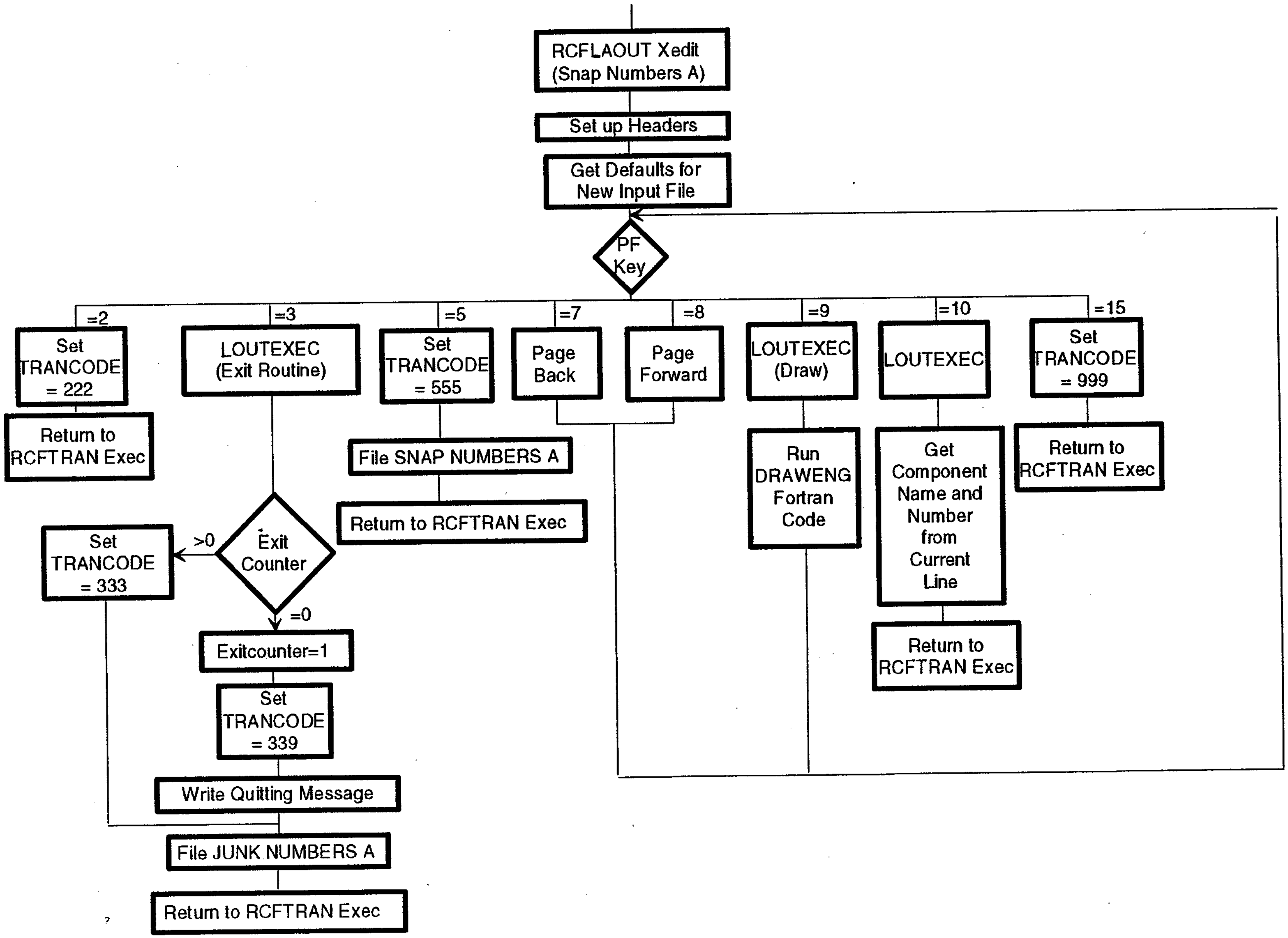

Figure 29: Engine Configuration Menu Flowchart

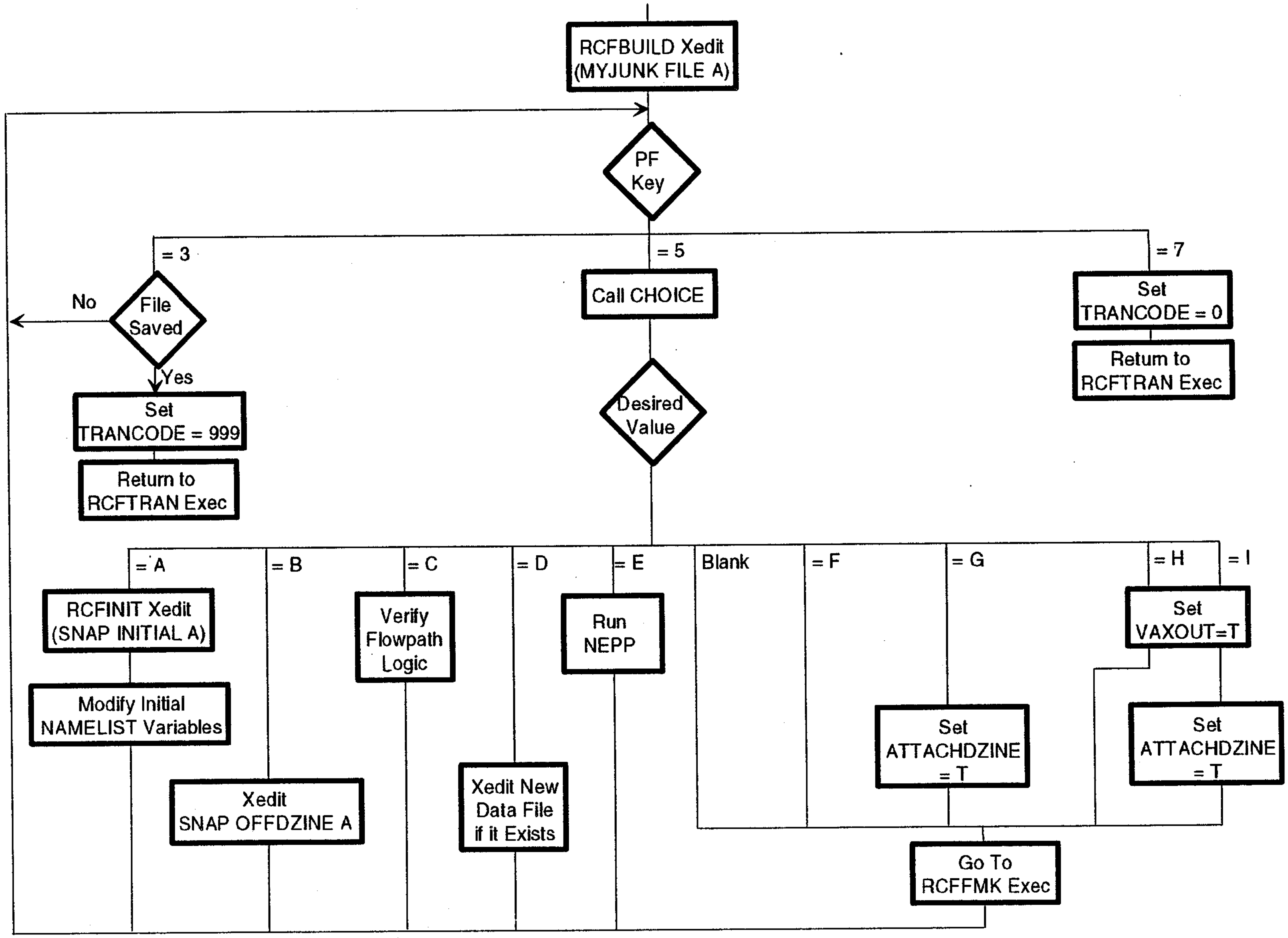

Figure 30: Dataset Creation Menu Flowchart

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13. ABSTRACT ***(Maximum 200 words)***

This report describes the Simplified NEPP Automated Preprocessor (SNAP), which is written to aid in the preparation of input data files for the NASA Engine Performance Program (NEPP). Specifically, SNAP is a software package on the Virtual Machine operating system that prompts the NEPP user for input information via a series of menus. The data collected from these menus are assimilated into an input file suitable for the running of NEPP. SNAP acts as a user-friendly preprocessing interface for NEPP. This report serves as an introduction to the SNAP software, a user's manual, a description of the program logic, and a maintenance manual for future modifications to the software.

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