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AN INTERACTIVE NASTRAN PREPROCESSOR

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SUMMARY

This paper describes a Langley Research Center version of NASTRAN Level 15.1.0 designed to provide the analyst with an added tool for debugging massive NASTRAN input data. The program checks all NASTRAN input data cards and displays on a CRT scope the graphic representation of the undeformed structure. In addition, the program permits the display and alteration of input data and allows reexecution without physically resubmitting the job. Core requirements on the CDC 6000 computer are approximately 77 000 octal words of central memory.

INTRODUCTION

As most NASTRAN users have discovered, there are input data errors made in defining a structure which are not illegal to the system but which will produce a rather oddly shaped graphic representation and erroneous analysis. It is imperative, therefore, that the structural plotter output be viewed before the user can be assured that his input data do not displace grid points or omit members. For a complex structure, it may be necessary to observe the picture from several orientations.

Motivated by the need for a complete checkout of structure-defining input data in the most rapid and efficient manner, development of an interactive type preprocessor was undertaken. Since the computer program described in reference 1 was already in existence, the decision was made to adapt it to the interacting CDC 250 CRT system. The Interactive NASTRAN Preprocessor Level 12.1.0 resulted from this adaptation. The NASTRAN portion has since been updated to Level 15.1.0.

The NASTRAN program and interactive graphic software used in the Interactive NASTRAN Preprocessor are designed to operate on the CDC 6600 computer at LRC, but the ideas are applicable to other NASTRAN computers.

PROGRAM DESCRIPTION

The following changes were made in the existing computer program (ref. 1):

1. NASTRAN routines¹ altered:

¹Description of routines may be found in reference 2.

<u>NAME</u>	<u>MODIFICATION</u>
NASTRAN	Tape 4 declared
XSEM1	Added capability of displaying message on screen
IFP1D	Error "Plot Tape Not A Physical Tape" made nonfatal
SGINOFF	Plot file written on Tape 4
XSEM2	Added capability of displaying messages on screen
	Added labeled COMMON block with plot loop flag
	Added call to CRTPLOT subroutine
	Added statement to change a DMAP instruction parameter if plot loop flag set
PLOT	Test for physical tape ignored
PROCES	Added labeled COMMON block to hold view angles for display and alteration
	Add statements to save and restore view angles
LD50	Additions made to allow looping through PLTSET and PLOT instructions if angles altered and reexecution requested (appendix A)

2. Subroutine CRTPLOT (appendix B) was coded to read the NASTRAN General Purpose Plotter output file and translate it for display on the CDC 250 CRT terminal (fig. 1).

3. Interactive graphic routines² added to program:

SEMSAGE (same as MESSAGE)	RSHFT
CDC250	ADVERSE

²See Langley Research Center Computer Programming Manual, Vol. II, Sections 3.2 and 3.11.

NEXT	SPACK (same as PACK)
PLT250	SLOCATE (same as LOCATE)
LODTBL	UNPK
DECOD3	CNTRLN
DECOD4	CREATEF
HOGWASH	DECOD1
WARTHOG	DECOD2
SCREEN	DROUTE
PLTOOO	EXOR
KEYBORD	IO3
CRT250	NOTATE
SPCMAT	PLOTSW
KGLER	PLT9999
LOADADR	TRUNCL
CALPLT	SAVPLOT
WHERE	XMIT
ENCOD2	SCAN
STRCALL	

4. Modifications were made in the graphic routines where data statements were used to enter values for variables in labeled COMMON. Restrictions in the CDC Linkage Editor necessitated replacing the data statements with a Block Data subprogram.

5. Overlay structure (appendix C) was adjusted to incorporate graphic routines and subroutine CRTPLOT, which were added.

CAPABILITIES OF THE INTERACTIVE NASTRAN PREPROCESSOR

The Interactive NASTRAN Preprocessor has the following capabilities:

1. Analyzes all input data.

2. Displays the graphic representation of the undeformed structure on the CDC 250 CRT Scope.

3. The alphanumeric keyboard³ on the CRT console provides a means for displaying the input and altering the input data.

4. Loops through the PLTSET and PLOT modules when only the view angle is altered are accomplished within the DMAP sequence of instructions. The program EDIT⁴ initiates restarts when other input data are changed.

5. The CRT function keyboard has such options as (a) positive and negative magnification of the total display or a part of the display; (b) recording the plot vector file for postprocessing permanent hard copies; and (c) producing nonpermanent hard copies on a connected hard copy unit.

6. Executable in approximately 77 000 octal words of central memory.

LIMITATIONS OF THE INTERACTIVE NASTRAN PREPROCESSOR

The Interactive NASTRAN Preprocessor has the following limitations:

1. Operational on CDC 6000 Computer complex at LRC; however ideas are applicable to other NASTRAN computers.

2. Displacement approach must be used.

3. Does not contain NASTRAN checkpoint or restart capabilities.

4. No punch output available.

5. Alterations to input data are made internal to the computer only; therefore, the user should make note of modifications so that he may make appropriate changes in the physical deck.

OPERATIONAL INSTRUCTIONS

The interactive NASTRAN program is housed on a data cell and requires no physical tapes unless the user wishes to save the plot vector file for permanent hard copies. The EDIT program is also housed on a data cell.

³Langley Research Center Computer Programming Manual, Vol. II, Section 3.6.

⁴Langley Research Center Simulation Manual, Section 2221.1.

<u>1. Deck Setup</u>	<u>Col. 68</u>	<u>Col. 78</u>
JOB,		X
USER,.....		X
FETCH(C1103, XXXX, BINARY, EDIT)	XXXX = data cell	X
LOAD (EDIT)		X
EXECUTE (BLOCKCC)		X
COMMENT.	X	
COMMENT. END CONTROL BLOCK		X
REQUEST, CRTTPE, CD. PLEASE ASSIGN XX XX = CRT No.		
FETCH (D3790, XXXX, BINARY, PREF1)	XXXX = data cell	
NORFL.		
LINECNT (10000)		
PREF1. CATLOG (PREF)		
COMMENT. END SETUP BLOCK		
PREF.		
REWIND (SAVPLT)		
COPYBF (SAVPLT, TEMP)	Required if hard copy plots desired	
BKS (TEMP, 1)		
LOAD (EDIT)		
COMMENT. END EXECUTE BLOCK		
FETCH (P0077, XXXX, BINARY, DDIPRO)	DDI, 80 Postprocessor	Required for hard copy for plots
REWIND (TEMP)		
REWIND (SAVPLT)		
DDIPRO (INITIALS, BLDG. NO., Division initials, zero)		
COMMENT. END STOP BLOCK		
EXIT.		

