RETRAN-02 INSTALLATION AND VERIFICATION FOR THE CRAY COMPUTER

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1.0 INTRODUCTION

The RETRAN-02 transient thermal-hydraulic analysis program[1] developed by the Electric Power Research Institute (EPRI) has been selected as a tool for use in assessing the operation and safety of the SP-100 space reactor system being developed at Los Alamos National Laboratory (LANL). The released versions of RETRAN-02 are not operational on CRAY computer systems which are the primary mainframes in use at LANL requiring that the code be converted to the CRAY system. This document describes the code conversion, installation, and validation of the RETRAN-02/MOD004 code on the LANL CRAY computer system.

The work was performed in accordance with CSA's Quality Assurance Program as implemented in the Project Requirements Document (PRD) LANL-PRD-001.[2] The PRD required that the work be based on a QA controlled version of the RETRAN-02 code. CSA started the code conversion task using the CDC version of RETRAN-02/MOD004 provided by LANL for this work. LANL obtained the code from the Electric Power Software Center (EPSC) which maintained it under a quality assurance program. The code was received by LANL on a transmittal tape and unloaded to disk files by LANL. The CDC binary program libraries from the transmittal tape were converted by LANL to ASCII source files which were used to generate UPDATE[3] program libraries for the CRAY version. All revisions to the program source are maintained as correction identifiers in the new program library files stored in the LANL CFS file system.[4]

All work on code conversion and installation was done on the LANL CRAY-XMP computers using the CTSS operating system.[4] Installing RETRAN-02 on the LANL CRAY computing system required effort in three task areas, i.e.,

- I. The RETRAN-02/MOD004 code includes a library of routines to extend FORTRAN capability and enhance portability among computer systems. This library required conversion to CRAY FORTRAN-77 and involved converting the assembly language routines to FORTRAN-77 equivalent routines, modifying differences in syntax between CDC and CRAY FORTRAN-77 in the FORTRAN routines, and making the modifications

required because of differences in the machine architecture and operating systems.

- II. Converting the RETRAN-02/MOD004 program source to CRAY FORTRAN-77. This involved the elimination of coding associated with CDC specific user features that are not supported by CRAY FORTRAN-77 and making modifications that are required because of differences in the machine architecture and operating systems.
- III. Installing and testing RETRAN-02/MOD004 on the LANL CRAY-XMP computer. This task combined the results from Tasks I and II to produce an executable code. Program execution procedures were developed for installing the environmental library and the RETRAN-02 code. Procedures were also developed for executing RETRAN-02 in each mode (initial run, restart, reedit, and plotting). The standard set of sample problems, restart cases, reedit cases, and plot cases were run and evaluated to verify that the code had been satisfactorily installed on the CRAY system.

A summary of the code installation and verification tasks is given in Section 2.0, the detailed changes to the environmental library and RETRAN-02 source are described in Sections 3.0 and 4.0 respectively, the CRAY procedures are described and listed in Section 5.0, changes to the RETRAN-02 input data are listed in Section 6.0, and the validation cases with results are described in Section 7.0. Comparison plots of the CDC data from the transmittal tape and results from the CRAY code version are shown in Appendix A. The updates to the environmental library source are listed in Appendix B and the updates to the RETRAN-02 source are listed in Appendix C.

2.0 SUMMARY

Several operations in the CDC version of RETRAN-02/MOD004 are carried out with the aid of assembly language coding either for efficiency or to provide user interface features not generally available through FORTRAN. Those functions which are supported by the CRAY FORTRAN-77 language were retained and those not supported were deleted. The assembly language routines were replaced with CRAY FORTRAN-77 versions. The user interface functions eliminated are listed below:

- (1) dynamic field length adjustment at the time of job execution,
- (2) monitoring the remaining CPU job time and terminating the job before the allotted CPU time is reached,
- (3) requesting the restart tape dataset name and volume serial number through data supplied as part of a RETRAN-02 input dataset,
- (4) displaying the restart tape dataset name and volume serial number in the program major edit output print file, and
- (5) making each volume of a multiple volume restart dataset an independent dataset for restarting (this feature was not supported for IBM installations).

No models or numerical calculations in the RETRAN-02 program were modified or removed by the loss of the above functions and the CRAY installation is functionally equivalent to both the CDC and IBM versions with respect to its analysis capability. Input data for the code is unchanged from the description given in Volume 3 of the documentation[1] except for the deletion of the tape request cards. One additional difference in the CRAY code version which affects the input data is that the CRAY is sensitive to upper and lower case characters. All character data such as minor edit request variables should be in lower case form.

Procedures were developed to execute the RETRAN-02 code under the CTSS system at LANL using the CFS file system. Input and restart datasets are assumed to reside in the CFS system and must be retrieved into the users local file space prior to program execution. Responsibility for the disposition of newly created files belongs to the user. Procedures were also developed for maintenance of both the environmental library and the RETRAN-02 code which include updating, compiling, building a library as necessary, and loading the revised program.

Installation of RETRAN-02 on the LANL CRAY system was verified by running the sample problems (ten initial cases, two restart cases, two reedit cases, and two plot cases) from Volume 3 of the RETRAN-02 documentation.[1] The results from the ten initial cases from the CRAY code version were compared to available results from corresponding cases obtained from the EPSC transmittal tape. Graphical comparisons of minor edit variables were made where sufficient data was available, otherwise visual comparisons of major edit values were made. Comparisons were also made of the number of time steps required for each version. In all cases any differences between the CRAY version and CDC version results were within acceptable bounds except for the TTWOB point kinetics case. The maximum time-step size specified in the data deck from the EPSC transmittal tape exceeded the range where the solution is converged. Rerunning the case with smaller time steps resulted in a converged solution where the CRAY version results were within the acceptable tolerance range of the CDC results.

3.0 RETRAN-02 ENVIRONMENTAL LIBRARY CONVERSION

The RETRAN-02 environmental library contains routines or sub-code packages for handling dynamic memory allocation, input data processing, plotting, bit manipulation, I/O processing, and other miscellaneous functions. Many of these library routines are written in FORTRAN and only discrepancies with CRAY FORTRAN-77 needed correcting. A number of routines (approximately 25) are written in CDC assembler code and all of these routines required replacement with functionally equivalent FORTRAN-77 routines where possible. In some instances it was not possible to duplicate the functionality of the CDC routines with CRAY FORTRAN-77 and those routines were dummied or eliminated. Specific modifications to the various environmental routine categories are summarized in the following sections. The source and deck names for the environmental library are in lower case character form.

3.1 FTB Package

The FTB storage allocation package is used in RETRAN-02 to dynamically assign main memory for FORTRAN arrays at execution time. There is also a feature that allows the field length (main memory size) to be adjusted to free unused memory. This feature cannot be readily implemented on the CRAY using only FORTRAN-77 and was not converted. On the CRAY, FTB will allocate storage from a large fixed length array of 130000 words. The subroutine FTBSET was modified to pass this length to the FTB initialization routines eliminating the need for subroutine GETCOR. The COMDECK OPSY\$CA and the assembly language subroutines GETCOR, FRECOR, and REDUCE which performed the dynamic memory allocation operation were deleted. The file descriptions for the FTB package are kept in four (4) word units in the FTB storage array. Information in these descriptions is packed into 32-bit half words. An assembly language routine named IA performs the packing and unpacking operation in the CDC library. This routine was deleted in the CRAY version and boolean (either RETRAN-02 library or CRAY intrinsic) functions are used to pack and unpack the file description words.

The CDC version of FTB also supports special purpose disk files referred to as process files. Process files are not needed and rely on a rather complicated I/O procedure that is system dependent and must be written in assembly language. The use of process disk files in the CRAY RETRAN-02 version was replaced with standard FORTRAN-77 files. Thus, subroutines FTBIO, PROCES, PROC4, OPEN, CLOSE, TRNCAT, CPYFIL, GET, ISFOPEN, ISFPRC, MXSETS, NFSET, and NFUNIT were eliminated from the CRAY version of the environmental library.

3.2 INP Free Form Input Processing Package

The INP free form input processing package is implemented for the CDC version by using a combination of FORTRAN and assembly language subroutines. For the CRAY implementation, the assembly language routines were replaced with FORTRAN routines that are functionally equivalent. The assembly language routines that were replaced with FORTRAN-77 versions were CVI, LINK, and PCKUPK. The INP processing package stores the input data in a table in such a manner that data from a particular card can be located readily. The key subroutines for building, finding data locations, and maintaining the data table are INP, LINK, INP8, and INP10. All of the INP subroutines were deleted from the CDC library source and replaced with the new versions compatible with the new INP, CVI, LINK subroutines. The subroutines in this group include INP, CVI, LINK, PCKUPK, INP2, INP4, INP5, INP6, INP7, INP8, INP10, and MODER. A new COMDECK INPC was added to the environmental library source.

3.3 PLOTMC Plotting Package

The PLOTMC plotting package uses CalComp compatible subroutine calls to generate X-Y plots. The CDC version of PLOTMC provides an assembly language version of the subroutine SYMBOL which does character string plotting. Since SYMBOL is a standard CalComp plotting subroutine, it can be obtained from the CalComp plot library that is required to satisfy references to the other CalComp (or compatible) subroutines PLOT and PLOTS. The assembly language version of SYMBOL was deleted from the CRAY environmental library.

3.4 Bit Manipulation Routines

Several of the CDC assembly language routines perform bit manipulation functions, are short single purpose functions, or access intrinsic functions whose names differ between system vendors. The bit manipulation and intrinsic function routines are present in the environmental library to maintain maximum transportability of the RETRAN-02 program among various vendor systems. These assembly language routines were replaced with FORTRAN equivalents using CRAY intrinsic FORTRAN-77 functions. Routines in this group include MASKF, DSL, DSR, DOR, DAND, IAND, IOR, ISL, ISR, COMPAR, PACK and UNPACK. Both the integer and real shift functions and the boolean functions use the full 64-bit word length of the CRAY. Bit packing also uses the 64-bit word length and 8-bit character length for the CRAY system.

3.5 Buffer Input/Output

The buffered input/output routines for the CDC version are written in assembly language and provide features that allow the user to request data sets via input data (rather than conventional job control language) and end-of-volume (EOV) processing that allows each volume of a multi-volume set to be used independently for restart problems. Entry point BUFREQ is used to request tape data sets dynamically at execution time. This entry point was eliminated from subroutine BUFOUT. Subroutine CIO= is a CDC system routine that is used by the assembly language version of BUFOUT. CIO= was eliminated from the CRAY environmental library. The other routines (BUFOUT, BUFIN, BUFWEF, and BUFSKP) were replaced with FORTRAN-77 versions which were functionally equivalent to their assembly language counterparts. Record structures and formats are consistent with the FORTRAN-77 binary input/output requirements.

Tape datasets are not available on the CRAY system but can be used for file archiving. Datasets such as RETRAN-02 restart files are initially written to files in the CRAY user's local area and may then be saved or deleted. References to tape datasets were removed from the RETRAN-02 code and the corresponding data cards removed from the data decks.

3.6 Extended I/O Routines

Several extended I/O subroutines are used by RETRAN-02 to write information to the job log and to perform incore reads and writes. The incore read/write routines are written using CDC ENCODE and DECODE extensions to FORTRAN. These routines will be used for the CRAY versions using the CRAY ENCODE and DECODE extensions. CRAY FORTRAN supports the REMARK routine (CDC FORTRAN library) that allows messages to be written to the job log. No changes were necessary to use these routines.

3.7 System Interrogation Routines

The system interrogation routines provide facilities to interrogate the operating system for elapsed CPU and wall clock times, remaining CPU time in excess of the job time limit, date and interval timing. Several of these functions are not available with CRAY FORTRAN. In particular, the NOTIM and ICPSEC functions that are used to terminate RETRAN-02 prior to exceeding the job time limit are not available. The NOTIM function was replaced with a dummy version to satisfy external references in the code and the function ICPSEC was deleted from the library. References to IPCSEC in the RETRAN-02 source were deleted. The other timing and date functions are available in CRAY FORTRAN-77.

The subroutine timing function TIMSET with entry points TIMEL and TIMER was replaced with a FORTRAN-77 version.

3.8 Miscellaneous Routines

The RETRAN-02 environmental library contains a few miscellaneous routines written in assembly language which were rewritten using CRAY FORTRAN-77 or deleted. These routines include LOCF, COMPAR, ERRMON, FINDEP, FLOATR, LCMBUF, LCMDUM, MOVE, MOVEI, and ZEROUT. CRAY FORTRAN supports a LOCF function in which the equivalent operation to the CDC LOCF has the entry point LOCX. References to LOCF were replaced with references to LOCX in the RETRAN-02

code. Subroutine FINDEP is used in the CDC version to locate the address of a primary entry point which is used to define an FTB file that coincides with the routine location in memory. This feature is not used in the CRAY version and the subroutine FINDEP was eliminated. The CRAY system does not have extended core and the routines LCMBUF and LCMDUM for accessing LCM were eliminated.

The subroutines COMPAR, FLOATR, MOVE, MOVEI, and ZEROOUT written in CDC assembly language and were replaced with CRAY FORTRAN-77 equivalent routines.

Subroutine FORTER, which defines the CDC error recovery process, was made into a dummy routine. The ERRMON subroutine, called during error processing in the CDC code version, is no longer needed and was deleted from the library. The FABEND routine, called from RETRAN-02 when errors are detected, was revised to call the CRAY traceback routine. References to the CDC function, STRACE, which processes the traceback were satisfied with a library routine which calls the CRAY traceback routine.

4.0 RETRAN-02 CODE CONVERSION

The RETRAN-02 MOD004 source code was modified for the CDC FORTRAN-77 compiler. Programming changes were required to convert the source to accommodate the different word length of the CRAY system, revise the logic associated with disabled, deleted, or revised program features in the CRAY version, and to eliminate any syntax differences between the CDC and CRAY compilers. The source and deck names for the RETRAN-02 program are in lower case character form.

Main memory storage for the CDC version resides between the beginning of the FTB common block and the end of the assigned region or field length. The amount of available storage can then be adjusted by changing the field length at execution time. Once the storage requirements are determined, unused space is freed by reducing the region size. This feature was deleted for the CRAY version. A large fixed dimension array of 130000 words is used for the storage pool from which FTB files are obtained. The array dimension is defined once in the subroutine INPUT and can be revised if more space is required.

The CDC version of RETRAN-02 stores data over unused coding blocks to minimize unused memory. This is necessary since RETRAN-02 does not use extended memory and the size of main memory is relatively small. Subroutine RESOPT is used to map FTB files onto optional program blocks. FTB files corresponding to unused options are deleted, thus, freeing the space for later use by new FTB files. The segmented loader is used to overlay the input segments and to force the transient segments to be loaded in a particular order that corresponds to the order that FTB files are reserved in RESOPT. This feature was deleted in the CRAY version and the subroutine RESOPT revised to remove calls to the function FINDEP and to save FTB files.

The FTB package also supports special purpose disk files referred to as process files. Process files are used with minor edits and printer plots.

The process file routines were not implemented for the CRAY version and the routines that used process files modified to use standard FORTRAN files.

Several routines in RETRAN-02 make use of information packed into half words or characters packed into real words. Word and character lengths used for packing and unpacking are controlled by a logical variable, IBMRUN. The code as received from EPSC is set to use 60-bit word lengths and six-bit character lengths for the non-IBM applications. The non-IBM option was retained and the respective bit lengths increased for the CRAY version. Half-word lengths were set to 32 bits and character lengths to eight bits.

Internal tape volume requests processed through the BUFREQ entry in the BUFOUT routine were eliminated since the BUFREQ entry was deleted. Coding associated with character field processing and checking for tape data set requests were deleted from the RETRAN-02 program. Tape EOVS processing was also disabled making a multi-volume restart file a contiguous data set. Coding associated with handling multiple volume data sets with EOVS processing was deleted since it is an unused feature.

The remaining source modifications for RETRAN-02 included removing the external file definitions from the PROGRAM card and opening each file with an explicit OPEN statement, deleting references to unit 81 which was the DATATRAN history file, deleting or replacing references to the routine PDUMP with FORTRAN write statements since the CRAY does not support PDUMP, and adding dummy routines to satisfy external references in the plotting routines. The page title was changed from specifying an EPSC code version to a LANL version.

External units used by the CRAY version of RETRAN-02 reference local files in either a read or write mode but not in a read/write mode. Existing local files which will become output files must be deleted prior to executing RETRAN-02. The procedures discussed in Section 5.0 contain the appropriate file deletions. External units referenced by RETRAN-02 (excluding scratch units) are listed in Table 1.

