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User's Guide for the PWR LOCA Analysis Capability of the WRAP-EM System

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Savannah River Laboratory

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ABSTRACT

The Water Reactor Analysis Package (WRAP) has been expanded to provide the capability to analyze loss-of-coolant accidents (LOCAs) in both pressurized water reactors (PWRs) and boiling water reactors (BWRs) by using evaluation models (EMs). The input specifications for modules in the WRAP-EM system are presented in this document along with the JOSHUA input templates. This document, along with the WRAP user's guide, provides a step-by-step procedure for setting up a PWR data base for the WRAP-EM system.

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DPST-NUREG-78-4 (September 1980)
DPST-NUREG-80-1 (September 1980)

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1. INTRODUCTION

The Water Reactor Analysis Package - Evaluation Model (WRAP-EM)[1] system is an integrated collection of computer codes designed to perform a complete analysis of the loss-of-coolant accident (LOCA) in light water power reactors. This system is designed to use evaluation models which generally conform to Nuclear Regulatory Commission (NRC) requirements for vendor licensing analyses. This manual addresses the analysis of pressurized water reactor (PWR) transients. A companion document[2] describes the capability of the WRAP-PWR system. WRAP-EM is also capable of analyzing boiling water reactor (BWR) accidents as described in an earlier document.[3]

The WRAP-EM modular system (for a PWR) (Figure 1) can be used to analyze an entire reactor transient from the end of normal operation, through the flooding stage, and terminating after quenching of the hot level. Modules contained in the system and brief descriptions of their functions follow:

- WRAPEX - controls the sequence in which the other modules are executed.
- GAPCON[4] - calculates fuel pin conditions during normal reactor operation.
- WRAPIT - reads input records and creates WRAP intermediate data set (WIDS) records through which other modules communicate.
- PWRSS[5] - automatic thermal-hydraulic initialization procedure.
- WRIN - pseudo initialization procedure from original RELAP4/MOD5[6] code.
- TWRAM - calculates transient response of system during blowdown phase of LOCA up until end of bypass (reprogrammed RELAP).
- REFILL - calculates time to refill lower plenum after end of bypass.
- FLOOD - calculates flooding portion of transient.
- FRAP[7,8] - performs detailed thermal analysis of the hottest pin in the core.

- WRROT - allows user to restart calculation from data stored on tape.

- WROP - creates plots of data from the transient analysis modules.

- RENPRE - automates much of the procedure involved in renoding a problem.

- MWRROT - restarts a problem after a renoding.

The modules WRAPIT, WRIN, TWRAM, and FLOOD are reprogrammed versions of RELAP4/MOD5.[6] RELAP has been converted to run under the JOSHUA[9] system at the Savannah River Laboratory (SRL) and has undergone extensive restructuring of input and dynamic dimensioning. GAPCON and FRAP, developed at other laboratories, were selected for the WRAP-EM system by NRC. The remaining modules, which enhance user interaction, were developed at SRL.

Each module in the analysis sequence performs only chronologically ordered portions of the total transient calculation; therefore, selected output parameters of one module are necessary for input to a subsequent module. Hand transfer of data is time consuming, and tedious and can have many errors, so interface routines which automatically select, massage, and transfer all necessary data between modules have been developed.

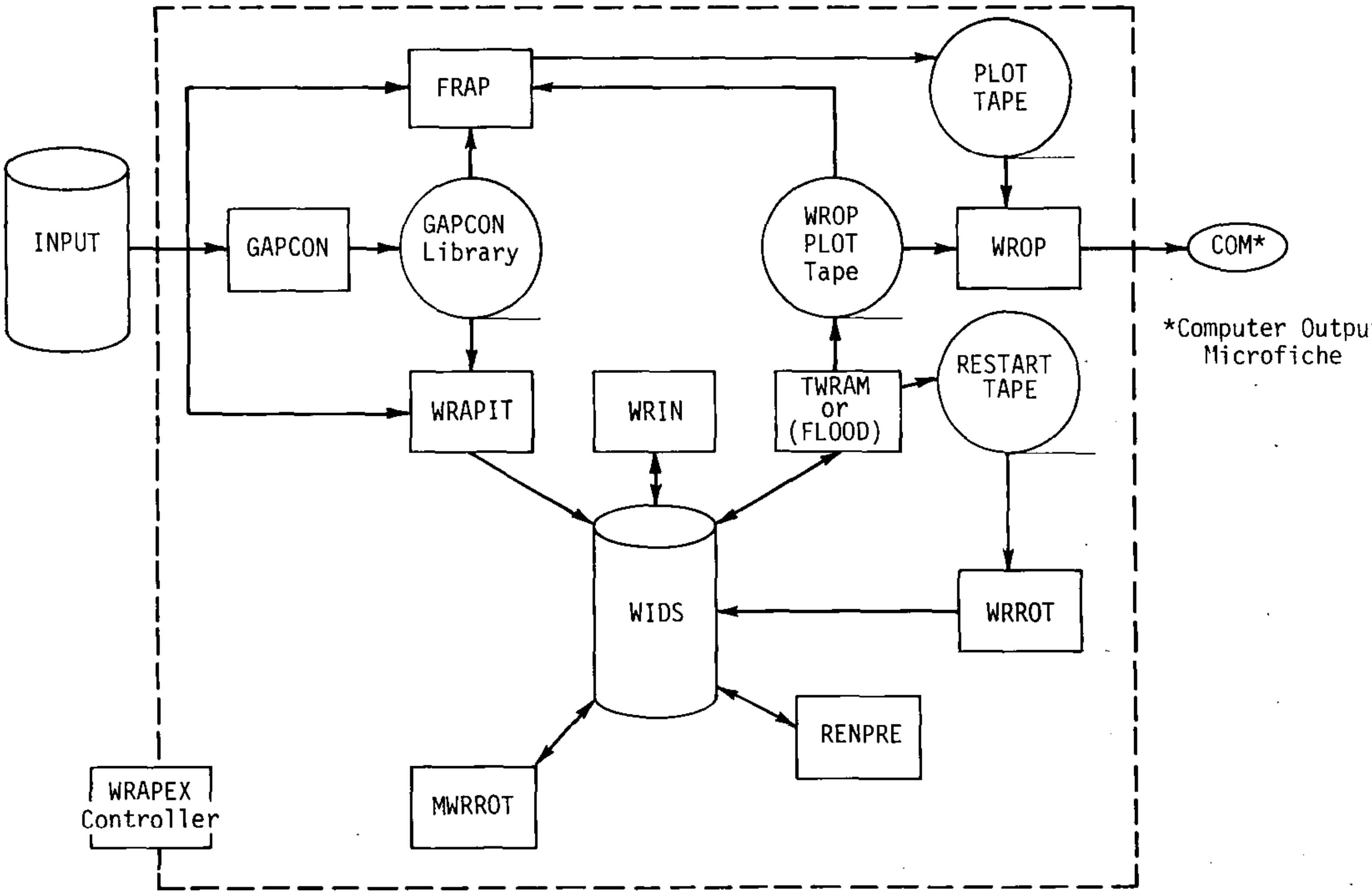


FIGURE 1. Conceptual View of Wrap-PWR-EM System

2. SUMMARY

This document provides the input specifications for the GAPCON, PWRSS, REFILL, FLOOD, FRAP, and RENPRE modules. Input specifications for the other modules in the WRAP-EM system for the PWR are given in Reference 10. Input data necessary for the various code interfaces are also described, including a discussion of the data passed from the GAPCON library to the FRAP and WRAPIT modules. WRAP templates developed since Reference 3 were published are described in the appendix. Prior knowledge of the JOSHUA[9] template concept and the application of this concept in the WRAP-EM system as described in Reference 10 are assumed.

3. INPUT DATA FOR MODULES

3.1 GAPCON

GAPCON-THERMAL-2 is used to compute the fuel pin parameters as a function of the operating power history of the reactor. (For a complete description of the code and input variables, the reader should consult Reference 4.) Selected output from GAPCON is automatically passed to the input processor WRAPIT and to the FRAP module. The number of GAPCON calculations required for the blowdown analysis is the same as the number of core heat slab stacks used in the transient run. Typically, a GAPCON is run for 1) the hot pin in the hot bundle; 2) the hot bundle, excluding the hottest pin; and 3) the entire core, excluding the hot bundle. FRAP requires a GAPCON analysis for the hottest pin. GAPCON output is stored in a library on disk. For transient analysis, the GAPCON output is retrieved by using the interface routines.

The templates for the GAPCON input records are presented on the following pages. The unnamed qualifier, signified by?, is the case name on all records except the WRAP.INPUT.JOB.? where the job name is the qualifier. Because output can be permanently stored in a GAPCON library for retrieval by subsequent calculational modules, each case included in a given library must be given a unique name. Flexibility is added by the form of the template WRAP.INPUT.GAPCON.CASE.? which allows the specification of different names (other than the present case name) as qualifiers in input records. This allows the user to input the same record for several different runs as would be done for parametric studies.

The following templates are used to prepare GAPCON input:

WRAP.INPUT.GAPCON.JOB.?JOBNAME

WRAP.INPUT.GAPCON.CASE.?CASENAME

WRAP.INPUT.GAPCON.COOLANT.?CASENAME

WRAP.INPUT.GAPCON.CLAD.?CASENAME

WRAP.INPUT.GAPCON.FUEL.COMPOS.?CASENAME

WRAP.INPUT.GAPCON.FUEL.?CASENAME

WRAP.INPUT.GAPCON.GAP.?CASENAME

WRAP.INPUT.GAPCON.POWER.?CASENAME

WRAP.INPUT.GAPCON.CONTROLS.?CASENAME

WRAP.INPUT.GAPCON.LIBRARY.?CASENAME

WRAP.GAPCON.CLAD.PROP.?CASENAME

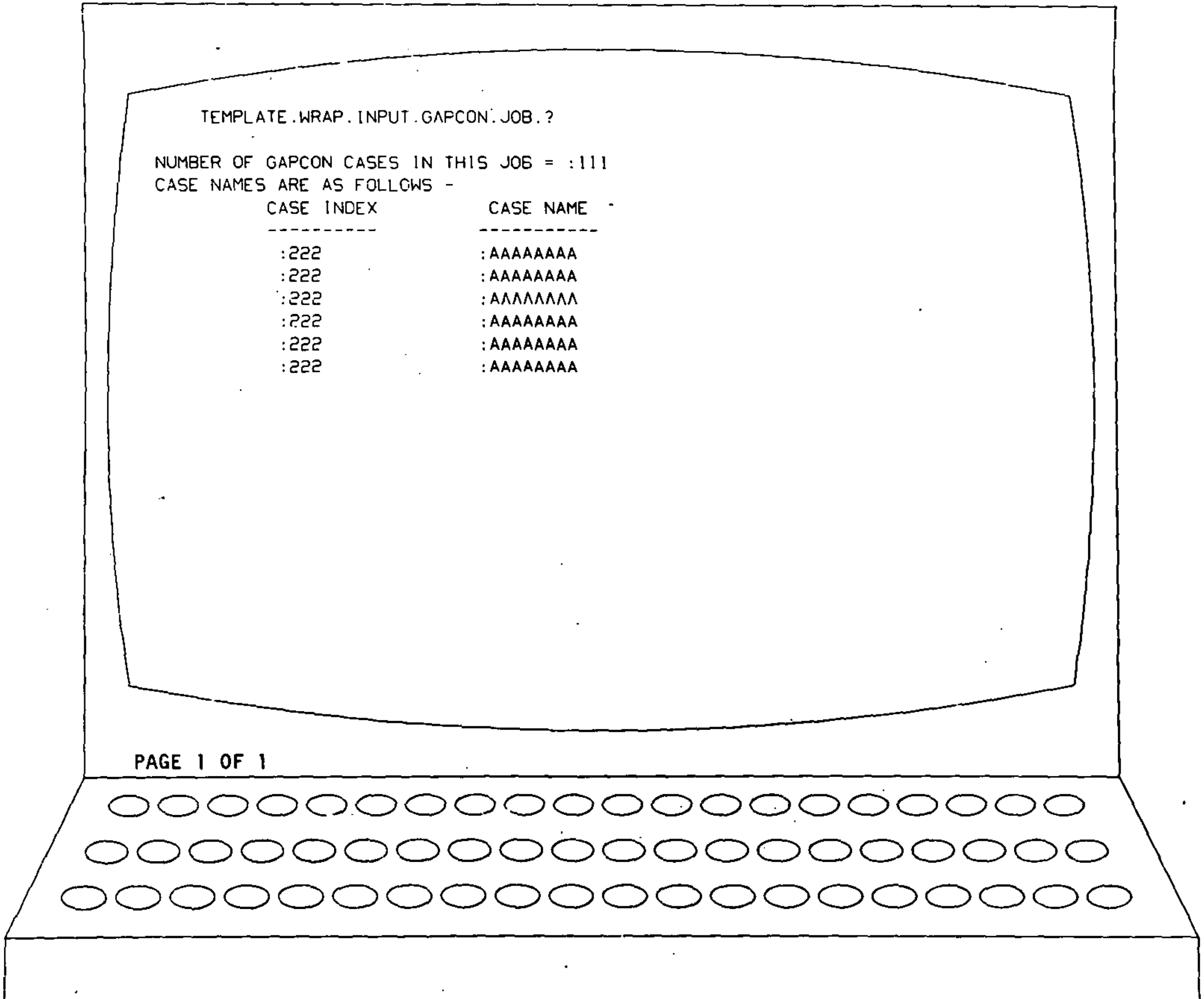
WRAP.GAPCON.CONDUCT.?CASENAME

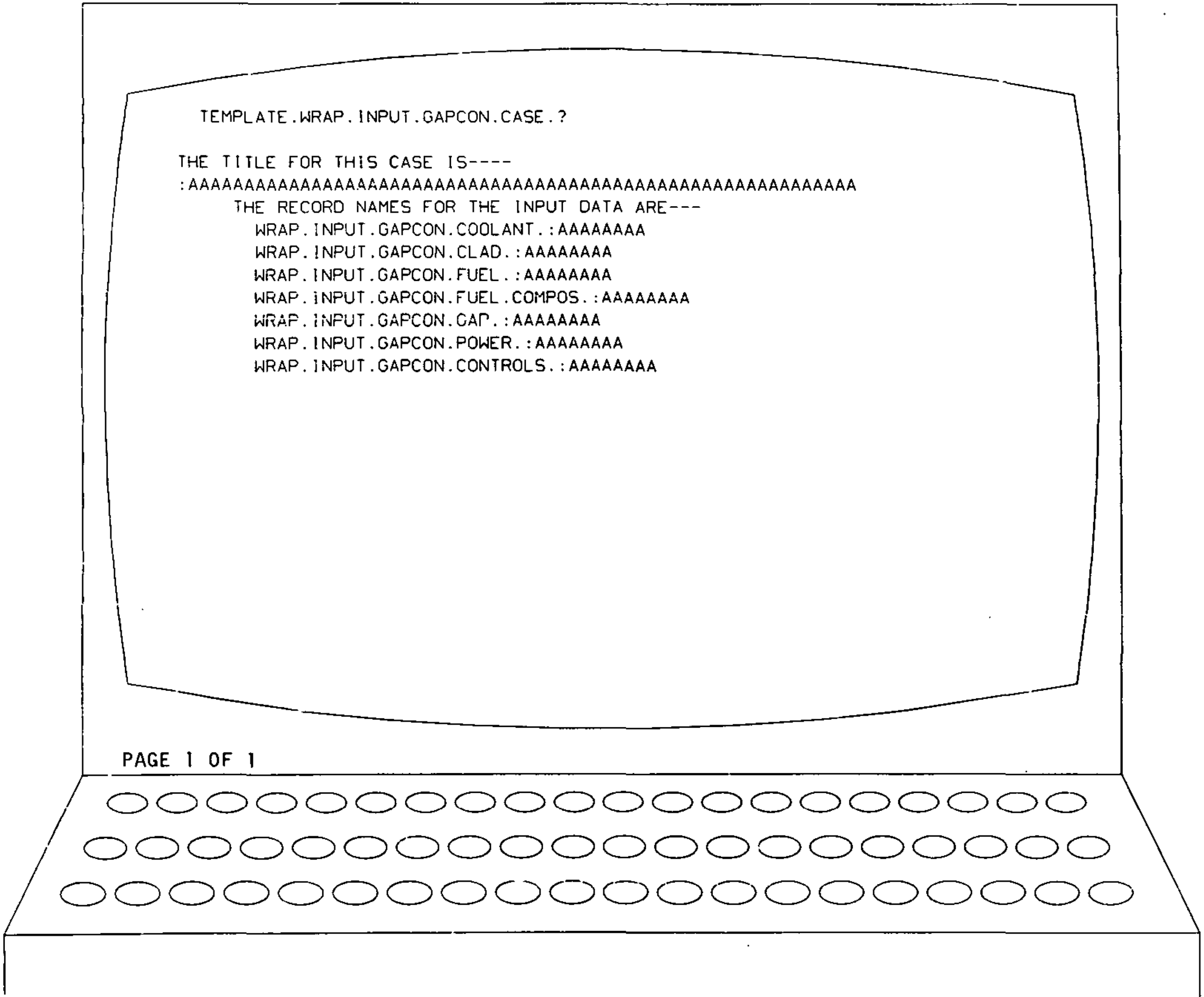
WRAP.GAPCON.CREPDWN.?CASENAME

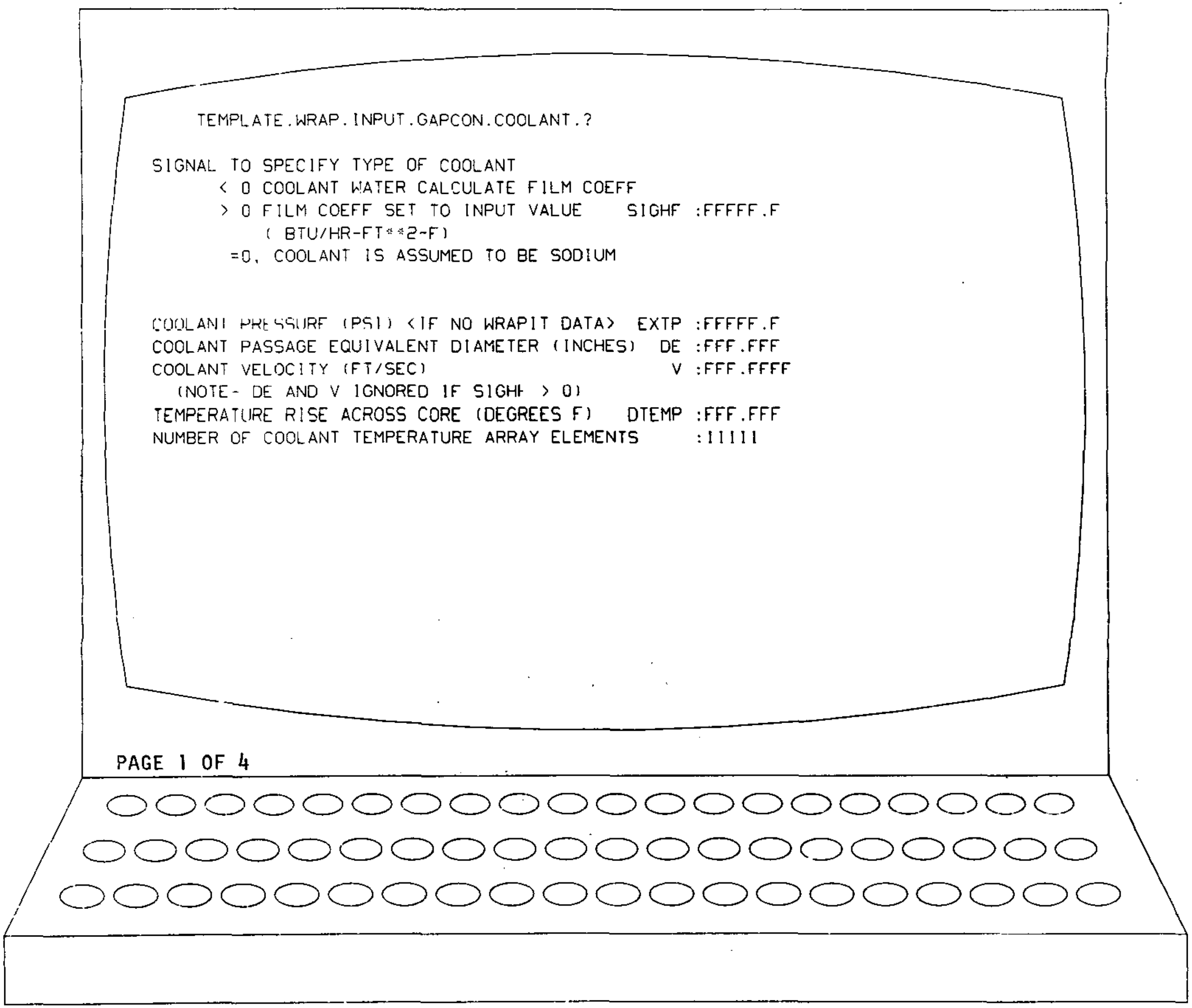
WRAP.GAPCON.FLUX.DEPRESS.?CASENAME

WRAP.GAPCON.AXIAL.PROFILE.?CASENAME

WRAP.OPERATE.POWER.HISTORY.?.?