1. Deck Setup (continued)

Col. 68

Col. 78

LOAD (EXIT)

EXECUTE (RESTART)

COMMENT. END RESTART BLOCK

End of record card

NASTRAN data deck

End of file card

2. Input

Input data are the same as for a regular NASTRAN run with the exception that the user must request NASTPLT output on the PLOTTER case control card.

3. Output

The Program produces the normal NASTRAN printed output from the Preface area of the program and from the structural plot module. The graphic representation of the undeformed structure is displayed on the CRT as it is being generated. Plots may be recorded for obtaining hard copies on one of the available plotters by depressing the appropriate function key on the CRT console. The proper postprocessor control cards must have been included in the card deck.

Since changes are made internal to the computer only, the user should make note of any such modifications so that he can make the appropriate changes in the physical deck.

APPENDIX A

NASTRAN ROUTINE LD50

FOR INTERACTIVE NASTRAN PREPROCESSOR

FORTRAN Code for Subroutine LD50

SUBROUTINE LD50(SUBSET)	LD500002
INTEGER RD(161)	LD500003
INTEGER RD1(61), RD2(100)	LD500004
EQUIVALENCE (RD(1),RD1), (RD(62),RD2)	LD500005
DATA NPTP/4HNPTP/	LD500006
INTEGER IS1(20)	LD500007
DATA IS1/1.1/	LD500008
DATA RD1/	LD500009
4AHBEGL, 4HN PR, 4HEFAC, 4HE - , 4MCHEC, 4HKS I, 4HNPUT, 4H AND,	LD500010
84H PLO, 4HTS U, 4HNDEF, 4HORME, 4HD ST, 4HRICT, 4HURE , 4HS ,	LD500011
44HGP1 , 4HGEOM, 4H1,GE, 4HOM2,, 4H/GPL, 4H,EOE, 4HXIN,, 4HGPD,	LD500012
44H,CST, 4HM,BG, 4HPDT,, 4HSIL/, 4HV,N,, 4HLUSE, 4HT/C,, 4HN,12,	LD500013
44H3/V,, 4HN,NO, 4HGPD, 4H S , 4HSAVE, 4H LUS, 4HET S, 4HGP2 ,	LD500014
44HGEOM, 4H2,EO, 4HEXIN, 4H/ECT, 4H S ,	LD500015
14HLABE, 4HL W1, 4H S ,	LD500016
24HPLTS, 4HET P, 4HCDB,,	LD500017
64HEGEX, 4HIN,E, 4HCT/P, 4HLTSE, 4HTX,P, 4HLTPA, 4HR,GP, 4HSETS,	LD500018
24H,ELS, 4HETS /	LD500019
DATA RD2/	LD500020
44H/V,N, 4H,NS1, 4HL/V,, 4HN,JU, 4HMPPL, 4HOT S, 4HSAVE, 4H NS1,	LD500021
14HL,JU, 4HMPPL, 4HOT S, 4HPRTM, 4HSG P, 4HLTSE, 4HTX//, 4H S ,	LD500022
44HSETV, 4HAL /, 4H/V,N, 4H,PLT, 4HFLG/, 4HC,N,, 4H1//,, 4HN,PF,	LD500023
44HILE/, 4HC,N, 4HO S , 4HSAVE, 4H PLT, 4HFLG,, 4HPFIL, 4HE S ,	LD500024
14HCOND, 4H P1,, 4HJUMP, 4HPLOT, 4H S , 4HPLOT, 4H PLT, 4HPAR,,	LD500025
44HGPSE, 4HTS,E, 4HLSET, 4HS,CA, 4HSECC, 4H,BGP, 4HOT,E, 4HGX1,	LD500026
44HN,SI, 4HL,,/, 4HPLOT, 4HX1/V, 4H,N,N, 4HSIL/, 4HV,N,, 4HLUSE,	LD500027
44HT/V,, 4HN,JU, 4HMPPL, 4HOT/V, 4H,N,P, 4HLTFL, 4HG/V,, 4HN,PF,	LD500028
44HILE , 4HS , 4HSAVE, 4H JUM, 4HPLO, 4HT,PL, 4HTFLG, 4H,PF1,	LD500029
44HLE S, 4HPRTM, 4HSG P, 4HLOTX, 4H1//S,	LD500030
14HCOND, 4H W2,, 4HPFIL, 4H E S , 4HJUMP,4H P1 , 4HS , 4HLABE,	LD500031
24H W2, 4HS , 4HREPT, 4H W1,, 4H100 ,4HS ,	LD500032
34HLABF, 4HL P1, 4HS ,	LD500033
44HEND , 4HS , 4H , 4H , 4H , 4H /	LD500034
CALL WRITE (NPTP,RD,160,1)	LD500035
CALL WRITE (NPTP,20,1,0)	LD500036
CALL WRITE (NPTP,1,1,0)	LD500037
CALL WRITE(NPTP,IS1,20,0)	LD500038
CALL WRITE(NPTP,0,1,0)	LD500039
RETURN	LD500041
END	LD500042