TABLE 1
RETRAN-02 EXTERNAL FORTRAN FILE DESCRIPTION

<u>Program Module</u>	<u>File Name</u>	<u>Description</u>
RETRAN	tape5	input data file (READ only)
	tape6	output print file (WRITE only)
	tape12	boundary condition data file if running a boundary condition case (READ only)
	tape14	new restart dataset if requested by input data (WRITE only)
	tape40	one-dimensional cross-section dataset if running a one-dimensional kinetics case (READ only)
RESTRT	tape5	input data file (READ only)
	tape6	output print file (WRITE only)
	tape12	boundary condition data file if running a boundary condition case (READ only)
	tape13	old restart dataset (READ only)
	tape14	new restart dataset (WRITE only)
	tape40	one-dimensional cross-section dataset if running a one-dimensional kinetics case (READ only)
REEDIT	tape5	input data file (READ only)
	tape6	output print file (WRITE only)
	tape13	old restart dataset (READ only)
	tape60	special edit dataset (WRITE only)
PLOTTER	tape5	input data file (READ only)
	tape6	output print file (WRITE only)
	tape11	plot dataset number 1 (READ only)
	tape12	plot dataset number 2 if requested by input data (READ only)
	tape13	plot dataset number 3 if requested by input data (READ only)
	tape14	plot dataset number 4 if requested by input data (READ only)

5.0 CRAY PROCEDURES

The modified RETRAN-02 source code and environmental library were installed on the CRAY computer using the CRAY UPDATE program[3] for source maintenance, the CFT FORTRAN-77 compiler,[5] and the LDR loader.[4] A normal program load (not segmented) was used to install the code. Procedures for the XEQ program[4] were developed to maintain the RETRAN-02 program and library and to execute RETRAN-02 in its various modes. These procedures are listed and described in this section. Existing files are assumed to reside in the CFS file system and any local files with the same name are destroyed. Requesting non-existent files from CFS results in a message to the user but does not cause an error. Newly created files are normally left in the local file area without saving them. It is the users responsibility to properly save or dispose of any new files.

5.1 Environmental Library Maintenance Procedure

A procedure for the XEQ program is listed in Table 2 for updating, compiling, and building an environmental program library. The library will consist only of those routines compiled in the current procedure execution since a previously existing compiler 'lgo' file is not merged. The old UPDATE program library is assumed to be named 'nenvpl' and a new program library named 'envpl01a' will be created. The UPDATE directives are in a local file named 'upd01.ev' and the UPDATE output listing is named 'envlist'. The compiler output is limited to error messages only. The final library is a file named 'r2m4lib'. In this example, the newpl and library are saved in the CFS system. The leading character 'r' in each instruction is a sentinel for the XEQ program. This procedure is executed by the statement 'xeq enviproc' where 'enviproc' is the file name of the procedure.

TABLE 2
PROCEDURE ENVIPROC

PROCEDURE TO UPDATE, COMPILE, AND BUILD A LIBRARY

```
rdestroy envp101a
rdestroy nenvpl
rdestroy r2m4lib
rcfs get nenvpl
rupdate p=nenvpl,c=compile,n=envp101a,l=envlist,i=upd01.ev,cd,in,id
rcft b=envlgo,i=compile,l=0
rbuild b=envlgo,nl=r2m4lib,a,l=liblist,lo=m
rcfs store envp101a
rcfs store r2m4lib
rend
```

5.2 RETRAN-02 Program Maintenance Procedure

A procedure for the XEQ program is listed in Table 3 for updating, compiling, and loading the RETRAN-02 program. The old UPDATE program library is assumed to be named 'newpl01a' and a new program library named 'newpl01b' will be created. The UPDATE directives are in a local file named 'r2upd05' and the UPDATE output listing is named 'r2updlst'. The compiler output is limited to error messages only. An old lgo file (compiled source file) named 'retlgo.b' will be merged with the newly created lgo file from the compiled source and the result saved in a file named 'retlgo.c'. Libraries made available to the loader include the RETRAN-02 environmental library named 'r2m4lib' and the cft system libraries. The leading characters 'r' and 'c' in the instructions are sentinels for the XEQ program. This procedure is executed by the statement 'xeq ret2ucl' where 'ret2ucl' is the file name of the procedure. Newly created files are saved in the CFS system in this example.

5.3 RETRAN-02 Program Execution Procedures

The procedure 'exretran' for the XEQ program listed in Table 4 will execute the RETRAN-02 program. The leading character 'r' in the instructions is a sentinel for the XEQ program. This procedure uses a substitutable name which allows the user to run different cases without retyping the procedure each time. The substitutable name is designated by the characters '%me' and the XEQ name is substituted when XEQ is called. The local copy of the restart file is switched to a 'read-write' mode by the command 'switch &merst rw.' and the local file overwritten. File naming conventions in these procedures use a deck name of one to five characters indicated by '*****' with a postscript identifier as follows:

```
*****dek = input dataset for initial case (complete deck)
*****xsc = one-dimensional cross-section file
*****rdk = input dataset for restart case
*****red = input dataset for reedit case
```

TABLE 3
PROCEDURE RET2UCL

PROCEDURE TO UPDATE, COMPILE, AND LOAD RETRAN-02

```
rdestroy newpl01b
rdestroy retlgo.b
rdestroy retlgo.c
rdestroy newpl01a
rcfs get newpl01a
rcfs get retlgo.b
rupdate p=newpl01a,c=compile,l=r2updlst,i=r2upd05,
c&n=newpl01b,cd,in,id,ed
rcft b=newlgo,i=compile,l=0
rdestroy oldlgo
rcopy retlgo.b oldlgo
rbuild b=newlgo,ol=oldlgo,r,l=liblist,lo=m
rldr i=oldlgo,lib=(r2m4lib,cftmath,cftlib),cs=170140b,x=retran,m1=map,
cmo=su
rcfs store retran
rcopy oldlgo retlgo.c
rcfs store retlgo.c
rcfs store newpl01b
rend
```

TABLE 4
PROCEDURE EXRETRAN

RETRAN PROCEDURE TO EXECUTE AN INITIAL CASE

```
rdestroy tape5
rdestroy tapel4
rdestroy tape40
rdestroy %medek
rdestroy %mexsc
rcfs get %mexsc
rcopy %mexsc tape40
rcfs get %medek
rcopy %medek tape5
rretran
rswitch %merst rw.
rcopy tapel4 %merst
rend
```



```
*****plt = input dataset for plot case
*****rst = restart dataset and plot dataset number 1
*****tp2 = plot dataset number 2
*****tp3 = plot dataset number 3
*****tp4 = plot dataset number 4.
```

The procedure is executed by copying the procedure to a local file having the problem name and then calling the XEQ program with that name as illustrated in the following commands:

```
copy exretran ttwob
xeq ttwob
```

assuming the procedure is named 'exretran' and one is running the 'ttwob' sample problem. Newly created files are not saved in the CFS system in this example.

A procedure to execute a restart case is listed in Table 5. This procedure differs from the procedure in Table 4 by copying a restart file to the local file 'tapel3' and using a different name '%merdk' for the input data file to avoid conflicts with the initial case data deck file name.

A procedure to execute a reedit case is listed in Table 6. The input data file is named '%mered'.

A procedure to execute a plot case is listed in Table 7. This procedure allows up to four restart/plot data files to be defined for use in overlay and/or combination plots. The primary data file is assumed to be named '%merst' and copied to the local file 'tapell'. The input data file is named '%meplt'. Output from the plot module is limited to the print file 'tape6' as no plotter specific routines are currently included in the RETRAN-02 program.

TABLE 5
PROCEDURE EXRETRST

RETRAN PROCEDURE TO EXECUTE A RESTART CASE

```
rdestroy tape5
rdestroy tapel4
rdestroy tape40
rdestroy tapel3
rdestroy %merdk
rcfs get %merst
rcopy %merst tapel3
rdestroy %mexsc
rcfs get %mexsc
rcopy %mexsc tape40
rcfs get %merdk
rcopy %merdk tape5
rretran
rswitch %merst rw.
rcopy tapel4 %merst
rend
```

TABLE 6
PROCEDURE EXREEDIT

RETRAN PROCEDURE TO EXECUTE A REEDIT CASE

```
rdestroy tape5  
rdestroy tapel3  
rdestroy tape60  
rdestroy %mered  
rdestroy %merst  
rcfs get %merst  
rcopy %merst tapel3  
rcfs get %mered  
rcopy %mered tape5  
rretran  
rend
```

TABLE 7
PROCEDURE EXRETPLT

RETRAN PROCEDURE TO EXECUTE A PLOT CASE

```
rdestroy tape5
rdestroy tapel1
rdestroy tapel2
rdestroy tapel3
rdestroy tapel4
rdestroy %merst
rcfs get %merst
rcfs get %metp2
rcfs get %mept3
rcfs get %mept4
rcopy %merst tapel1
rcopy %metp2 tapel2
rcopy %metp3 tapel3
rcopy %metp4 tapel4
rdestroy %meplt
rcfs get %meplt
rcopy %meplt tape5
rretran
rend
```

6.0 INPUT DATA DECK CHANGES

Minor changes in the input data decks as described in Volume 3 of the RETRAN-02 documentation[1] were required for the CRAY version of the code. These changes were limited to the deletion of the tape request cards for the restart, reedit, boundary condition, and plot files. In addition, since the CRAY computer software is character case sensitive, character data such as minor edit variables and control block types must be in lower case characters. Input data changes from Volume 3 are as follows.

Section IV.4.0 Boundary Condition Tape Request Data Cards 01XX20 and 01XX2Y.

Delete these cards from data decks where XX ranges from 1 to 99 and Y ranges from 1 to 9.

Section IV.5.0 Data Tape Label Data Cards 01XX40 and 01XX4Y.

Delete these restart tape request cards from data decks where XX ranges from 1 to 99 and Y from 1 to 9.

Section V.3.0 Data Tape Request Cards 010130 and 01013Y

Delete these restart tape request cards from data decks where Y ranges from 1 to 9.

Section V.4.0 Data Tape Label Data Cards 01XX40 and 01XX4Y

Delete these restart tape request cards from data decks where XX ranges from 1 to 99 and Y from 1 to 9.

Section VI.3.0 Data Tape Request Data Cards 01XX30 and 01XX3Y

Delete these reedit tape request cards from data decks where XX ranges from 1 to 99 and Y from 1 to 9.

Section VII.3.0 Data Tape Request Data Cards 01XXY0 and 01XXYS

Delete these plot tape request cards from data decks where XX ranges from 1 to 99, Y ranges from 1 to 9, and S from 1 to 9.

Section IV.6.0 Minor Edit Variable Data Cards 02000Y

The alphabetic characters in the symbol lists in Tables IV.6-1 through IV.6-17 are input to RETRAN-02 as lower case characters.

Section IV.17.4 Decay Heat Power History Interval Data 14700X

The units parameter in word 3 is in lower case characters.

Section IV.25.4 Control Input Definition Data Cards 702XXX

The variable symbol 'CSYM' in word 2 is input with lower case characters.

Section IV.25.5 Control Input Description Data Cards 703XXX

The variable symbol 'ITYPE' in word 2 is input with lower case characters.

Section VI.5.0 Auxiliary Data File Format Description Card 03000Y

The character string 'binary', if used, is in lower case characters.

Section VII.4.0 Independent Axis Specification Data Cards 02XX0Y

The character variables in words 1, 3, 7, 8, 9, and 10 are input as lower case characters.

Section VII.5.0 Dependent Axis Specification Data Cards 03XXYZ

The character variables in words 1, 5, 6, 7, and 8 are input as lower case characters.

Section VII.6.0 Plot Curve Request Data Cards 4XXYZS

The character variable in word 1 is input as lower case characters.

Section VII.7.2 Parametric Plot Curve Request Data Cards 50XXYS

The character variables in words 5, 8, 11, etc., are input as lower case characters.

Section VII.7.3 Parametric Plot Curve Request Data Cards 51XXYS

The character variable in word 5 is input as lower case characters.

Section VII.8.0 Relap3, Relap4/002/003/005/007 Plot Request Symbols

This option is not available in the CRAY version.

Section VII.9.0 Retran Stranger Data Tape Format and Structure

This option is not available in the CRAY version.

7.0 VALIDATION TESTS

A variety of test cases were run on the CRAY version of RETRAN-02 to ensure that the program was correctly converted and installed. Test cases were run for the RETRAN program, the restart, reedit, and plotting options. The ten sample problems on the EPSC transmittal tape were run as validation cases and the results were compared against the corresponding CDC cases included with the EPSC transmittal. The restart, reedit, and two plot test cases given in the RETRAN-02 User's Manual[1] were run as validation cases for these options. The validation cases are discussed in more detail below.

7.1 RETRAN

The ten sample problems that were included with the RETRAN-02 transmittal package from the EPSC were run to test the CRAY version of RETRAN-02 MOD004. These problems are as follows:

- (1) Standard Problem One,
- (2) Standard Problem Five,
- (3) Eight Volume Sample Problem,
- (4) Standard Problem Four,
- (5) Uncontrolled Rod Withdrawal,
- (6) Turbine Trip Without Bypass (Point Kinetics),
- (7) Two-Dimensional Flow Field,
- (8) Secondary-Side Sample Problem,
- (9) Turbine Trip Without Bypass (One-Dimensional Kinetics), and
- (10) Anticipated Transient Without Scram.

The results from these cases were checked against the respective sample problem output files from the transmittal tape by comparing the number of time steps taken and by making overlay plots for several of the minor edit variables from the CDC and CRAY version. The sample problem output from the transmittal tape did not contain minor edits for the following cases: Standard Problem One, Standard Problem Four, and the Two-Dimensional Flow Field. Point

values from the major edits in these latter cases were included on the plots without connecting curves except for the Two-Dimensional Flow Field which was not plotted. The latter case converges to a steady-state condition and values in the final edit were compared as a check on the correctness of the solution.

The time-step comparisons between the CDC and CRAY cases are listed in Table 8 for the ten sample problems. In seven cases, the actual number of time steps taken by the CRAY version were the same as for the respective CDC cases. In two cases, i.e., the Secondary-Side Problem and the TTWOB, the number of actual time steps were within two of the CDC cases. The CRAY calculation of the ATWS problem took eight (8) fewer time steps than did the CDC calculation. The CPU times for both the CRAY and CDC versions are also listed in Table 8 for each case.

Some differences were expected in the calculated results since the CRAY and CDC word lengths and floating point hardware are different. The FORTRAN library functions, e.g., SQRT, EXP, ALOG, etc., could also generate slightly different results between the two systems. Three categories of differences between the CRAY and CDC results were identified[6] and a corresponding measure of acceptability for these differences defined. The categories are:

- (1) timing, time-of-day, data, or operating system dependent results, e.g., CPU time, memory size, etc.;
- (2) differences of similar magnitude numbers that are approximately equal to zero, within the accuracy of the given machine's representation of floating point words with a fixed number of bits; and
- (3) the other calculated quantities.

TABLE 8
TIME-STEP COMPARISON BETWEEN THE CDC AND CRAY SYSTEM
FOR RETRAN-02 SAMPLE PROBLEMS

Problem	Problem end sec	CRAY			CDC		
		*	**	CPU time sec	*	**	CPU time sec
Std Prb1	0.465	223	45	3.8	223	45	20.8
Std Prb5	5.0	485	345	10.1	485	345	56.6
Eight Vol	0.4	1001	335	26.6	1001	335	105.7
Std Prb4	1.0	462	325	30.0	462	325	206.2
UCRW	3.05	71	69	9.05	71	69	67.3
TTWOB	2.01	224	200	17.7	222	200	118.8
Two-Dim Flow	1.002	664	100	10.7	664	100	47.3
Sec Side	0.5	743	500	43.4	745	500	343.1
TTQX1	1.005	223	200	23.8	223	200	234.0
ATWS	150.0	609	306	53.2	617	306	404.9

* Actual time-step number

** Standard time-step number

Essentially all category (1) and (2) items were expected to differ and no comparisons made for these quantities. Typical category (2) items are the time-zero acceleration pressure, enthalpy, mass, slip velocity, and control system convergence values.

The category 3 items may or may not differ. Those that do differ should not differ significantly. The acceptability criteria specified[6] was that overlay plots of results from the CDC and CRAY runs should not differ more than several pen widths. The correctness of the code installation is demonstrated by the graphs shown in Appendix A. The CRAY and CDC results have been overlaid in these graphs with the CDC results as the solid curve and the CRAY results as the dashed curve. In most cases, the curves are indistinguishable. In the worst case, i.e., the TTWOB case, the two calculations were similar in behavior but did not coincide precisely. The sample problems from the CRAY version which did not produce an exact match with the CDC version were using the iterative implicit numerical solution scheme. The time-step controller for the iterative implicit method did not always select the same criteria in the two versions because of machine related differences resulting in a slightly different set of time steps for the two versions. These differences can lead to results which are similar but not identical as shown below. Specifically, comparisons of the sample problem calculations resulted in the following:

7.1.1 Standard Problem One

Standard Problem One had only two major edits and no minor edits on the transmittal print file. The values in the major edits were the same (differing, at most, in the least significant digit) for both code versions. Both code versions executed the same number of time steps. Plots of minor edit variables from the CRAY version with corresponding major edit values from the CDC version as point data are shown in the Figures 1 through 6 in Appendix A. Standard Problem One executed successfully and met the acceptance criteria.