TEMPLATE.WRAP.INPUT.GAPCON.JOB.?
NUMBER OF GAPCON CASES IN THIS JOB = :111
CASE NAMES ARE AS FOLLOWS -
CASE INDEX
CASE NAME
:222 :AAAAAAAA
:222 :AAAAAAAA
:222 :AAAAAAAA
:222 :AAAAAAAA
:222 :AAAAAAAA
:222 :AAAAAAAA
PAGE 1 OF 1


TEMPLATE.WRAP.INPUT.GAPCON.CASE.?
THE TITLE FOR THIS CASE IS----
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
THE RECORD NAMES FOR THE INPUT DATA ARE---
WRAP.INPUT.GAPCON.COOLANT.:AAAAAAAA
WRAP.INPUT.GAPCON.CLAD.:AAAAAAAA
WRAP.INPUT.GAPCON.FUEL.:AAAAAAAA
WRAP.INPUT.GAPCON.FUEL.COMPOS.:AAAAAAAA
WRAP.INPUT.GAPCON.GAP.:AAAAAAAA
WRAP.INPUT.GAPCON.POWER.:AAAAAAAA
WRAP.INPUT.GAPCON.CONTROLS.:AAAAAAAA
PAGE 1 OF 1


TEMPLATE.WRAP.INPUT.GAPCON.COOLANT.?
SIGNAL TO SPECIFY TYPE OF COOLANT
< 0 COOLANT WATER CALCULATE FILM COEFF
> 0 FILM COEFF SET TO INPUT VALUE SIGHF :FFFFF.F
(BTU/HR-FT**2-F)
=0, COOLANT IS ASSUMED TO BE SODIUM
COOLANT PRESSURE (PSI) <IF NO WRAPIT DATA> EXTP :FFFFF.F
COOLANT PASSAGE EQUIVALENT DIAMETER (INCHES) DE :FFF.FFF
COOLANT VELOCITY (FT/SEC) V :FFF.FFFF
(NOTE- DE AND V IGNORED IF SIGHF > 0)
TEMPERATURE RISE ACROSS CORE (DEGREES F) DTEMP :FFF.FFF
NUMBER OF COOLANT TEMPERATURE ARRAY ELEMENTS :IIIII
PAGE 1 OF 4

```
TEMPLATE.WRAP.INPUT.GAPCON.COOLANT.?

COOLANT TEMPERATURE ARRAY. IF DTEMP IS SPECIFIED, THEN| SKIP
ONLY A SINGLE VALUE (CORE INLET T DEG F) IS INPUT AND |  TO
THE CODE CALCULATES THE T RISE BASED ON POWER GENERAT-| NEXT
ION. DITTUS-BOELTER OR THOM HEAT TRANSFER IS SELECTED | PAGE
BY CODE TO GIVE LOWEST CLAD TEMPERATURES.             |  IF
                                                      | USING
   I    TINLET(I)      OPTIONAL...CAN CHOOSE +/-      | WRAPIT
                       FOR TINLET(I) TO INDICATE      | DATA
 :111  :FFFF.FF        IF COOLANT IS LIQUID(+) OR     |
 :111  :FFFF.FF        2PHASE(-) IN OUTPUT. (THIS     |
 :111  :FFFF.FF        IS AUTOMATICALLY DONE FOR      |
 :111  :FFFF.FF        WRAPIT DATA INPUT).            |
 :111  :FFFF.FF                                       |
 :111  :FFFF.FF                                       |
 :111  :FFFF.FF                                       |
 :111  :FFFF.FF                                       |
 :111  :FFFF.FF                                       |
 :111  :FFFF.FF                                       |
```

PAGE 2 OF 4

```
TEMPLATE.WRAP.INPUT.GAPCON.COOLANT.?


THIS PAGE IS FILLED IN IF WRAPIT INPUTS ARE USED. MAY NEGLECT BY
SETTING NCORE=0.

NCORE  :III   NUMBER OF WRAPIT CORE VOLUMES TO SPAN GAPCON PROBLEM

GSYNAM :AAAAAAAA   REFERS TO CORE COOLANT T AND P FOR CORE VOLUME
GSYVER :AAAAAAAA   IN WRAP.SYSTEM.GSYNAM?.GSYVER?.INITIAL.VOLUME
                   RECORD.


DRODUP :FFF.FFFF   DISTANCE (INCHES) THAT FUEL ROD SLAB IS UP
                   FROM BOTTOM OF LOWER CORE COOLANT VOLUME
                   ADJACENT TO ROD. (REFER TO VOLUME RECORDS
                   ON NEXT PAGE).
```

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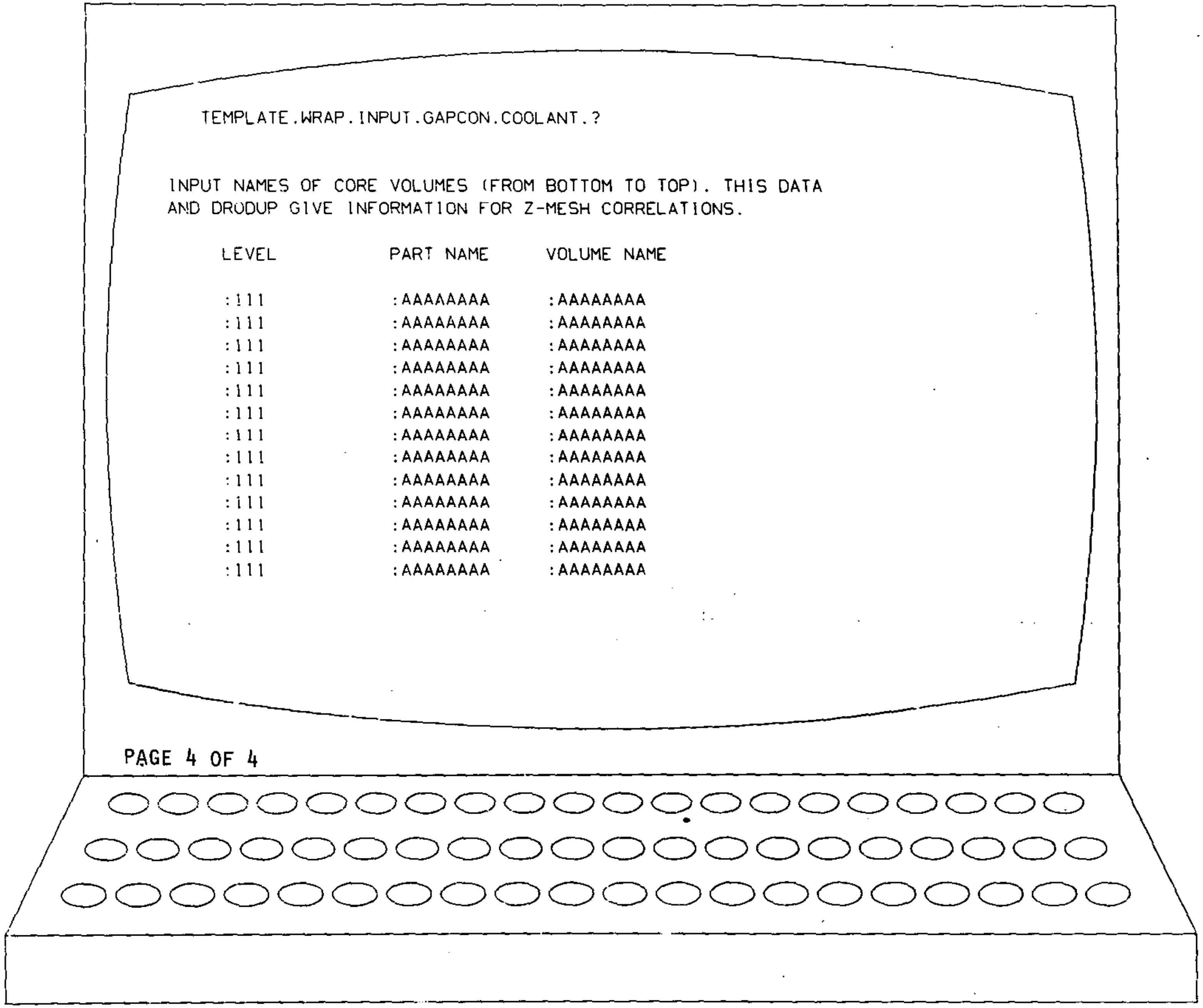
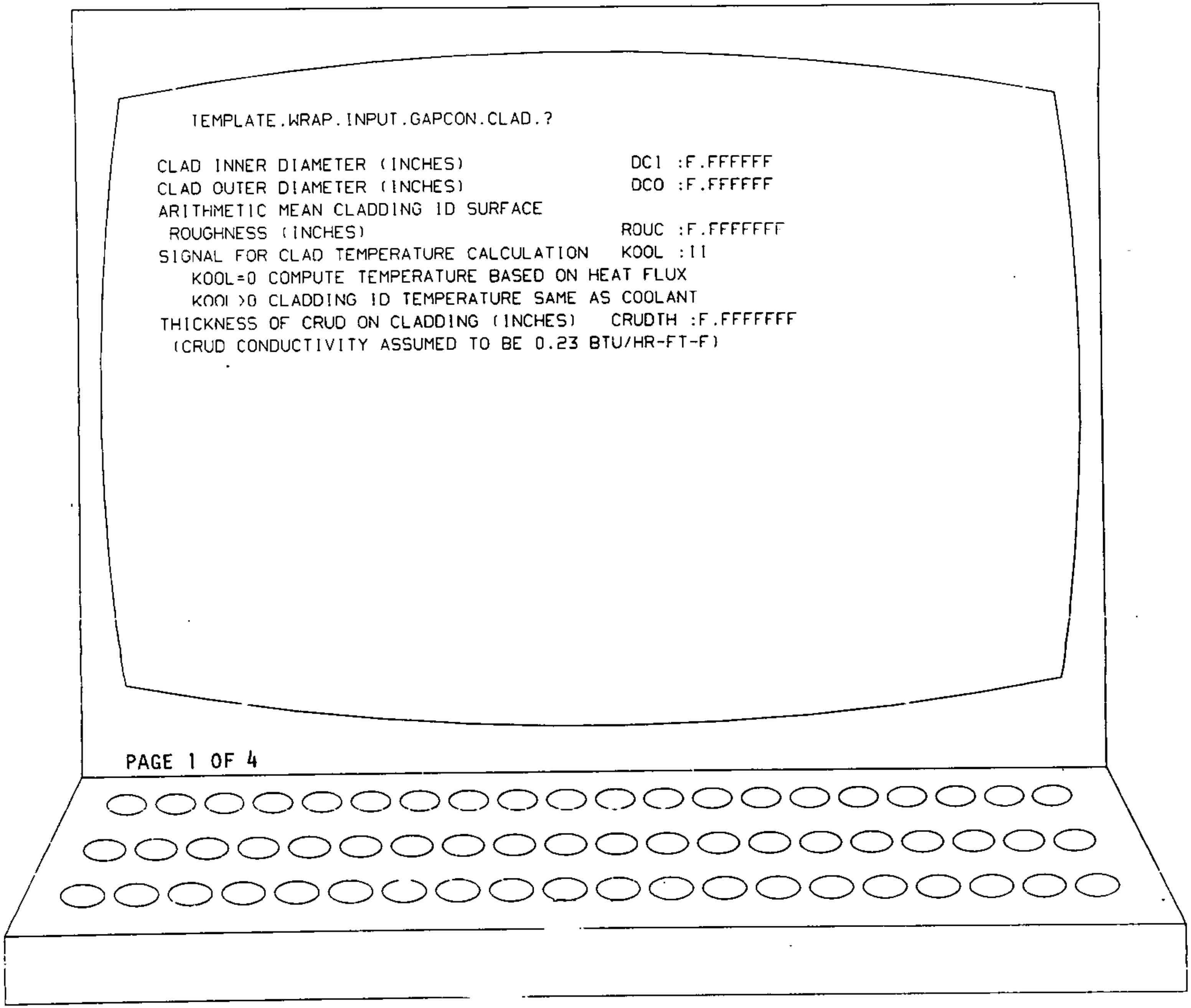
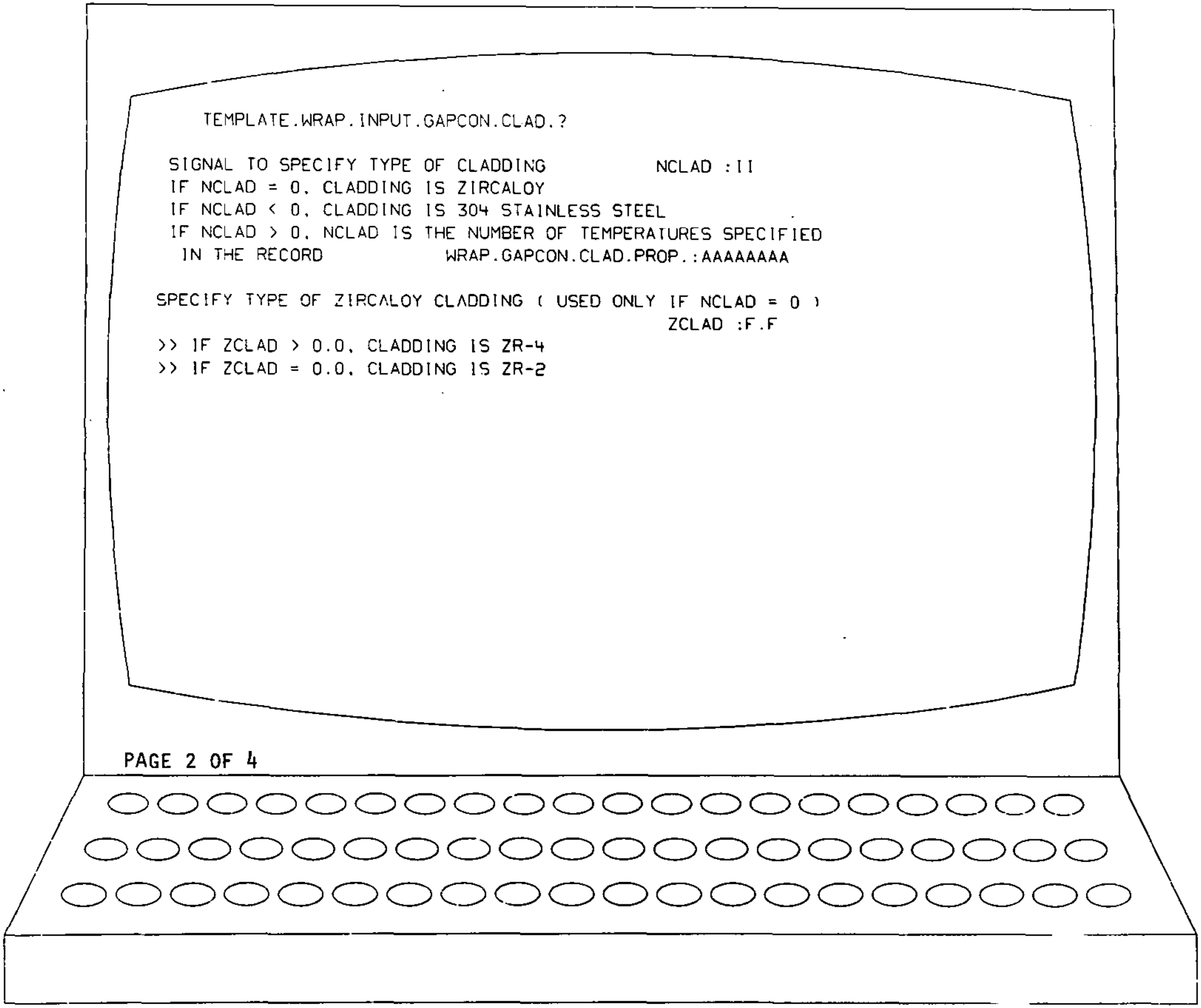

TEMPLATE.WRAP.INPUT.GAPCON.COOLANT.?
INPUT NAMES OF CORE VOLUMES (FROM BOTTOM TO TOP). THIS DATA
AND DRODUP GIVE INFORMATION FOR Z-MESH CORRELATIONS.
LEVEL PART NAME VOLUME NAME
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
PAGE 4 OF 4



```
TEMPLATE.WRAP.INPUT.GAPCON.CLAD.?

CLAD INNER DIAMETER (INCHES)                   DCI  :F.FFFFFF
CLAD OUTER DIAMETER (INCHES)                   DCO  :F.FFFFFF
ARITHMETIC MEAN CLADDING ID SURFACE
 ROUGHNESS (INCHES)                            ROUC :F.FFFFFFF
SIGNAL FOR CLAD TEMPERATURE CALCULATION        KOOL :II
   KOOL=0 COMPUTE TEMPERATURE BASED ON HEAT FLUX
   KOOL>0 CLADDING ID TEMPERATURE SAME AS COOLANT
THICKNESS OF CRUD ON CLADDING (INCHES)     CRUDTH :F.FFFFFFF
 (CRUD CONDUCTIVITY ASSUMED TO BE 0.23 BTU/HR-FT-F)
```

PAGE 1 OF 4



```
TEMPLATE.WRAP.INPUT.GAPCON.CLAD.?

SIGNAL TO SPECIFY TYPE OF CLADDING          NCLAD :II
IF NCLAD = 0, CLADDING IS ZIRCALOY
IF NCLAD < 0, CLADDING IS 304 STAINLESS STEEL
IF NCLAD > 0, NCLAD IS THE NUMBER OF TEMPERATURES SPECIFIED
 IN THE RECORD           WRAP.GAPCON.CLAD.PROP.:AAAAAAAA

SPECIFY TYPE OF ZIRCALOY CLADDING ( USED ONLY IF NCLAD = 0 )
                                               ZCLAD :F.F
>> IF ZCLAD > 0.0, CLADDING IS ZR-4
>> IF ZCLAD = 0.0, CLADDING IS ZR-2
```

PAGE 2 OF 4

```
   TEMPLATE.WRAP.INPUT.GAPCON.CLAD.?

ICDF IS A SIGNAL THAT ALLOWS THE USER TO INCLUDE    ICDF :I1
CHANGES IN THE PELLET-TO-CLAD HOT GAP FROM ELASTIC DEFLECTION
OF THE CLAD DUE TO DIFFERENT INTERNAL AND EXTERNAL PRESSURES
    ICDF=0 OPTION NOT USED
    ICDF>0 ELASTIC CLAD DEFORMATION ACCOUNTED FOR
          (NOT USED IF CREEPDOWN VALUES INPUT)
ICREP IS AN INTEGER SIGNAL TO SPECIFY INPUT OF     ICREP :I1
OF CLADDING CREEPDOWN
    ICREP=0 NO TIME DEPENDENT CLAD DEFORMATION
    ICREP>0 READ ICREP RADII FROM WRAP.GAPCON.CREPDWN.:AAAAAAAA
```

```
TEMPLATE.WRAP.INPUT.GAPCON.CLAD.?

ICOR IS A SIGNAL TO SPECIFY CLAD OXIDATION RATES  ICOR :II
  ICOR=0 NO CLAD OXIDATION
  ICOR =2 RATES FOR PWR; ICOR =4 RATES FOR BWR
OUTSIDE DIAMETER OF SECONDARY CLADDING OR BASKET (INCHES)
(NOTE A VALUE OF 0.0 MEANS NO SECONDARY CLAD)      DBO :F.FFFFFF
THERMAL CONDUCTIVITY OF SECONDARY CLADDING OR
 BASKET (BTU/HR-FT-F)                          KB :FFF.FFFFFF
HEAT TRANSFER COEFFICIENT BETWEEN BASKET AND
CLADDING (BTU/HR-FT**2-F)                        HBC :FFFFFF.F
CLADDING EMISSIVITY (FORMER DEFAULT .9)         EPSIC :FF.FFFFFF
```