NASTRAN Source Program Compilation

DMAP-DMAP INSTRUCTION

NO.	
1	BEGIN PREFACE - CHECKS INPUT AND PLOTS UNDEFORMED STRUCTURE \$
2	GP1 GEOM1,GEOM2,/GPL,EGEXIN,GPDT,CSTM,BGPDOT,SIL/V,N,LUSET/C,N,123/ V,N,NOGPDT \$
3	SAVE LUSET \$
4	GP2 GEOM2,EGEXIN/ECT \$
5	LABEL W, \$
6	PLTSET PCDB,EGEXIN,ECT/PLTSETX,PLTPAR,GPSETS,ELSETS /V,N,NSIL/V,N, JUMPPLOT \$
7	SAVE NSIL,JUMPPLOT \$
8	PRTMSG PLTSETX// \$
9	SETVAL //V,N,PLTFLG/C,N,1/V,N,PFILE/C,N,0 \$
10	SAVE PLTFLG,PFILE \$
11	COND P1,JUMPPLOT \$
12	PLOT PLTPAR,GPSETS,ELSETS,CASECC,BGPDOT,EGEXIN,SIL,./PLOTX1/V,N,NSIL/ V,N,LUSET/V,N,JUMPPLOT/V,N,PLTFLG/V,N,PFILE \$
13	SAVE JUMPPLOT,PLTFLG,PFILE \$
14	PRTMSG PLOTX1// \$
15	COND W2,PFILE \$
16	JUMP P1 \$
17	LABEL W2\$
18	REPT W1,100 \$
19	LABEL P1\$
20	END \$

APPENDIX B

FORTRAN CODED SUBROUTINE CRTPLOT

SUBROUTINE CRTPLOT	CRT0002
COMMON/SPEC/NVIEW,CALPHA,CBETA,CGAMMA	CRT0003
COMMON/CRT/NCRT	CRT0004
DIMENSION A(30),ID(2)	CRT0005
DIMENSION IANS(30)	CRT0006
DIMENSION STRING(60)	CRT0007
INTEGER PC,C1,TEN	CRT0008
DATA ID/3HWS,8HBIN 2058/	CRT0009
DATA STRING/	CRT0010
1 1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1HA,1HB,1HC,1HD,1HE,1HF	CRT0011
2 1HG,1HH,1HI,1HJ,1HK,1HL,1HM,1HN,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV	CRT0012
3 1HW,1HX,1HY,1HZ,1H(.1H),1H+,1H-,1H*,1H/,1H=,1H.,1H.,1H.,1H-,1H	CRT0013
4, 12+0/	CRT0014
EQUIVALENCE (IANS(1),IS2), (IANS(2),IS3), (IANS(3),IS4), (IANS(4),	CRT0015
1IR0), (IANS(5),IR1), (IANS(6),IR2), (IANS(7),IR3), (IANS(8),IR4),	CRT0016
2(IANS(9),C1), (IANS(10),PC), (IANS(11),IU2), (IANS(12),IU3),	CRT0017
3(IANS(13),IU4), (IANS(14),ITO), (IANS(15),IT1), (IANS(16),IT2),	CRT0018
4(IANS(17),IT3), (IANS(18),IT4), (IANS(19),ISO), (IANS(20),IS1),	CRT0019
5(IANS(29),IU0), (IANS(30),IU1)	CRT0020
NVIEW = 0	CRT0021
NCRT=0	CRT0022
NFIRST = 0	CRT0023
REWIND 4	CRT0024
WRITE(6,1001)	CRT0025
1001 FORMAT(1H1)	CRT0026
TEN = 10	CRT0027
MASK = 77B	CRT0028
CALL CDC 250	CRT0029
CALL CALPLT(0,0,3)	CRT0030
CALL SMESAGE(1,35HBEGIN EXECUTION OF CRT PLOT PROGRAM,35)	CRT0031
CALL PARAMS	CRT0032
CALL PARAMS(5LALPHA,CALPHA,4LBETA,CBETA,5LGAMMA,CGAMMA)	CRT0033
800 READ(4) A	CRT0034
IF(EOF,4) 99,10	CRT0035
10 CONTINUE	CRT0036
DO 1 I=1,30,3	CRT0037
L = I+2	CRT0038
K = 0	CRT0039
DO 15 N=I,L	CRT0040
DO 15 J=1,10	CRT0041
K= K+1	CRT0042
IF(J,EQ,1) GO TO 17	CRT0043
CALL RSMFT(A(N),6)	CRT0044
17 IANS(K) = (A(N),AND,MASK)	CRT0045
15 CONTINUE	CRT0046
IF(PC,GT,6) PC=PC-10	CRT0047
IF(PC,EQ,0,OR,PC,EQ,2,OR,PC,EQ,3) GO TO 300	CRT0048
R = TEN*(TEN*(TEN*(TEN*IR4 +IR3)+IR2)+IR1)+IRO	CRT0049
S = TEN*(TEN*(TEN*(TEN*IS4 +IS3)+IS2)+IS1)+ISO	CRT0050
T = TEN*(TEN*(TEN*(TEN*IT4 +IT3)+IT2)+IT1)+ITO	CRT0051
U = TEN*(TEN*(TEN*(TEN*IU4 +IU3)+IU2)+IU1)+IU0	CRT0052
300 NC = PC+1	CRT0053
GO TO (401,402,403,404,405,406,406), NC	CRT0054
C*	CRT0055
C* PLOT COMMAND IS NO OPERATION	CRT0056
C*	CRT0057
401 GO TO 1	CRT0058
C*	CRT0059
C* PLOT COMMAND IS START NEW PLOT	CRT0060