7.1.2 Standard Problem Five

Values in the major edits were the same for both code versions. Both code versions executed the same number of time steps. Overlay plots from minor edit variables from both the CRAY and CDC code versions are shown in Figures 7 through 12 in Appendix A. Standard Problem Five executed successfully and met the acceptance criteria.

7.1.3 Eight Volume Sample Problem

Values in the major edits were the same for both code versions. Both code versions executed the same number of time steps. Overlay plots from minor edit variables from both the CRAY and CDC code versions are shown in Figures 13 and 14 in Appendix A. The eight volume sample problem executed successfully and met the acceptance criteria.

7.1.4 Standard Problem Four

Values in the major edits were the same for both code versions. Both code versions executed the same number of time steps. Plots of minor edit variables from the CRAY version with corresponding major edit values from the CDC version as point data are shown in the Figures 15 through 19 in Appendix A. Standard Problem Four executed successfully and met the acceptance criteria.

7.1.5 Uncontrolled Rod Withdrawal

Values in the major edits were the same for both code versions. Both code versions executed the same number of time steps. Overlay plots from minor edit variables from both the CRAY and CDC code versions are shown in Figures 20 through 26 in Appendix A. The uncontrolled rod withdrawal problem executed successfully and met the acceptance criteria.

7.1.6 Turbine Trip Without Bypass (Point Kinetics)

The transient calculations, as shown in the TTWOB figures, were similar for the CDC and CRAY code versions but did not overlay each other exactly. The CRAY version took two more time steps than did the CDC version, one occurring early in the calculation and the second late in the calculation. Overlay plots from minor edit variables from both the CRAY and CDC code versions are shown in Figures 27 and 28 in Appendix A. The turbine trip without bypass problem with point kinetics executed successfully but did not meet the acceptance criteria.

It was suspected that the CDC case was marginally converged and that smaller time steps would produce converged solutions on both the CRAY and CDC machines. Consequently, the problem was rerun on both the CDC and CRAY versions of RETRAN-02/MOD004. Both code versions executed the same number of time steps for this case. Overlay plots of the results from this case are shown in Figures 29 through 32 in Appendix A. The modified turbine trip without bypass problem with point kinetics executed successfully and met the acceptance criteria.

7.1.7 Two-Dimensional Flow Field

Values in the major edits were the same for both code versions. Both code versions executed the same number of time steps. No plots were made of the results from this test problem since it converges to a steady-state condition. The two-dimensional flow field problem executed successfully and met the acceptance criteria.

7.1.8 Secondary-Side Sample Problem

Values in the major edits were the same for both code versions. The CRAY version took two fewer time steps than did the CDC version. The difference in time steps occurred in the first 50 time steps where the time steps were being limited by different criteria in the two versions. Overlay plots from minor

edit variables from both the CRAY and CDC code versions are shown in Figures 35 through 44 in Appendix A. The secondary-side sample problem executed successfully and met the acceptance criteria.

7.1.9 Turbine Trip Without Bypass (One-Dimensional Kinetics)

Values in the major edits were the same for both code versions. Both code versions executed the same number of time steps. Overlay plots from minor edit variables from both the CRAY and CDC code versions are shown in Figures 45 through 52 in Appendix A. The turbine trip without bypass problem with one-dimensional kinetics executed successfully and met the acceptance criteria.

7.1.10 Anticipated Transient Without Scram

Calculated results were nearly the same for both code versions. The CRAY version took eight fewer time steps than did the CDC version. The difference in time steps occurred after 81.0 seconds into the transient where the time steps were being limited by different criteria in the two versions. The ATWS case has a set of relief valves which cycle during the transient. One more reset occurs in the CRAY calculation after 81.0 seconds into the calculation leading to the differences observed in the junction 90 behavior. Overlay plots from minor edit variables from both the CRAY and CDC code versions are shown in Figures 53 through 66 in Appendix A. The anticipated transient without scram problem executed successfully and met the acceptance criteria.

7.2 RESTART

The restart option was validated by running the restart sample problems given in Reference 1 for test cases 5 and 6 above and the acceptability of the test case results validated by comparing the restart edits with the original cases. The UCRW restart case utilized the generalized restart option in the code. Results from this case were the same as the values listed in Volume 3 of the code documentation.[1] The TTWOB (Point Kinetics) case was also restarted.

The restart calculation for the TTWOB case was similar to the base case but did not duplicate it exactly. Both the UCRW restart case and the TTWOB restart case executed successfully. The UCRW restart case met the acceptance criteria but the TTWOB restart did not meet the acceptance criteria for the same reasons as the base case (the solution was not converged with respect to the time-step size). A restart case was run using the modified TTWOB case which did meet the acceptance criteria.

7.3 REEDIT

The reedit test cases given in Reference 1 were run. Successful execution and validation of the test cases was demonstrated by retrieving and printing the previously archived results from the appropriate restart data files. The reedit cases were successful and met the acceptance criteria.

7.4 PLOT

Two of the plot sample problems given in Reference 1 were run. Dummy routines to satisfy the Calcomp external references were provided and the plot feature validated by examining tabular output for the curves normally plotted. The RETRAN-02 plot option successfully executed the test cases and results met the acceptance criteria.

8.0 REFERENCES

1. McFadden, J. H., et al, "RETRAN-02 - A Program for Transient Thermal-Hydraulic Analysis of Complex Fluid Flow, NP-1850-CCM-A, R4, Volumes 1-4, Electric Power Research Institute, June 1987.
2. Project Requirements Document for the RETRAN-02 Modifications, LANL-PRD-001, Revision 0, February, 1990.
3. UPDATE Reference Manual, Cray Research, Inc., SR-0013, Revision J, November 1989.
4. CTSS Mini-Reference, Los Alamos National Laboratory, CIC #205, August, 1988.
5. FORTRAN (CFT) Reference Manual, Cray Research, Inc., SR-0009, Revision L, July 1986.
6. Software Design Document for the RETRAN-02 Cray Installation, LANL-SDD-001, Revision 0, March, 1990.

APPENDIX A

SAMPLE PROBLEM DATA OVERLAY PLOTS

The results from nine of the sample problem cases were checked against the respective sample problem output files from the transmittal tape by making overlay plots for several of the minor edit variables from the CDC and CRAY versions. The CRAY and CDC results have been overlaid in the figures in this Appendix with the CDC results as the solid curve and the CRAY results as the dashed curve. The sample problem output from the transmittal tape did not contain minor edits for two of these cases, i.e., Standard Problem One and Standard Problem Four. Point values from the major edits in these latter cases were included on the data plots without connecting curves (X markers). The figures from each of the sample problems are as follows:

Standard Problem One	Figures 1 - 6
Standard Problem Five	Figures 7 - 12
Eight Volume Problem	Figures 13 - 14
Standard Problem Four	Figures 15 - 19
Uncontrolled Rod Withdrawal	Figures 20 - 26
Turbine Trip Without Bypass (Point Kinetics)	Figures 27 - 34
Secondary-Side Sample Problem	Figures 35 - 44
Turbine Trip Without Bypass (1-D Kinetics)	Figures 45 - 52
Anticipated Transient Without Scram	Figures 53 - 66

Figure 1

Standard Problem One

Figure 2

Standard Problem One

Figure 3

Standard Problem One

Figure 4

Standard Problem One

Figure 5

Standard Problem One

Figure 6

Standard Problem One

Figure 7

Standard Problem Five

Figure 8

Standard Problem Five

Figure 9

Standard Problem Five

Figure 10

Standard Problem Five

Figure 11

Standard Problem Five

Figure 12

Standard Problem Five

Figure 13

Volume 8

Figure 14

Volume 8

Figure 15

Standard Problem Four

Figure 16

Standard Problem Four

Figure 17

Standard Problem Four

Figure 18

Standard Problem Four

Figure 19

Standard Problem Four

Figure 20

Uncontrolled Rod Withdrawal

Figure 21

Uncontrolled Rod Withdrawal

Figure 22

Uncontrolled Rod Withdrawal

Figure 23

Uncontrolled Rod Withdrawal

Figure 24

Uncontrolled Rod Withdrawal

Figure 25

Uncontrolled Rod Withdrawal

Figure 26

Uncontrolled Rod Withdrawal

Figure 27

TTWOB With Point Kinetics

Figure 28

TTWOB With Point Kinetics

Figure 29

TTWOB With Point Kinetics

Figure 30

TTWOB With Point Kinetics

Figure 31

TTWOB With Point Kinetics

Figure 32

TTWOB With Point Kinetics

Figure 33

TTWOB With Point Kinetics

Figure 34

TTWOB With Point Kinetics

Figure 35

Secondary System Sample Problem

Figure 36

Secondary System Sample Problem

Figure 37

Secondary System Sample Problem

Figure 38

Secondary System Sample Problem

Figure 39

Secondary System Sample Problem

Figure 40

Secondary System Sample Problem

Figure 41

Secondary System Sample Problem

Figure 42

Secondary System Sample Problem

Figure 43

Secondary System Sample Problem

Figure 44

Secondary System Sample Problem

Figure 45

TTWOB With Space Time Kinetics

Figure 46

TTWOB With Space Time Kinetics

Figure 47

TTWOB With Space Time Kinetics

Figure 48

TTWOB With Space Time Kinetics

Figure 49

TTWOB With Space Time Kinetics

Figure 50

TTWOB With Space Time Kinetics

Figure 51

TTWOB With Space Time Kinetics

Figure 52

TTWOB With Space Time Kinetics

Figure 53

PWR ATWS

Figure 54

PWR ATWS

Figure 55

PWR ATWS

Figure 56

PWR ATWS

Figure 57

PWR ATWS

Figure 58

PWR ATWS

Figure 59

PWR ATWS

Figure 61

PWR ATWS

Figure 60

PWR ATWS

Figure 62

PWR ATWS

Figure 63

PWR ATWS

Figure 64

PWR ATWS

Figure 65

PWR ATWS

Figure 66

PWR ATWS

APPENDIX B

ENVIRONMENTAL LIBRARY UPDATE DECK

The environmental library for the CRAY RETRAN-02 code version was built from the CDC library source with a single update correction deck labeled with the identifier 'ident lan101'. The correction deck is listed in this Appendix. The CRAY source is written in lower case characters.

```
*ident lan101
*/comment  purge assembly language and unnecessary decks
*/comment
*purgedk opsy$ca
*purgedk bufout
*purgedk cio
*purgedk cpar
*purgedk cvi
*purgedk dand
*purgedk dor
*purgedk dsl
*purgedk dsr
*purgedk errm
*purgedk findep
*purgedk floatr
*purgedk frecor
*purgedk ftbio
*purgedk ftbset
*purgedk getcor
*purgedk ia
*purgedk iand
*purgedk icpsec
*purgedk inp
*purgedk ior
*purgedk isl
*purgedk isr
*purgedk lcmbuf
*purgedk lcm dum
*purgedk link
*purgedk maskf
*purgedk move
*purgedk movei
*purgedk notim
*purgedk pack
*purgedk pckupk
*purgedk reduce
*purgedk symbol
*purgedk tims
```

```

*purgedk unpack
*purgedk zerout
*/comment
*/comment purge process file decks
*/comment
*purgedk close
*purgedk cpyfil
*purgedk get
*purgedk isfopen
*purgedk isfprc
*purgedk mxsets
*purgedk nfset
*purgedk nfunit
*purgedk open
*purgedk proces
*purgedk proc4
*purgedk trncat
*/
*/ *****
*/
*i ftbd.17
    integer ia(1)
    equivalence (a(1), ia(1))

C
*/
*/ *****
*/
*c axis
*/
*/ *****
*/
*c delete
*d delete.9,11
    kset = mask(32).and.ia(il+2)
    if (isr(kset, 32) .ne. 0) call error (9)
    unit = mask(96) .and. ia(il+2)
    locsiz = mask(96) .and. ia(il+3)
*d delete.14,15
    100 kidx = mask(32).and.ia(lasdes+3)
        kidx = isr(kidx, 32)
        if (kidx .ge. min(1)) go to 101
        min(1) = kidx
*d delete.17,18
    101 ksiz = mask(96).and.ia(lasdes+3)
        if (kidx .ge. max(1)) max(1) = kidx + ksiz
*d delete.27
    kidx = mask(32).and.ia(nexdes+197)
    lasdes = isr(kidx, 32) + 4
*d delete.31,33
    130 kidx = mask(32).and.ia(il+3)
        kidx = isr(kidx, 32)
        if (kidx .eq. 0) go to 133

```

```

        if (kidx .ge. min(unit)) go to 131
        min(unit) = kidx
*d delete.35
131 if (kidx .ge. max(unit)) max(unit) = kidx + locsiz
*/
*/ *****
*/
*c dmpfil
*d dmpfil.10,13
    kdsc = mask(32).and.ia(il+2)
    if (isr(kdsc, 32) .ne. 0) call error (9)
    kidx = mask(32).and.ia(il+3)
    if (isr(kidx, 32) .eq. 0) call error (13)
    j = mask(96).and.ia(il+1)
    kset = mask(32).and.ia(il+1)
    m = isr(kset, 32) - 1
*d dmpfil.15
*d dmpfil.17
6 format (1h0,43x,'process file id = ',f10.0, 'feature is disabled -
* exit called')
    call exit
*d dmpfil.18,28
*d dmpfil.30
2 ib = isr(kidx, 32)
*d dmpfil.34
    if (format .eq. 0) go to 7
    write (6,3) (a(k),k=ib,im)
3 format (1x,1p,7e17.8)
    go to 10
7 write (6,8) (a(k),k=ib,im)
8 format (1x,6z20)
10 continue
*/
*/ *****
*/
*c dmplst
*d dmplst.9,11
5 format('0unit = ',5x,7(2x,i2,8x)/' size = ',7(4x,o8)/
* ' max = ',7(4x,o8)/' min = ',7(4x,o8)/,'0nolink = ',i5,5x,
* 'nofils = ',i5,5x,'link1 = ',o8,5x,'lasdes = ',o8,5x,'nexdes = ',
* o8)
*d dmplst.22,27
    m1 = isr(mask(32).and.ia(j+1), 32)
    m2 = mask(96).and.ia(j+1)
    m3 = isr(mask(32).and.ia(j+2), 32)
    m4 = mask(96).and.ia(j+2)
    m5 = isr(mask(32).and.ia(j+3), 32)
    m6 = mask(96).and.ia(j+3)
*d dmplst.33,37
6 format (//65x,'link',i3/65x,'*****'//2(8x,'id setsiz nosets
* idsdsc unit filidx filsiz',4x))
8 format ( 1x,f9.0,3x,i6,2x,i6,2x,o8,3x,i2,3x,o8,2x,o8)

```

```

    9 format ('+',67x,f9.0,3x,i6,2x,i6,2x,o8,3x,i2,3x,o8,2x,o8)
1  nl = isr(mask(32).and.ia(n2), 32)
*/
*/ *****
*/
*c describ
*d describ.16,17
    a(nexdes+1) = 0.0e0
    ia(nexdes+1) = shiftl(setsiz, 32) .or. nosets
*d describ.19
    ia(nexdes+2) = unit
*d describ.27
    ia(nexdes+1) = mask(32).and.ia(nexdes+1)
*d describ.29,31
    ia(nexdes+2) = 1
    a(nexdes+3) = 0.0
    ia(nexdes+3) = shiftl(i1, 32) .or. 200
*d describ.36
    ia(nexdes+197) =
    * (mask(96).and.ia(nexdes+197)) .or. shiftl(lasdes-4, 32)
*/
*/ *****
*/
*c envid
*d envid.11
    data usr / 8h1an13/90 /
*/
*/ *****
*/
*c error
*d error.9
    call fabend
*/
*/ *****
*/
*c fabend
*i fabend.3
    integer unit
*d fabend.6,9
    data unit /6htape6 /
*d fabend.11,30
    call trbk (unit)
*/
*/ *****
*/
*c fort
*d fort.6,60
*/
*/ *****
*/
*c idfind
*d idfind.20

```

```

        i = isr(mask(32).and.ia(i+197), 32)
*/
*/ *****
*/
*c incorw
*/
*/ *****
*/
*c inital
*d inital.24
*d inital.28,29
*d inital.31,41
*d inital.44
20 continue
*d inital.82,84
    ia(link1+2) = 1
    ia(link1+3) = shift1(link1, 32) .or. 200
*d inital.87
*d inital.97
*/
*/ *****
*/
*c inpsfh
*/
*/ *****
*/
*c isfdes
*c lavail
*c lcontg
*/
*/ *****
*/
*c lifopn
*d lifopn.11,15
    kdsc = isr((mask(32).and.ia(il+2)), 32)
    if (kdsc .ne. 0) call error (9)
    kset = mask(96).and.ia(il+1)
    if (kset .eq. 0) call error (8)
    iunt = mask(96).and.ia(il+2)
    if (iunt .gt. 1) go to 6
    kidx = isr (mask(32).and.ia(il+3), 32)
    if (unitb .ne. iunt .or. kidx .ne. 0) go to 3
    ksiz = isr(mask(32).and.ia(il+1), 32)
    lifopn = ksiz*kset + 2
*d lifopn.19,20
6  n = iunt - 1
    ksiz = isr(mask(32).and.ia(il+1), 32)
    if (ksiz*kset .gt. reclen(n)) go to 7
*/
*/ *****
*/
*c lines