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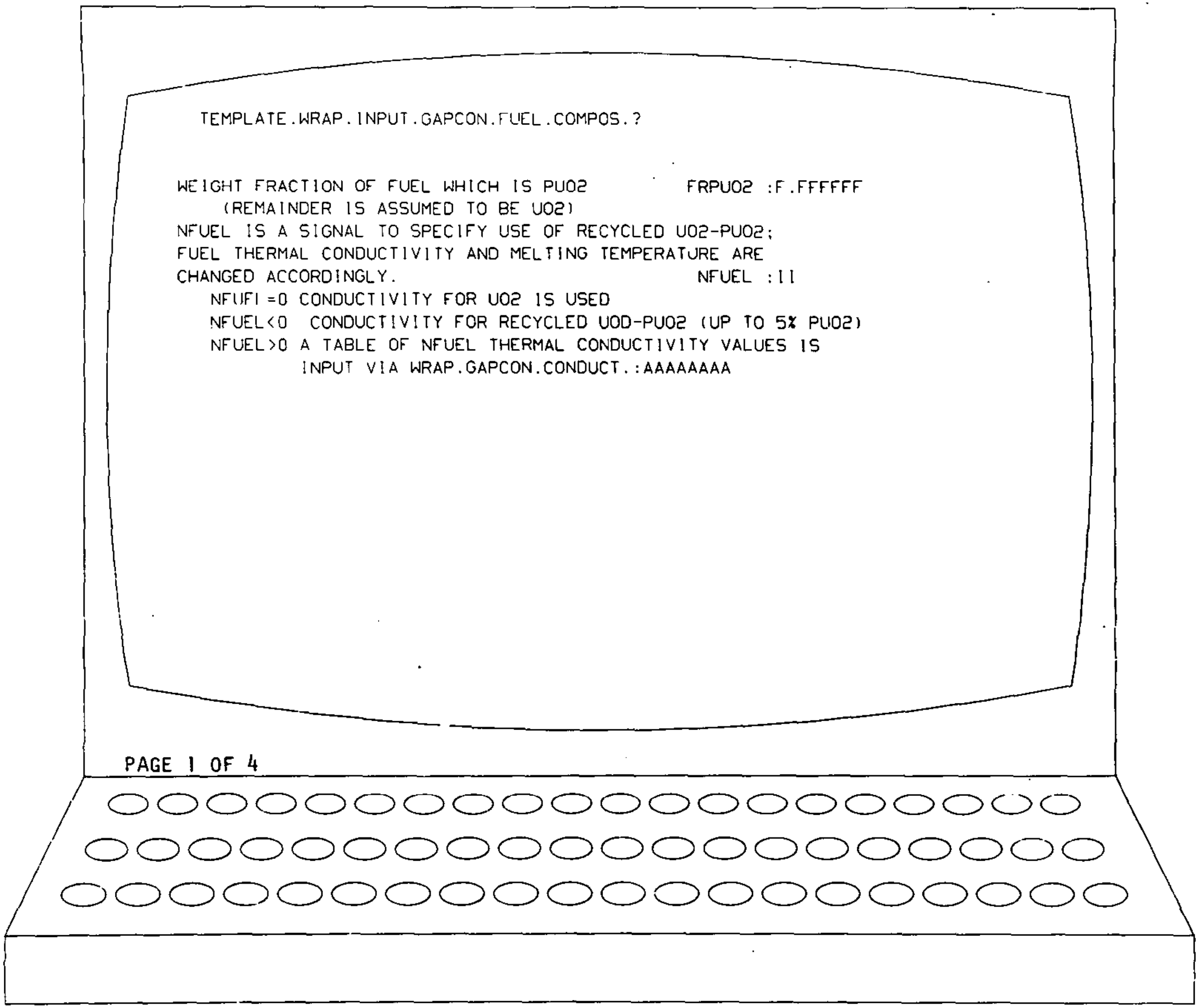
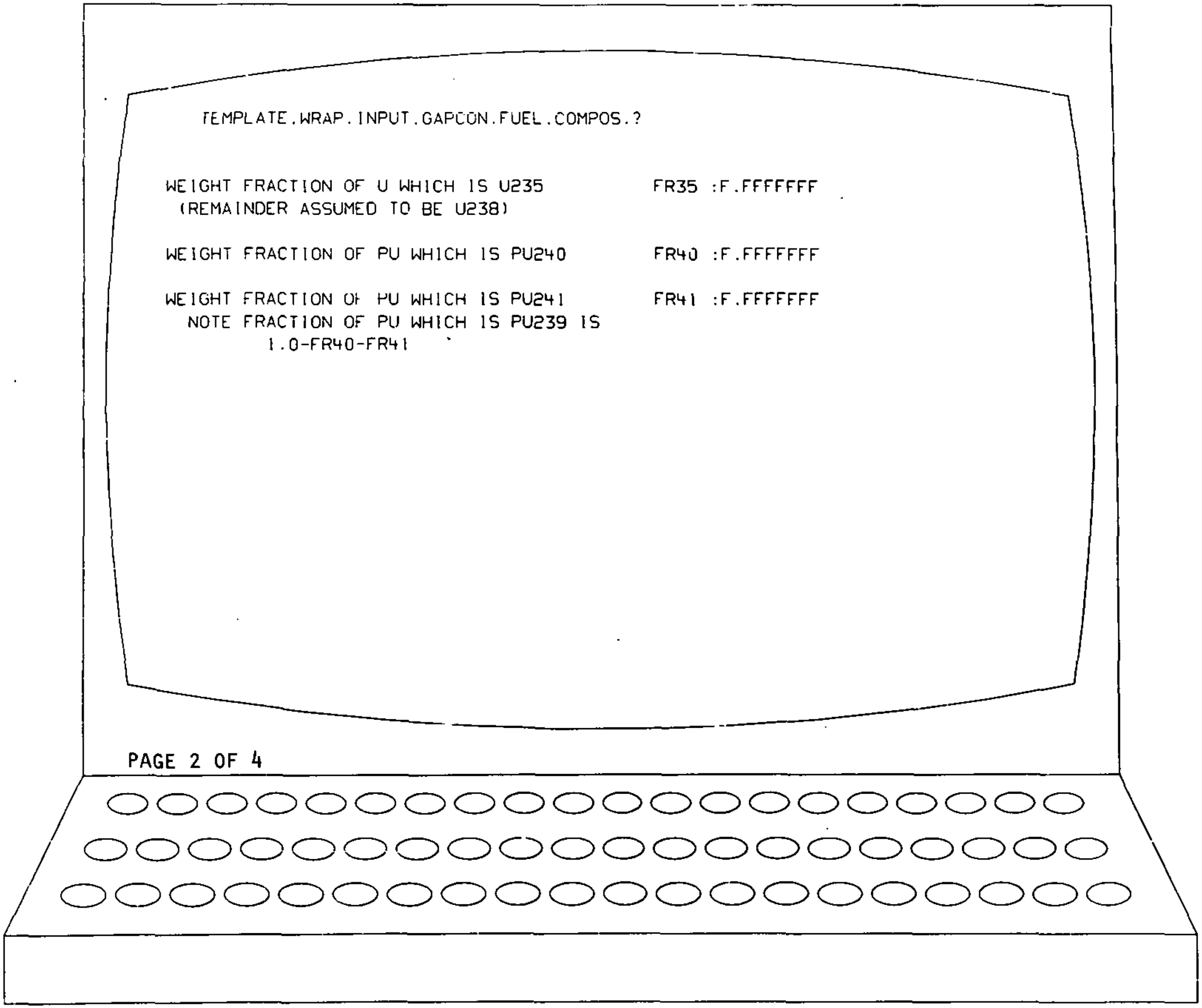
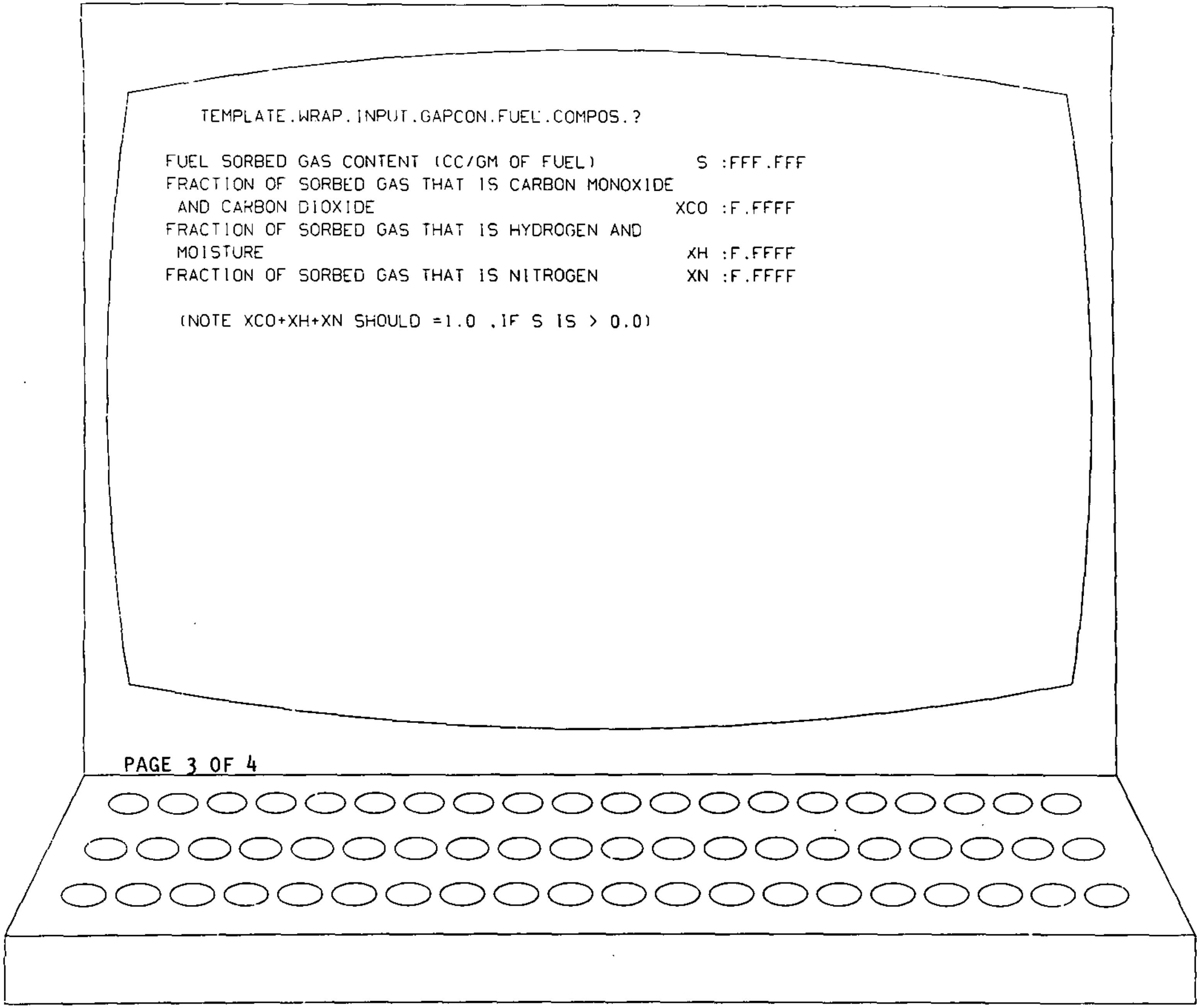
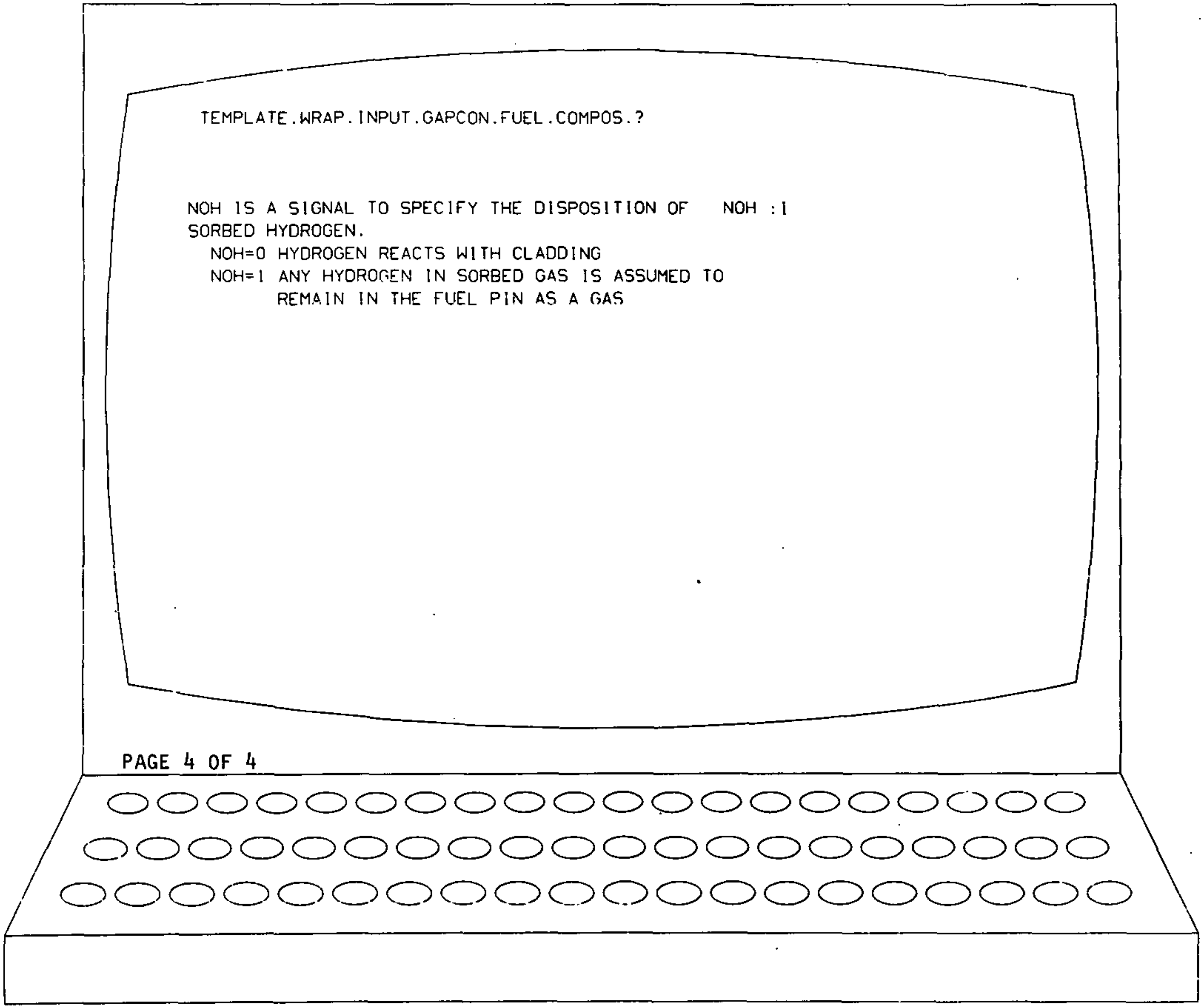
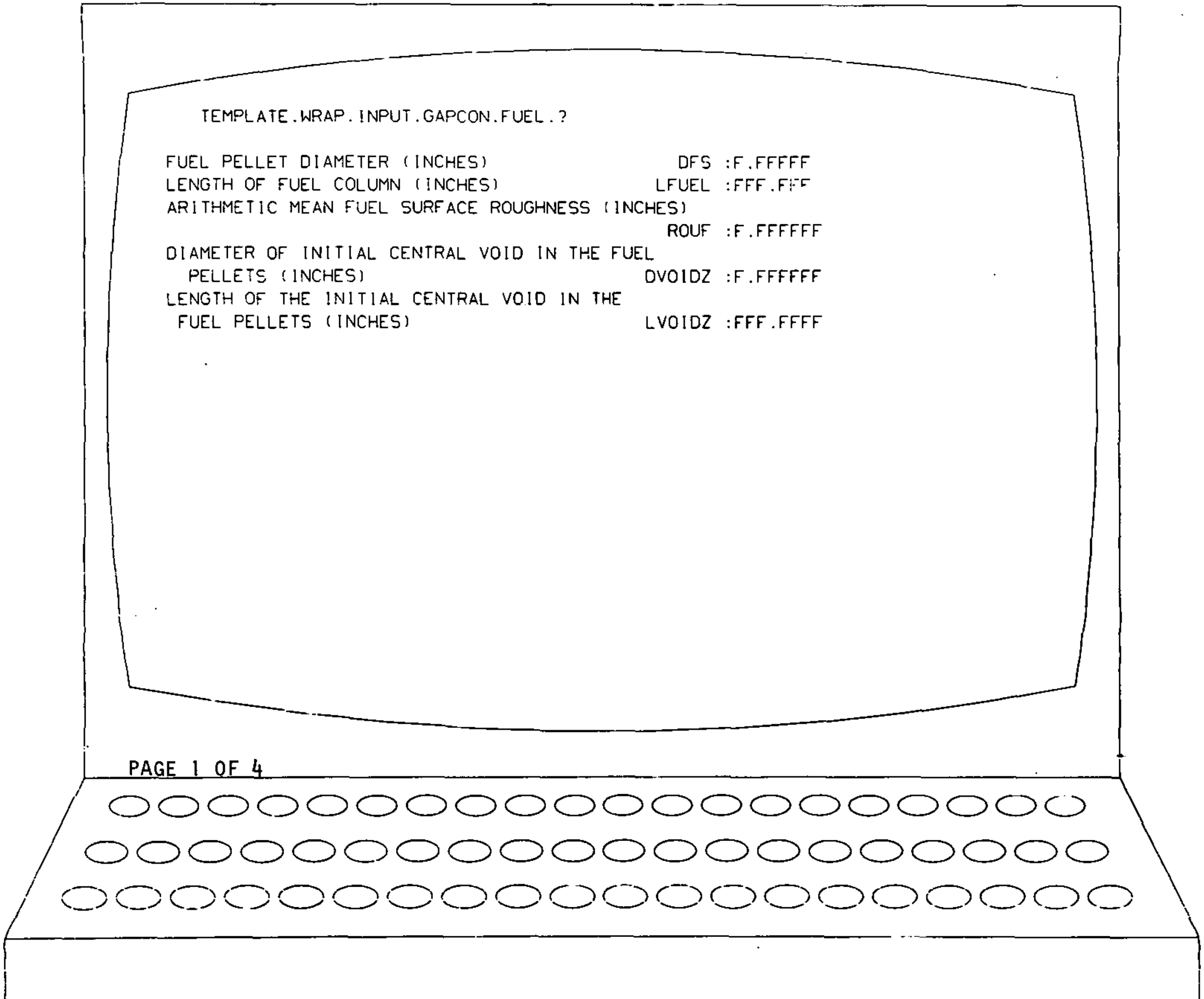

TEMPLATE.WRAP.INPUT.GAPCON.FUEL.COMPOS.?
WEIGHT FRACTION OF FUEL WHICH IS PUO2 FRPUO2 :F.FFFFFF
(REMAINDER IS ASSUMED TO BE UO2)
NFUEL IS A SIGNAL TO SPECIFY USE OF RECYCLED UO2-PUO2;
FUEL THERMAL CONDUCTIVITY AND MELTING TEMPERATURE ARE
CHANGED ACCORDINGLY. NFUEL :II
NFUEL=0 CONDUCTIVITY FOR UO2 IS USED
NFUEL<0 CONDUCTIVITY FOR RECYCLED UOD-PUO2 (UP TO 5% PUO2)
NFUEL>0 A TABLE OF NFUEL THERMAL CONDUCTIVITY VALUES IS
INPUT VIA WRAP.GAPCON.CONDUCT.:AAAAAAAA
PAGE 1 OF 4


TEMPLATE.WRAP.INPUT.GAPCON.FUEL.COMPOS.?
WEIGHT FRACTION OF U WHICH IS U235 FR35 :F.FFFFFFF
(REMAINDER ASSUMED TO BE U238)
WEIGHT FRACTION OF PU WHICH IS PU240 FR40 :F.FFFFFFF
WEIGHT FRACTION OF PU WHICH IS PU241 FR41 :F.FFFFFFF
NOTE FRACTION OF PU WHICH IS PU239 IS
1.0-FR40-FR41
PAGE 2 OF 4


TEMPLATE.WRAP.INPUT.GAPCON.FUEL.COMPOS.?
FUEL SORBED GAS CONTENT (CC/GM OF FUEL) S :FFF.FFF
FRACTION OF SORBED GAS THAT IS CARBON MONOXIDE
AND CARBON DIOXIDE XCO :F.FFFF
FRACTION OF SORBED GAS THAT IS HYDROGEN AND
MOISTURE XH :F.FFFF
FRACTION OF SORBED GAS THAT IS NITROGEN XN :F.FFFF
(NOTE XCO+XH+XN SHOULD =1.0 ,IF S IS > 0.0)
PAGE 3 OF 4


TEMPLATE.WRAP.INPUT.GAPCON.FUEL.COMPOS.?
NOH IS A SIGNAL TO SPECIFY THE DISPOSITION OF SORBED HYDROGEN.
NOH :1
NOH=0 HYDROGEN REACTS WITH CLADDING
NOH=1 ANY HYDROGEN IN SORBED GAS IS ASSUMED TO REMAIN IN THE FUEL PIN AS A GAS
PAGE 4 OF 4


TEMPLATE.WRAP.INPUT.GAPCON.FUEL.?
FUEL PELLET DIAMETER (INCHES) DFS :F.FFFFF
LENGTH OF FUEL COLUMN (INCHES) LFUEL :FFF.FFF
ARITHMETIC MEAN FUEL SURFACE ROUGHNESS (INCHES) ROUF :F.FFFFFF
DIAMETER OF INITIAL CENTRAL VOID IN THE FUEL PELLETS (INCHES) DVOIDZ :F.FFFFFF
LENGTH OF THE INITIAL CENTRAL VOID IN THE FUEL PELLETS (INCHES) LVOIDZ :FFF.FFFF
PAGE 1 OF 4

```
TEMPLATE.WRAP.INPUT.GAPCON.FUEL.?

RADIUS OF FUEL PELLET DISH (INCHES)              RADS :F.FFFFF
(SEE BNWL-1898 PAGE 62 FOR SKETCH)

PERCENT OF FUEL COLUMN VOLUME THAT IS
  DISH VOLUME                                   PRCDH :F.FFFFF

VOLUME OF GAS PLENUM INCLUDED IN FUEL PIN (IN**3)
                                         VPLENZ :FF.FFFFF
```

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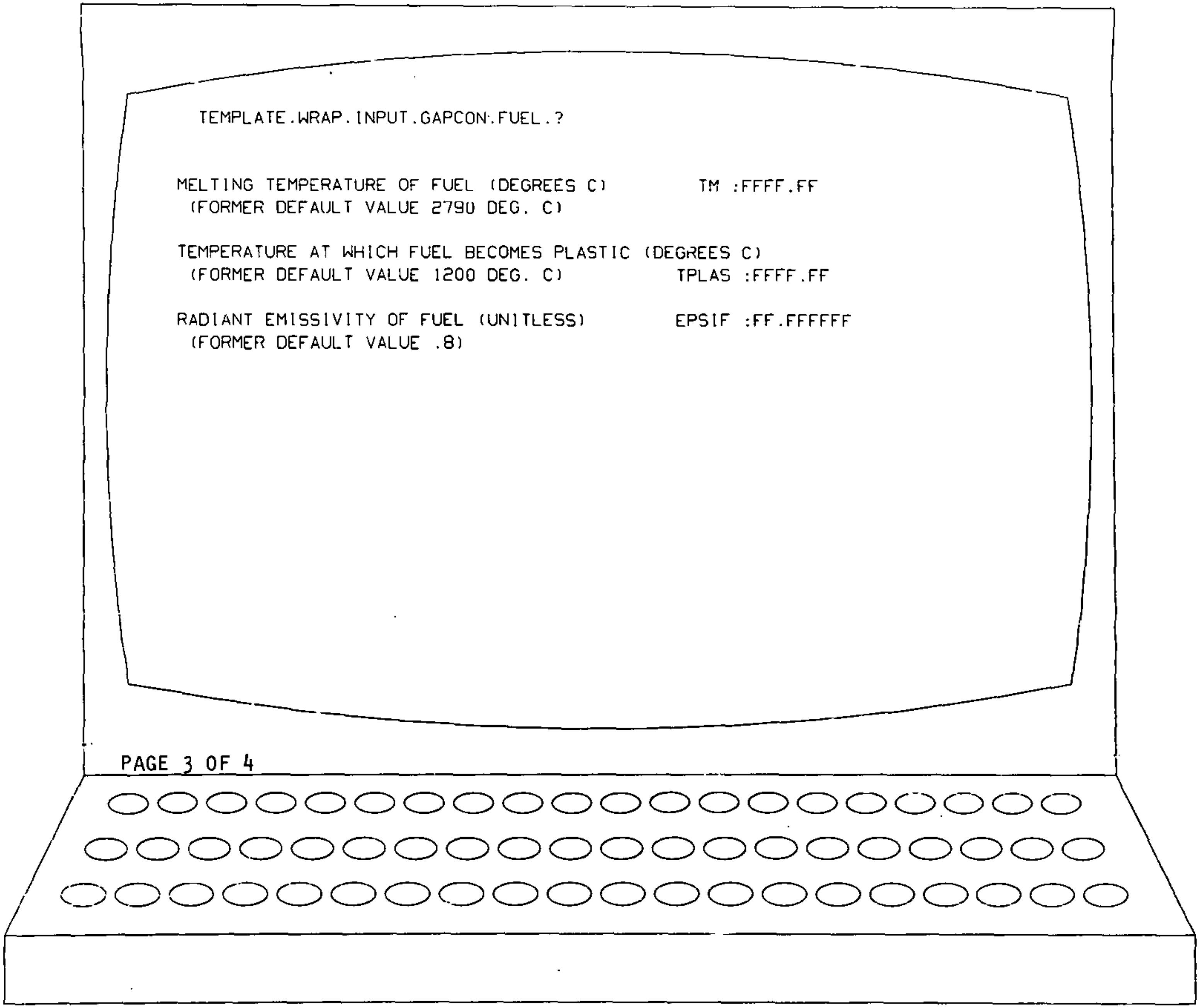
TEMPLATE.WRAP.INPUT.GAPCON.FUEL.?
MELTING TEMPERATURE OF FUEL (DEGREES C)
TM :FFFF.FF
(FORMER DEFAULT VALUE 2790 DEG. C)
TEMPERATURE AT WHICH FUEL BECOMES PLASTIC (DEGREES C)
(FORMER DEFAULT VALUE 1200 DEG. C)
TPLAS :FFFF.FF
RADIANT EMISSIVITY OF FUEL (UNITLESS)
EPSIF :FF.FFFFFF
(FORMER DEFAULT VALUE .8)
PAGE 3 OF 4

```
   TEMPLATE.WRAP.INPUT.GAPCON.FUEL.?

FRACTIONAL DENSITY OF FUEL PELLET             FRDEN :F.FFFFFF

FRACTIONAL DENSITY OF RESTRUCTURED FUEL       FRSIN :F.FFFFFF
(FOR NO RESTRUCTURING ENTER SAME VALUE AS FRDEN)

INITIAL DIAMETER OF RESTRUCTURED FUEL (INCHES) DSINZ :F.FFFFF
   (NORMALLY=0.0)

FRACTIONAL DENSITY OF IRRADIATED FUEL         FRDEN2 :F.FFFFFF
  ( FOR NO HARDENING ENTER SAME VALUE AS FRDEN)
```