C*		CRT0061
402	PLOTID = R	CRT0062
	XMIN = 0.0	CRT0063
	YMIN = 0.0	CRT0064
	XMAX = S	CRT0065
	YMAX = T	CRT0066
	XSCALE = 10.0/XMAX	CRT0067
	YSCALE = 10.0/YMAX	CRT0068
	GO TO 1	CRT0069
C*		CRT0070
C*	PLOT COMMAND IS SELECT CAMERA	CRT0071
C*		CRT0072
403	GO TO 1	CRT0073
C*		CRT0074
C*	PLOT COMMAND IS SKIP TO A NEW FRAME	CRT0075
C*		CRT0076
404	CONTINUE	CRT0077
	IF(NFIRST.EQ.0) GO TO 4041	CRT0078
	CALL CALPLT(0,0,-3)	CRT0079
	CALL SMESAGE(1,32)HTO RECORD PLOT, DEPRESS FN KEY 6,32)	CRT0080
	CALL SMESAGE(1,34)HTO CLEAR PICTURE, DEPRESS FN KEY 2,34)	CRT0081
	CALL SMESAGE(1,37)HTO GO TO NEXT FRAME, DEPRESS FN KEY 3,37)	CRT0082
	CALL CALPLT(12,0,0,-3)	CRT0083
	CALL SMESAGE(1,30)HIT KEY 45 TO END PLOT PROGRAM,30)	CRT0084
	CALL SMESAGE(1,39)HIT KEY 47 TO RE-DISPLAY PREVIOUS PLOTS,39)	CRT0085
	CALL SMESAGE(1,38)HIT ANY OTHER KEY TO CONTINUE PLOTTING,38)	CRT0086
	CALL NEXT(N)	CRT0087
	IF(N.EQ.45) GO TO 99	CRT0088
	IF(N.EQ.47) GO TO 199	CRT0089
	GO TO 1	CRT0090
4041	CONTINUE	CRT0091
	NFIRST = 1	CRT0092
	GO TO 1	CRT0093
C*		CRT0094
C*	PLOT COMMAND IS TYPE A CHARACTER	CRT0095
C*		CRT0096
405	X = R*XSCALE	CRT0097
	Y = S*YSCALE	CRT0098
	CALL NOTATE(X,Y,.1,STRING(CI),0.0,1)	CRT0099
	GO TO 1	CRT0100
C*		CRT0101
C*	PLOT COMMAND IS DRAW A LINE OR AN AXIS.	CRT0102
C*		CRT0103
406	CONTINUE	CRT0104
	X1 = R*XSCALE	CRT0105
	Y1 = S*YSCALE	CRT0106
	X2 = T*XSCALE	CRT0107
	Y2 = U*YSCALE	CRT0108
	CALL CALPLT(X1,Y1,3)	CRT0109
	CALL CALPLT(X2,Y2,2)	CRT0110
4062	GO TO 1	CRT0111
1	CONTINUE	CRT0112
	GO TO 800	CRT0113
C*		CRT0114
C*	RE-DISPLAY PREVIOUS PLOTS	CRT0115
C*		CRT0116
199	REWIND 4	CRT0117
	GO TO 800	CRT0118
C*		CRT0119
C*	END OF PLOT TAPE	CRT0120

C*		CRT0121
99	CONTINUE	CRT0122
	CALL CALPLT(0.0,999)	CRT0123
	CALL SMESAGE(1.20HEND OF FILE ON TAPE4,20)	CRT0124
	REWIND 4	CRT0125
C*****		CRT0126
C	BREAK POINT IN PROGRAM TO ALLOW OPERATOR TO DISPLAY	CRT0127
C	AND/OR CHANGE THE CURRENTLY ESTABLISHED VIEW ANGLE.	CRT0128
C*****		CRT0129
	CALL SMESAGE(1.50HTO DISPLAY AND/OR CHANGE THE CURRENTLY ESTABLISH	CRT0130
	IED.50)	CRT0131
	CALL SMESAGE(1.34HVIEW ANGLE**ALPHA,BETA AND GAMMA**,34)	CRT0132
	CALL SMESAGE(1.43HALTER THE APPROPRIATE ANGLE AND PRESS KEY 49,43)	CRT0133
	CALL NEXT(NK)	CRT0134
	IF(NK.NE.49) GO TO 499	CRT0135
	NVIEW = 1	CRT0136
	NCRT = 2	CRT0137
499	WRITE(6,4999) NVIEW,NCRT,NK,CALPHA ,CBETA,CGAMMA	CRT0138
4999	FORMAT(12H0*****NVIEW=I4,7H NCRT=I4,5H NK=I4/	CRT0139
	A10H0**CALPHA=E20.8,8H CBETA=E20.8,9H CGAMMA=E20.8)	CRT0140
	RETURN	CRT0141
	END	CRT0142