```



```

*/
*/ *****
*/
*c locate
*d locate.26,28
    20 lunit = mask(96).and.ia(i+2)
        if (unit .ne. lunit) go to 21
        jstr = isr(mask(32).and.ia(i+3), 32)
        kksz = mask(96).and.ia(i+3)
        jend = jstr + kksz
*d locate.35
    jstr = isr(mask(32).and.ia(i+2), 32)
    jstr = iabs(jstr)
*d locate.37
    kksz = mask(96).and.ia(jstr+1)
    jend = jstr + kksz
*d locate.54
    kksz = isr(mask(32).and.ia(i+197), 32)
    i = kksz + 4
*d locate.72,73
*/
*/ *****
*/
*c lxis
*c minv
*/
*/ *****
*/
*c nextid
*d nextid.22
    i = isr(mask(32).and.ia(i+197), 32)
*/
*/ *****
*/
*c normal
*c number
*c plmc
*c psc1
*/
*/ *****
*/
*c reserv
*d reserv.12
    ia(il+1) = mask(32).and.ia(il+1)
*d reserv.17,18
    ia(il+3) = 0
    ia(il+3) = shiftl(i2, 32) .or. filsiz
*/
*/ *****
*/
*c shftlk
*d shftlk.18

```

```

        j = isr(mask(32).and.ia(l+3), 32)
*d  shftlk.21
        ia(l+2) = mask(32).and.ia(l+2)
*d  shftlk.29
        ia(l+2) = (mask(32).and.ia(l+2)) .or. 1
*d  shftlk.32
        ia(l+3) = (mask(96).and.ia(l+3)) .or. shiftl(i2, 32)
*d  shftlk.48,49
        kidx = isr(mask(32).and.ia(i2+199), 32)
        k = kidx + 196
        ia(k+1) = (mask(96).and.ia(k+1)) .or. shiftl(i2+192, 32)
*/
*/ *****
*/
*c  shift
*d  shift.13
        kset = mask(96).and.ia(il+1)
        if (kset .ne. 0) call error (43)
*d  shift.15
        1  ia(il+2) = mask(32) .and. ia(il+2)
*d  shift.20,21
        kidx = isr(mask(32).and.ia(il+3), 32)
        ksiz = mask(96).and.ia(il+3)
        if (kidx .lt. min(1)) min(1) = kidx
        if (kidx .ge. max(1)) max(1) = kidx + ksiz
*d  shift.25
        if (i2 .eq. kidx) go to 140
*d  shift.27
        1 = mask(96).and.ia(il+3)
        ksiz = 1
*d  shift.29
        j = kidx
*d  shift.43,48
        130  ia(il+3) = mask(96).and.ia(il+3) .or. shiftl(i2, 32)
        140  size(1) = size(1) - flsz + ksiz
        ia(il+3) = mask(32).and.ia(il+3) .or. flsz
        ia(il+1) = mask(96).and.ia(il+1) .or. shiftl(flsz, 32)
        ia(il+2) = mask(32).and.ia(il+2) .or. 1
        indx = isr(mask(32).and.ia(il+3), 32)
*d  shift.51,53
        150  kidx = isr(mask(32).and.ia(il+3), 32)
        ksiz = mask(96).and.ia(il+3)
        if (flsz .gt. ksiz) go to 160
        if (max(1) .le. kidx) max(1) = kidx + ksiz
        if (min(1) .ge. kidx) min(1) = kidx + flsz
*d  shift.55
        160  min(1) = kidx
*/
*/ *****
*/
*c  xplt
*c  xpta

```

```

*/
*/ *****
*/
*/ delete inp routines and replace
*/
*purgedk inp2
*purgedk inp4
*purgedk inp5
*purgedk inp6
*purgedk inp7
*purgedk inp8
*purgedk inp10
*purgedk moder
*/
*/ *****
*/
*/ comment
*/ add new fortran routines
*/ comment
*comdeck inpc
      common / inpcom / fkey(5), ifkey(5), lmask(5), amask(2),
      *               fmtmsk(4), ptrn1, ptrn2, nbits
c
*deck zero
      subroutine zerout (a, n)
c
c      subroutine to zero an array
c
c      dimension a(*)
c
c      data zero/ 0.0e0/
c
c      nn      = n
c      do 20 i= 1,nn
c      a(i)    = zero
20 continue
      return
      end
*deck move
      subroutine move (a, b, nn)
c      move nn floating words in array a to array b
c      nn      gt 0  => a and b do not overlap
c                      b has a lower address than a
c      nn      lt 0  => backwards move - a and b overlap
c                      b has a higher address than a
c      nn      eq 0  => no move
c      dimension a(*), b(*)
c
c      n      = nn
c      if (n .eq. 0) return
c      if (n .gt. 0) then

```

```

c          forward move
c
c          do 300 i = 1,n
c            b(i) = a(i)
300        continue
c          else
c
c          backward move
c
c          k      = -n
c          kk     = k
c          do 375 i = 1,k
c            b(kk) = a(kk)
c            kk    = kk - 1
375        continue
c          end if
c          return
c          end
*deck movi
c          subroutine movei (a, b, nn)
c
c          move nn integer words in array a to array b
c          nn    gt 0 => a and b do not overlap
c                    b has a lower address than a
c          nn    lt 0 => backwards move - a and b overlap
c                    b has a higher address than a
c          nn    eq 0 => no move
c
c          integer a(*), b(*)
c
c          n      = nn
c          if (n .eq. 0) return
c          if (n .gt. 0) then
c
c          forward move
c
c          do 300 i = 1,n
c            b(i) = a(i)
300        continue
c          else
c
c          backward move
c
c          k      = -n
c          kk     = k
c          do 375 i = 1,k
c            b(kk) = a(kk)
c            kk    = kk - 1
375        continue
c          end if
c          return
c          end

```

```

*deck dsl
  real function dsl (vv, n)
c    vv shifted left n bits (arithmetic - circular)
    dsl = shift (vv, n)
    return
  end
*deck dsr
  real function dsr (vv, n)
c    vv shifted right arithmetically n bits
    temp = shiftr (vv, n)
    if (vv .lt. 0.0e0) then
      temp = temp .or. mask(n)
    end if
    dsr = temp
    return
  end
*deck dsrl
  real function dsrl (vv, n)
c    vv shifted right logically n bits
    dsrl = shiftr (vv, n)
    return
  end
*deck dor
  real function dor (vv, ww)
c    logical sum of vv and ww
    dor = vv.or.ww
    return
  end
*deck dand
  real function dand (vv, ww)
c    logical product of vv and ww
    dand = vv.and.ww
    return
  end
*deck isl
  integer function isl (kv, n)
c    kv shifted left n bits (arithnetic - circular)
    isl = shift (kv, n)
    return
  end
*deck isr
  integer function isr (kv, n)
c    kv shifted right n bits (arithmetic)
    ktem = shiftr (kv, n)
    if (kv .lt. 0) then
      ktem = ktem .or. mask(n)
    end if
    isr = ktem
    return
  end
*deck isrl
  integer function isrl (kv, n)

```

```

c      kv shifted right logically n bits
      isrl = shiftr (kv, n)
      return
      end
*deck iand
      integer function iand (kv, n)
c      logical product of kv and n
      iand = kv.and.n
      return
      end
*deck ior
      integer function ior (kv, n)
c      logical sum of kv and n
      ior = kv.or.n
      return
      end
*deck locf
      integer function locfx(k)
c
c      function to return address of variable n
c
      locfx = loc(k)
      return
      end
*deck maskf
      real function maskf (n)
c      build a mask of n bits
c      n > 0 mask in high order bits
c      n < 0 mask in low order bits
c
      data zero /0.0e0/
c
      maskf = zero
      if (n.gt.0) then
         maskf = mask(n)
      else
         maskf = mask(128+n)
      end if
      return
      end
*deck cpar
      subroutine compar (a, b, nchar)
c      compare nchar characters in strings a and b
c      nchar = 0 returned if a mismatch is found
c
      character*1 a(*), b(*)
      nn = nchar
      nchar = 0
      do 20 i = 1,nn
         if (a(i) .ne. b(i)) go to 30
      20 continue
      nchar = nn

```

```

30 return
end
*deck pack
subroutine pack (word, noitms, nobits, items)
c
c routine to pack noitms into word from right to left
c nobits = field width in bits for each item
c items = positive integer list to pack
c
integer word
dimension nobits(*), items(*)
c
nn = noitms
isf = 0
word = 0
do 20 i = 1,nn
k = nobits(i)
word = word.or.shiftl (items(i), isf)
isf = isf + k
20 continue
return
end
*deck unpk
subroutine unpack (word, noitms, nobits, items)
c
c routine to unpack noitms from word from right to left
c nobits = field width in bits for each item
c items = positive integer list of unpacked items
c
integer word, wordt
c
dimension nobits(*), items(*)
c
nn = noitms
wordt = word
do 20 i = 1,nn
k = nobits(i)
items(i) = wordt .and. mask(128-k)
wordt = shiftr(wordt, k)
20 continue
return
end
*deck noti
logical function notim (acpu, aio)
c
c dummy function to determine if cpu or i/o time limits are being
c approached.
c
c acpu = dummy
c aio = dummy
c
notim = .false.

```

```

        return
    end
*deck tims
    subroutine timset (time)
C
C     subroutine to calculate elapsed cpu time
C     time = elapsed time - returned
C
C     entry points  timel, timer
C
C     timel - inner measure of time,   elapsed time since last call
C           to either timset, timel, or timer
C
C     timer - outer measure of time,   elapsed time since last call
C           to timset or timer
C
C     timset - initializes timer and timel
C
        atime = second (t)
        etime = 0.0
        rtime = 0.0
        return
C
        entry timel (time)
        n      = 0
        go to 20
C
        entry timer (time)
        n      = 1
C
    20 continue
        etime = second (t)
        time  = etime - atime
        atime = etime
        rtime = rtime + time
        if (n .eq. 1) then
            time  = rtime
            rtime = 0.0
        endif
C
        return
    end
*deck ftbs
    subroutine ftbset (idolr, ndsks, nfiles, idxlo, idxhi, length)
C
C     initialize ftb common block
C
*call ftbd
    integer  ftb
    data     ftb /3hftb /
C
    if (first .ne. ftb) first = idolr

```



```

      call zerout (szz(1), 7)
      ndsk2 = ndsk5
      norelf = nfils
      dmplo = idxlo
      dmphi = idxhi
      if (length .gt. 0) szz(1) = length
      return
    end
*deck flot
      function floatr (a)
c
c      function floatr tests the contents of argument a and converts
c      it to a floating point number if it is an integer -- if the
c      contents of a is a floating point number it is returned as the
c      value of the function.
c
      equivalence (aa,ia)
      data i7777 / 4095 /
c
      itest = shift (a,12).and.i7777
      if (itest .eq. i7777) go to 10
      if (itest .eq. 0 ) go to 10
      floatr = a
      return
c
      10 continue
      aa = a
      floatr = ia
      return
    end
*deck inpp
      subroutine inppck (packed, nwrds, items)
c
*call inpc
      real items(*)
      equivalence (rmode,mode)
c
      answer = 0.0e0
      nshft = 0
c
      do 10 i = 1,nwrds
      rmode = items(i)
      in = mode + 1
      if (in.le.0 .or. in.gt.4) go to 10
      answer = dor (answer, dsrl (fmtmsk(in),nshft))
      nshft = nshft + 2
      10 continue
      packed = answer
      return
    end
*deck inpu
      subroutine inpupk (packed, nwrds, items)

```

```

C
*call inpc
C
    dimension items(*)
    real answer
    integer ia
    equivalence (answer, ia)
C
    nshft = 0
    mshft = ifkey(1) - 1
C
    do 10 i = 1,nwrds
        answer = dsrl (dand (packed, dsrl (fmtmsk(4),nshft)), mshft)
        nshft = nshft + 2
        mshft = mshft - 2
        items(i) = ia
10 continue
    return
end
*deck strace
    subroutine strace
C
C    subroutine to call traceback on cray
C
    integer unit
C
    data unit /6htape6 /
C
    call trbk (unit)
    return
end
*deck inp2
    subroutine inp2 (loc1,loc2,ics)
C
C    routine to transfer data from input card buffer to designated
C    storage area in core
C
C    subroutine arguments
C    loc1(1)      starting location of input buffer -
C    loc2(1)      starting location of moved information
C    ics          control information
C    ics(1) = first = card number to process first
C    ics(2) = last  = final card number to process
C                  may be 0.0 if only one card
C                  > 0 - card numbers sequential
C                  < 0 - card numbers increasing, not sequential
C    ics(3) = min   = minimum number of data words on card
C    ics(4) = max   = maximum number of data words on card -
C                  0 if no upper limit
C    ics(5) = nj    = displacement of data - data stored every nj+1 loc
C    ics(6) = j     = abs(j)=starting address of data in loc2
C                  move/check data - >0 => move, <or=0 => check

```

```

c          upon exit, ics(6) contains number of items moved
c          if j>0, -(number of items checked) if j<0
c
c      real loc1(*),loc2(*)
c      integer ics(*), first, last, c, add
c
c      first = ics(1)
c      last  = ics(2)
c      min   = ics(3)
c      max   = ics(4)
c      nj    = ics(5)
c      j     = ics(6)
c      nlast = 1
c      ncase = 1
c      nmove = 1
c      if (last .lt. 0) then
c
c  to process any cards between first and last go to 120
c
c      ncase = 2
c      go to 120
c      endif
c
c  one card only
c
c      if (last .eq. 0) then
c          last = first
c      endif
c 120 continue
c      c = first
c      add = 0
c
c  check if data to be moved - no - set nmove = 2
c
c      if (j .le. 0) nmove = 2
c      nc = 0
c      mgo = 1
c
c  check if max number of data items specified
c  if none - set mgo = 2
c
c      if (max .eq. 0) mgo = 2
c 130 continue
c      c = c + add
c
c  get card location
c
c 135 continue
c      call link (c, next, loc, ndata, loc1)
c
c  ndata - number of data fields on card
c

```

```

        if (ncase .ne. 1) go to 170
        if (ndata) 160,150,180
150    if (next-iabs(last)) 155,165,255
155    if (next.lt.0) go to 255
        go to 165
c
160    write (6,1000) c
1000    format ('0***** illegal format on card',i10)
        go to 265
c
165    write (6,1001) c
1001    format ('0***** card',i10,' missing in sequence')
        go to 265
c
c    check data count
c
170    if (ndata ) 160,175,180
c
c    no data - set card number to next higher card location
c
175    continue
        c      = next
        ncard = 2
        if (c) 255,185,185
c
180    ncard = 1
185    if (c-iabs(last)) 195,190,255
190    nlast = 2
c
c    this is the last card
c
195    if (ncard .ne. 1) go to 135
        nom    = nc + ndata
        if (mgo .ne. 1) go to 210
c
c    test number of data words
c
        if (nom .le. max) go to 210
        write (6,1002) first,c
1002    format ('0***** too many numbers on cards',i10,' through',i10)
        go to 265
c
c    check mode of data
c
210    continue
        call moder (loc1,ics,loc,ndata, ltype,nc)
        if (ltype.gt.10000) go to 225
        if (ltype) 220,230,215
c
c    floating point number found for fixed point
c
215    write (6,1003) ltype,c

```

```

1003 format ('0***** word',i3,' on card',i10,
*          ' should be in integer format.')
      go to 265
c
c fixed point number found for a floating point
c
220 ltype = -ltype
      write (6,1004) ltype,c
1004 format ('0***** word',i3,' on card',i10,
*          ' should be in floating point format')
      go to 265
c
c alpha-numeric data expected - not found
c
225 ltype = ltype - 10000
      write (6,1005) ltype,c
1005 format ('0***** word',i3,' on card',i10,
*          ' should be in alphanumeric format')
      go to 265
c
c check if data to be moved to new location
c
230 continue
      if (nmove .ne. 1) go to 245
c
c move to new location
c
      l      = loc
      maxnum = l + ndata - 1
      locb   = j + (nj + 1)*nc
c
      do 240 loca = l,maxnum
        loc2(locb) = loc1(loca)
        locb = locb + nj + 1
240 continue
c
245 continue
      nc = nc + ndata
c
c check for last card
c
      if (nlast .ne. 1) go to 255
c
c another card expected
c
      add = 1
      go to 130
c
c last card
c
255 continue
      if (nc .ge. min) go to 270