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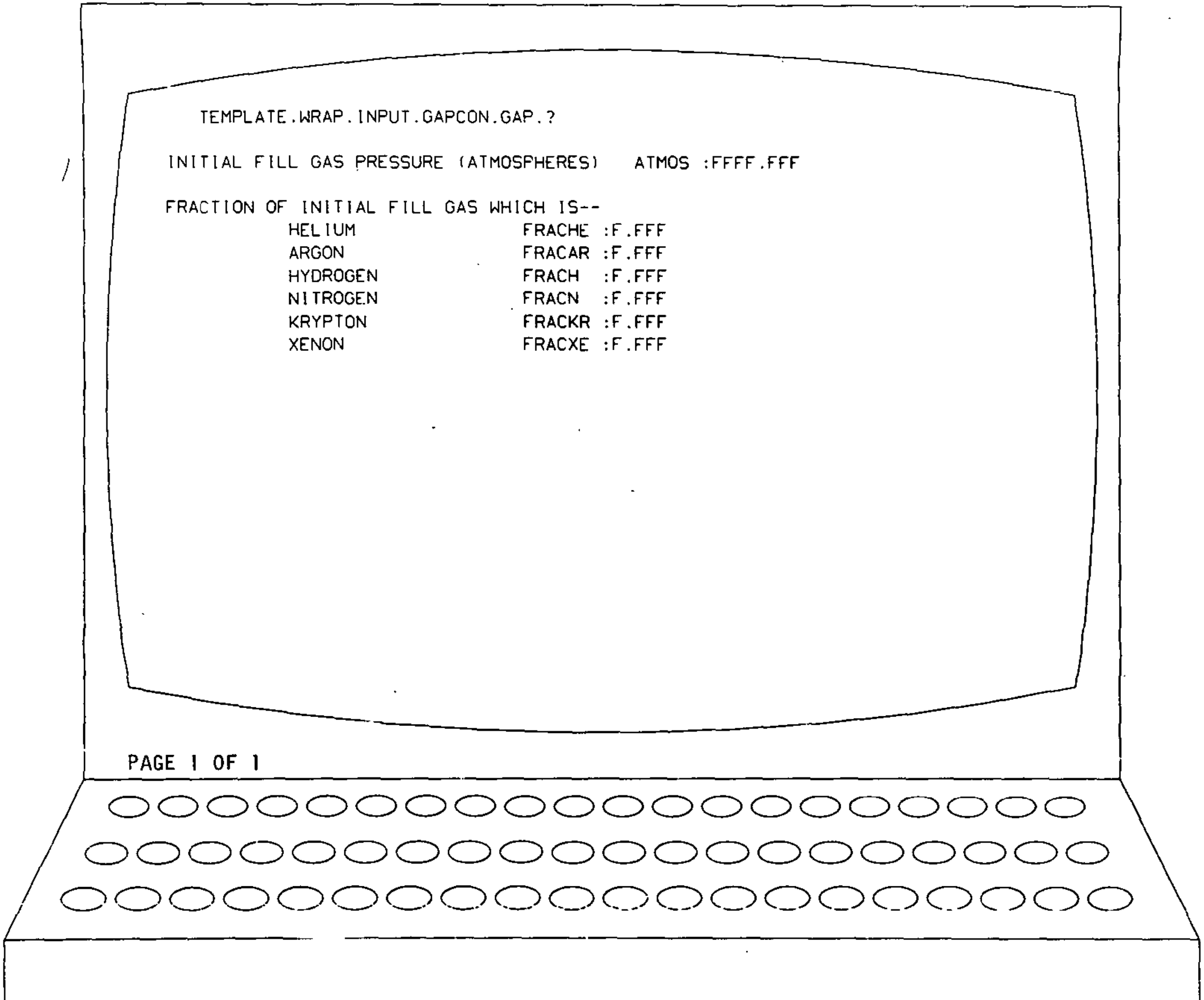
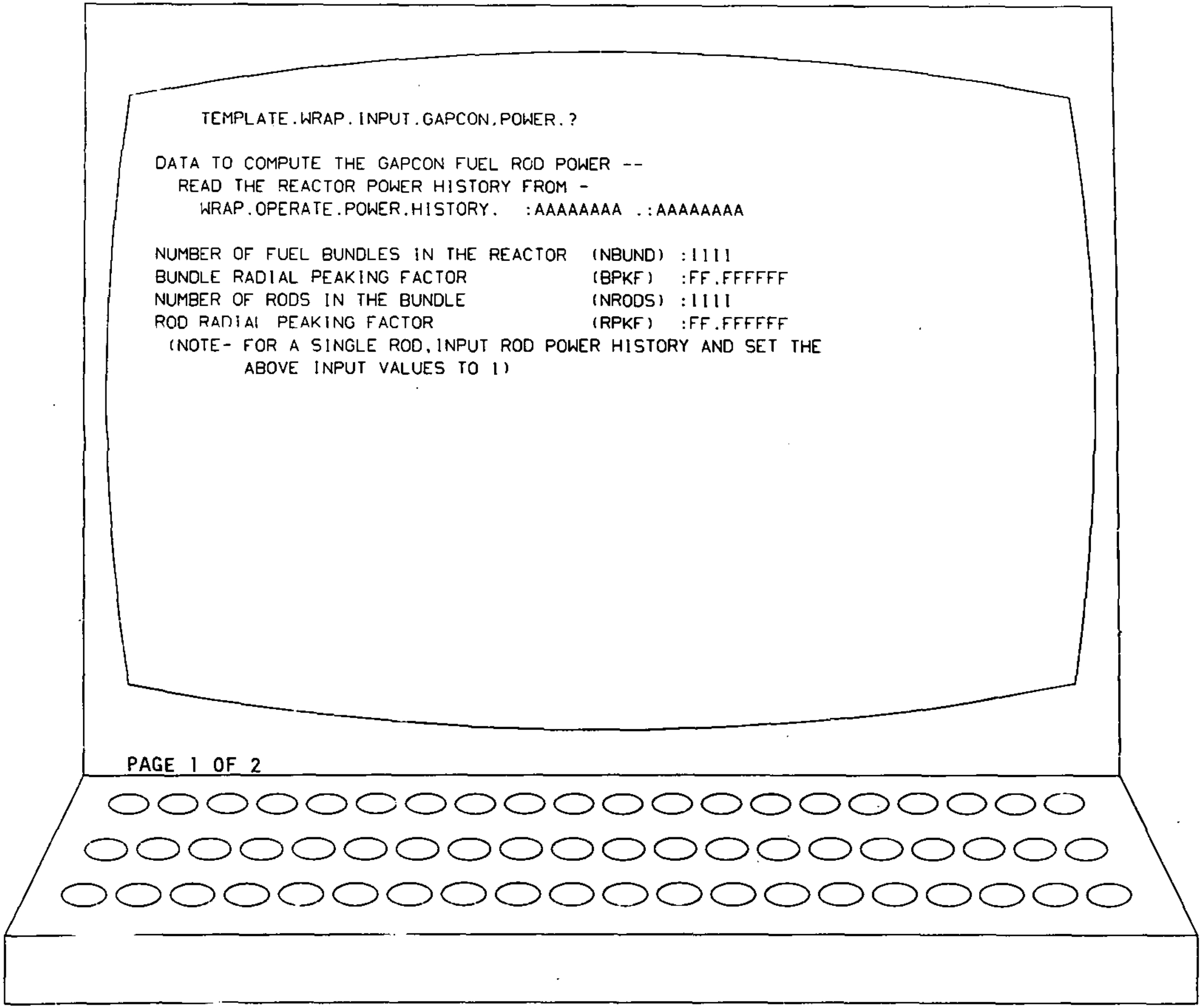
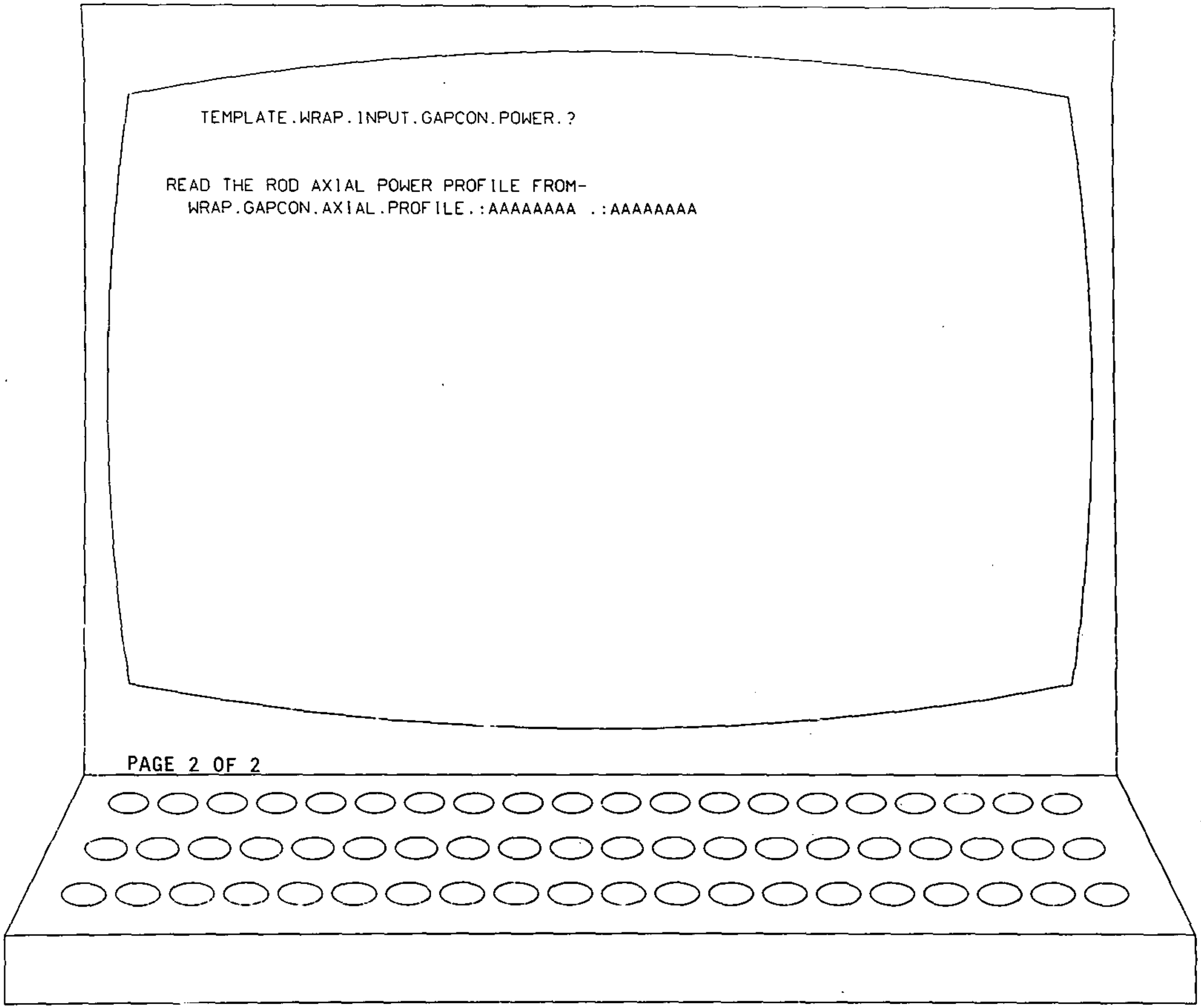

TEMPLATE.WRAP.INPUT.GAPCON.GAP.?
INITIAL FILL GAS PRESSURE (ATMOSPHERES)   ATMOS :FFFF.FFF
FRACTION OF INITIAL FILL GAS WHICH IS--
HELIUM   FRACHE :F.FFF
ARGON   FRACAR :F.FFF
HYDROGEN   FRACH :F.FFF
NITROGEN   FRACN :F.FFF
KRYPTON   FRACKR :F.FFF
XENON   FRACXE :F.FFF
PAGE 1 OF 1


TEMPLATE.WRAP.INPUT.GAPCON.POWER.?
DATA TO COMPUTE THE GAPCON FUEL ROD POWER --
READ THE REACTOR POWER HISTORY FROM -
WRAP.OPERATE.POWER.HISTORY. :AAAAAAAA .:AAAAAAAA
NUMBER OF FUEL BUNDLES IN THE REACTOR (NBUND) :IIII
BUNDLE RADIAL PEAKING FACTOR (BPKF) :FF.FFFFFF
NUMBER OF RODS IN THE BUNDLE (NRODS) :IIII
ROD RADIAL PEAKING FACTOR (RPKF) :FF.FFFFFF
(NOTE- FOR A SINGLE ROD, INPUT ROD POWER HISTORY AND SET THE
ABOVE INPUT VALUES TO 1)
PAGE 1 OF 2


TEMPLATE.WRAP.INPUT.GAPCON.POWER.?
READ THE ROD AXIAL POWER PROFILE FROM-
WRAP.GAPCON.AXIAL.PROFILE.:AAAAAAAA .:AAAAAAAA
PAGE 2 OF 2

```
   TEMPLATE.WRAP.INPUT.GAPCON.CONTROLS.?

NFLX IS A SIGNAL TO SPECIFY FLUX DEPRESSION IN      NFLX :II
THE FUEL
     NFLX=0 COMPUTED IN SUBROUTINE DEPRES
     NFLX<0 ASSUME NO DEPRESSION
     NFLX>0 READ NFLX FLUX DEPRESSION VALUES FROM
              WRAP.GAPCON.FLUX.DEPRESS.:AAAAAAAA

     NOTE NFLX<0 SHOULD NOT BE USED FOR FUEL PINS CONTAINING
          PUO2 OR FOR PINS WITH U235 ENRICHMENT GREATER THAN
          4%.
```

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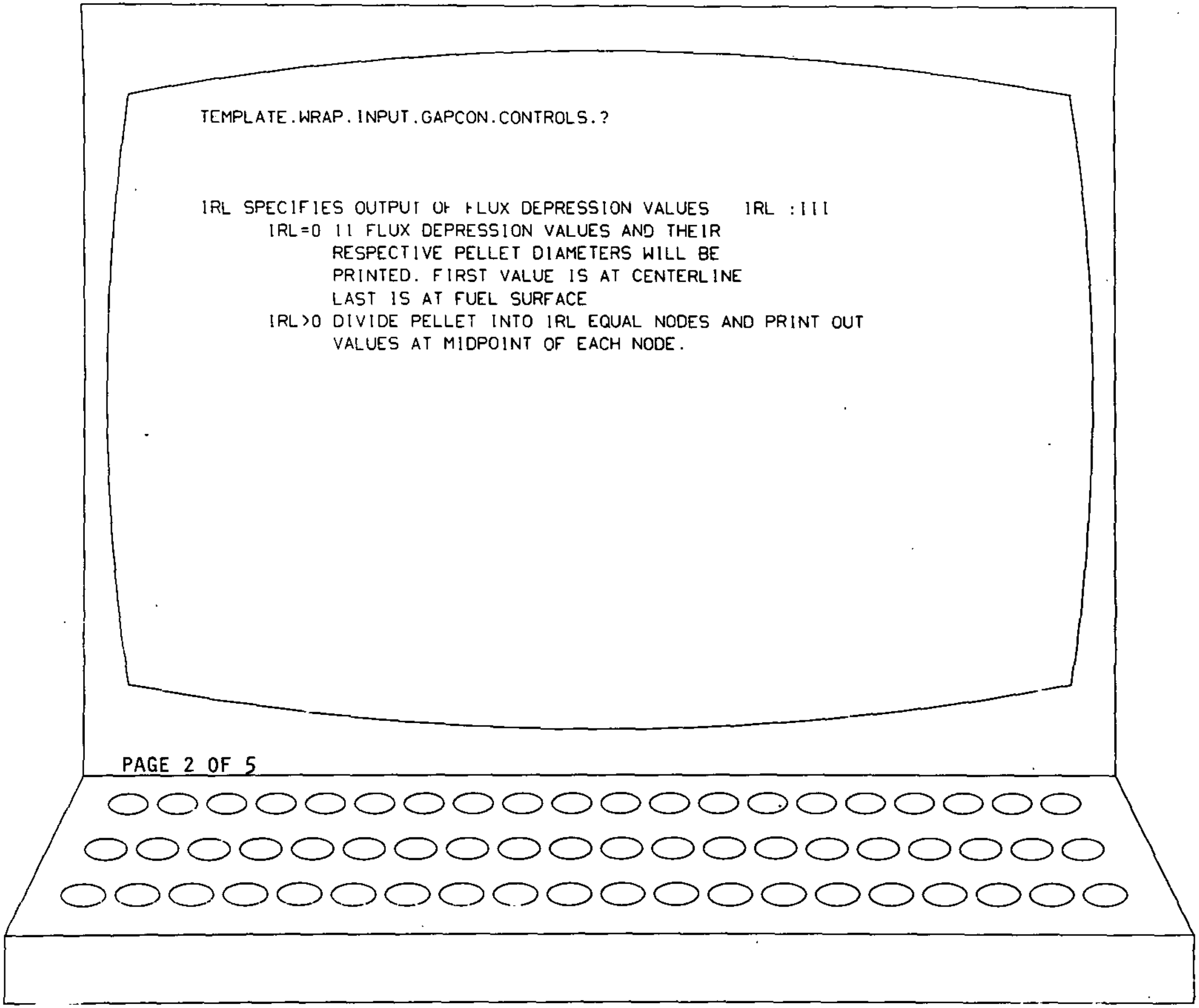
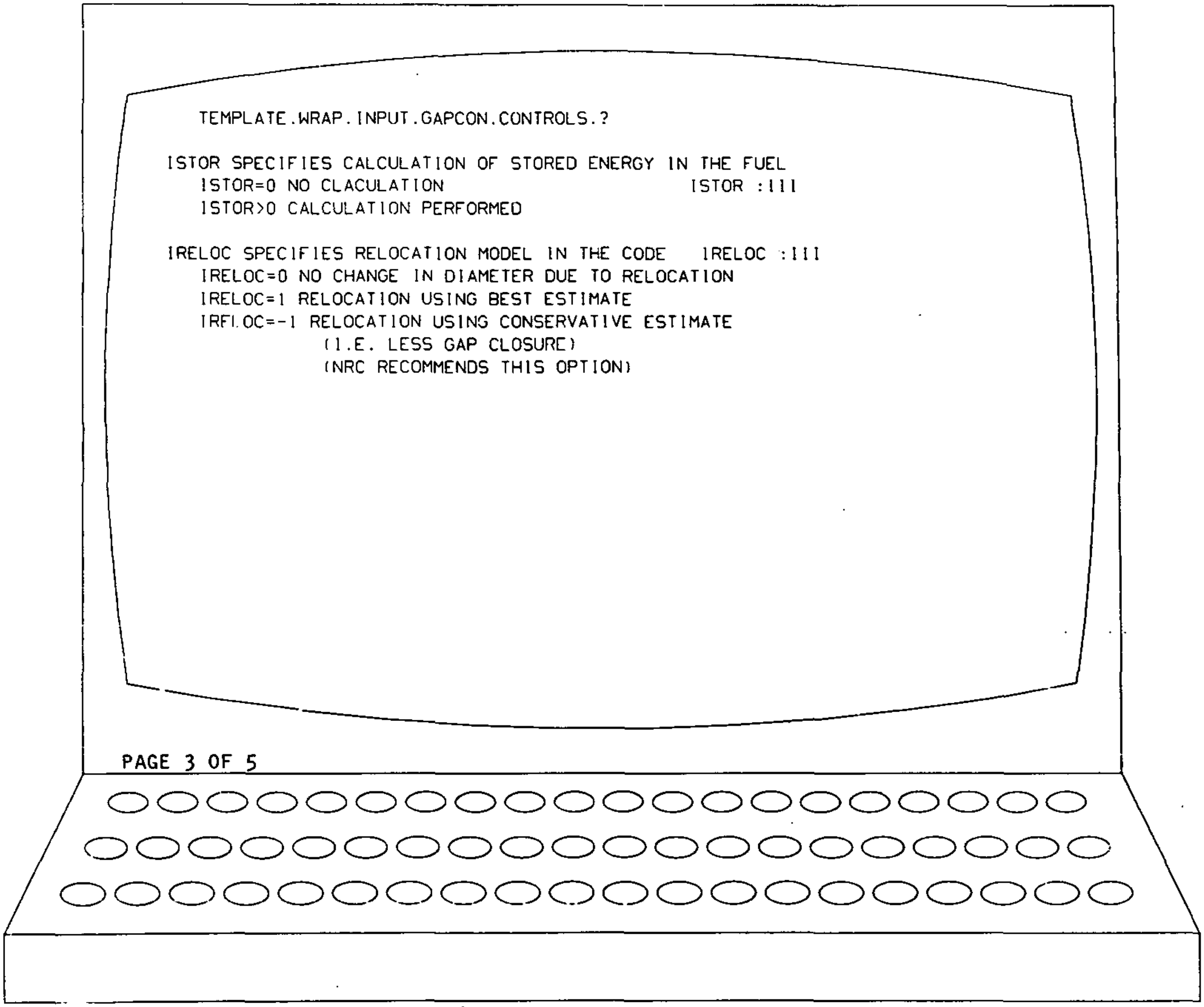

TEMPLATE.WRAP.INPUT.GAPCON.CONTROLS.?
IRL SPECIFIES OUTPUT OF FLUX DEPRESSION VALUES IRL :III
IRL=0 11 FLUX DEPRESSION VALUES AND THEIR
RESPECTIVE PELLET DIAMETERS WILL BE
PRINTED. FIRST VALUE IS AT CENTERLINE
LAST IS AT FUEL SURFACE
IRL>0 DIVIDE PELLET INTO IRL EQUAL NODES AND PRINT OUT
VALUES AT MIDPOINT OF EACH NODE.
PAGE 2 OF 5

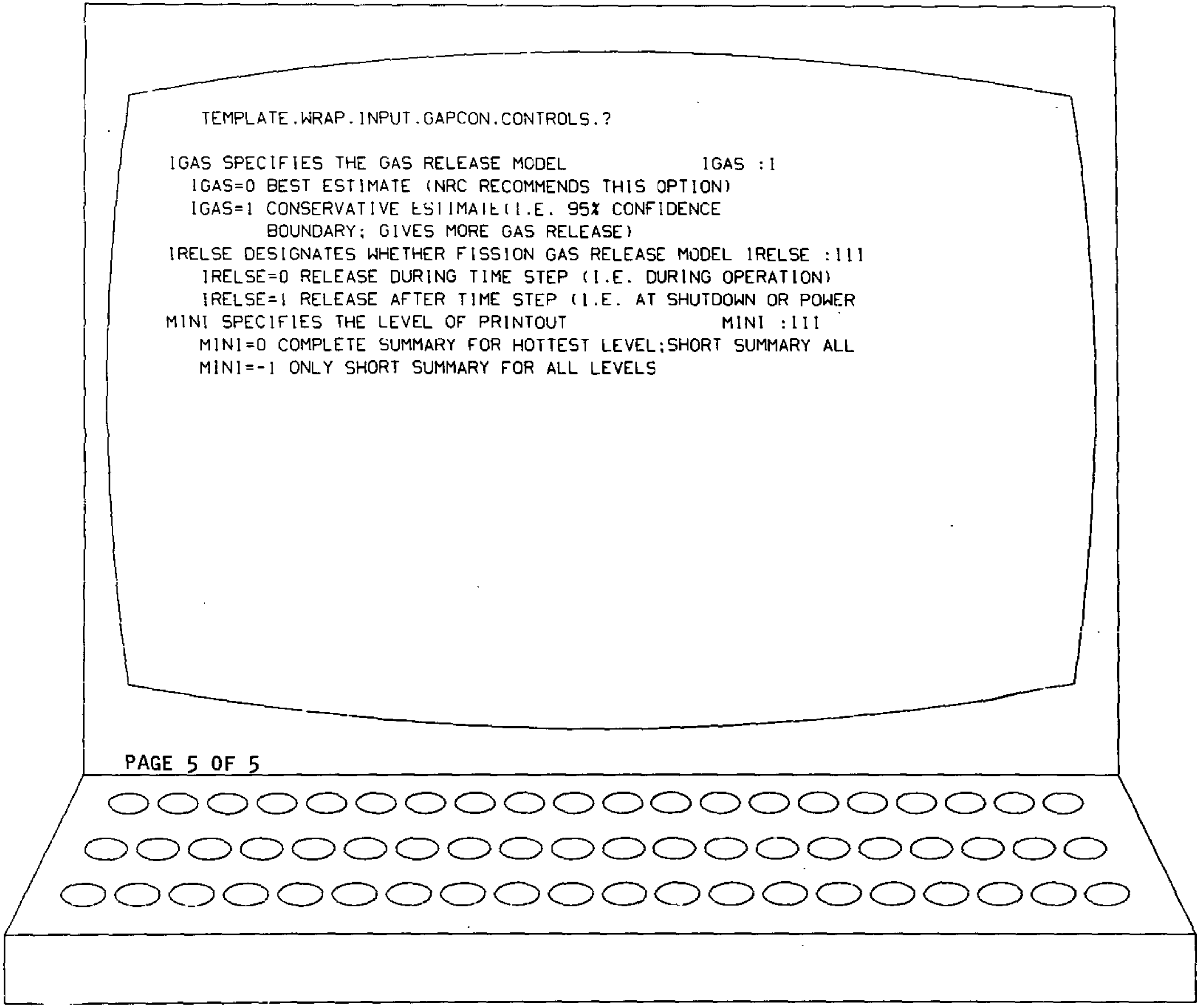

TEMPLATE.WRAP.INPUT.GAPCON.CONTROLS.?
ISTOR SPECIFIES CALCULATION OF STORED ENERGY IN THE FUEL
ISTOR=0 NO CLACULATION
ISTOR :III
ISTOR>0 CALCULATION PERFORMED
IRELOC SPECIFIES RELOCATION MODEL IN THE CODE
IRELOC :III
IRELOC=0 NO CHANGE IN DIAMETER DUE TO RELOCATION
IRELOC=1 RELOCATION USING BEST ESTIMATE
IRELOC=-1 RELOCATION USING CONSERVATIVE ESTIMATE
(I.E. LESS GAP CLOSURE)
(NRC RECOMMENDS THIS OPTION)
PAGE 3 OF 5

TEMPLATE.WRAP.INPUT.GAPCON.CONTROLS.?