APPENDIX C

LINKAGE EDITOR CONTROL CARDS FOR
INTERACTIVE NASTRAN PREPROCESSOR

LINKEDIT LET,OUTFILE=NAST(T),PARAM(4)=20,PARAM(5)=50,PARAM(6)=6000, PARAM(2)=1200	LKED0002
LIBRARY NASTOBJ/WWS/BNFILE/XCAL	LKED0003
LINK 0	LKED0004
RENAME AFACTGR = ABSENT.	LKED0005
RENAME LABRT = ABSENT.	LKED0006
RENAME GATOR = ABSENT.	LKED0007
RENAME RECOVERY = RETURN \$\$ RCV NOT AVAILABLE AT CDC DATA CENTER	LKED0008
RENAME XWRITE(106600) = WRITEX \$---BLAST I/O FEATURE---\$	LKED0009
RENAME XREAD(106600) = READX \$---BLAST I/O FEATURE---\$	LKED0010
RENAME SYSTEM = SYSTEM.	LKED0011
RENAME PEXIT = LINK20.	LKED0012
RENAME MSGWRT = LINK20.	LKED0013
RENAME RWUNLD = RETURN	LKED0014
INCLUDE NASTOBJ(GINO, XCORSZ)	LKED0015
INCLUDE WWS(NASTRAN)	LKED0016
INCLUDE WWS(BLKDATA(TIME))	LKED0017
INCLUDE NASTOBJ(NASTRAN,BLKDATA(TIME),BLKDATA(GINO66),CONMSG)	LKED0018
INCLUDE NASTOBJ(106600,DUMP,RETURN)	LKED0019
INCLUDE NASTOBJ(XEOT,TMTOGO,WRTRRL,RDTRL)	LKED0020
INCLUDE NASTOBJ(WRTRRLZ,MESSAGE,FNAME)	LKED0021
INCLUDE NASTOBJ(OPNCOR,WRTCOR,RDCOR,OPNCORZ,PRELOC,LOCATE,PRELOCZ)	LKED0022
INCLUDE NASTOBJ(GOPEN,FREAD,CLSTAB,SSWTCH)	LKED0023
INCLUDE NASTOBJ(DSIGN) \$ FIX FOR 0 ARGUMENTS	LKED0024
INCLUDE WWS(BLKDATA(SPEC))	LKED0025
INCLUDE WWS(BLKDATA(CRT))	LKED0026
INSERT CRT	LKED0027
INSERT SYSTEM,GINOX,TIME,GINO66	LKED0028
INSERT ZBLPKX,ZNTPKX,PACKX,UNPAKX	LKED0029
ENTRY NASTRAN	LKED0030
END	LKED0031
	LKED0032
	LKED0033
LINK 1	LKED0034
RENAME CORSZ = XCORSZ	LKED0035
RENAME NTRAN=DUMP \$ 1108 DECK ONLY	LKED0036
RENAME SEARCH=DUMP \$ NOT USED ON THE 6400/6600	LKED0037
RENAME SYSTEM = SYSTEM. \$ RENAME THE CDC SYSTEM ROUTINE CALLS	LKED0038
RENAME PEXIT = LINK20.	LKED0039
RENAME SEMTRN = RETURN	LKED0040
RENAME XOR = XORF	LKED0041
RENAME LD01 = LD50	LKED0042
RENAME LD02 = LD50	LKED0043
RENAME LD03 = LD50	LKED0044
RENAME LD04 = LD50	LKED0045
RENAME LD05 = LD50	LKED0046
RENAME LD06 = LD50	LKED0047
RENAME LD07 = LD50	LKED0048
RENAME LD08 = LD50	LKED0049
RENAME LD09 = LD50	LKED0050
RENAME LD10 = LD50	LKED0051
RENAME LD11 = LD50	LKED0052
RENAME LD12 = LD50	LKED0053
RENAME LD13 = LD50	LKED0054
RENAME LD45 = LINK20.	LKED0055
RENAME LD46 = LINK20.	

RENAME LD47 = LINK20.	LKED0056
RENAME LD48 = LINK20.	LKED0057
RENAME LD49 = LINK20.	LKED0058
RENAME LD51 = LINK20.	LKED0059
RENAME BUG = RETURN	LKED0060
RENAME TTLPGE = RETURN	LKED0061
INCLUDE WWS(XSEM1)	LKED0062
INCLUDE NASTOBJ(XSEM1,TAPBIT,PAGE,PAGE1,PAGE2,PAGEZZZ)	LKED0063
INCLUDE NASTOBJ(BLKDATA(XSRTBD))	LKED0064
INSERT XSRTBD,ZZZPAGE,BLANK..	LKED0065
OVERLAY A1	LKED0066
INCLUDE NASTOBJ(MSGWRT,USRMSG)	LKED0067
OVERLAY A1	LKED0068
INCLUDE WWS(SMESSAGE)	LKED0069
INCLUDE WWS(CDC250,NEXT,PLT250)	LKED0070
INCLUDE WWS(LODTBL)	LKED0071
INCLUDE BNF ILE(CDC250,DECOD3,DECOD4,HOGWASH,LODTBL,NEXT,PLT250)	LKED0072
INCLUDE BNF ILE(WARTHOG,SCREEN)	LKED0073
INCLUDE WWS(PLT000,KEYBORD,CRT250)	LKED0074
INCLUDE WWS(SPCMAT)	LKED0075
INCLUDE WWS(KG1FR)	LKED0076
INCLUDE XCAL(CALPLT)	LKED0077
INCLUDE WWS(ENCOD2,RSHT,ADVERSE,SPACK,SLOCATE,CALPLT,UNPK,CNTRLN)	LKED0078
INCLUDE WWS(CREATEF,DECOD1,DECOD2,DROUTE,EXOR,IO3,NOTATE,PLOTSW)	LKED0079
INCLUDE WWS(PLT9999,SAVLOT,SCAN,STRCALL,TRUNCL,WHERE,XMIT,LOADADR)	LKED0080
INCLUDE WWS(BLKDATA(GRAPHNO))	LKED0081
INSERT GRAPHNO,LANGLEY,TRIAL,VPARMS	LKED0082
OVERLAY A1	LKED0083
INCLUDE WWS(BTSTRP)	LKED0084
INCLUDE NASTOBJ(BTSTRP,ENDSYSZ,ENDSYS,BGNSYS)	LKED0085
INSERT ZENDSYS	LKED0086
OVERLAY ENDSSS	LKED0087
INSERT ENDSSS	LKED0088
OVERLAY A1	LKED0089
INCLUDE NASTOBJ(XPOLCK,XFILPS,XPLEOK,XPOLCKZ)	LKED0090
OVERLAY XIX	LKED0091
INCLUDE NASTOBJ(XCE1,XPURGE)	LKED0092
OVERLAY XIX	LKED0093
INCLUDE NASTOBJ(BLKDATA(XSFA1),XSFA,XSOSGN,XCLEAN,XPUNP,XDPH)	LKED0094
INSERT XSFA1,ZXPOLCK	LKED0095
OVERLAY ESFA	LKED0096
INSERT ESFA	LKED0097
OVERLAY A1	LKED0098
INCLUDE NASTOBJ(BLKDATA(IFPX0),BLKDATA(IFPX1),BLKDATA(UMFZZZ),SEMINT)	LKED0099
INSERT IFPX0,XOLDPT,IFPX1,UMFZZZ	LKED0100
OVERLAY DD	LKED0101
INCLUDE NASTOBJ(XRCARD)	LKED0102
OVERLAY D	LKED0103
INCLUDE NASTOBJ(GNF IAT, XCSA,XRGDFM,XSBSET)	LKED0104
INCLUDE NASTOBJ(WALTIM)	LKED0105
OVERLAY E1	LKED0106
INSERT XCSABF	LKED0107
OVERLAY E1	LKED0108
INCLUDE WWS(LD50)	LKED0109
OVERLAY D	LKED0110
INCLUDE NASTOBJ(SORT)	LKED0111
OVERLAY DE	LKED0112