```

```

        loca = iabs (last)
        if (nc .gt. 0) go to 260
        write (6,1006) first,loca
1006 format ('0***** cards',i10,' through',i10,' missing')
        go to 265
c
    260 continue
        write (6,1007) first,loca
1007 format ('0***** too few numbers on cards',i10,' through',i10)
    265 ics(6) = -1
        go to 280
c
    270 continue
        if (nmove .eq. 1) go to 275
        ics(6) = -nc
        go to 280
c
    275 ics(6) = nc
c
    280 continue
        return
        end
*deck inp4
        subroutine inp4 (c1,c2,min,max,nj,j,c3,ntimes,j1,loc1,loc2,loc5)
        real loc1(*),loc2(*)
        integer c1,c2,c3,loc5(*),lray(46),ac1,ac2
c
        nj1 = j
        lm = 1
        ac1 = c1
        ac2 = c2
        ncount = 0
        if (ntimes .le. 0) call fabend
c
        do 100 ma = 7,46
            lray(ma) = loc5(ma-6)
100 continue
c
        lray(3) = min
        lray(4) = max
        lray(5) = nj
c
        do 105 mc = 1,ntimes
            lray(1) = ac1
            lray(2) = ac2
            lray(6) = nj1
            call inp2 (loc1,loc2,lray)
            ac1 = ac1+c3
            if (c2)110,125,120
110 continue
            ac2 = ac2-c3
            go to 125

```

```

120 continue
    ac2      = ac2+c3
125 continue
    if (lray(6)+1) 130,140,150
140 continue
    lm = 2
    nj1 = -1
    go to 105
130 continue
    if (lm .eq. 1) go to 135
    go to 105
150 continue
    nj1      = nj1 + j1
    go to 136
135 continue
    nj1      = lray(6)
136 continue
    ncount = ncount + lray(6)
105 continue
    if (lm .ne. 1) go to 170
    j      = ncount
    go to 180
170 continue
    j      = -1
c
180 continue
    return
    end
*deck inp5
    subroutine inp5 (c1,c2,c3,in1,in2,in3,in4,in5,in6,in7,loc1,loc2,
    * loc5,loc6,in8)
c
    real loc1(*), loc2(*), loc6(1)
    integer c1, c2, c3, ac1, ac2, lray(46), cn2, card, loc5(*)
    real at
    integer iat
    equivalence (at, iat)
c
    if (in1) 105,110,115
110 call fabend
105 continue
    ltpe      = 2
    n1        = -in1
    if (in2) 120,125,130
120 continue
    n2        = -in2
140 continue
    limlow = 1
    go to 135
c
125 continue
    n2        = 0

```

```

        go to 140
c
130 continue
    n2      = in2
    limlow = 2
    go to 135
c
115 continue
    n1      = in1
    ltpe    = 1
    limlow = 1
    n2      = in2
135 continue
    if (in4) 145,110,155
145 continue
    n4      = -in4
    mode    = 2
    go to 160
c
155 continue
    n4      = in4
    mode    = 1
160 continue
    if (in3) 165,170,175
165 continue
    n3      = -in3
185 continue
    limup   = 1
    go to 180
c
170 continue
    n3      = 32000 - 1
    go to 185
175 continue
    n3      = in3
    limup   = 2
180 continue
    ac1     = c1
    ac2     = c2
    ls      = in7
    nmove   = 0
    lray(1) = ac1
    lray(2) = ac2
    lray(3) = 1
    lray(4) = in8
    lray(5) = 0
    lray(6) = 1
c
    do 190 la = 1,40
    lb      = la + 6
    lray(lb) = loc5(la)
190 continue

```



```

c
do 100 mad = 1,in5
call inp2 (loc1,loc6,lray)
nmov = lray(6)
if (nmov) 205,500,210
205 continue
in7 = -1
go to 500
210 continue
luplim = limup
lowlim = limlow
nmove = nmove + nmov
k1 = n1 + ltpe
k2 = nmov/k1
last = n2
if (nmov .eq. k1*k2) go to 220
cn2 = iabs(ac2)
write (6,1) nmov,ac1,cn2,k1
1 format ('0***** ',i5,' numbers on cards',i10,' through',i10,
* ' are not a multiple of',i4)
in7 = -1
go to 500

c
220 continue
if (mode .ne. 1) go to 230
k4 = ls + n4*last
k5 = 1
k6 = n4
go to 235

c
230 continue
k4 = ls+last
k5 = n4
k6 = 1
235 continue

c
do 400 k3 = 1,nmov,k1
if (ltpe .ne. 1) go to 245
nstart = last + 1
k12 = k3
k13 = k3 + n1 - 1
go to 250
245 continue
at = loc6(k3)
nstart = iat
k12 = k3 + 1
k13 = k3 + n1
if (nstart-n2) 255,260,265
255 cn2 = iabs (ac2)
call inp6 (ac1,cn2,k3,card,item,loc1)
write (6,2) item,card,n2
2 format ('0***** item',i3,' on card',i10,' is less than minimum'

```

```

      *      , ' allowed of', i5)
      in7    = -1
      go to 500
c
260 continue
    lowlim = 1
265 continue
    if (mode .ne. 1) go to 275
    k4      = 1s + n4*(nstart - 1)
    go to 250
c
275 continue
    k4      = 1s + (nstart - 1)
250 continue
    if (k4 .le. 0) go to 110
    k11     = k3 + k1 - 1
    at = loc6(k11)
    last = iat
    if (last-n3) 290,305,310
310 continue
    cn2     = iabs (ac2)
    call inp6 (acl, cn2, k11 ,card, item, loc1)
    write (6,3) item,card,n3
3 format ('0***** item',i3,' on card',i10,' exceeds maximum allow
*ed of',i5)
    in7     = -1
    go to 500
c
305 continue
    luplim = 1
290 continue
    if (nstart-last) 315,315,320
320 continue
    cn2     = iabs (ac2)
    call inp6 (acl, cn2, k3, card, item, loc1)
    write (6,4) item,card
4 format ('0***** error in limits of the set beginning at item'
*,i3,' on card',i10)
    in7     = -1
    go to 500
c
315 if (in7) 500,325,325
325 continue
c
    do 200 k8 = nstart,last
    k9      = k4
c
    do 300 k10 = k12,k13
    loc2(k9) = loc6(k10)
    k9      = k9+k5
300 continue
    k4      = k4 + k6

```

```

200 continue
400 continue
    if (lowlim .eq. 1) go to 330
    cn2    = iabs (ac2)
    write (6,5) n2,ac1,cn2
5 format ('0***** lower limit of',i5,' not included on cards',
* i10,'through',i10)
    in7    = -1
    go to 500
c
330 if (luplim .eq. 1) go to 500
    cn2    = iabs (ac2)
    write (6,6) n3,ac1,cn2
6 format ('0***** upper limit of',i5,' not included on cards',
* i10,'through',i10)
    in7    = -1
500 continue
    if (ac2) 350,355,360
350 continue
    ac2    = ac2 - c3
    go to 355
c
360 continue
    ac2    = ac2 + c3
355 continue
    ac1    = ac1 + c3
    ls     = ls + in6
    lray(1) = ac1
    lray(2) = ac2
602 continue
    lray(6) = 1
100 continue
    if (in7 .ge. 0) in7 = nmove
c
    return
end
*deck inp6
subroutine inp6 (c1, c2, n1, card, item, loc1)
real loc1(*)
integer c1, c2, card, ac1, ac2, d
c
    if (c2.eq.0) then
        ac2    = c1
    else
        ac2    = c2
    endif
c
    d        = c1
    ntot     = 0
c
10 ac1      = d
    if (ac1 .gt. ac2) call fabend

```

```

c      call link (acl, d, m, n, loc1)
      ntot = ntot + n
      if (ntot .lt. n1) go to 10
      card = acl
      item = n1-(ntot-n)
c
      return
      end
*deck inp7
      subroutine inp7 (card, item)
      integer card
c
      write (6,1) item,card
      1 format ('0***** item',i3,' on card',i10,' in error')
      return
      end
*deck inp8
      function inp8 (list,a)
c
c      inp8 on return is the number of extraneous cards found.
c      here extraneous means no reference by link (hence, also inp2,4,5)
c
      dimension a(*)
      real r1
      integer ir1
      equivalence(r1,ir1)
c
      icnt = 0
      r1 = a(1)
      i1 = ir1 + 3
      r1 = a(2)
      i2 = i1 + ir1 - 1
      if (i2 .ge. i1) then
c
          do 1 i = i1,i2,3
              r1 = a(i)
              if (ir1 .lt. 0) go to 1
              if ((icnt .eq. 0) .and. (list .ne. 0)) write (6,2)
              icnt = icnt + 1
              r1 = a(i)
              ncrd = ir1
              if (list.ne.0) write (6,3) ncrd
          1 continue
c
          endif
          inp8 = icnt
          return
c
          2 format('0***** the following cards were not used'///)
          3 format (10x,i10)
          end

```

```

*deck inl0
      function inpl0 (a, nc1, nc2)
c
c
c  routine to delete card numbers in the rangine of nc1 to nc2 from
c  the table-list.  the result of this function is the new length of
c  the input array of input data plus cards plus one.
c      *
c  * * * *      parameters in the call list
c      *
c  a          buffer array containing table and list beginning at a(1)
c  nc1        first card to delete
c  nc2        last card to delete
c              all cards c1 through c2 will be deleted.
c
*call inpc
c
      dimension a(*)
      real r1
      integer ir1
      logical s9, s1
      equivalence (ptrn1,iptrn), (ptrnk,kptrn), (r1, ir1)
c
      s9      = .false.
      go to 11
c
      entry inp9 (a)
      s9      = .true.
c
c  take table-list word apart to find old table, list lengths
c
      11 continue
         r1 = a(2)
         ltab = ir1
         r1 = a(1)
         list = ir1
c
c  list = length of list, ltab = length of table
c
      if (list.eq.0 .or. ltab.eq.0) go to 10
      nfirst = list + 3
      last   = nfirst + ltab - 1
      lend   = list + 1
      s1     = .false.
c
c  top of loop for each table entry
c
      20 continue
         do 2 lcard = nfirst,last,3
c
c  take table entry apart to look at individual items
c

```

```

    r1 = a(lcard)
    ncard = abs(irl)
    if (s9) go to 12
    if (ncard.lt.nc1 .or. ncard.gt.nc2) go to 2
    go to 13
C
12 continue
    r1 = a(lcard)
    if (irl .ge. 0) go to 2
C
C card has been used and should be deleted
C
13 continue
    r1 = a(lcard + 1)
    loc = irl
C
C loc = index (in a) of first item on the card
C
    r1 = a(lcard + 2)
    many = irl
    many = many + (many + nbits - 1)/nbits
C
C many = number of data items on the card plus the number of
C format mode words
C
    if (s1) go to 21
    if (many .eq. 0) go to 2
C
C set bit pattern in list for later deletion
C
    l1 = loc + many - 1
C
    do 4 i = loc,l1
        a(i) = ptrn1
4 continue
    go to 2
C
C clear the table entry
C
21 continue
    a(lcard) = 0.e0
C
C correct all table entries with list entries higher than loc
C
    do 5 l = nfirst+1,last+1,3
        if (a(l-1) .eq. 0.e0) go to 5
C
C take table entry apart to look at individual items
C
    r1 = a(l)
    nthis = irl
C

```

```

c  nthis = index (in a) of data for current card
c
c      if (nthis .lt. loc) go to 5
c
c  repack new list location into table entry
c
c      newidx = nthis - many
c      irl = newidx
c      a(1) = r1
c      5 continue
c
c  reduce the list length
c
c      list = list - many
c
c  reduce the table length
c
c      ltab = ltab - 3
c      2 continue
c
c  end of loop for each table entry
c
c      sl = .not.sl
c      if (sl) go to 20
c      if (ltab .eq. 0) go to 30
c
c  squeeze the list
c
c      k = 1
c      do 18 i = 2, lend
c      if (a(i+1) .eq. ptrn1) go to 18
c      k = k + 1
c      a(k+1) = a(i+1)
c      18 continue
c      if (k .ne. list+1) then
c          write (6,500) ltab,list,k
c          len = ltab + list + 1
c          write (6, 1010) (a(1), 1=1,len)
c          call fabend
c      endif
c
c  move table up to the list dropping out all cleared entries
c
c      l = 0
c      do 6 i = nfirst,last,3
c      if (a(i) .eq. 0.0e0) go to 6
c      do 66 j = 0, 2
c      l = l + 1
c      k = k + 1
c      a(k+1) = a(i+j)
c      66 continue
c      6 continue

```

```

        if (l .ne. ltab) then
            write (6,500) ltab,list,l
            len = ltab + list + 1
            write (6, 1010) (a(k), k=1,len)
1010    format (1x,6z20)
            call fabend
        endif
c
c repack new table-list length word into a(1)
c
30 continue
    ir1 = list
    a(1) = r1
    ir1 = ltab
    a(2) = r1
10 continue
c
    inpl0 = list + ltab + 2
c
    return
c
500 format (' ***** error in inpl0 - computed table length mismatch
*, ltab = ',i7,' list = ',i7,' len = ',i7)
    end
*deck link
    subroutine link (cardno, next, where, nwrds, a)
c
c subroutine link locates card number cardno in the inp card table
c using a binary search of the inp card number table that is ordered
c in descending card number order. if cardno exists, a pointer is
c returned that points to the data on the card and the number or
c data words is also returned.
c
c cardno = the requested data card number (input)
c next = the next larger card number in the table (output)
c where = the index in array a pointing to the beginning
c of the data on card cardno. (output)
c nwrds = the number of data items on card cardno. (output)
c a = array containing inp card number and data tables. (input)
c
    dimension a(*)
    integer frstcd, frstm1, cardno, where, powr2
    real r1
    integer ir1
    equivalence (r1, ir1)
    data inext / 0 /, jnext / 0 /
c
    r1 = a(2)
    length = ir1
    r1 = a(1)
    frstm1 = ir1 + 2
    lastcd = length + frstm1

```



```

    frstcd = frstm1 + 1
    length = length / 3
c
c  check to see if next from previous call to link is equal to cardno
c
    if (cardno .ne. inext) go to 10
    if (cardno .eq. 0)      go to 10
    if (jnext .gt. lastcd) go to 10
    j      = jnext
    r1 = a(j)
    num = abs(ir1)
    if (cardno .eq. num) go to 70
c
c  find power of two greater than length and subtract one
c
    10 continue
        ipow2 = 0
        powr2 = 1
    20 continue
        ipow2 = ipow2 + 1
        powr2 = 2*powr2
        if (powr2 .le. length) go to 20
c
        ipow2 = ipow2 - 1
        powr2 = powr2/2
        j      = frstm1 + (powr2 * 3) - 2
        r1 = a(j)
        num = abs(ir1)
        if (num .le. cardno) go to 40
c
c  num from first guess is greater than cardno, ensure that the first
c  guess plus the next lower power of two is not outside the table.
c
    30 continue
        if (j+(2**(ipow2-1)*3) .le. lastcd) go to 50
        ipow2 = ipow2 - 1
        if (ipow2 .ge. 0) go to 30
        go to 80
c
    40 continue
        if (num .eq. cardno) go to 70
        if (num .lt. cardno) go to 60
c
c  num is greater than cardno -- increment pointer by next lower
c  power of 2
c
    50 continue
        ipow2 = ipow2 - 1
        if (ipow2 .lt. 0) go to 80
        powr2 = 2**ipow2
        if (j+(powr2*3) .gt. lastcd) go to 50
        j      = j + (powr2 * 3)

```

```

        r1 = a(j)
        num = abs(irl)
        go to 40
c
c num is less than cardno -- decrement pointer by next lower
c power of 2
c
60 continue
    ipow2 = ipow2 - 1
    if (ipow2 .lt. 0) go to 80
    powr2 = 2**ipow2
    if (j-(powr2*3) .lt. frstcd) go to 60
    j      = j - (powr2 * 3)
    r1 = a(j)
    num = abs(irl)
    go to 40
c
c found the right card no.
c
70 continue
    r1 = a(j)
    if (irl .gt. 0) then
        irl = -irl
        a(j) = r1
    endif
    r1 = a(j+1)
    where = irl
    r1 = a(j+2)
    nwrds = irl
    if (j .le. frstcd) then
        next = -1
        jnext = 0
    else
        jnext = j - 3
        r1 = a(jnext)
        next = abs(irl)
    endif
c
    inext = next
    return
c
c card no. not found
c
80 continue
    where = 0
    nwrds = 0
    jnext = j
    next = num
    if (next .lt. cardno) then
        jnext = j - 3
        r1 = a(jnext)
        next = abs(irl)

```

```

        if (jnext .lt. frstcd) then
            next = -1
            jnext = 0
        endif
    endif
c
    inext = next
    return
end
*deck mode
    subroutine moder (loc1, loc3, j, m, n, nc)
c
c  mode is a subroutine that checks the probable mode of m numbers at
c  loc1(j) and on by using the format array at loc3(7) and on. the
c  number of items already processed (nc) determines the starting
c  point in loc3(7). on exit n=0 if the mode is in all probability
c  correct, n+= the number of the item in error if it should be fixed
c  and is not, n=- the number of the item in error if it should be
c  floating and is not.
c
c  n .gt. 10000 means item n-10000 should be alpha-numeric and is not
c
*call inpc
    real loc1(*)
    dimension loc3(*), mud(32)
c
    if (j.le.0 .or. m.le.0 .or. nc.lt.0) call fabend
    modes = nbits
    im = 1
    ilm = j + m
    nfun = 1
    num = nc - 1
    ma = 7
130 if (iabs(loc3(ma)) .ge. 2) go to 110
c
c  full section not in a repeat
c
    if (num .lt. 0) go to 121
    num = num - 1
    ma = ma + 1
    go to 130
c
c  keep going through until past no. already processed
c
121 md = ma
    ngo = 1
    go to 120
c
c  test for type of repeat
c
110 if (loc3(ma) .lt. 0) go to 235
c