IDENSF SPECIFIES MODEL FOR RADIAL FUEL   IDENSF :III
SHRINKAGE DUE TO ISOTROPIC DENSIFICATION.
(CODE ASSUMES FINAL VALUE 96.5% OF THEORETICAL)
   IDENSF=0 NO FUEL DENSIFICATION
   IDENSF=1 CHANGES IN FUEL DIAMETER CALCULATED

NOTE FOR INITIAL DENSITY >96.5% THERE IS NO SWELLING
TO ACHIEVE 96.5% FINAL DENSITY

PAGE 4 OF 5

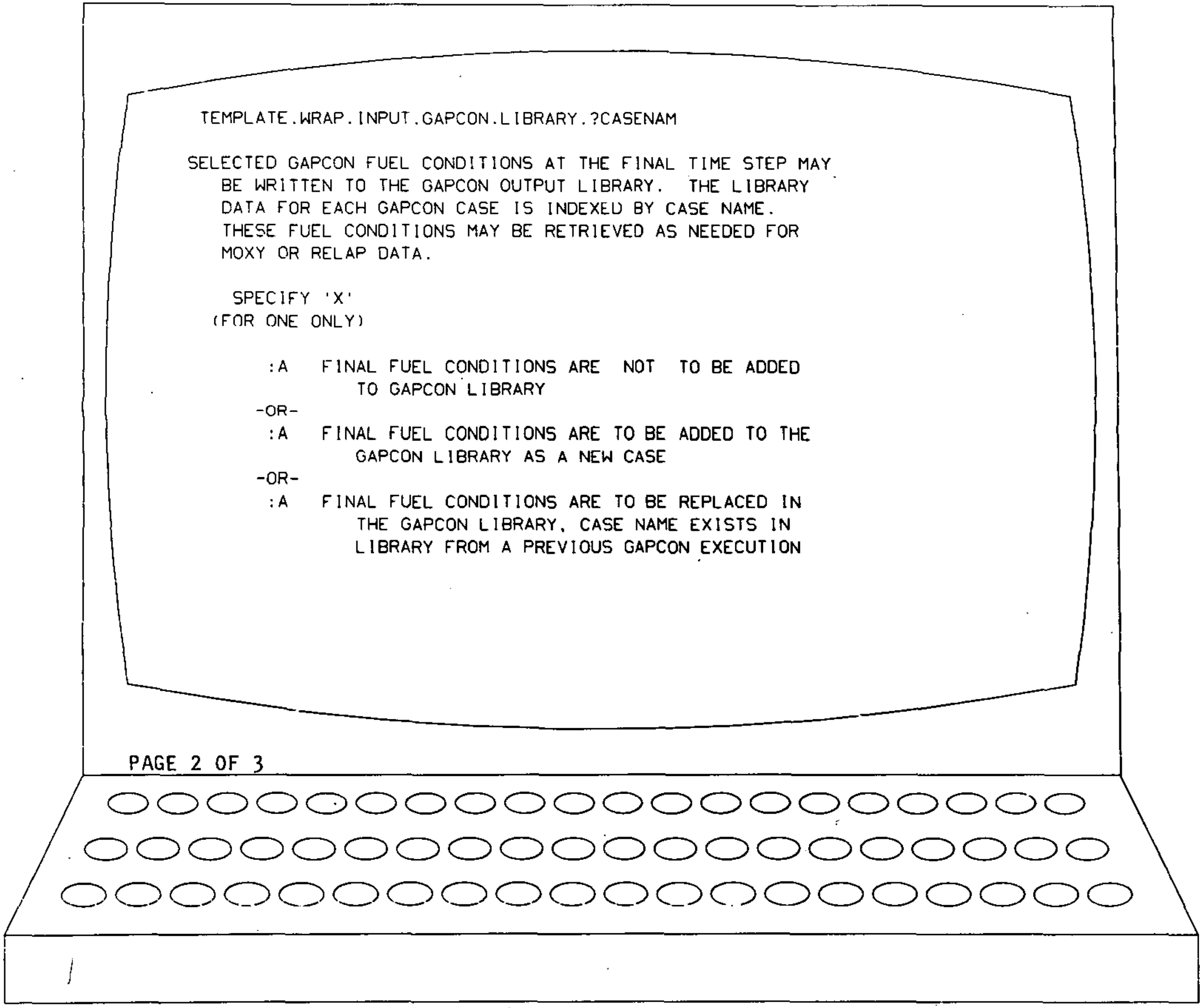

TEMPLATE.WRAP.INPUT.GAPCON.CONTROLS.?
IGAS SPECIFIES THE GAS RELEASE MODEL IGAS :I
IGAS=0 BEST ESTIMATE (NRC RECOMMENDS THIS OPTION)
IGAS=1 CONSERVATIVE ESTIMATE(I.E. 95% CONFIDENCE
BOUNDARY; GIVES MORE GAS RELEASE)
IRELSE DESIGNATES WHETHER FISSION GAS RELEASE MODEL IRELSE :III
IRELSE=0 RELEASE DURING TIME STEP (I.E. DURING OPERATION)
IRELSE=1 RELEASE AFTER TIME STEP (I.E. AT SHUTDOWN OR POWER
MINI SPECIFIES THE LEVEL OF PRINTOUT MINI :III
MINI=0 COMPLETE SUMMARY FOR HOTTEST LEVEL;SHORT SUMMARY ALL
MINI=-1 ONLY SHORT SUMMARY FOR ALL LEVELS
PAGE 5 OF 5

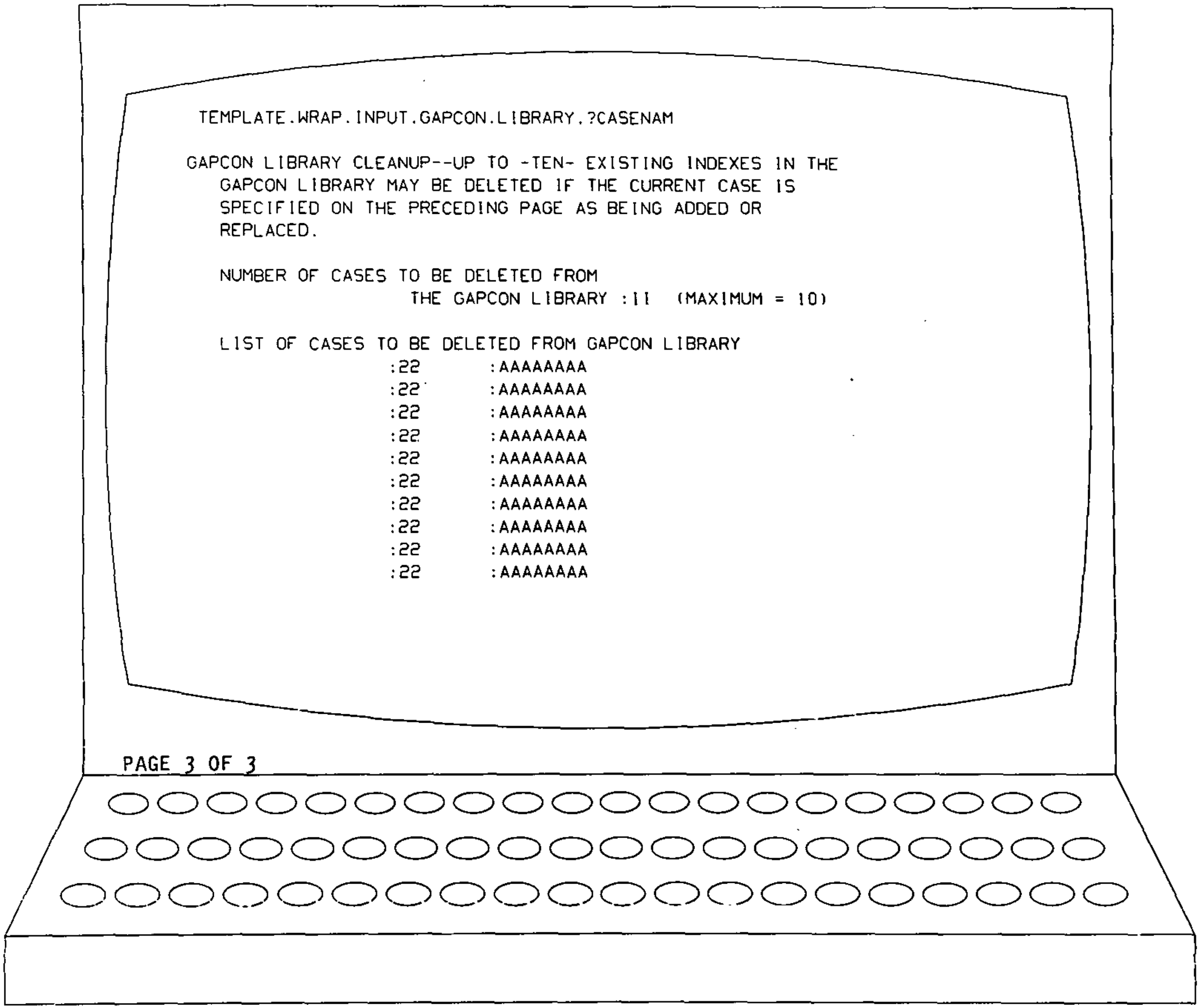
TEMPLATE.WRAP.INPUT.GAPCON.LIBRARY.?CASENAM

1ST QUALIFIER = ?CASENAM = CASE NAME

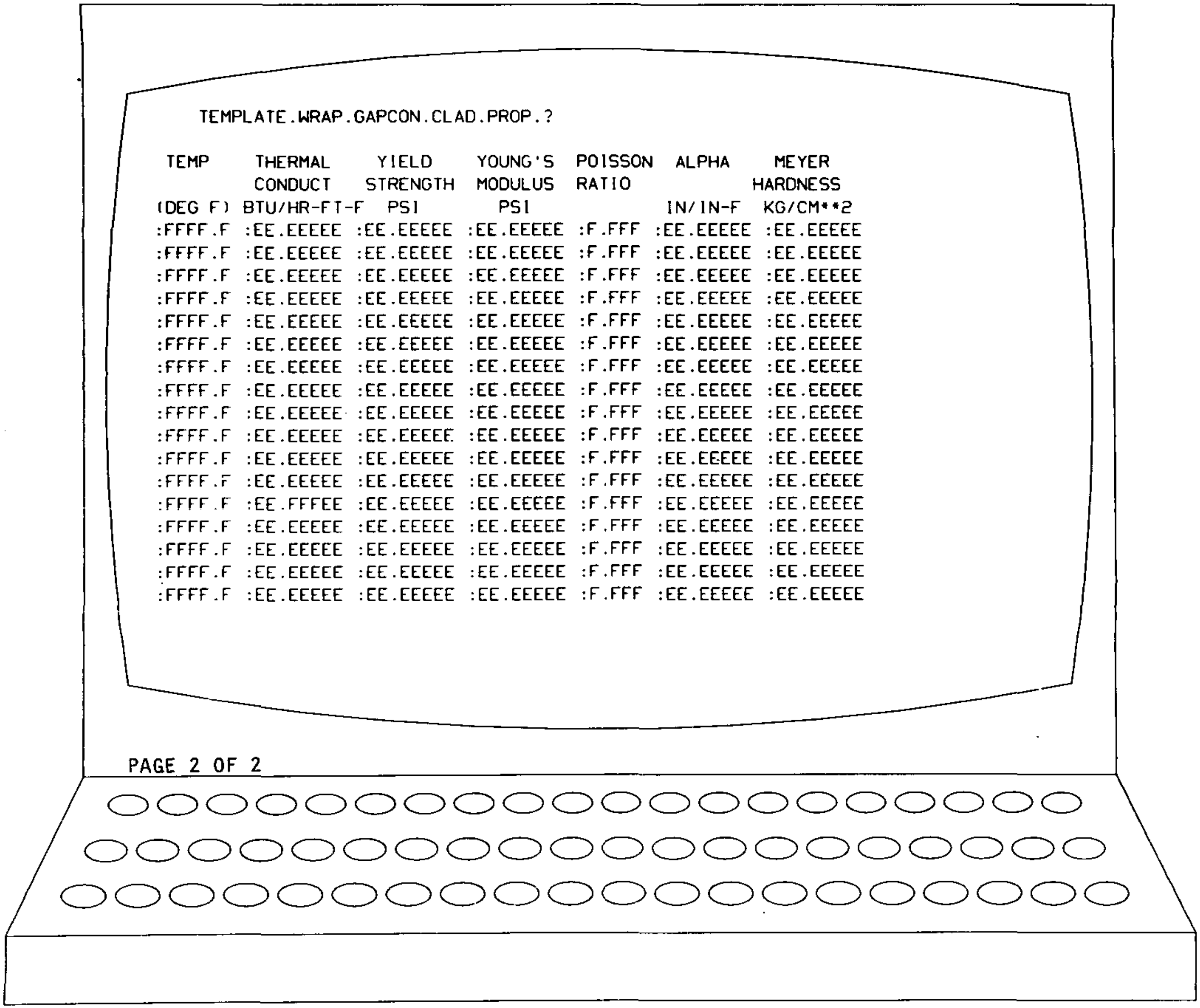
OPTIONAL RECORD--THIS RECORD MAY BE OMITTED IF FINAL FUEL CONDITIONS ARE NOT TO BE ADDED TO GAPCON LIBRARY.

PAGE 1 OF 3


TEMPLATE.WRAP.INPUT.GAPCON.LIBRARY.?CASENAM
SELECTED GAPCON FUEL CONDITIONS AT THE FINAL TIME STEP MAY BE WRITTEN TO THE GAPCON OUTPUT LIBRARY. THE LIBRARY DATA FOR EACH GAPCON CASE IS INDEXED BY CASE NAME. THESE FUEL CONDITIONS MAY BE RETRIEVED AS NEEDED FOR MOXY OR RELAP DATA.
SPECIFY 'X'
(FOR ONE ONLY)
:A FINAL FUEL CONDITIONS ARE NOT TO BE ADDED TO GAPCON LIBRARY
-OR-
:A FINAL FUEL CONDITIONS ARE TO BE ADDED TO THE GAPCON LIBRARY AS A NEW CASE
-OR-
:A FINAL FUEL CONDITIONS ARE TO BE REPLACED IN THE GAPCON LIBRARY, CASE NAME EXISTS IN LIBRARY FROM A PREVIOUS GAPCON EXECUTION
PAGE 2 OF 3


TEMPLATE.WRAP.INPUT.GAPCON.LIBRARY.?CASENAM
GAPCON LIBRARY CLEANUP--UP TO -TEN- EXISTING INDEXES IN THE GAPCON LIBRARY MAY BE DELETED IF THE CURRENT CASE IS SPECIFIED ON THE PRECEDING PAGE AS BEING ADDED OR REPLACED.
NUMBER OF CASES TO BE DELETED FROM THE GAPCON LIBRARY :II (MAXIMUM = 10)
LIST OF CASES TO BE DELETED FROM GAPCON LIBRARY
:22 :AAAAAAAA
:22 :AAAAAAAA
:22 :AAAAAAAA
:22 :AAAAAAAA
:22 :AAAAAAAA
:22 :AAAAAAAA
:22 :AAAAAAAA
:22 :AAAAAAAA
:22 :AAAAAAAA
:22 :AAAAAAAA
PAGE 3 OF 3

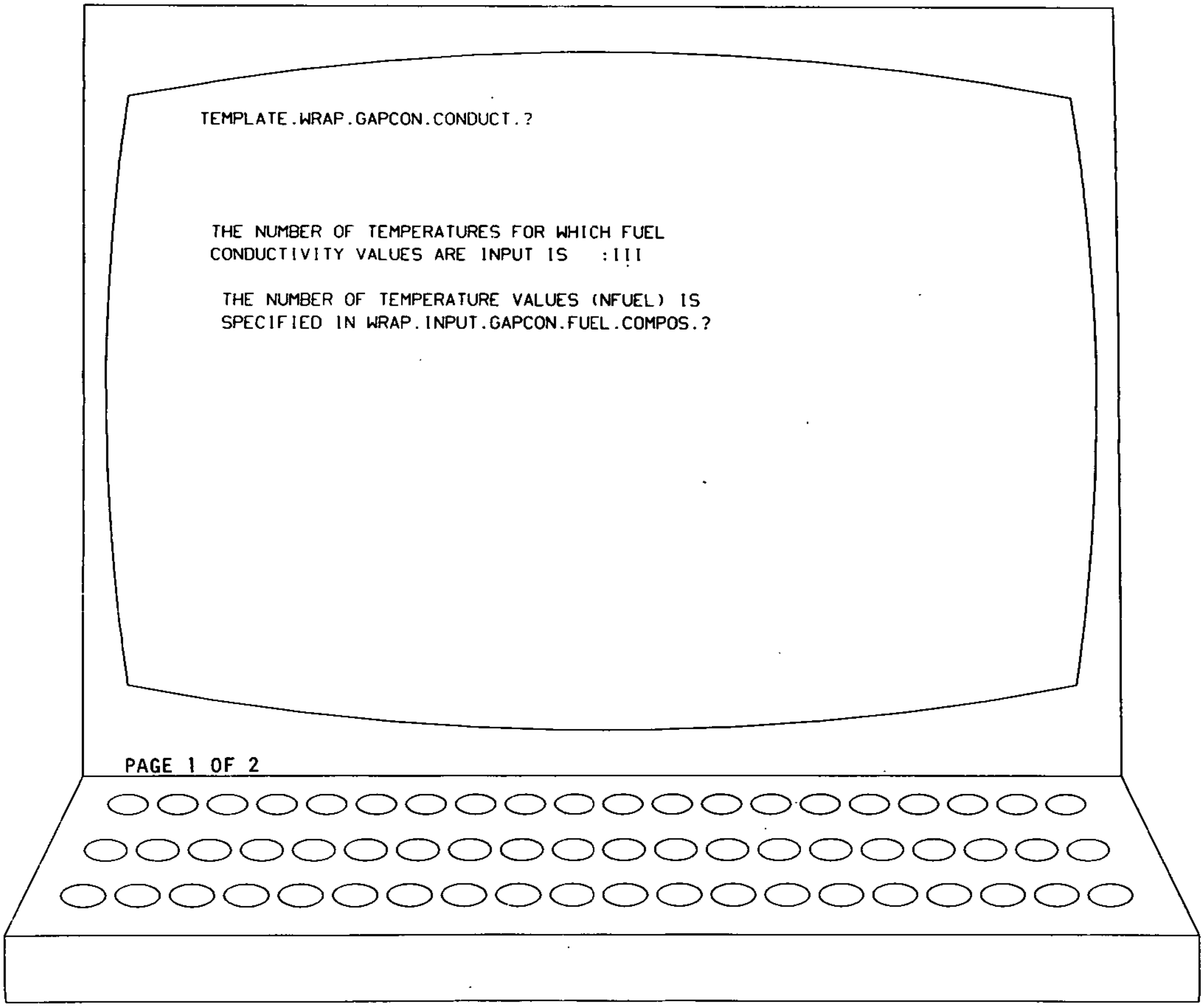
```
TEMPLATE.WRAP.GAPCON.CLAD.PROP.?


 THE NUMBER OF TEMPERATURES FOR WHICH CLAD
 PROPERTIES ARE LISTED IS :IIII

NOTE THE NUMBER OF TEMPERATURES (NCLAD) IS
     SPECIFIED IN WRAP.INPUT.GAPCON.CLAD.?
```

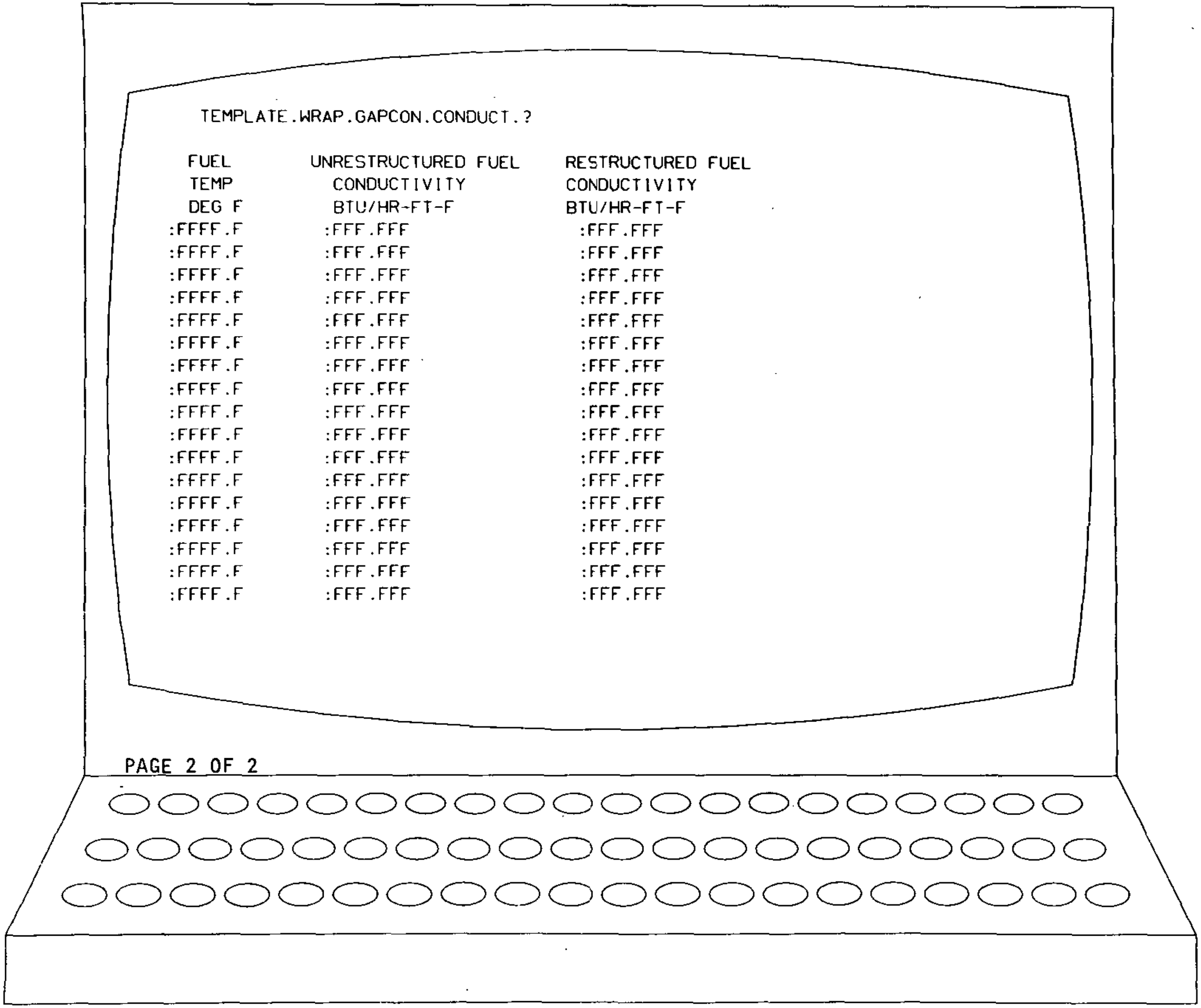


TEMPLATE.WRAP.GAPCON.CLAD.PROP.?