INCLUDE NASTOBJ(BLKDATA(IFP1A),FNDPLT)	LKED0113
INCLUDE WWS(IFP1D)	LKED0114
INCLUDE NASTOBJ(IFP1,IFP1C,IFP1D,IFP1E,IFP1F,IFP1G,SWSRT)	LKED0115
INSERT SETUP,IFP1A	LKED0116
OVERLAY IFP1X	LKED0117
INSERT IFP1X	LKED0118
OVERLAY DE	LKED0119
INCLUDE NASTOBJ(IFP4B,IFP4C,IFP4E,IFP4F,IFP4G,BISRCH)	LKED0120
OVERLAY IFP45	LKED0121
INCLUDE NASTOBJ(IFP4,IFP4A)	LKED0122
OVERLAY IFP4ZZ	LKED0123
INSERT IFP4ZZ	LKED0124
OVERLAY IFP45	LKED0125
INCLUDE NASTOBJ(IFP5,IFP5A)	LKED0126
OVERLAY IFP5ZZ	LKED0127
INSERT IFP5ZZ	LKED0128
OVERLAY D	LKED0129
INCLUDE NASTOBJ(XFADJ1,XRECPS,XFADJ,CROFLG,RPAGE,XBCDBI,EXTINT,INITCO)	LKED0130
INCLUDE NASTOBJ(XPRETY,INTEXT,XRECPSZ,ISFT)	LKED0131
INSERT ZXRECPS	LKED0132
OVERLAY UMF	LKED0133
INCLUDE NASTOBJ(XSORT)	LKED0134
OVERLAY ESORT	LKED0135
INSERT ESORT	LKED0136
OVERLAY UMF	LKED0137
INCLUDE NASTOBJ(UMFEDT)	LKED0138
OVERLAY UMFXXX	LKED0139
INSERT UMFXXX	LKED0140
OVERLAY D	LKED0141
INCLUDE NASTOBJ(BLKDATA(XGP12),BLKDATA(XGP1C),XGP1,XGP1DG,XGP1MW)	LKED0142
INCLUDE NASTOBJ(XGP1DGZ)	LKED0143
INSERT XGP1C,XGP1D,XGP12,XGP13,XGP14,XGP15,XGP16,XGP17,XGP18,XGP12X	LKED0144
INSERT ZXGP1DG	LKED0145
OVERLAY E	LKED0146
INCLUDE NASTOBJ(BLKDATA(XLKSPC),XGP1BS,MPLPRT)	LKED0147
INSERT XLKSPC	LKED0148
OVERLAY XGP11 & THIS MUST BE UNDER LONGEST SEGMENT UNDER OVERLAY E	LKED0149
INSERT XGP11	LKED0150
OVERLAY E	LKED0151
INCLUDE NASTOBJ(XFLORD,XFLDEF)	LKED0152
OVERLAY E	LKED0153
INCLUDE NASTOBJ(OSCDMP)	LKED0154
OVERLAY E	LKED0155
INCLUDE NASTOBJ(XOSGEN,XLNKHD,XIPFL,XPARAM,XSCNDM)	LKED0156
OVERLAY DD	LKED0157
INCLUDE NASTOBJ(IFPDCO)	LKED0158
INCLUDE NASTOBJ(BLKDATA(IFPOTA))	LKED0159
INSERT IFPOTA	LKED0160
OVERLAY ODD	LKED0161
INCLUDE NASTOBJ(RCARD,IFP)	LKED0162
INCLUDE NASTOBJ(BLKDATA(IFPX2),BLKDATA(IFPX3),BLKDATA(IFPX4))	LKED0163
INCLUDE NASTOBJ(BLKDATA(IFPX5),BLKDATA(IFPX6),BLKDATA(IFPX7))	LKED0164
INSERT IFPX2,IFPX3,IFPX4,IFPX5,IFPX6,IFPX7	LKED0165
OVERLAY DD1	LKED0166
INCLUDE NASTOBJ(IFS1P)	LKED0167

OVERLAY DD1	LKED0168
INCLUDE NASTOBJ(IFS2P)	LKED0169
OVERLAY IFPXX	LKED0170
INSERT IFPXX	LKED0171
OVERLAY DD1	LKED0172
INCLUDE NASTOBJ(IFS3P)	LKED0173
OVERLAY DD1	LKED0174
INCLUDE NASTOBJ(IFS4P)	LKED0175
OVERLAY DD1	LKED0176
INCLUDE NASTOBJ(IFS5P)	LKED0177
OVERLAY DDD	LKED0178
INCLUDE NASTOBJ(BLKDATA(IFP3BD),IFP3,IFP3B)	LKED0179
INSERT IFP3BD,IFP3LV	LKED0180
OVERLAY IFP3ZZ	LKED0181
INSERT IFP3ZZ	LKED0182
ENTRY XSEM1	LKED0183
END	LKED0184
LINK 2	LKED0185
RENAME CORSZ = XCORSZ	LKED0186
RENAME NTRAN=DUMP \$ 1108 DECK ONLY	LKED0187
RENAME SEARCH=DUMP \$ NOT USED ON THE 6400/6600	LKED0188
RENAME PEXIT = LINK20.	LKED0189
RENAME BTSTRP = RETURN	LKED0190
RENAME SYSTEM = SYSTEM.	LKED0191
RENAME SETC = RETURN	LKED0192
RENAME TAID = RETURN	LKED0193
RENAME TAIE = RETURN	LKED0194
RENAME TAPSWI = ABSENT.	LKED0195
RENAME OPMESG = ABSENT.	LKED0196
INCLUDE WWS(XSEM2)	LKED0197
INCLUDE NASTOBJ(XSEM2,TAPBIT,INTLST)	LKED0198
INCLUDE NASTOBJ(RDMODE,RDMODX,RDMODXZ)	LKED0199
INCLUDE NASTOBJ(RDMODY,RDWORD)	LKED0200
INSERT ZRDMODX,BLANK..	LKED0201
OVERLAY ONE	LKED0202
INCLUDE NASTOBJ(PAGE,PAGE1,PAGE2,PAGEZZZ)	LKED0203
INSERT ZZZPAGE	LKED0204
OVERLAY A	LKED0205
INCLUDE NASTOBJ(MSGWRT,USRMSG)	LKED0206
OVERLAY A	LKED0207
INCLUDE WWS(SMESSAGE)	LKED0208
INCLUDE WWS(LODTBL)	LKED0209
INCLUDE WWS(CDC250,NEXT,PLT250)	LKED0210
INCLUDE BNFIL(CDC250,DEC003,DEC004,HOGWASH,LODTBL,NEXT,PLT250)	LKED0211
INCLUDE BNFIL(WARTHOG,SCREEN)	LKED0212
INCLUDE WWS(PLT000,KEYBORD,CRT250)	LKED0213
INCLUDE WWS(SPCMAT)	LKED0214
INCLUDE WWS(KG1FR)	LKED0215
INCLUDE XCAL(CALPLT)	LKED0216
INCLUDE WWS(ENCOD2,RSHT,ADVERSE,SPACK,SLOCATE,CALPLT,UNPK,CNTRLN)	LKED0217
INCLUDE WWS(CREATEF,DECOD1,DECOD2,DROUTE,EXOR,IO3,NOTATE,PLOTSW)	LKED0218
INCLUDE WWS(PLT9999,SAVLOT,SCAN,STRCALL,TRUNCL,WHERE,XMIT,LOADADR)	LKED0219
INCLUDE WWS(PARAMS)	LKED0220