```

```

c a repeat that is reset for each card
c
    ngo      = 2
145 md       = ma
    mb       = loc3(md)
155 md       = md + 1
    if (mb .ne. 0) go to 120
    go to 145
c
c do not reset repeat for each card
c
235 ngo      = 3
135 md       = ma
    mb       = -loc3(md)
165 md       = md + 1
    if (mb .eq. 0) go to 135
    if (num .le. 0) go to 120
    mb       = mb - 1
    num      = num - 1
    go to 165
c
120 if (mod(im,modes).ne.1) go to 801
    call inpupk (loc1(ilm),modes,mud)
    im       = 1
    ilm      = ilm + 1
801 if (mud(im).eq.0 .and. loc3(md).ne.(-1)) go to 440
    nback    = mud(im) - 1
    if (nback .eq. 2) nback = -1
    if (loc3(md) .eq. nback) go to 440
c
c desired mode does not match input conversion mode
c
    if (loc3(md)) 410,420,430
c
c should be hollerith
c
410 n        = 10000 + nfun
    go to 115
c
c should be integer
c
420 n        = nfun
    go to 115
c
c should be real
c
430 n        = -nfun
    go to 115
440 im       = im + 1
    if (nfun .ge. m) go to 311
    nfun      = nfun + 1
    if (ngo .ne. 1) go to 320

```

```

      ma      = ma + 1
      go to 130
320  mb      = mb - 1
      if (ngo .eq. 2) go to 155
      go to 165
311  n      = 0
115  return
      end
*deck bufo
      subroutine bufout (unit, a, next, chek, last, vsn)
c
      dimension a(*)
      dimension bfil(10), mode(10)
      dimension inout(10), istart(10), iend(10)
      integer unit,next,chek,last,nerror,rec,file,cero
      real nextid
      character*8 crmark, ctest
      character*6 tapexx
      character*4 tape
      character*2 xx(10)
c
      common / ftb / buf(1)
c
      data nerror / 0 /, cero / 0 /
      data mode / 10*0 /, bfil / 10*0.0e0 /
      data lbuf / 4096 /
      data crmark / 'recmark' /
      data rmark / 8hrecmark /, vblk / 6h /
      data savtap / 8hsavtap /, datjul / 8htoday /
      data xx / '1', '2', '3', '4', '5',
*          '11', '12', '13', '14', '15' /
      data tape / 'tape' /
c
c      mode flags
c          0 => file rewound but not open
c          1 => last operation was a write
c          2 => last operation was a read
c          3 => eof encountered in last read
c
c      check for valid unit number
c
      vsn      = vblk
      if (unit .ge. 6 .and. unit .le. 10) go to 50
      iunt      = unit
      if (unit .ge. 11) iunt = unit - 5
      if (iunt .le. 0 .or. iunt .gt. 10) go to 50
c
c      check for correct mode number
c
      if (mode(iunt) .eq. 2) go to 60
      i      = 1
      nwrds   = next

```

```

        last  = next
        lohi  = chek
        chek  = 1
C
C  open file buffers if mode is 0
C
        if (mode(iunt) .eq. 0) then
C
            tapexx = tape//xx(iunt)
            open (unit=unit,file=tapexx,status='new',access='sequential',
*              form='unformatted',err=70,iostat=iostat)
C
            bfil(iunt) = nextid(0)
            call reserv (bfil(iunt), lbuf, lohi, istart(iunt))
            inout(iunt) = istart(iunt)
            iend (iunt) = istart(iunt) + lbuf - 1
        endif
C
        mode(iunt) = 1
C
20 continue
    min  = inout(iunt)
    max  = min + nwrds - 1
    if (max .ge. iend(iunt)) go to 30
C
    do 25 j = min,max
        buf(j) = a(i)
        i      = i + 1
25 continue
    inout(iunt) = max + 1
    return
C
C  write spans a buffer - fill rest of buffer then write
C
30 continue
    max  = iend(iunt)
C
    do 35 j = min,max
        buf(j) = a(i)
        i      = i + 1
35 continue
C
    ilo  = istart(iunt)
    ihi  = iend(iunt)
    write (unit,err=40,iostat=iostat) (buf(l),l=ilo,max)
    nwrds = nwrds + min - max - 1
    inout(iunt) = istart(iunt)
    if (nwrds .gt. 0) go to 20
    return
C
C  write error has occurred
C

```

```

40 continue
   chek   = 2
   last   = 0
   return
C
C unit number out of range
C
50 continue
   last   = 0
   chek   = 4
   return
C
C mode error
C
60 continue
   last   = 0
   chek   = 2
   return
C
C open error on unit
C
70 continue
   last   = iostat
   chek   = 4
   return
C
C*****
C      entry bufin (unit, a, next, chek, last, vsn)
C*****
C
   vsn    = vblk
   if (unit .ge. 6 .and. unit .le. 10) go to 50
   iunt    = unit
   if (unit .ge. 11) iunt = unit - 5
   if (iunt .le. 0 .or. iunt .gt. 10) go to 50
   if (mode(iunt) .eq. 1) go to 60
   i       = 1
   nwrds   = next
   last    = next
   lohi    = chek
   chek    = 1
C
C open file buffers if mode is 0
C
   if (mode(iunt) .eq. 0) then
C
      tapexx = tape//xx(iunt)
      open (unit=unit,file=tapexx,status='old',access='sequential',
*         form='unformatted',err=70,iostat=iostat)
C
      bfil(iunt) = nextid(0)
      call reserv (bfil(iunt),lbuf,lohi,istart(iunt))

```

```

        inout(iunt) = istart(iunt)
        iend (iunt) = istart(iunt) + lbuf - 1
C
        ilo      = istart(iunt)
        ihi      = iend(iunt)
        read (unit,err=160,iostat=iostat,end=140) (buf(1),l=ilo,ihl)
        endif
C
C      test to see if eof was encountered last time through
C
        if( mode(iunt) .eq. 3 ) then
            nwrds = 0
            go to 140
        endif
C
        mode(iunt) = 2
120 continue
        min      = inout(iunt)
        max      = min + nwrds - 1
        if (max .gt. iend(iunt)) go to 130
C
        do 125 j = min,max
            a(i)  = buf(j)
            i     = i + 1
125 continue
        inout(iunt) = max + 1
        nwrds = 0
        if (max .eq. iend(iunt)) then
            inout(iunt) = istart(iunt)
        else
            write (ctest,'(a8)') buf(max+1)
            if (ctest .ne. crmark) return
            write (ctest,'(a8)') buf(iend(iunt))
            if (ctest .ne. crmark) return
        endif
C
        ilo      = istart(iunt)
        ihi      = iend(iunt)
        read (unit,err=150,end=140,iostat=iostat) (buf(1),l=ilo,ihl)
        write (ctest,'(a8)') buf(ilo)
        if (ctest .eq. crmark) go to 150
        return
C
C      read spans a buffer - empty current buffer - then read the next
C
130 continue
        max      = iend(iunt)
C
        do 135 j = min,max
            a(i)  = buf(j)
            i     = i + 1
135 continue

```



```

C      ilo      =  istart(iunt)
      ihi      =  iend(iunt)
      read (unit,err=150,end=140,iostat=iostat)  (buf(1), 1=ilo,ihl)
      write (ctest,'(a8)') buf(ilo)
      if (ctest .eq. crmark) go to 150
      nwrds    =  nwrds + min - max - 1
      inout(iunt) = istart(iunt)
      if (nwrds .gt. 0) go to 120
      return

C
C      end of file encountered
C
      140 continue
      mode(iunt) = 3
      chek      = 3
      last      = next - nwrds
      return

C
C      read error - if a record mark, read next buffer
C
      150 continue
C      check if read error was a short read
      write (ctest,'(a8)') buf(istart(iunt))
      if (ctest .ne. crmark) go to 40
      write (ctest,'(a8)') buf(iend(iunt))
      if (ctest .ne. crmark) go to 40

C
      ilo      =  istart(iunt)
      ihi      =  iend(iunt)
      read (unit,err=160,end=140,iostat=iostat)  (buf(1), 1=ilo,ihl)
      mode(iunt) = 2
      inout(iunt) = istart(iunt)
      if (nwrds .gt. 0) go to 120
      return

C
C      read error -
C
      160 continue
      chek      = 2
      last      = 0
      return

C
C*****
C      entry bufskp (unit, rec, file, chek)
C*****
C
      if (unit .ge. 6 .and. unit .le. 10) go to 50
      iunt      = unit
      if (unit .ge. 11) iunt = unit - 5
      if (iunt .le. 0 .or. iunt .gt. 10) go to 50
      if (file .lt. 0) go to 330

```

```

C
C  check for valid mode
C
      if (mode(iunt) .eq. 1) go to 60
      if (rec .lt. 0) go to 40
      nskip   = rec
      ilo     = istart(iunt)
      ihi     = iend(iunt)
C
C  skip a record
C
300 continue
      read (unit,end=140,err=310,iostat=iostat) (buf(1),l=ilo,ihl)
      write (ctest,'(a8)') buf(ilo)
      if (ctest .ne. crmark) go to 300
      write (ctest,'(a8)') buf(ihl)
      if (ctest .ne. crmark) go to 300
C
C  read error - test for record mark
C
310 continue
      nskip   = nskip - 1
      if (nskip .gt. 0) go to 300
C
C  finished skipping - read a buffer
C
      read (unit,end=140,err=40,iostat=iostat) (buf(1),l=ilo,ihl)
      inout(iunt) = istart(iunt)
      chek       = 1
      return
C
C  rewind the file
C
330 continue
      rewind unit
      inout(iunt) = 0
      mode(iunt)  = 0
C
      close (unit=status='keep')
C
      call delete (bfil(iunt))
      bfil(iunt) = 0.0e0
      chek       = 1
      return
C
C*****
      entry bufwef (unit,a,id,chek)
C*****
C
      if (unit .ge. 6 .and. unit .le. 10) go to 50
      iunt      = unit
      if (unit .ge. 11) iunt = unit - 5

```

```

        if (iunt .le. 0 .or. iunt .gt. 10) go to 50
C
C   check valid operation mode
C
        ilo    = istart(iunt)
        ihi    = iend(iunt)
        if (mode(iunt) .eq. 2) go to 60
        if (inout(iunt) .eq. istart(iunt)) go to 225
C
C   pad buffer with record mark
C
        min    = inout(iunt)
C
        buf(min) = rmark
        buf(ihi) = rmark
C
        write (unit,err=40,iostat=iostat) (buf(l), l=ilo, ihi)
C
C   write a record mark
C
225 continue
        buf(ilo) = rmark
        buf(ihi) = rmark
C
        write (unit,err=40,iostat=iostat) (buf(l), l=ilo, ihi)
        inout(iunt) = istart(iunt)
C
        if (id .ne. 15) go to 240
        endfile unit
C
240 continue
        chek    = 3
        return
C
C*****
C   entry bufaev (unit, a, id, chek)
C*****
C
        return
        end
*deck hlfi
        function hlfinp (n1, n2)
C
C   pack two integers into a real word (8-byte word for ibm)
C
C   n1      = integer to merge into top half of real word      (input)
C   n2      = integer to merge into bottom half of real word   (input)
C
*call inpc
        equivalence (a1,ial), (a2,ia2)
C
        ial    = n1

```

```

        ia2      = n2
C
        a1      = dsrl (a1,nbits)
        a2      = dsrl (a2,nbits)
        hlfinp  = dor (dsl (a1,nbits), a2)
C
        return
        end
*deck inp
        subroutine inp (ll, nll, titl, ncase, ndata, isw)
C
*call inpc
C
        integer errpos
        real ll(*), maskf
        dimension titl(*)
        dimension imask (5,2), mbits(2)
        equivalence (ptrn1,iptrn), (ptrnk,kptrn)
        equivalence (crd,ncrd), (rmode,mode)
        logical nuse, nocard, newcrd, nx, eoff, edt
        character*1 card(80), errbuf(80), idlrs, tmpchr
        character*1 iblack, slash, equals, pls, ast, comma, period
        character*8 buff(10)
        real rl
        integer irl
        integer time
        save time
        equivalence (errbuf(1),buff(1)), (rl, irl)
        data mbits / 60, 64 /
        data imask / 1, 29, 1, 18, 11, 1, 29, 1, 17, 16 /
        data ikp / 0 /, clear / 0.0e0 /
        data blank / 8h /, error / 8h**error* /
        data slash / '/' /, equals / '=' /, pls / '+' /, iblack / ' ' /,
*      ast / '*' /, comma / ',' /, period / '.' /, idlrs / '$' /
C
C initialize inpc common block
C
        nbits = 32
        time = 0
        nshft = 0
        do 10 i = 1,5
            lmask(i) = imask(i,2)
            fkey(i) = dsrl (maskf (lmask(i)), nshft)
            nshft = nshft + lmask(i)
            ifkey(i) = mbits(2) - nshft
10 continue
        nbits = (ifkey(1) + 1)/2
        fmtmsk(1) = 0.0e0
        fmtmsk(3) = maskf (1)
        fmtmsk(2) = dsrl (fmtmsk(3),1)
        fmtmsk(4) = dor (fmtmsk(2),fmtmsk(3))
        amask(1) = maskf (nbits)

```

```

amask(2) = maskf (-nbits)
ptrn1    = dsrl (maskf (ifkey(1)),1)
ptrn2    = dsrl (maskf (ifkey(1)-1),1)
mxcrd    = 999999999
mxidx    = 999999
mxwds    = 999999

c
c some local variable definitions:
c
c   nwrds = no. of words on the current card
c   errpos = returned from cvi pointing to the position on the card
c           where cvi detected a card error
c   nocard = logical flag indicating if there has been a previous
c           card to continue with a plus card
c
c get todays date
c
c   titl(11) = blank
c   call date (titl(12))
c
c   ncase = ncase + 1
c   eoff  = .false.
c   nuse  = ndata .le. 0
c   edt   = isw .ne. 0
c   isw   = 0
c   nt    = n11 - 2
c   nb    = 3
c
c clear card number use flags from previous case data
c
c   if (nuse) go to 20
c   r1     = 11(2)
c   ntt    = irl
c   r1     = 11(1)
c   nbb    = irl
c   nt     = nt - ntt
c   nb     = nb + nbb
c   if (nb .ge. nt) go to 901
c   n1     = n11
c   n2     = ntt + nbb + 2
c
c   do 15 i = 1,ntt,3
c   11(n1) = 11(n2)
c   n1     = n1 - 1
c   n2     = n2 - 1
c   11(n1) = 11(n2)
c   n1     = n1 - 1
c   n2     = n2 - 1
c   r1     = 11(n2)
c   irl    = abs(irl)
c   11(n1) = r1
c   n1     = n1 - 1

```

```

      n2      = n2 - 1
15 continue
C
20 continue
   ncn      = 0
   nwrds    = 0
   nx       = .true.
   nuse     = .true.
   nocard   = .true.
   n1       = nb
   n2       = (nt+nb)/2
   n3       = n2
C
C read data cards in alpha-numeric format - will be converted
C into correct format later by cvi.
C
21 continue
   newcrd = .true.
   read (5,1100,end=902) card
1100 format (80a1)
   if (edt .and. ncn .eq. 0) write (6, 1001) ncase
1001 format ('listing of input data for case',i3,/)
   ncn     = ncn + 1
C
C find first non-blank character on the card
C
   do 22 i = 1,80
   if (card(i) .ne. iblank) go to 23
22 continue
   go to 30
C
C check for continuation card (first non-blank is a +)
C
23 continue
   if (card(i) .eq. pls) then
   if (nocard) go to 903
   ikp     = i
   newcrd = .false.
   go to 50
   endif
C
   if (card(i) .eq. ast .or. card(i) .eq. idlrs) go to 30
C
C new title card - write it into titl array
C
   if (card(i) .eq. equals) then
   card(i) = iblank
C
   do 25 ii = i,80
   errbuf(ii-i+1) = card(ii)
25   continue
   read (buff,1005) (titl(ii),ii=1,10)