TEMP	THERMAL CONDUCT	YIELD STRENGTH	YOUNG'S MODULUS	POISSON RATIO	ALPHA	MEYER HARDNESS
(DEG F)	BTU/HR-FT-F	PSI	PSI		IN/IN-F	KG/CM**2
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.FFFEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE
:FFFF.F	:EE.EEEEE	:EE.EEEEE	:EE.EEEEE	:F.FFF	:EE.EEEEE	:EE.EEEEE

PAGE 2 OF 2


TEMPLATE.WRAP.GAPCON.CONDUCT.?
THE NUMBER OF TEMPERATURES FOR WHICH FUEL CONDUCTIVITY VALUES ARE INPUT IS :III
THE NUMBER OF TEMPERATURE VALUES (NFUEL) IS SPECIFIED IN WRAP.INPUT.GAPCON.FUEL.COMPOS.?
PAGE 1 OF 2


TEMPLATE.WRAP.GAPCON.CONDUCT.?
FUEL
TEMP
DEG F
UNRESTRUCTURED FUEL
CONDUCTIVITY
BTU/HR-FT-F
RESTRUCTURED FUEL
CONDUCTIVITY
BTU/HR-FT-F
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
:FFFF.F :FFF.FFF :FFF.FFF
PAGE 2 OF 2

TEMPLATE.WRAP.GAPCON.CREPDWN.?

THE NUMBER OF TIME ENTRIES IN THE CREEPDOWN
TABLE IS :1111

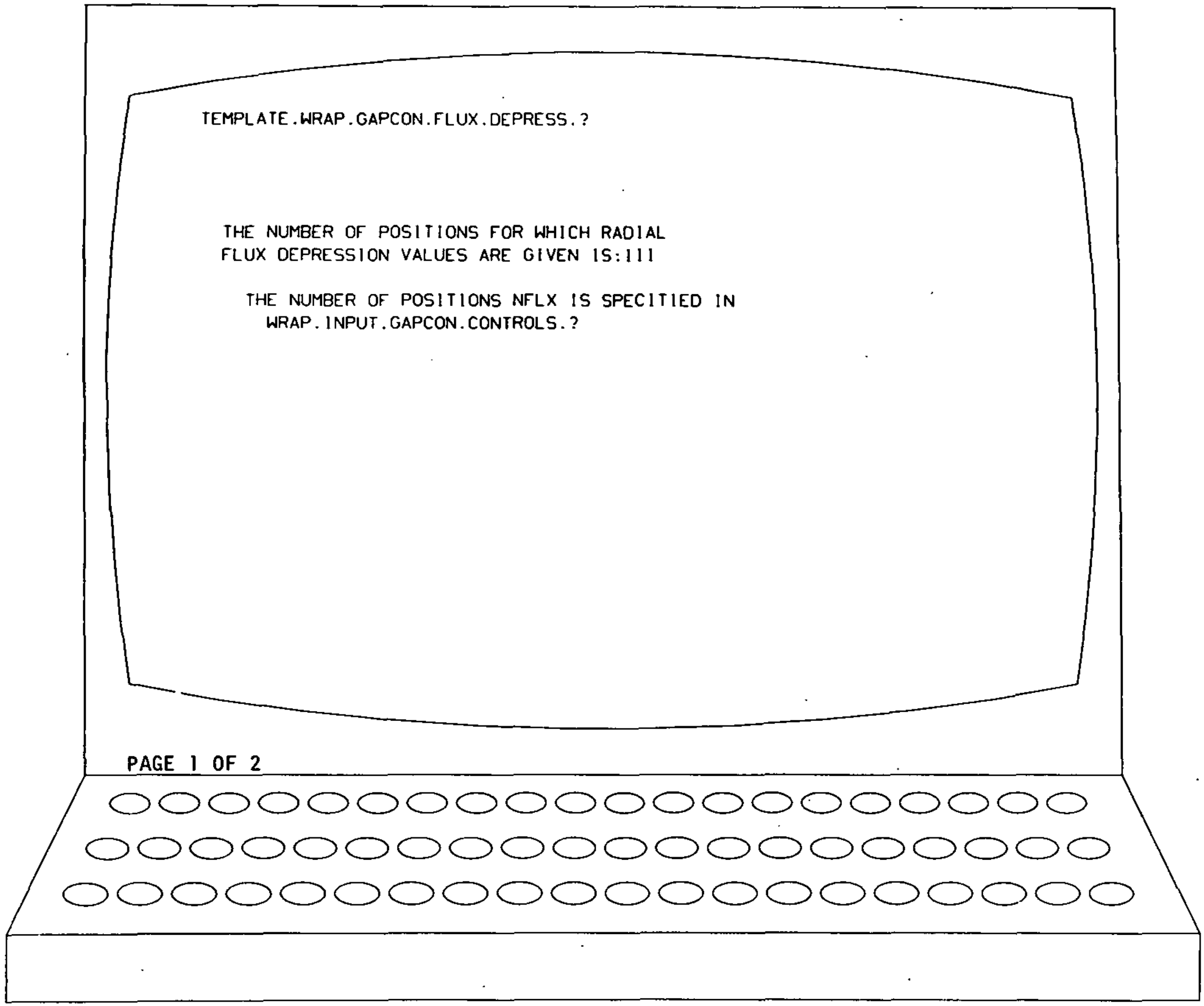
THE NUMBER OF ENTRIES ICREP IS SPECIFIED IN
WRAP.INPUT.GAPCON.CLAD.?

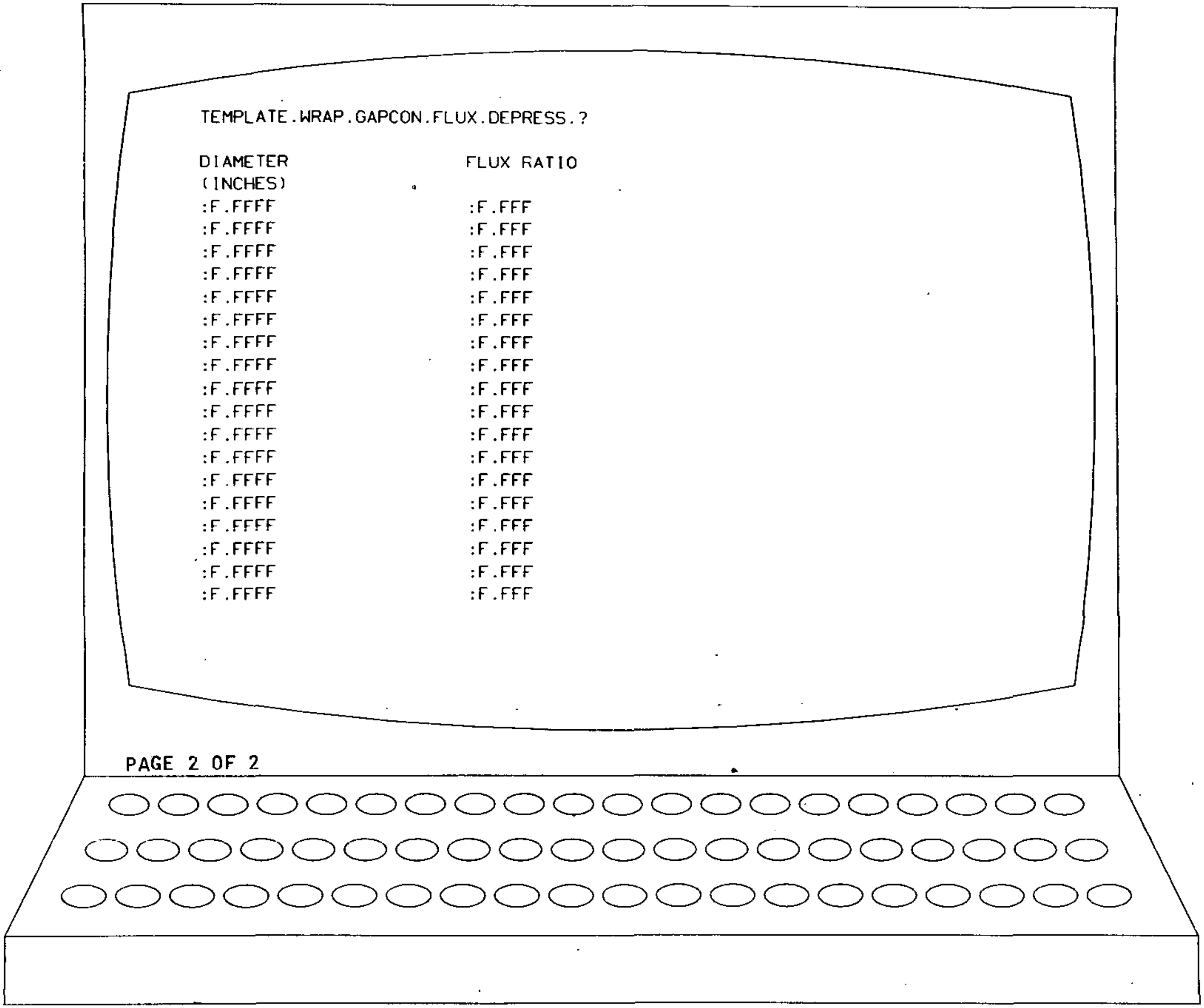
PAGE 1 OF 2

TEMPLATE.WRAP.GAPCON.CREPDWN.?

TIME (DAYS)	CLAD DIAMETER (INCHES)
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF
:FFFF.F	:FF.FFFF

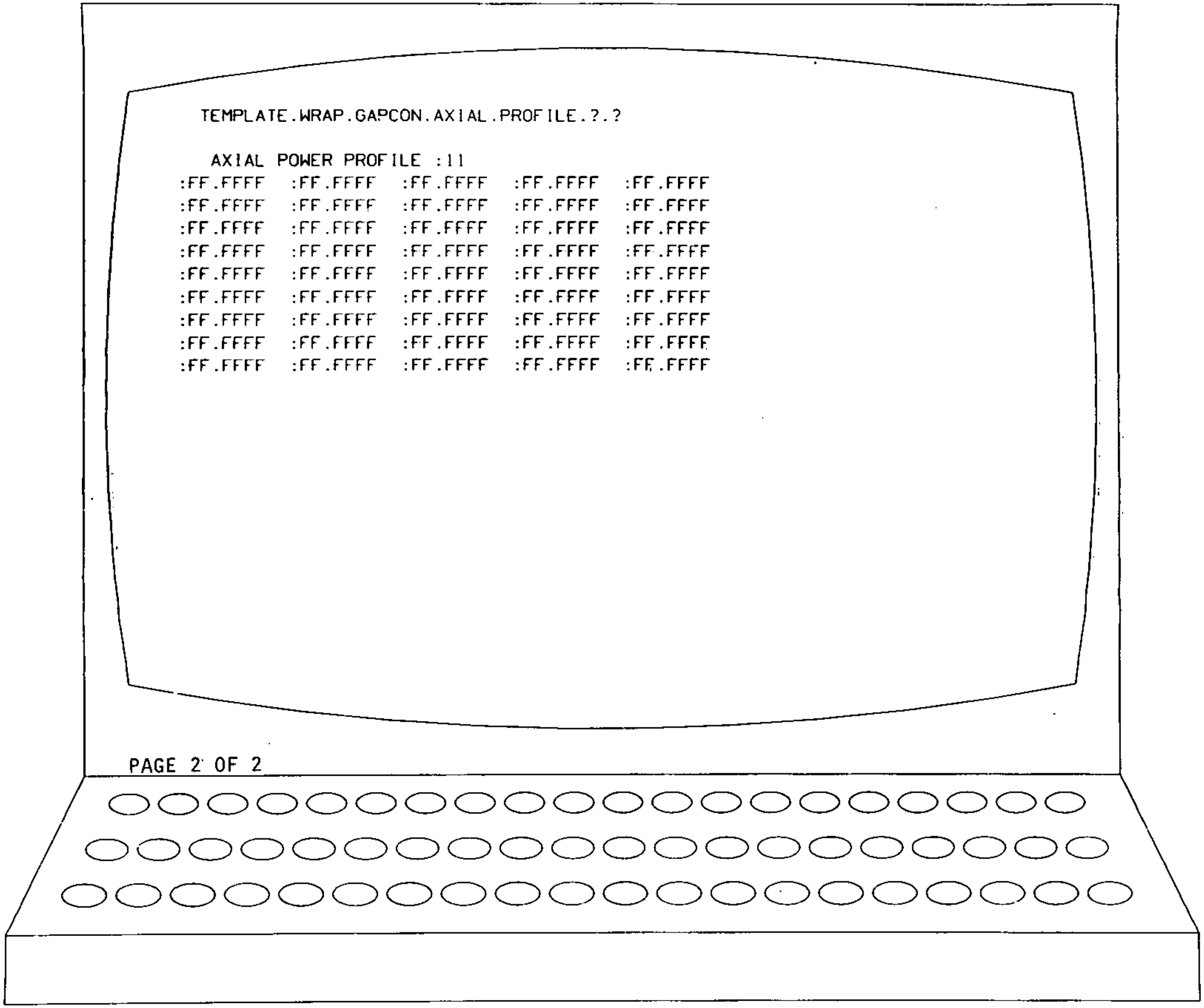
PAGE 2 OF 2

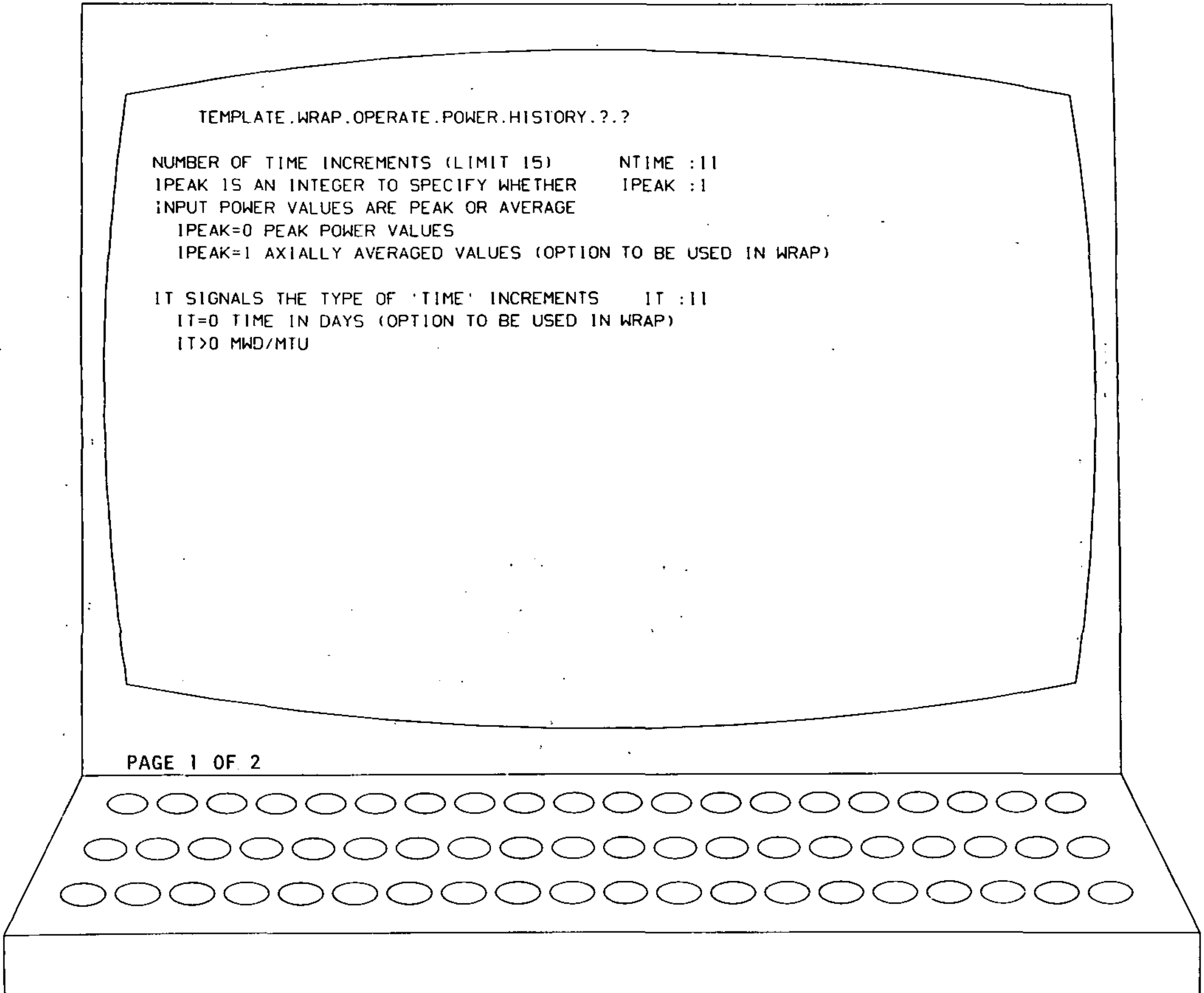

TEMPLATE.WRAP.GAPCON.FLUX.DEPRESS.?
THE NUMBER OF POSITIONS FOR WHICH RADIAL
FLUX DEPRESSION VALUES ARE GIVEN IS:111
THE NUMBER OF POSITIONS NFLX IS SPECITIED IN
WRAP.INPUT.GAPCON.CONTROLS.?
PAGE 1 OF 2


TEMPLATE.WRAP.GAPCON.FLUX.DEPRESS.?
DIAMETER
(INCHES)
FLUX RATIO
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
:F.FFFF :F.FFF
PAGE 2 OF 2

```
    TEMPLATE.WRAP.GAPCON.AXIAL.PROFILE.?.?

NUMBER OF AXIAL FUEL SEGMENTS (LIMIT 20)        NPOW :I I
NPRFIL IS A SIGNAL TO SPECIFY THE NUMBER OF AXIAL
POWER PROFILES TO BE USED IN THE CALCULATION  NPRFIL :I I
   NPRFIL=1 USE THE SAME PROFILE FOR ALL TIME STEPS
   NPRFIL=NTIME (SPECIFIED IN WRAP.OPERATE.POWER.HISTORY.?.?)
          USE A DIFFERENT AXIAL PROFILE FOR EACH TIME STEP
NVAL IS THE NUMBER OF ENTRIES IN THE AXIAL POWER  NVAL :I I
PROFILE. THERE ARE NPOW+1 VALUES FOR EACH PROFILE.
THE FIRST AND LAST CORRESPOND TO THE TOP AND BOTTOM
OF THE FUEL.
```

PAGE 1 OF 2


TEMPLATE.WRAP.GAPCON.AXIAL.PROFILE.?.?
AXIAL POWER PROFILE :11
:FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF
:FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF
:FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF
:FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF
:FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF
:FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF
:FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF
:FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF
:FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF :FF.FFFF
PAGE 2 OF 2


TEMPLATE.WRAP.OPERATE.POWER.HISTORY.?.?
NUMBER OF TIME INCREMENTS (LIMIT 15) NTIME :11
IPEAK IS AN INTEGER TO SPECIFY WHETHER IPEAK :1
INPUT POWER VALUES ARE PEAK OR AVERAGE
IPEAK=0 PEAK POWER VALUES
IPEAK=1 AXIALLY AVERAGED VALUES (OPTION TO BE USED IN WRAP)
IT SIGNALS THE TYPE OF 'TIME' INCREMENTS IT :11
IT=0 TIME IN DAYS (OPTION TO BE USED IN WRAP)
IT>0 MWD/MTU
PAGE 1 OF 2

```
TEMPLATE.WRAP.OPERATE.POWER.HISTORY.?.?

INDEX        TIME                     PSEUDO
         (DAYS OR MWD/MTU)        (REACTOR POWER,MW)
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
:11       :EE.EEEEEEEE             :EE.EEEEEEEE
```

PAGE 2 OF 2

3.2 PWRSS

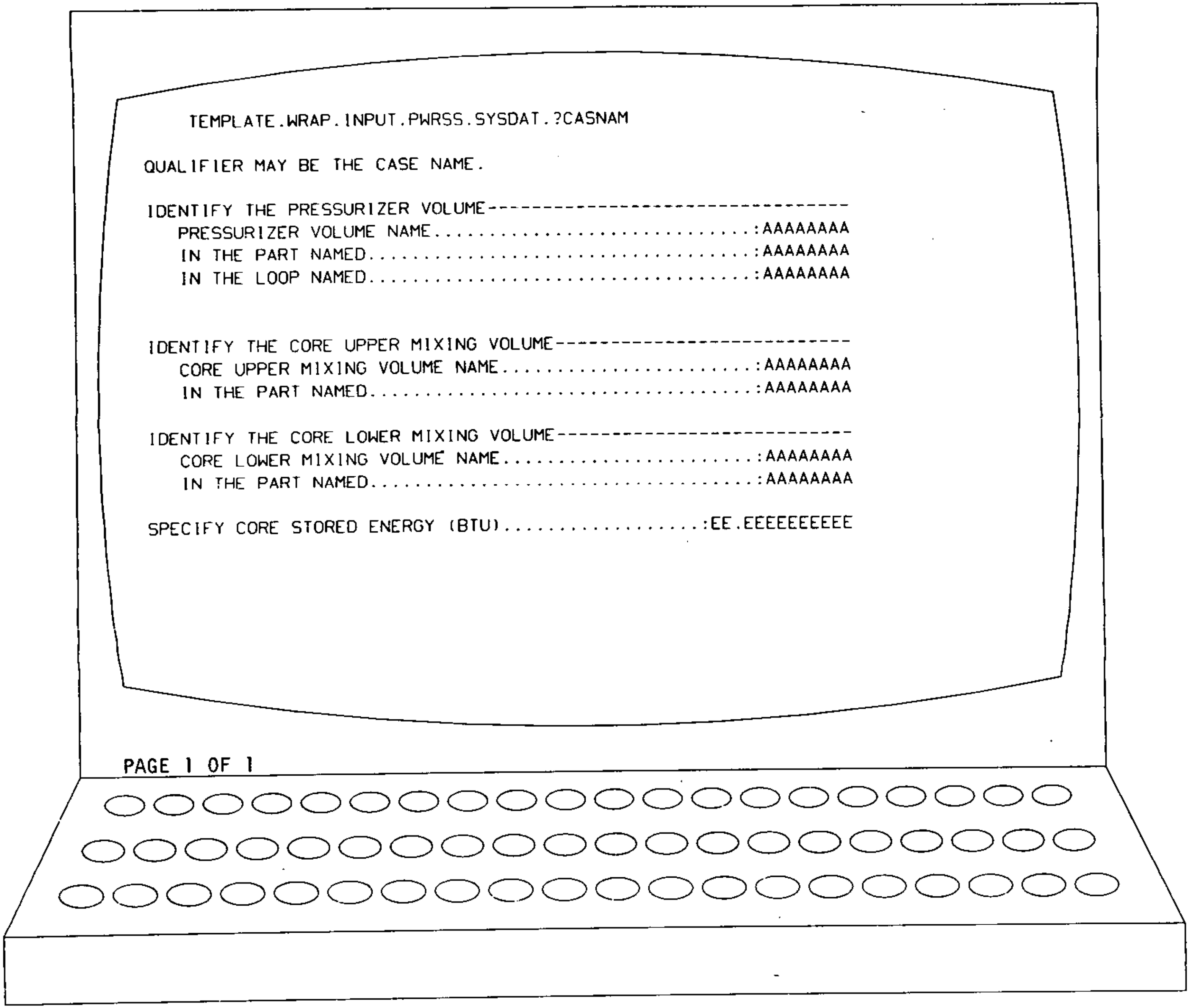
With a minimum amount of user supplied input, the PWRSS[5] module determines the thermal-hydraulic steady state of a PWR. Templates for the necessary input records, which are in addition to the WRAP input records normally required for the transient calculation, are indicated on the following pages. A solution for the steady state is obtained, including automatic balancing of the secondary side of the steam generators, and then a pseudo-transient (a transient calculation with no break) is run to allow damping out of any minor perturbations due to different computational techniques in PWRSS and TWRAM.