INCLUDE WWS(CRTPLOT)	LKED0221
INCLUDE WWS(BLKDATA(GRAPHNO))	LKED0222
INSERT GRAPHNO,LANGLEY,TRIAL,VPARMS	LKED0223
OVERLAY A	LKED0224
INCLUDE NASTOBJ(ENDSYSZ,ENDSYS,BGNSYS)	LKED0225
INSERT ZENDSYS	LKED0226
OVERLAY ENDSSS	LKED0227
INSERT ENDSSS	LKED0228
OVERLAY A	LKED0229
INCLUDE NASTOBJ(OPARAM)	LKED0230
OVERLAY A	LKED0231
INCLUDE NASTOBJ(XSAVE)	LKED0232
OVERLAY A	LKED0233
INCLUDE NASTOBJ(XCEI)	LKED0234
OVERLAY A	LKED0235
INCLUDE NASTOBJ(XCHK)	LKED0236
OVERLAY A	LKED0237
INCLUDE NASTOBJ(BLKDATA(XSFA1),XPURGE,XPUMP,XDPH)	LKED0238
INCLUDE NASTOBJ(XPOLCK,XFILPS,XPLEQK,XPOLCKZ,XSFA,XCLEAN,XSOSGN,GNFIST)	LKED0239
INSERT ZXPOLCK,XSFA1	LKED0240
OVERLAY ESFA	LKED0241
INSERT ESFA	LKED0242
OVERLAY A	LKED0243
INCLUDE NASTOBJ(TABPT,TABPRT)	LKED0244
OVERLAY TABPRX	LKED0246
INSERT TABPRX	LKED0247
OVERLAY A	LKED0248
INCLUDE NASTOBJ(PRTPRM)	LKED0249
OVERLAY A	LKED0250
INCLUDE NASTOBJ(BLKDATA(INPUTA,IUNION,INPUT)	LKED0251
INSERT INPUTA	LKED0252
OVERLAY INPUTX	LKED0253
INSERT INPUTX	LKED0254
OVERLAY A	LKED0255
INCLUDE NASTOBJ(EJECT,WRTMSG,PRTMSG)	LKED0256
OVERLAY XXPMSG	LKED0257
INSERT XXPMSG	LKED0258
OVERLAY A	LKED0259
INCLUDE NASTOBJ(INPTT1)	LKED0260
INCLUDE NASTOBJ(TPSWIT,FORFIL)	LKED0261
OVERLAY INP1XX	LKED0262
INSERT INP1XX	LKED0263
OVERLAY A	LKED0264
INCLUDE NASTOBJ(INPTT2)	LKED0265
OVERLAY INP2XX	LKED0266
INSERT INP2XX	LKED0267
OVERLAY A	LKED0268
INCLUDE NASTOBJ(BLKDATA(CHAR94),AXIS,DRWCHR,DPLOT,LINE,PLTSET,PRINT)	LKED0269
INCLUDE WWS(SGINOZZ)	LKED0270
INCLUDE NASTOBJ(SCLOSE,SELCAM,SEOF,SGINOZZ,SKPFRM,SOPEN,STPLOT,SWRITE)	LKED0271
INCLUDE NASTOBJ(SYMBOL,TYPE,TYPINT,FNDPLT)	LKED0272
INSERT CHAR94,CHRDRW,XPARM,PLTDAT,SYMBOLS,ZZSGINO	LKED0273
OVERLAY DRAW	LKED0274
INCLUDE NASTOBJ(LINE10,TYPE10,WPLT10)	LKED0275
OVERLAY LONGST	LKED0276
INCLUDE NASTOBJ(DPLOT,DRAW)	LKED0277
INCLUDE NASTOBJ(ELELBL,FIND,FNDSET, GPTLBL,GPTSYM,HEAD,INTVEC)	LKED0278
INCLUDE WWS(PLOT)	LKED0279
INCLUDE WWS(PROCES)	LKED0280
INCLUDE NASTOBJ(MINMAX,PARAM,PERPEC,PLOT,PLTOPR,PROCES,SHAPE,WRTPRT)	LKED0281
INSERT DRWDAT,RSTXXX	LKED0282
OVERLAY XXPLOT	LKED0283