```

```

1005    format (a8)
        card(i) = equals
        i       = i + 1
        go to 30
    endif
c
c    check to see if card is a case terminator (slash)
c
        if (card(i) .eq. slash) then
            nuse = .false.
            go to 30
        endif
c
c    check to see if card is a problem terminator (period)
c
        if (card(i) .eq. period) then
            ncase = -ncase
            nuse = .false.
            go to 30
        endif
c
28 continue
    newcrd = .false.
    nx     = .false.
c
c    this card may contain data -- test for valid card number
c
30 continue
    if (nocard) go to 50
    rmode = ll(n2)
    if (mode .ne. 1) go to 904
    crd   = ll(nb)
    if (ncrd.le.0 .or. ncrd.gt.mxcrd) go to 904
    nwrds = nwrds - 1
c
c    check data index and number of data words to insure that limits
c    on the table word field lengths have not been exceeded
c
32 continue
    if (nb .ge. mxidx) go to 908
    if (nwrds .ge. mxwds) go to 906
c
c    pack and store table word with card number, data index and word count
c
        ir1 = ncrd
        ll(nt) = r1
        ir1 = nb
        ll(nt+1) = r1
        ir1 = nwrds
        ll(nt+2) = r1
c
c    compress data to eliminate the card number from the data

```

```

C      if (nwrds .eq. 0) go to 45
      do 35 i = 1,nwrds
      ll(nb) = ll(nb+1)
      nb     = nb + 1
35 continue
C
C      pack data format flags into format mode word(s) and store after data
C
      nmod    = nwrds
37 continue
      nwpck   = min0 (nmod,nbits)
      call inppck (ll(nb), nwpck, ll(n2+1))
      nb      = nb + 1
      n2      = n2 + nbits
      n3      = n3 - nbits
      nmod    = nmod - nbits
      if (nmod .gt. 0) go to 37
C
C      check if this is a replacement card
C
45 continue
      if (ncrd .eq. 0) go to 49
      if (nt .eq. n11-2) go to 46
      n4      = nt + 3
C
      do 39 i = n4,n11,3
      r1 = ll(i)
      if (abs(ir1) .eq. ncrd) go to 38
39 continue
C
46 continue
      if (nwrds .eq. 0) go to 40
49 continue
      nt      = nt - 3
      go to 40
C
C      this is a replacement card
C
38 continue
      if (edt) write (6, 3001)
3001 format (1h+,90x,'*** this card is a replacement card. ***')
      r1 = ll(i+2)
      items = ir1
      r1 = ll(i+1)
      index = ir1
      iwrds = items + (items + nbits - 1)/nbits
      n3    = nb - 1
      if (items .eq. nwrds) go to 42
      do 100 j=0, 2
      ll(i+j) = ll(nt+j)
100 continue

```



```

        nb      = index
        n5      = nb + iwrds
c
c  compress data table by eliminating data for first occurrence of card
c
        if (n5 .gt. n3) go to 47
c
        do 41 n2 = n5,n3
            ll(nb) = ll(n2)
            nb     = nb + 1
        41 continue
c
c  adjust data table indices in card word to reflect data table
c  compression
c
        do 43 n2 = n4,n11,3
            r1 = ll(n2+1)
            idxold = ir1
            if (idxold .le. index) go to 43
            ir1 = idxold-iwrds
            ll(n2+1) = r1
        43 continue
c
        if (nwrds .ne. 0) go to 40
        47 continue
        do 110 j=0, 2
            ll(i+j) = ll(n4+j)
110    continue
        nt      = n4
        go to 40
c
c  replacement card has same number of data items as the original card
c
        42 continue
        ir1 = index
        ll(i+1) = r1
        nb     = nb - iwrds
c
c  move replacement data into old table locations
c
        do 44 i = nb,n3
            ll(index) = ll(i)
            index     = index + 1
        44 continue
c
c  convert the data on card just read
c
        40 continue
        nocard = .true.
        n1     = nb
        n2     = (nt+nb)/2
        n3     = n2

```

```

        nwrds = 0
50 continue
    if (eoff) go to 61
    if (edt) write (6, 1101) ncn, card
1101 format (i6,4x,80a1)
    if (newcrd .and. nuse) go to 21
    if (newcrd) go to 61
    if (ikp .ne. 0) then
        card(ikp) = iblank
        ikp = 0
    endif
c
c 51 continue
    errpos = 1
    if (n1+40 .ge. n2) go to 905
c
c convert the card from alpha-numeric to its appropriate binary values
c
    call cvi (card, 11(n1), 11(n3), items, errpos)
    if (items .eq. 0) go to 59
c
c check to insure that data items do not have unallowed bit pattern
c
    nocard = .false.
    do 58 i = 1, items
        if (11(n1) .ne. ptrn1) go to 58
        11(n1) = ptrn2
        write (6, 2011) i
2011 format (' *****word', i3, ' has an unallowed bit pattern,',
*          ' it has been changed by truncating the lowest bit')
58 continue
c
    n1 = n1 + items
    n3 = n3 + items
    nwrds = nwrds + items
c
c test if available space in data table is adequate
c
    ntest = nb + nwrds + (nwrds + nbits - 1)/nbits
    if (ntest .ge. nt) go to 901
c
c check if cvi detected an error on this card
c
59 continue
    if (errpos .eq. 0) go to 21
    mode = 3
    11(n2) = rmode
    nocard = .false.
    isw = 2
    11(n1) = error
    n1 = n1 + 1
    n3 = n3 + 1

```

```

        nwrds = nwrds + 1
c
        do 52 i = 1,80
            errbuf(i) = iblank
52 continue
c
        errpos = min0 (errpos,80)
        errbuf(errpos) = idlrs
        write (6,1102) errbuf
1102 format (10x,80a1,4x,'$ points to error on card above.')
c
c blank out the location where the error occurred, then
c go on to process the rest of the card by calling cvi again.
c
        if (errpos .ge. 80) go to 21
        do 53 i = errpos,80
            tmpchr = card(i)
            card(i) = iblank
            if (tmpchr .ne. iblank .and. tmpchr .ne. comma) go to 53
        go to 51
53 continue
        go to 21
c
c finished reading cards -- finish bookkeeping and return
c
61 continue
        ntt = n11 - nt - 2
        nbb = nb - 3
        ndata = ntt + nbb + 2
        irl = nbb
        l1(1) = r1
        irl = ntt
        l1(2) = r1
        if (nx) ndata = -ndata
c
c re-order card number table in descending order from top to bottom
c
        nt = nt + 6
        do 54 i = nt,n11,3
            r1 = l1(i)
            ncrd = abs(irl)
            r1 = l1(i-3)
            if (ncrd .le. abs(irl)) go to 54
            temp = l1(i)
            temp1 = l1(i+1)
            temp2 = l1(i+2)
            n1 = i
56 continue
            l1(n1) = l1(n1-3)
            l1(n1+1) = l1(n1-2)
            l1(n1+2) = l1(n1-1)
            n1 = n1 - 3

```

```

        if (n1 .lt. nt) go to 55
        r1 = l1(n1-3)
        if (ncrd .gt. abs(irl)) go to 56
55 continue
        l1(n1) = temp
        l1(n1+1) = temp1
        l1(n1+2) = temp2
54 continue
C
C move the card table immediately following the data table
C
        nt      = nt - 3
        do 70 i = nt,n11
        l1(nb) = l1(i)
        nb     = nb + 1
70 continue
        return
C
C error exit
C
901 write (6,2001) n11
2001 format (' ***** storage allocation of',i8,' words is ',
*          'insufficient for previous data, processing terminated.')
        isw = 3
        return
C
902 continue
        if (ncn .ne. 0) go to 907
        isw = 1
        return
C
903 continue
        write (6,2003)
2003 format (' ***** continuation card indicated, but no previous',
*          ' data card. treated as new data card.')
        isw = 2
        go to 28
C
904 continue
        write (6,2004)
2004 format (' ***** unrecognized card number on card above.')
        ncrd = 0
        nwrds = 1
        isw = 2
        go to 32
C
905 continue
        write (6,2005)
2005 format (' 0***** insufficient storage for data, processing ',
*          'terminated.')
        isw = 3
        return

```

```

c
906 continue
   write (6,2006) mxwds
2006 format ('0***** number of words on card above exceeds the ',
*          'maximum of',i10,', execution terminated.')
   isw = 3
   return

c
907 continue
   write (6,2002)
2002 format (' ***** end of file encountered before end(.) card.')
   eoff  = .true.
   isw   = 2
   ncase = -ncase
   nuse  = .false.
   go to 30

c
908 continue
   write (6,2008) mxidx
2008 format ('0***** number of data items on all cards processed ',
*          'above exceeds the maximum of',i10,', execution terminated.')
   isw = 3
   return
end
*deck conv
   subroutine conv (a, xnum, type, lstart, lend, err)

c
c  a      = input array
c  xnum   = converted floating point or integer number      (output)
c  type   = real variable containing integer format flag
c          for xnum                                         (output)
c          = 0 integer or floating point zero
c          = 1 for integer
c          = 2 floating point
c  lstart = starting index in array a                      (input )
c  lend   = ending index in array a                       (output)
c  err    = error flag                                     (output)
c
   character*(*) a(1)
   character*24 c
   character*1 b(24)
   character*1 decpt, blank, comma, ast, eee, dee, plus, minus
   logical real, ldecpt, leee, err
   integer num
   equivalence (c,b(1)), (rnum,num)

c
   data decpt / '.' /, blank / ' ' /, comma / ',' /, ast / '*' /
   data eee   / 'e' /, dee   / 'd' /, plus / '+' /, minus / '-' /

c
   c = '
   err = .false.
   ldecpt = .false.

```

```

    real   = .false.
    leee   = .false.
    itype  = 0
    lend   = 80
C
C  check for integer of floating point format
C
    do 10 i = lstart,lend
    if (a(i).eq.blank .or. a(i).eq.comma .or. a(i).eq.ast) go to 20
    if (a(i) .eq. decpt) then
        real = .true.
        if (ldecpt) then
            err   = .true.
            lend  = i + 1
            return
        endif
        ldecpt = .true.
    endif
C
C  test for exponent with no preceeding decimal point
C
    if (i .gt. lstart) then
        if (.not.ldecpt) then
            if (a(i).eq.eee .or. a(i).eq.dee .or.
*           a(i).eq.plus .or. a(i).eq.minus) then
                leee   = .true.
                real    = .true.
                ldecpt  = .true.
            endif
        endif
    endif
    10 continue
    i      = 81
C
C  convert to integer or floating point
C
    20 continue
    length = i - lstart
    if (length .gt. 24) go to 70
    lend   = i - 1
    j      = 0
    k      = 0
C
C  move number into a character string -- then convert to a
C  floating point number
C
    if (.not.real) go to 40
    if (leee) then
C
C  insert a leading decimal point before converting the number
C
        length = length + 1

```

```

        i      = lstart
        k      = k + 1
        j      = 24 - length + k
        if (a(i).eq.plus .or. a(i).eq.minus) then
            b(j) = a(i)
            a(i) = decpt
        else
            b(j) = decpt
        endif
    endif
c
    do 30 i = lstart,lend
        k      = k + 1
        j      = j + 1
        b(j)   = a(i)
    30 continue
c
c  convert the string to a floating point number
c
    read (c, '(bn,e24.7)', err=80) xnum
    if (xnum .ne. 0.0e0) itype = 2
    go to 60
c
c  move number into a character string -- then convert to an
c  integer
c
    40 continue
        do 50 i = lstart,lend
            k      = k + 1
            j      = 24 - length + k
            b(j)   = a(i)
        50 continue
c
c  convert the string to an integer
c
    read (c, '(bn,i24)', err=90) num
    if (num .eq. 0) then
        xnum = 0.0e0
        itype = 0
    else
        xnum = rnum
        itype = 1
    endif
c
    60 continue
        lend = lstart + length
c
    65 continue
        num = itype
        type = rnum
        return
c

```

```

c error path
c
  70 continue
    write (6,100) c
100 format (' ***** number longer than 24 characters in ',
*         'subroutine conv ',a24,' ')
    err = .true.
    itype = 0
    go to 65
c
  80 continue
    write (6,110) c
110 format (' ***** floating point conversion error in ',
*         'subroutine conv ',a24,' ')
    err = .true.
    go to 65
c
  90 continue
    write (6,120)
120 format (' ***** integer conversion error in subroutine ',
*         'conv ',a24,' ')
    err = .true.
    go to 65
end
*deck cvi
  subroutine cvi (char, binary, cond, num, ipos)
c
  character*1 char(*)
  dimension binary(*), cond(*)
  logical err
  character*1 blank, comma, astrsk, dollar, equal
  character*1 d, e, slash, dp, apos, dblqt, number(13)
c
  data number
  */'0', '1', '2', '3', '4', '5', '6', '7', '8', '9', '-', '+', '.', /
  data blank, comma, astrsk, dollar, equal, d, e, slash, dp, apos /
  *      ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ' /
  data dblqt / '"' /
c
c find first non-blank character.
c
  ipos = 0
  num = 0
  do 10 11 = 1,80
    if (char(11) .ne. blank) go to 20
  10 continue
  return
c
c process data card by first determining whether it is numeric or hollerith
c
  20 continue
    lstart = 11

```



```

30 continue
   do 40 k = 1,13
   if (char(lstart) .eq. number(k)) go to 60
40 continue
C
C this word is a hollerith string
C
   ll      = lstart
   call holstr (char, ll, binary(num+1), cond(num+1), nwrds, err)
   num     = num + nwrds
   lend    = ll + 1
   if (.not. err) go to 80
   ipos    = ll
   return
C
C this word is a number
C
60 continue
   call conv (char, binary(num+1), cond(num+1), lstart, lend, err)
   if (err) go to 70
   num     = num + 1
   go to 80
C
70 continue
   ipos    = lend - 1
   return
C
80 continue
   if (lend .gt. 80) go to 100
C
C find the next word on the card
C
   do 90 k = lend,80
   if (char(k) .eq. blank .or. char(k) .eq. comma) go to 90
   if (char(k) .eq. astrsk .or. char(k) .eq. dollar) go to 100
   lstart = k
   go to 30
90 continue
100 continue
   return
   end
*deck hols
   subroutine holstr(a, ll, wrk, cond, nwrds, err)
C
C ll = start of hollerith string on input
C   = end of hollerith string+1 on output
C
   dimension wrk(*), cond(*)
   character*1 a(*), irk(8), apos, term(2), dblqt, com, blk
   character*8 answer
   logical err
   equivalence (rmode,mode)

```

```

equivalence (answer, irk(1))
equivalence (term(1),apos), (term(2),dblqt)
data apos / ' ' /, dblqt / ' ' /, com / ',' /, blk / ' ' /
C
err      = .false.
nwrds    = 0
C
C determine string termination character being used
C
    if (a(11) .eq. apos ) go to 10
    if (a(11) .eq. dblqt) go to 15
    ist    = 3
    go to 25
C
10 continue
    ist    = 1
    go to 20
C
15 continue
    ist    = 2
C
20 continue
    11     = 11 + 1
C
25 continue
    lend   = min0 ((11+7),80)
    j      = 1
    answer = '      '
C
    do 35 i = 11,lend
        isave = i
        if (ist .ne. 3) then
            if (term(ist) .eq. a(i)) go to 40
            go to 30
        endif
        if (a(i).eq.com .or. a(i).eq.blk) go to 40
30 continue
        irk(j) = a(i)
        j      = j + 1
35 continue
        read (answer,101) wrk(nwrds+1)
        mode   = 3
        cond(nwrds+1) = rmode
        nwrds  = nwrds + 1
        11     = lend + 1
        if (11 .le. 80) go to 25
C
    if (ist .eq. 3) go to 50
    err      = .true.
    write (6,100)
100 format (' ***** error on card above - hollerith string was ',
*          'not terminated.')