The following templates are used to prepare PWRSS input:

WRAP.INPUT.PWRSS.SYSDAT.?CASENAME

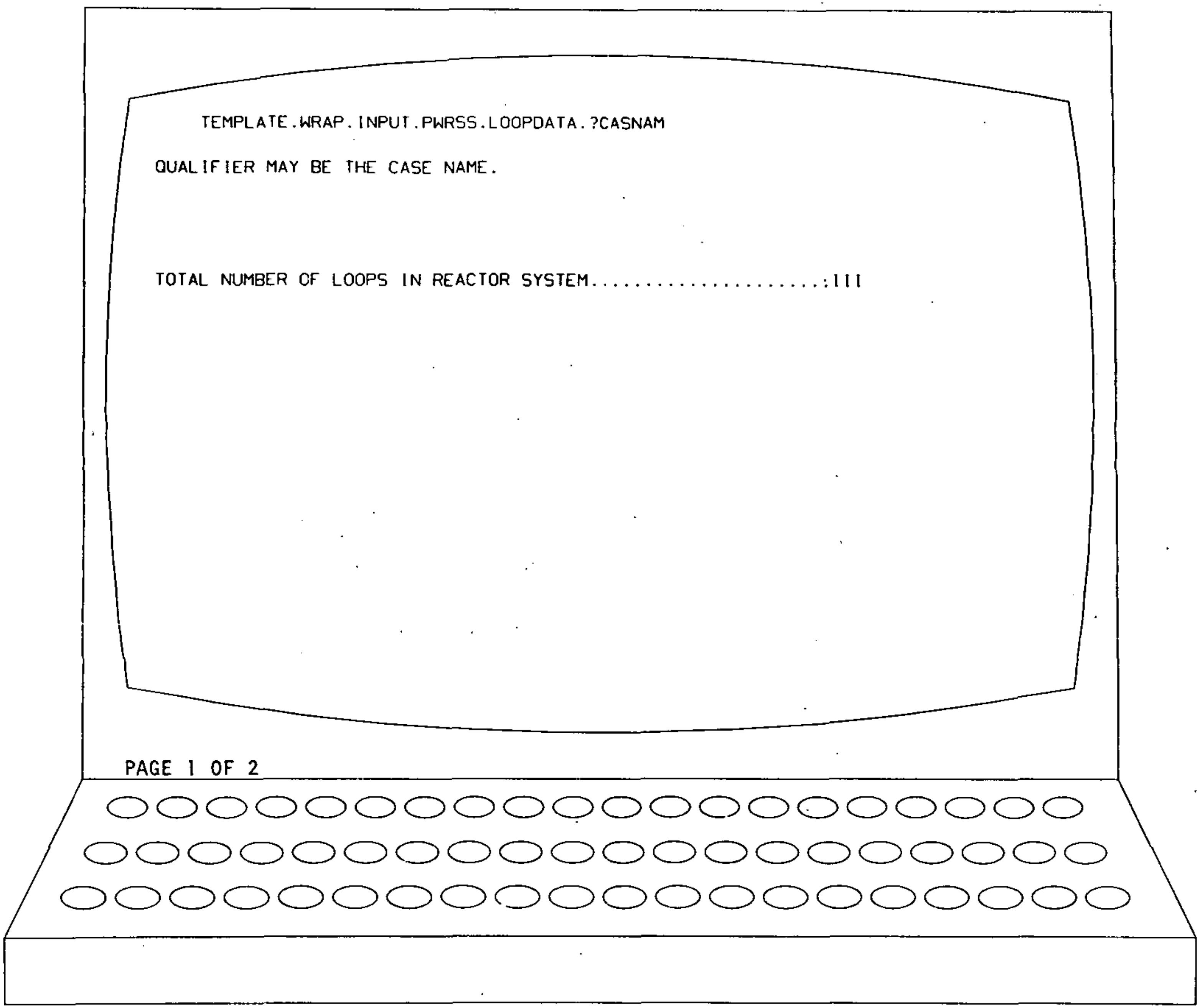
WRAP.INPUT.PWRSS.LOOPDATA.?CASENAME

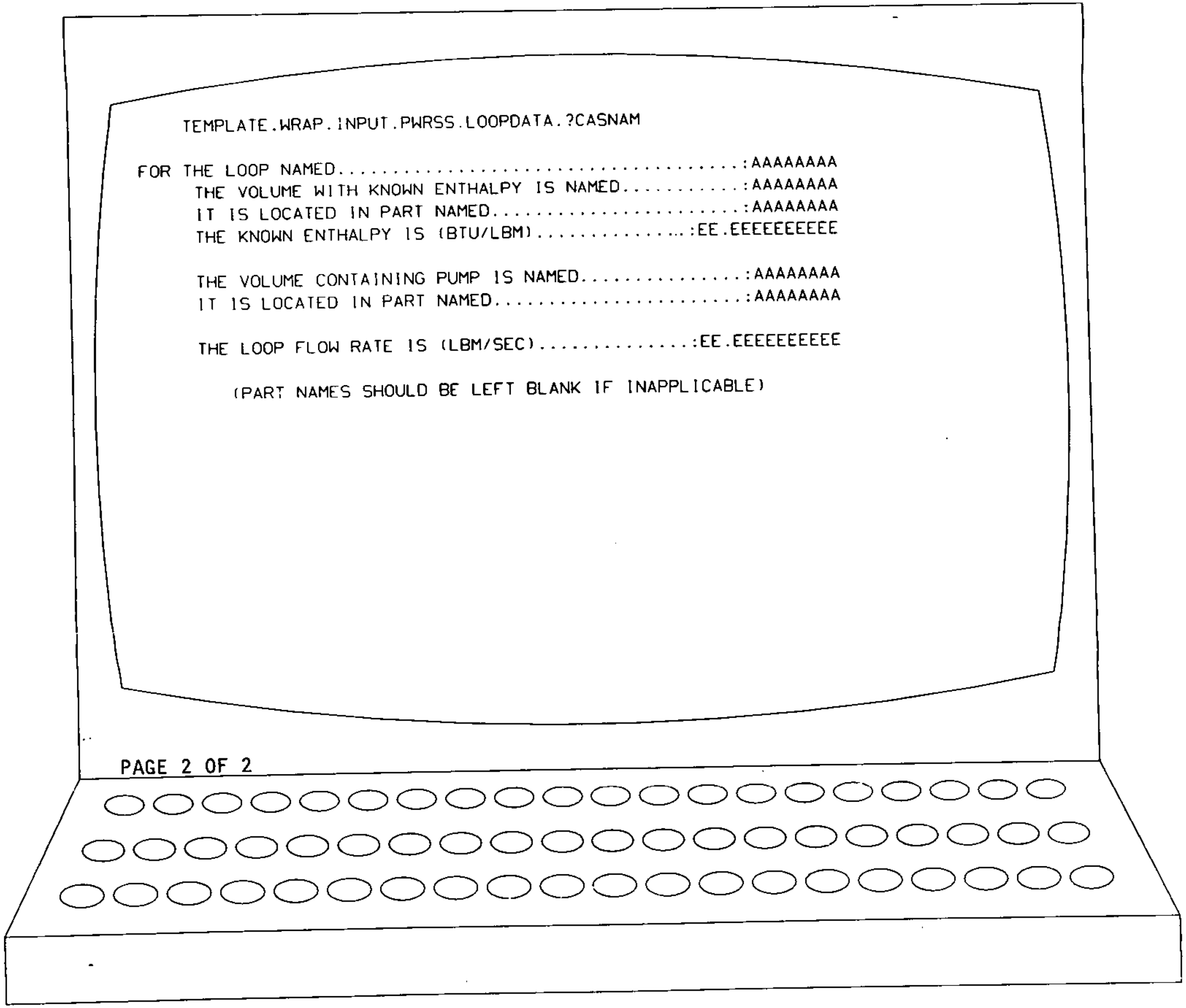
WRAP.INPUT.PWRSS.HXDATA.?CASENAME

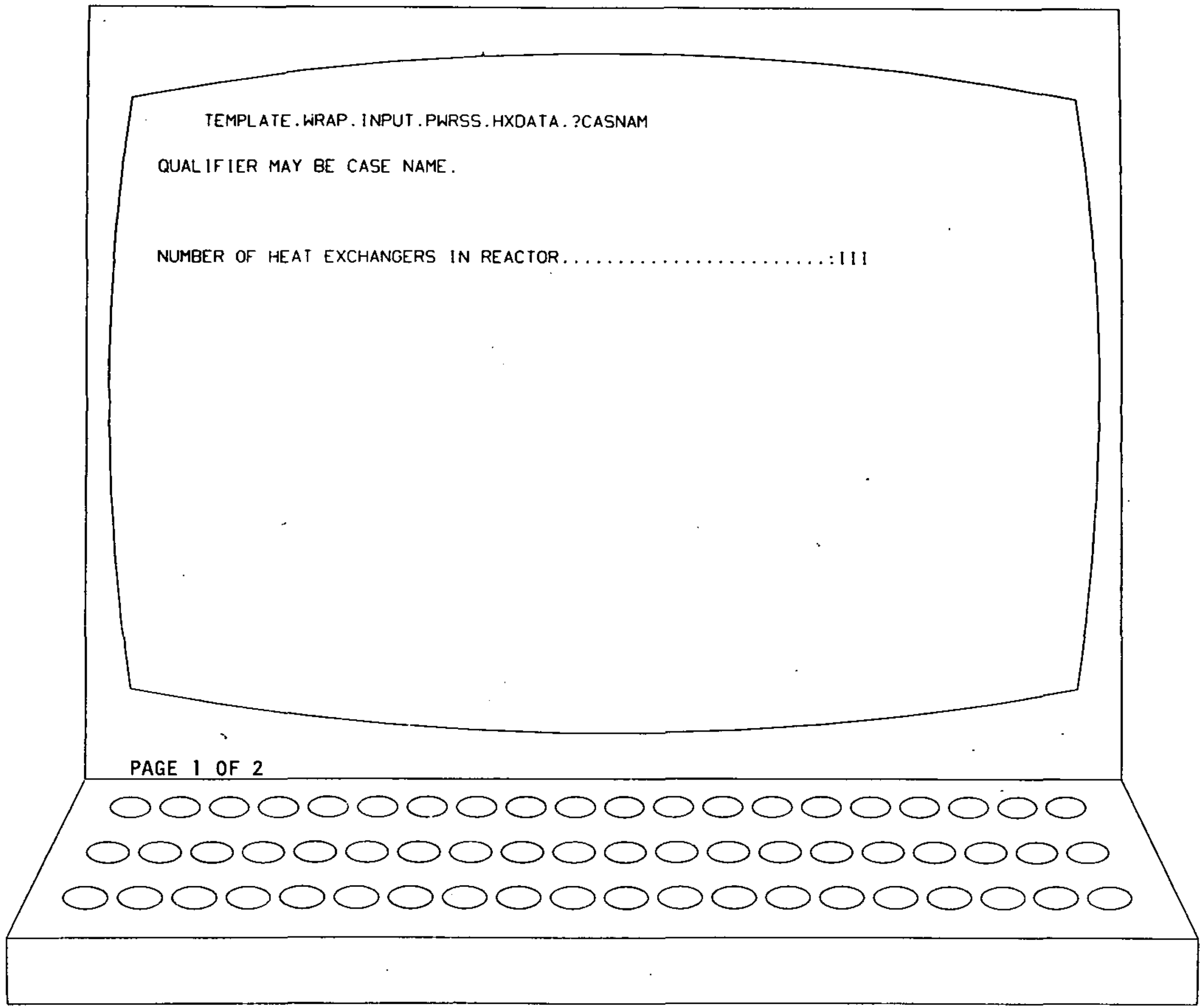


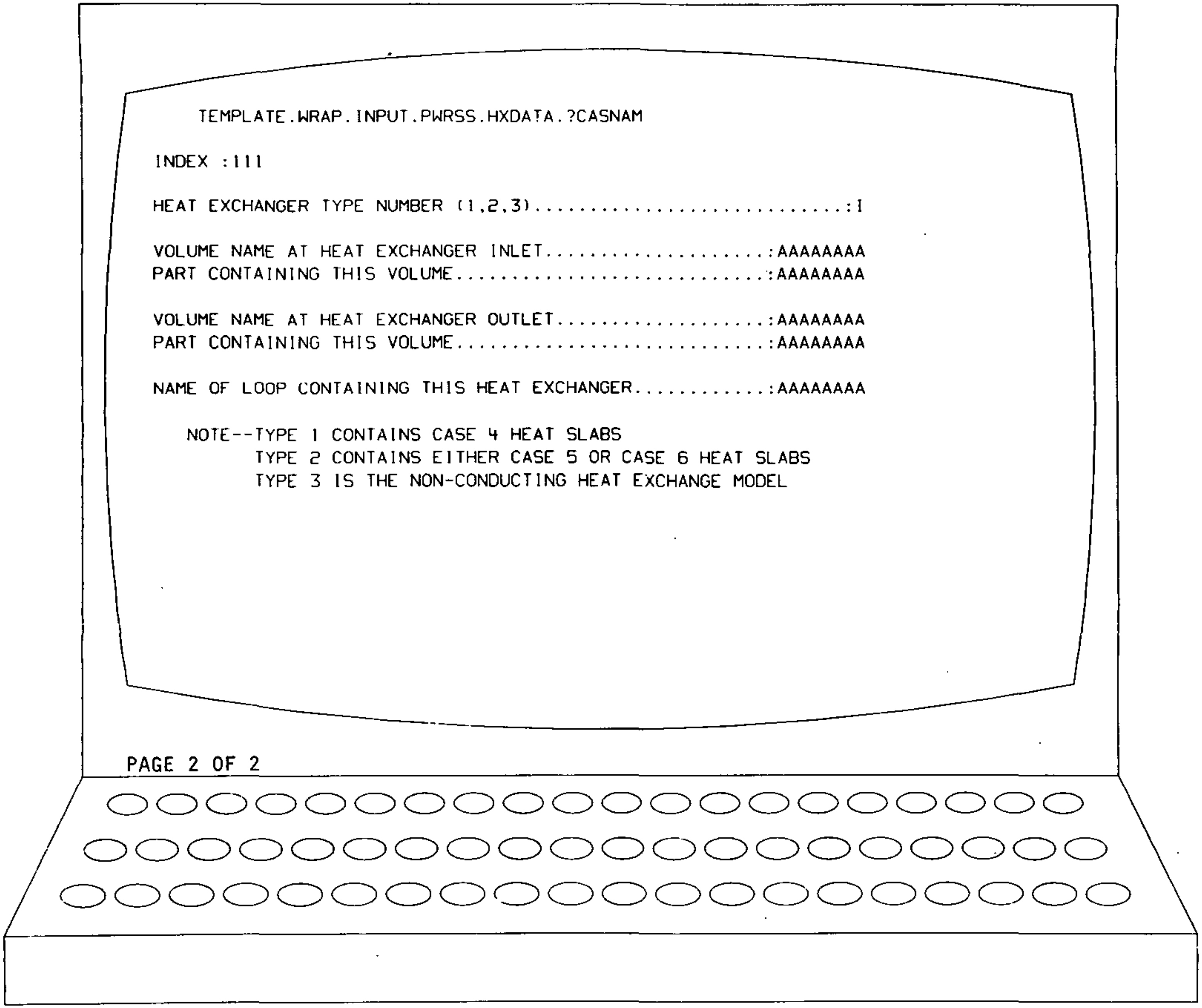
```
    TEMPLATE.WRAP.INPUT.PWRSS.SYSDAT.?CASNAM

QUALIFIER MAY BE THE CASE NAME.

IDENTIFY THE PRESSURIZER VOLUME-----------------------------------
   PRESSURIZER VOLUME NAME.............................:AAAAAAAA
   IN THE PART NAMED...................................:AAAAAAAA
   IN THE LOOP NAMED...................................:AAAAAAAA


IDENTIFY THE CORE UPPER MIXING VOLUME-----------------------------
   CORE UPPER MIXING VOLUME NAME.......................:AAAAAAAA
   IN THE PART NAMED...................................:AAAAAAAA

IDENTIFY THE CORE LOWER MIXING VOLUME-----------------------------
   CORE LOWER MIXING VOLUME NAME.......................:AAAAAAAA
   IN THE PART NAMED...................................:AAAAAAAA

SPECIFY CORE STORED ENERGY (BTU)...................:EE.EEEEEEEEE
```

PAGE 1 OF 1


TEMPLATE.WRAP.INPUT.PWRSS.LOOPDATA.?CASNAM
QUALIFIER MAY BE THE CASE NAME.
TOTAL NUMBER OF LOOPS IN REACTOR SYSTEM.....................:III
PAGE 1 OF 2


TEMPLATE.WRAP.INPUT.PWRSS.LOOPDATA.?CASNAM
FOR THE LOOP NAMED......................................:AAAAAAAA
THE VOLUME WITH KNOWN ENTHALPY IS NAMED...........:AAAAAAAA
IT IS LOCATED IN PART NAMED.......................:AAAAAAAA
THE KNOWN ENTHALPY IS (BTU/LBM)..............:EE.EEEEEEEEEE
THE VOLUME CONTAINING PUMP IS NAMED...............:AAAAAAAA
IT IS LOCATED IN PART NAMED.......................:AAAAAAAA
THE LOOP FLOW RATE IS (LBM/SEC)..............:EE.EEEEEEEEEE
(PART NAMES SHOULD BE LEFT BLANK IF INAPPLICABLE)
PAGE 2 OF 2


TEMPLATE.WRAP.INPUT.PWRSS.HXDATA.?CASNAM
QUALIFIER MAY BE CASE NAME.
NUMBER OF HEAT EXCHANGERS IN REACTOR........................:III
PAGE 1 OF 2


TEMPLATE.WRAP.INPUT.PWRSS.HXDATA.?CASNAM
INDEX :111
HEAT EXCHANGER TYPE NUMBER (1,2,3)............................:I
VOLUME NAME AT HEAT EXCHANGER INLET...................:AAAAAAAA
PART CONTAINING THIS VOLUME...........................:AAAAAAAA
VOLUME NAME AT HEAT EXCHANGER OUTLET..................:AAAAAAAA
PART CONTAINING THIS VOLUME...........................:AAAAAAAA
NAME OF LOOP CONTAINING THIS HEAT EXCHANGER...........:AAAAAAAA
NOTE--TYPE 1 CONTAINS CASE 4 HEAT SLABS
TYPE 2 CONTAINS EITHER CASE 5 OR CASE 6 HEAT SLABS
TYPE 3 IS THE NON-CONDUCTING HEAT EXCHANGE MODEL
PAGE 2 OF 2

3.3 REFILL

The REFILL module computes the time to refill the lower plenum and the degree of subcooling in the lower plenum fluid after refill. After end of bypass has been signalled in the TWRAM run, the REFILL module can be automatically initiated if the input described on the following pages is provided. Further information on the REFILL model can be found in Reference 2.