INSERT	XXPLOT	LKED0284
OVERLAY	DRAW	LKED0285
INCLUDE	NASTOBJ(LINE9,TYPE9,WPLT9)	LKED0286
OVERLAY	ONE	LKED0287
INCLUDE	NASTOBJ(SETVAL)	LKED0288
OVERLAY	ONE	LKED0289
INCLUDE	NASTOBJ(BLKDATA(GPTA1),DELSET)	LKED0290
INSERT	GPTA1	LKED0291
OVERLAY	TAIGP1	LKED0292
INCLUDE	NASTOBJ(SORT)	LKED0293
INSERT	SETUP	LKED0294
OVERLAY	GPX1	LKED0295
INCLUDE	NASTOBJ(GP1)	LKED0296
OVERLAY	GPA1	LKED0297
INSERT	GPA1	LKED0298
OVERLAY	GPX1	LKED0299
INCLUDE	NASTOBJ(GP2)	LKED0300
OVERLAY	GPA2	LKED0301
INSERT	GPA2	LKED0302
OVERLAY	TAIGP1	LKED0303
INCLUDE	NASTOBJ(COMECT,CNSTRC,DPLTST,SETINP)	LKED0304
OVERLAY	XXPSET	LKED0305
INSERT	XXPSET	LKED0306
OVERLAY	ONE	LKED0307
INCLUDE	NASTOBJ(INPTT3)	LKED0308
OVERLAY	ONE	LKED0309
INCLUDE	NASTOBJ(INPTT4)	LKED0310
ENTRY	XSEM2	LKED0311
END		LKED0312

LINK 20		LKED0314
RENAME	CORSZ = XCORSZ	LKED0315
RENAME	APACTGR = ABSENT. * REMOVE THIS CARD WHEN RUNNING AT CYBERNET	LKED0316
RENAME	SYSTEM = SYSTEM.	LKED0317
RENAME	EXIT(PEXIT, * PEXIT66	LKED0318
INCLUDE	NASTOBJ(PEXIT,MSGWRT,USRMSG,PAGE,PAGE1,PAGE2,PAGEZZZ,PEXIT66)	LKED0319
ENTRY	PEXIT	LKED0320
END		LKED0321
ENDLINKS		LKED0313

REFERENCES

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2. Douglas, Frank J., ed.: The NASTRAN Programmer's Manual. NASA SP-233, 1970.

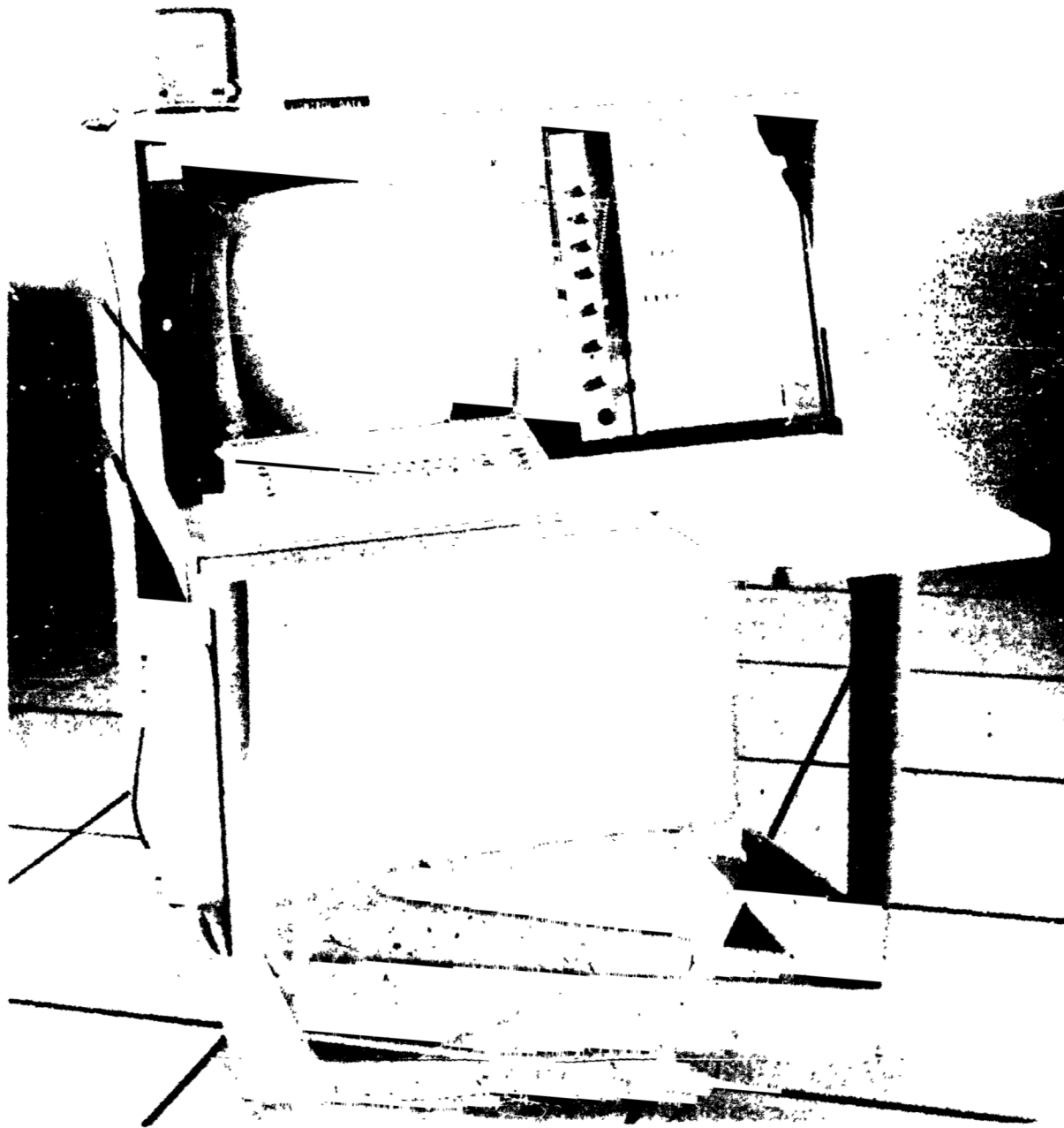


Figure 1. - CDC 250 CRT terminal.