```

```

        return
c
40 continue
   if (l1 .eq. isave) return
   nwrds = nwrds + 1
   l1    = isave
   read (answer,101) wrk(nwrds)
101 format (a8)
   mode = 3
   cond(nwrds) = rmode
50 continue
   return
   end

```

APPENDIX C

RETRAN-02 UPDATE DECK

The correction decks to build the CRAY version of RETRAN-02 from the CDC source file are in three update decks labeled with the identifiers 'ident lan101', 'ident lan102', and 'ident lan103'. These correction decks are not independent and must be processed sequentially to obtain a correct source. The RETRAN-02 source is written in lower case characters.

```
*ID lan101
*/
*/      - lan101   modifies deck(s):  id02      chek
*/                                           eda2      eda3
*/                                           eda5      edin
*/                                           edtr      idat
*/                                           inrp      inrs
*/                                           iple      ovrl
*/                                           prpt      pull
*/                                           ress      sear
*/
*/      *****
*DC id02
*/      *****
*/
*/      add variable nprset to filid = 2 (number of minor edit sets)
*/
*D id02.12
*      neweqs(1), nsepr(1), nprset(1),
*D id02.28
*      (istor(39),neweqs(1)),(istor(40),nsepr(1)) ,(istor(41),nprset(1)),
*/
*/      *****
*DC chek
*/      *****
*/
*I chek.34
*      data vsn /6h      /
c
*D chek.36
*      nbits = 32
*D chek.39
*      nchpwd = 8
*D chek.44, chek.57
*      10 continue
*D chek.145, chek.146
*      80 continue
```

```

*D chek.164
    write (6, 700) (rstor(idxscr+i-1),i=1,len)
    700 format (1x,6z20)
*/
*/ *****
*DC eda1
*/ *****
*/
*D eda1.139
    nbits = 32
*D eda1.141
    nbyte = 8
*D eda1.146
    len = -3
*/
*/ *****
*DC eda2
*/ *****
*/
*D eda2.181
    nbits = 32
*D eda2.183
    nbyte = 8
*D eda2.188
    len = -3
*/
*/ *****
*DC eda3
*/ *****
*/
*D eda3.200
    nbits = 32
*D eda3.202
    nbyte = 8
*D eda3.207
    len = -3
*/
*/ *****
*DC eda4
*/ *****
*/
*D eda4.167
    nbits = 32
*D eda4.169
    nbyte = 8
*D eda4.174
    len = -3
*/
*/ *****
*DC eda5
*/ *****
*/
*/

```

```

*D eda5.201
    nbits = 32
*D eda5.203
    nbyte = 8
*D eda5.208
    len = -3
*/
*/ *****
*DC edin
*/ *****
*/
*D edin.68,edin.69
    nbits = 32
    nbyte = 8
*D edin.280,edin.283
*/
*/ *****
*DC edit
*/ *****
*/
*D edit.267,edit.281
    315 continue
*D edit.304,edit.306
    call bufout(3,rstor(idxb),nedv,iok,last,dumy)
    if (iok.ne.1 .or. nedv.ne.last) then
        write (6, 801)
801    format ('0 ***** bufout error writing printer plot records')
        nogo = .true.
        call fail
    end if
*/
*/ *****
*DC edtr
*/ *****
*/
*D edtr.23
*D edtr.40
    nbits = 32
*D edtr.47,edtr.50
*D edtr.79,edtr.80
*D edtr.85,edtr.95
    35 write (6, 700) ivol
    700 format ('0 ***** end of volume processing disabled - fail calle
        *d')
        call fail
        go to 200
*D edtr.134,edtr.137
*D edtr.142
    write (6, 620) iplot
*D edtr.147
    write (6, 630) kunit
*D edtr.160

```

```

        write (6, 660)
*D edtr.167,edtr.174
  620 format("0 ***** data record",i6," can not be reached")
  630 format("0 ***** bufskip error on unit",i3," in subroutine editre
    *)
*D edtr.177,edtr.178
  660 format ("0 tape is not a relap/e data tape/" execution deleted")
*/
*/ *****
*DC idat
*/ *****
*/
*D idat.55,idat.80
*/
*/ *****
*DC iede
*/ *****
*/
*D iede.29
  nbits = 32
*D iede.87,iede.128
  num = 1
*D iede.130,iede.133
*/
*/ *****
*DC inrp
*/ *****
*/
*D inrp.34
  nbits = 32
*D inrp.146,inrp.198
  num = 1
*D inrp.200,inrp.208
*/
*/ *****
*DC inrs
*/ *****
*/
*D inrs.36
  nbits = 32
*D inrs.78,inrs.125
  num = 1
*D inrs.140,inrs.199
*D inrs.232,inrs.240
  write(6,720)
*D inrs.244,inrs.264
*D inrs.272,inrs.273
*D inrs.316
  720 format ("0 restart from a retran data tape ")
*/
*/ *****
*DC intv

```

```

*/ *****
*/
*D intv.33
  nbits = 32
*D intv.150,intv.170
*D intv.172,intv.200
*/
*/ *****
*DC iple
*/ *****
*/
*D iple.135
  nbits = 32
*D iple.157,iple.195
*D iple.197
*/
*/ *****
*DC ovr1
*/ *****
*/
*D ovr1.18
  nbits = 32
*D ovr1.109,ovr1.126
*D ovr1.134
*/
*/ *****
*DC plta
*/ *****
*/
*D plta.41
  nbits = 32
*D plta.59,plta.97
*D plta.106
*/
*/ *****
*DC prpt
*/ *****
*/
*I prpt.12
  real nextid
c
*D prpt.15,prpt.17
  ndata = nprset(i2)
*I prpt.41
  prplot = nextid(0)
  lenplt = nplts
  call reserv (prplot, lenplt, 2, index)
*D prpt.43
*D prpt.52
  call bufin (3, rstor(index), lenplt, iok, last, dum)
  if (iok.ne.0 .or. last.ne.lenplt) then
    write (6, 1001) i

```



```

1001    format ('0 ***** bufin error reading printer plot data file
        *for minor edit no. ',i5)
        call fail
        end if
*D prpt.58
    call bufskip(3, 1, -1, iok)
    if (iok.ne.0) then
        write (6, 1002)
1001    format ('0 ***** bufskip error reading printer plot data file
        * for minor edits')
        call fail
        end if
*D prpt.62
    50 continue
*/
*/ *****
*DC pull
*/ *****
*/
*D pull.25
    nbits = -32
*/
*DC rdtp
*D rdtp.33,rdtp.34
    nbyte = 8
    nbits = 32
*D rdtp.37
    nchars = 32
*D rdtp.91
*D rdtp.103,rdtp.104
*D rdtp.147
*D rdtp.204,rdtp.207
    call reserv (datid, isiz3, 2, index)
*I rdtp.208
c    write all data from dataset i to disk file
    call bufout (3, rstor(index), isiz3, iok, next, dum)
    if (iok.ne.0 .or. last.ne.isiz3) then
        irec = 1
        write (6, 1001) irec, i
1001    format ('0 ***** bufout error writing plot data file for rec
        *ord ',i4,' in data set ',i4)
        call fail
        end if
*D rdtp.227,rdtp.248
    write (6, 1002)
1002 format ('0 ***** error in reading plot data file. Multiple tap
        *es requested, feature has been disabled')
    call fail
    go to 600
*D rdtp.257
    295 continue
*I rdtp.260

```

```

        call bufout (3, rstor(index), isiz3, iok, next, dum)
        if (iok.ne.0 .or. last.ne.isiz3) then
            irec = iplot
            write (6, 1003) irec, i
1003    format ('0 ***** bufout error writing plot data file for rec
            *ord ',i4,' in data set ',i4)
            call fail
        end if
*D rdtb.269,rdtb.272
    310 call delete(datid)
        npsets(idxdat) = iplot
*D rdtb.333
    470 continue
*D rdtb.339
    480 continue
*D rdtb.341
    530 write (6, 830) kunit
*D rdtb.348
        write (6, 820)
*D rdtb.351,rdtb.352
*D rdtb.354,rdtb.357
    820 format("0 ***** tape is not a retran data tape"/
        * " execution deleted")
    830 format ("0***** bufskp error on unit",i3," in subroutine redtap
        *")
*/
*/ *****
*DC res
*/ *****
*/
*I res.25
    nosemi = .true.
*/
*/ *****
*DC sear
*/ *****
*/
*D sear.42,sear.43
    nbits = 32
    nbyte = 8
*/
*/ *****
*DC tpbc
*/ *****
*/
*D tpbc.50
    nbits = 32
*D tpbc.78,tpbc.79
*D tpbc.248,tpbc.269
    write (6, 1002)
1002 format ('0 ***** error in reading time-dependent volume data fi
        *le. Multiple tapes requested, feature has been disabled')

```

```

        call fail
        go to 251
*D tpb.320,tpb.322
  315 format("0***** error, data record",i6," cannot be found")
*D tpb.331,tpb.342
  340 continue
*/
*/ *****
*/
*/      - End of lan101
*/
*/
*ident lan102
*/
*/ *****
*/
*/      corrections to r2mod4
*/
*/
*/      - lan102  modifies deck(s):  rman          doc
*/                                     docu          infm
*/                                     inpu          itrn
*/                                     posi          plta
*/                                     prpt          reso
*/                                     ress          rtrn
*/                                     time
*/
*c rman
*d rman.2,3
  program rmain
*i rman.3510
  open (unit=5,iostat=ierr,err=501,file='tape5',status='old',
*   access='sequential',form='formatted')
  open (unit=6,iostat=ierr,err=502,file='tape6',status='new',
*   access='sequential',form='formatted')
c
*d rman.3516
  i = locx(rstor(2)) - locx(rstor(1))
*d rman.3553
*d rman.3558
*i rman.3561
c
  501 write (6, 9001) ierr
  9001 format ('0 ***** error number ',i5,' returned attempting to ope
    *n tape5')
    go to 110
c
  502 write (6, 9002) ierr
  9002 format ('0 ***** error number ',i5,' returned attempting to ope
    *n tape6')
    go to 110
*/

```

```

*/ *****
*/
*c doc
*d doc.27,29
*d doc.43
*d doc.45
*/
*/ *****
*/
*c docu
*d docu.14,15
    data doc1 / 8h los ala /, doc2 / 8hmos nati /,
    *   doc3 / 8honal lab /, doc4 / 8horatory /
*/
*/ *****
*/
*c infm
*i infm.16
    data bin /8hbinary /
*i infm.65
    if (usrfmt(idxf) .eq. bin) go to 550
c    formatted file
    open (unit=60,iostat=ierr,err=601,file='tape60',status='new',
    *   access='sequential',form='formatted')
    go to 580
c
c    unformatted binary file
550 open (unit=60,iostat=ierr,err=602,file='tape60',status='new',
    *   access='sequential',form='unformatted')
c
580 continue
*i infm.72
    go to 700
601 write (6, 1010) ierr
1010 format ('0 ***** error no. ',i6,' encountered attempting to open
    * formatted file = tape60')
    go to 700
c
602 write (6, 1020) ierr
1020 format ('0 ***** error no. ',i6,' encountered attempting to open
    * unformatted file = tape60')
c
*/
*/ *****
*/
*c inpu
*d inpu.24,25
c    common / blkcm / blkcm
    common /      / blkcom, spacer(130000)
    real ncp
*d inpu.36,37
    * 8hretran-0, 8h2-mod004, 8h.1 03/16, 8h/90 epri, 8h best es,

```

```

      * 8htimate f, 8hluid hyd, 8hraulics , 8hanalysis, 8h program,
*d inpu.51
      lastad = locx(lastad) + 1 - locx(rstor(1))
*d inpu.54
      istor(1) = (locx(bstor(1)) - locx(rstor(1)))/ nlocf + 1
*d inpu.55
      nunit = 3
*d inpu.59
      len = locx(blkcom) - locx(rstor(1)) + 130000
      call ftbset (idolr, nunit, nfils, idxlo, idxhi, len)
*d inpu.65
      ncp = 1000.0
*d inpu.69,71
      if (ibmrun) len = locx(blkcm)
      if (.not.ibmrun) len = locx(blkcom)
      len = (len - locx(lastad) + nlocf - 1)/nlocf
*d inpu.211
      len = locx(blkcom) - locx(rstor(1)) + 130000
      call ftbset (idolr, nunit, nfils, idxlo, idxhi, len)
*/
*/ *****
*/
*c itrn
*d itrn.25
      nbits = 32
*/
*/ *****
*/
*c posi
*d posi.76,77
      write (6, 650) (rstor(idxscr+k-1), k = 1,len)
650 format (1x,6z20)
*/
*/ *****
*/
*c plta
*r plta.76
*/
*/ *****
*/
*c prpt
*d lan101.77
1002 format('0 ***** bufskip error reading printer plot data file
*/ *****
*/
*c reso
*d reso.51,322
*/
*/ *****
*/
*c ress

```

```

*d ress.33
  iadd = locx(lastad)
*d ress.41
  lastad = locx(istor(idxinp+len-1))
*d ress.51
  iadd = locx(istor(idxinp))
*d ress.81
  go to 80
*d ress.83
c   maxa = findep(advflo, dummy)
   maxa = mina
*/
*/ *****
*/
*c rtn
*d rtn.45
  100 continue
*/
*/ *****
*/
*c time
*d time.149
*d time.151
  200 format ('1', 15a8,3x,'page',i4)
*d time.153
  205 format (' *** epri release 02 -- multi-fluid reactor transient',
*/
*/ *****
*/
  end of lan102
*/
*ident lan103
*/
*/ *****
*/
  - lan103   modifies deck(s):  chek      edco
*/                                edin      edit
*/                                idat      inrs
*/                                inxs      iple
*/                                plts      prpt
*/                                rdtp      sear
*/                                tave      tpbc
*/                                plot      symbol
*/
*c chek
*i chek.43
  10 continue
*restore chek.49,50
*d lan101.7
*/
*/ *****
*/

```

```

*/
*c edco
*d edco.40
  nbits = -32
*/
*/ *****
*/
*c edin
*d edin.76
*d edin.279
*restore edin.283
*/
*/ *****
*/
*c edit
*d edit.75
*i edit.86
  if (nedi .gt. 0) go to 1
  nrec = 0
  open (unit=20,iostat=ierr,err=1010,status='scratch',
    * access='sequential',form='unformatted')
*i lanl01.28
  write (6, 740) ndatrc, iunit
*d lanl01.29,35
  write (20) (rstor(idxb+i), i=1,nedv)
  nrec = nrec + 1
  istor(i2+40) = nrec
*d edit.120
  nbits = 32
*i edit.346
  1010 write (6, 1012) ierr
  1012 format ('0 ***** error number ',i4,' encountered attempting to
    *open unit = 20')
  call fail
  go to 500
*d edit.374,375
  740 format (////' data record number ',i6,' has been written to unit =
    * ',i3)
*/
*/ *****
*/
*c idat
*d idat.91
*d idat.107
  len = len - 4096
*/
*/ *****
*/
*c inrs
*restore inrs.146,150
*restore inrs.173
*restore inrs.193,194

```

```

*restore inrs.232,233
*/
*/ *****
*/
*c inxs
*i inxs.138
    open (unit=40,iostat=ierr,err=1010,status='old',file='tape40',
    * access='sequential',form='formatted')
*i inxs.320
    1010 write (6, 1012) ierr
    1012 format ('0 ***** error number ',i4,' encountered attempting to
    *open file = tape40')
    call fail
    return
*/
*/ *****
*/
*c iple
*restore iple.166
    jvs = 3
*restore iple.195
*/
*/ *****
*/
*c plts
*i plts.51
    tfid = bufy + 1.0
*d plts.57
*d plts.63
    nbyte = 8
*d plts.65
    nbits = 32
*i plts.171
c    kset = dataset number of curve
*d plts.178,180
    ireel = 1
*d plts.184
    fid = tfid + float(kset) - 1.0
*d plts.185,186
    iunit = kset + 20
*d plts.191
    rewind iunit
*i plts.193
    call reserv (fid, jsiz, 2, idxp)
    read (iunit) (rstor(idxp+m-1), m = 1,jsiz)
*d plts.238
    rewind iunit
    call delete (fid)
*d plts.323
    read (iunit) (rstor(idxp+m-1), m=1,jsiz)
    index = idxp
*d plts.422

```



```

180 if (.not.ltbl) then
      rewind iunit
      call delete (fid)
    end if
*/
*/ *****
*/
*c prpt
*d lanl01.65
      endfile 20
      rewind 20
      lenplt = nplts + 1
*d lanl01.67,73
      read (20) (rstor(index+l-1), l=1,lenplt)
*d lanl01.74,80
      rewind 20
*/
*/ *****
*/
*c rdtp
*d rdtp.46
*d rdtp.54
*i rdtp.59
      kunit = i + 10
*i rdtp.95
      ntaps = 1
*d lanl01.88,95
      idxp = index
      iunit = i + 20
      open (unit=iunit,iostat=ierr,err=1001,access='sequential',
* status='scratch',form='unformatted')
c
      write (iunit) (rstor(index+m-1), m=1,isiz3)
*i rdtp.209
c
1001 write (6, 1005) ierr, iunit
1005 format ('0 ***** error number ',i5,' encountered attempting to o
      *pen unit = ',i2)
      call fail
      go to 310
*i lanl01.101
      index = idxp
*d lanl01.102,109
      write (iunit) (rstor(idxp+m-1), m=1,isiz3)
*d rdtp.254
      if (ieov .eq. 1) go to 310
*d rdtp.265
      305 endfile iunit
      rewind iunit
*d rdtp.279
      endfile iunit
      rewind iunit

```

```

*/
*/ *****
*/
*c sear
*d sear.29
  data fmt1 / 8h(5x,i3) /
*d sear.145
  if (.not.libm) call incorr(8, fmt1, aode, aode, 1)
*/
*/ *****
*/
*c tave
*d tave.32,33
  if (ig(m) .eq. 2) then
    xosqr = xdcr(idxr1)**2 - vreg(idxr1)/pi
    xosqr = amax1(xosqr, zero)
    x0     = sqrt(xosqr)
  end if
*/
*/ *****
*/
*c tpbc
*d tpbc.358
  write (6, 2011) (istor(idxscr+jj-1), jj = 1,3)
  2011 format (5x,3z20)
*/
*/ *****
*/
*deck plot
  subroutine plot
c
c   dummy routine for ploter
c
  entry plots
  return
  end
*/
*/ *****
*/
*deck symbol
  subroutine symbol
c
c   dummy routine for ploter
c
  return
  end
*/
*/ *****
*/
  end of lan103
*/

```