The following templates are used to prepare REFILL input:

WRAP.INPUT.REDBLUE.?CASENAME

WRAP.INPUT.CREARE.?CASENAME

WRAP.INPUT.ACCUM.?CASENAME

TEMPLATE.WRAP.INPUT.REDBLUE.?CASNAM

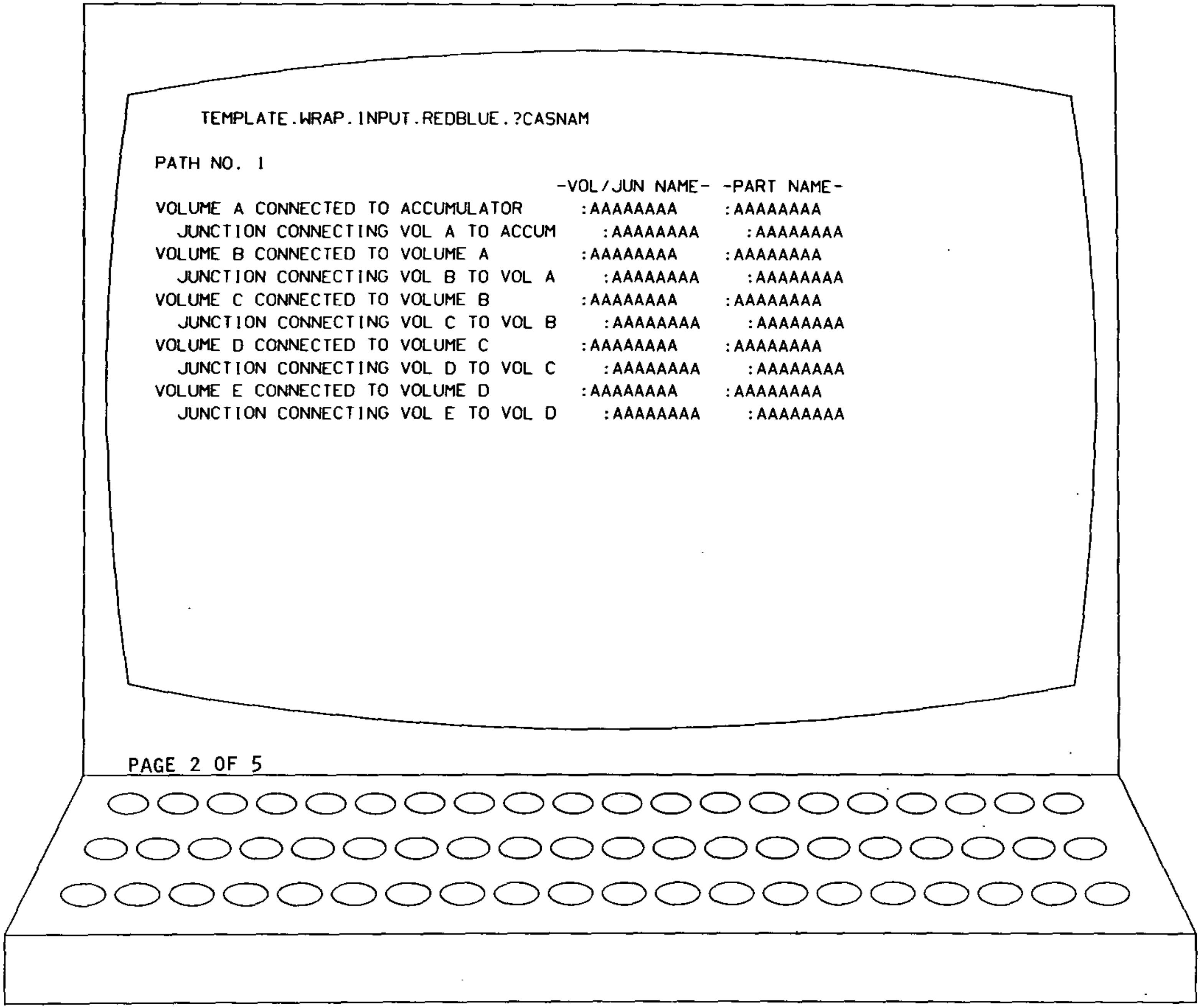
QUALIFIER MAY BE THE CASE NAME.

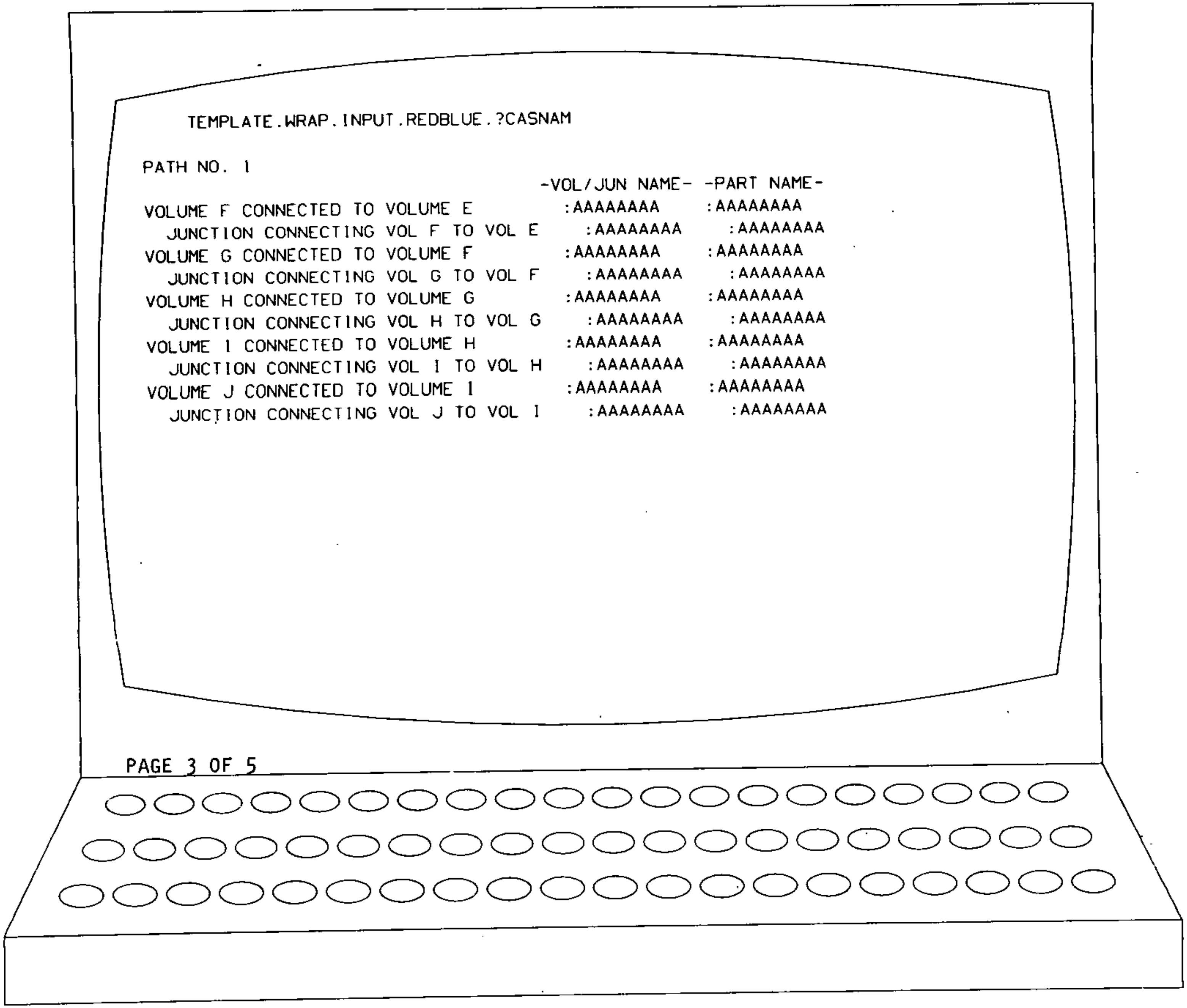
USE THIS RECORD TO SPECIFY THE VOLUMES AND JUNCTIONS
TAKING PART IN THE 'RED WATER, BLUE WATER' ECC BYPASS MODEL.

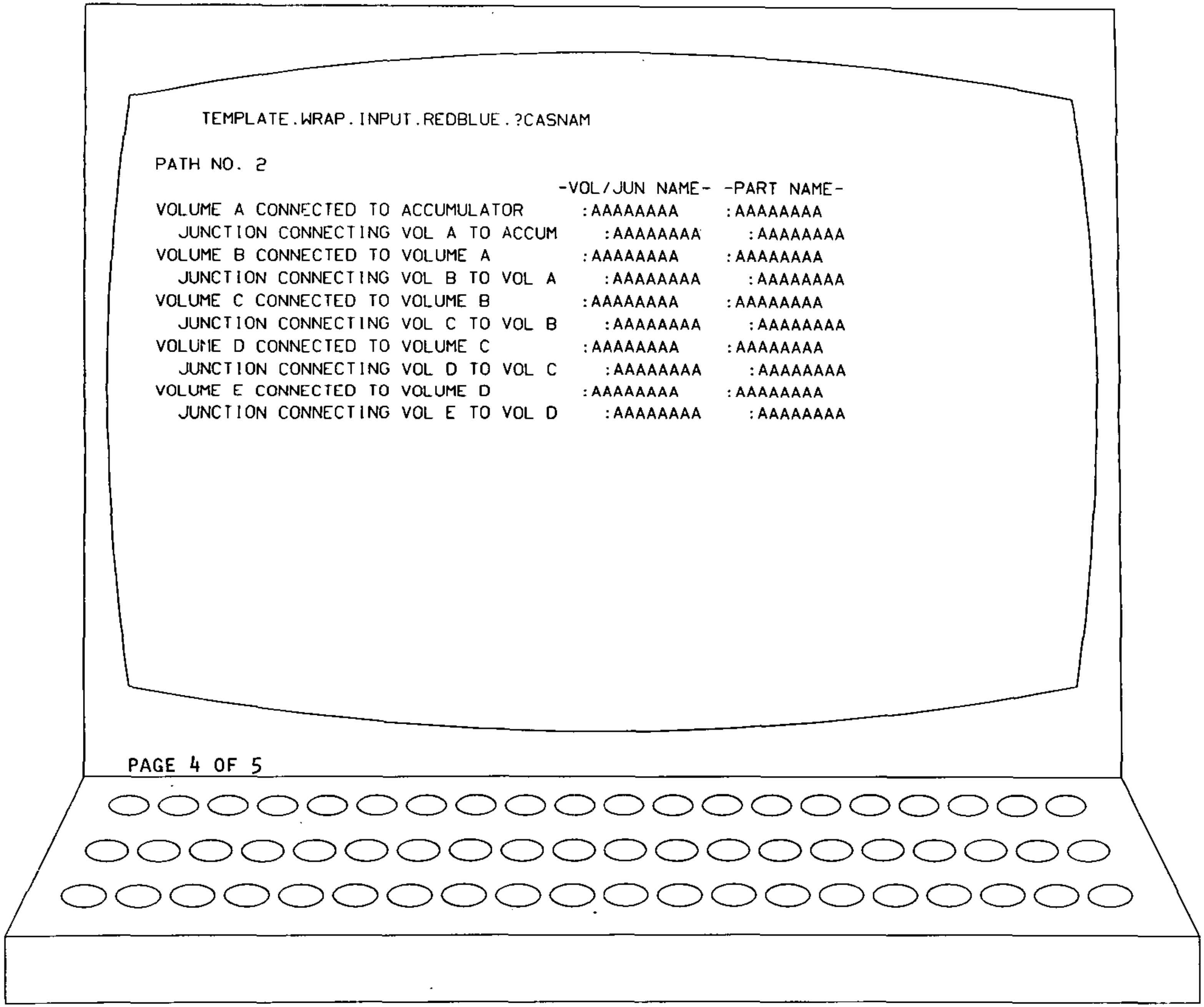
UP TO TWO FLOW PATHS MAY BE DEFINED, EACH CONTAINING UP TO
TEN VOLUMES. LEAVE THOSE QUANTITIES WHICH ARE NOT REQUIRED
EITHER BLANK OR 'AAAAAAAA'.

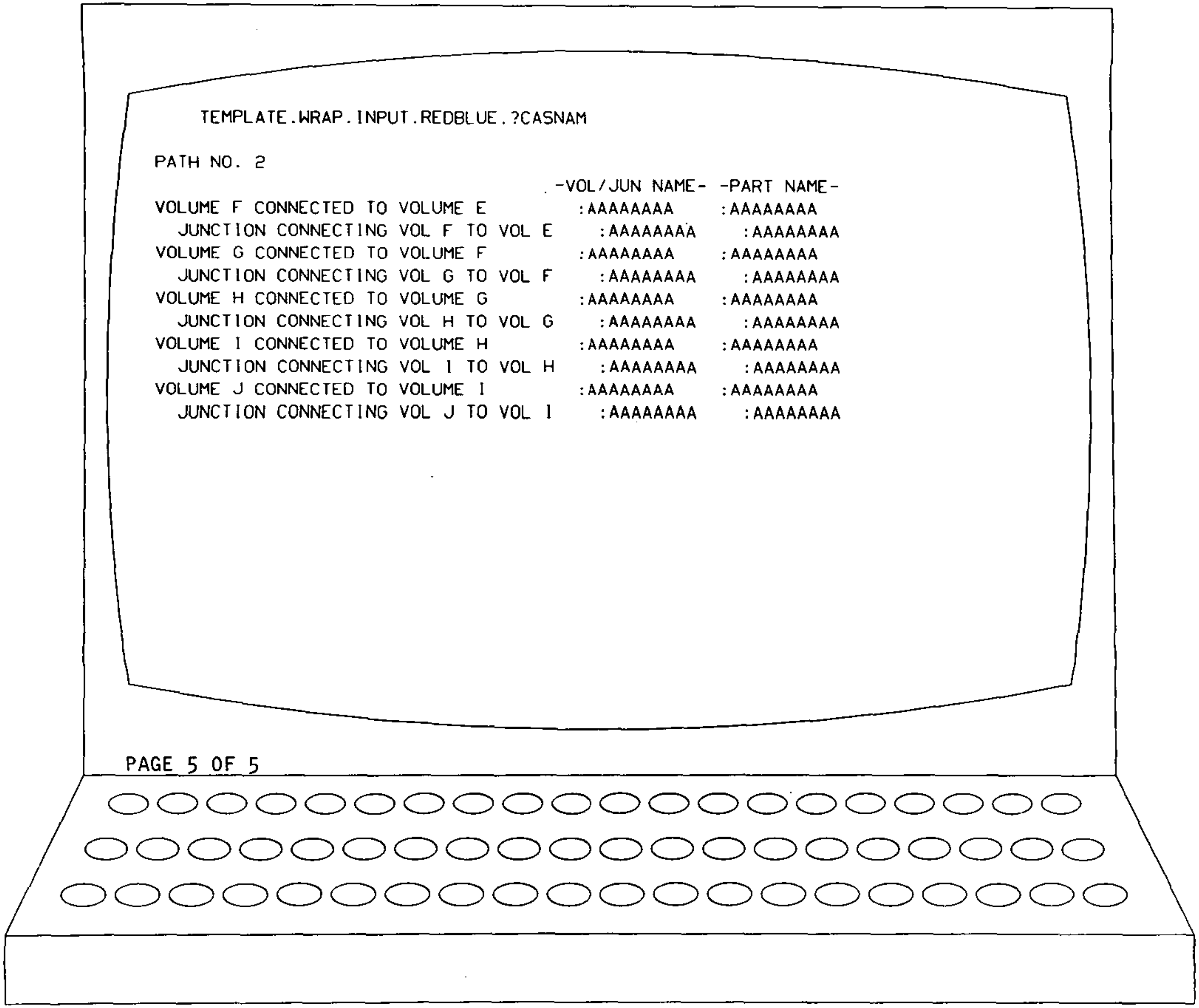
THE FINAL VOLUME IN EACH PATH MUST BE THE VOLUME TO WHICH
THE BREAK JUNCTION IS ATTACHED.

PAGE 1 OF 5


TEMPLATE.WRAP.INPUT.REDBLUE.?CASNAM
PATH NO. 1
-VOL/JUN NAME- -PART NAME-
VOLUME A CONNECTED TO ACCUMULATOR :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL A TO ACCUM :AAAAAAAA :AAAAAAAA
VOLUME B CONNECTED TO VOLUME A :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL B TO VOL A :AAAAAAAA :AAAAAAAA
VOLUME C CONNECTED TO VOLUME B :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL C TO VOL B :AAAAAAAA :AAAAAAAA
VOLUME D CONNECTED TO VOLUME C :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL D TO VOL C :AAAAAAAA :AAAAAAAA
VOLUME E CONNECTED TO VOLUME D :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL E TO VOL D :AAAAAAAA :AAAAAAAA
PAGE 2 OF 5


TEMPLATE.WRAP.INPUT.REDBLUE.?CASNAM
PATH NO. 1
-VOL/JUN NAME- -PART NAME-
VOLUME F CONNECTED TO VOLUME E :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL F TO VOL E :AAAAAAAA :AAAAAAAA
VOLUME G CONNECTED TO VOLUME F :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL G TO VOL F :AAAAAAAA :AAAAAAAA
VOLUME H CONNECTED TO VOLUME G :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL H TO VOL G :AAAAAAAA :AAAAAAAA
VOLUME I CONNECTED TO VOLUME H :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL I TO VOL H :AAAAAAAA :AAAAAAAA
VOLUME J CONNECTED TO VOLUME I :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL J TO VOL I :AAAAAAAA :AAAAAAAA
PAGE 3 OF 5


TEMPLATE.WRAP.INPUT.REDBLUE.?CASNAM
PATH NO. 2
-VOL/JUN NAME- -PART NAME-
VOLUME A CONNECTED TO ACCUMULATOR :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL A TO ACCUM :AAAAAAAA :AAAAAAAA
VOLUME B CONNECTED TO VOLUME A :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL B TO VOL A :AAAAAAAA :AAAAAAAA
VOLUME C CONNECTED TO VOLUME B :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL C TO VOL B :AAAAAAAA :AAAAAAAA
VOLUME D CONNECTED TO VOLUME C :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL D TO VOL C :AAAAAAAA :AAAAAAAA
VOLUME E CONNECTED TO VOLUME D :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL E TO VOL D :AAAAAAAA :AAAAAAAA
PAGE 4 OF 5


TEMPLATE.WRAP.INPUT.REDBLUE.?CASNAM
PATH NO. 2
-VOL/JUN NAME- -PART NAME-
VOLUME F CONNECTED TO VOLUME E :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL F TO VOL E :AAAAAAAA :AAAAAAAA
VOLUME G CONNECTED TO VOLUME F :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL G TO VOL F :AAAAAAAA :AAAAAAAA
VOLUME H CONNECTED TO VOLUME G :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL H TO VOL G :AAAAAAAA :AAAAAAAA
VOLUME I CONNECTED TO VOLUME H :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL I TO VOL H :AAAAAAAA :AAAAAAAA
VOLUME J CONNECTED TO VOLUME I :AAAAAAAA :AAAAAAAA
JUNCTION CONNECTING VOL J TO VOL I :AAAAAAAA :AAAAAAAA
PAGE 5 OF 5

```
    TEMPLATE.WRAP.INPUT.CREARE.?CASNAM

QUALIFIER MAY BE THE CASE NAME.
USE THIS RECORD TO SPECIFY THE DATA FOR THE CREARE CORRELATION
FOR DOWNCOMER HOT WALL DELAY TIME.

 |-------| POSSIBLE DOWNCOMER CONFIGURATIONS--------------------
 |       |
 |   A   | FOR ONE DOWNCOMER VOLUME ONLY, USE 'A'.
 |       |
 |       | FOR TWO DOWNCOMER VOLUMES IN SERIES, USE 'A' AND 'B'.
 |---|---|
 |   |   | FOR TWO DOWNCOMER VOLUMES IN PARALLEL, USE 'B'
 | B | C |   AND 'C'.
 |   |   |
 |   |   | FOR ONE DOWNCOMER VOLUME IN SERIES WITH TWO PARALLEL
 |---|---|   VOLUMES, USE 'A', 'B', AND 'C'.
```

PAGE 1 OF 5

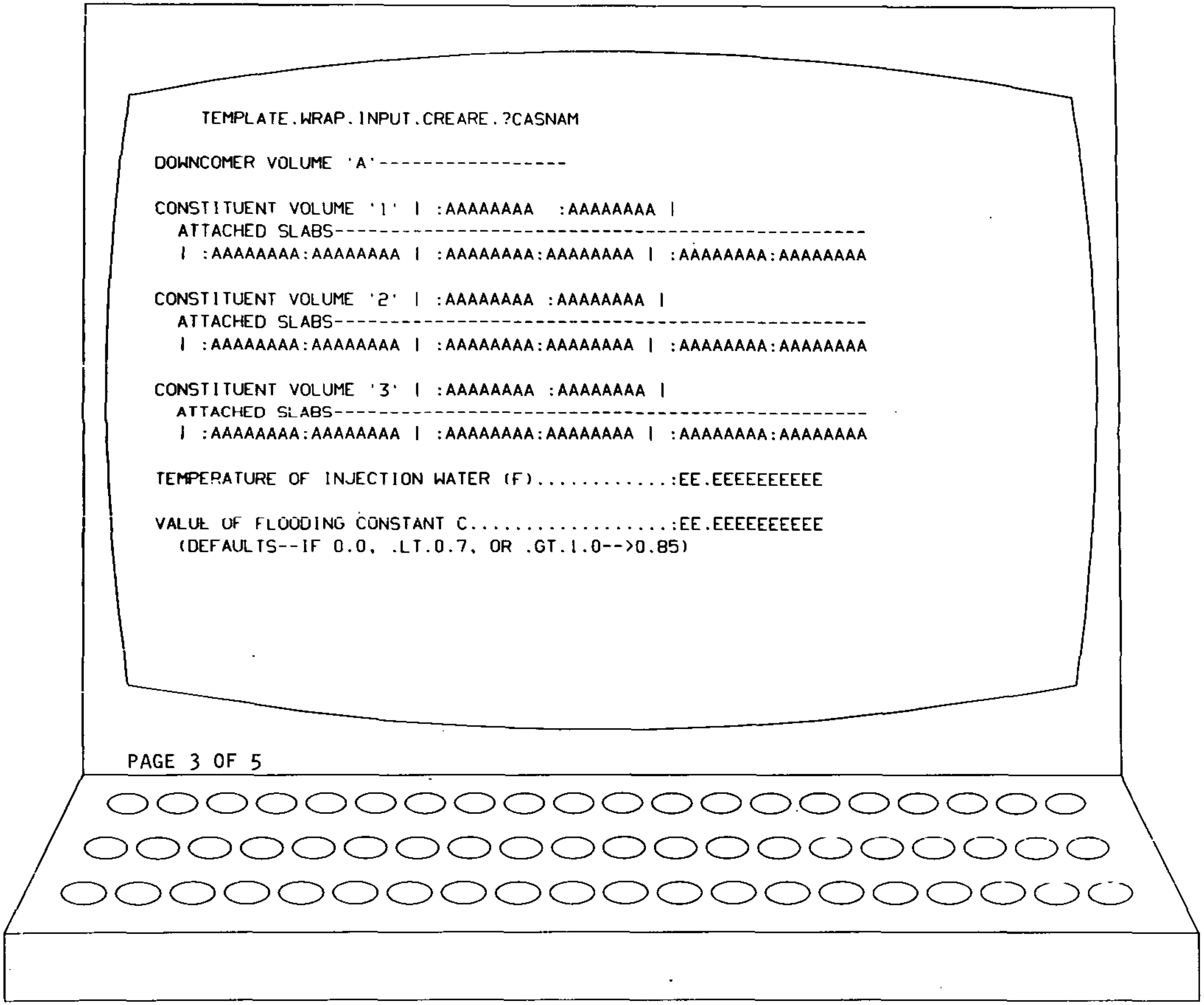
TEMPLATE.WRAP.INPUT.CREARE.?CASNAM

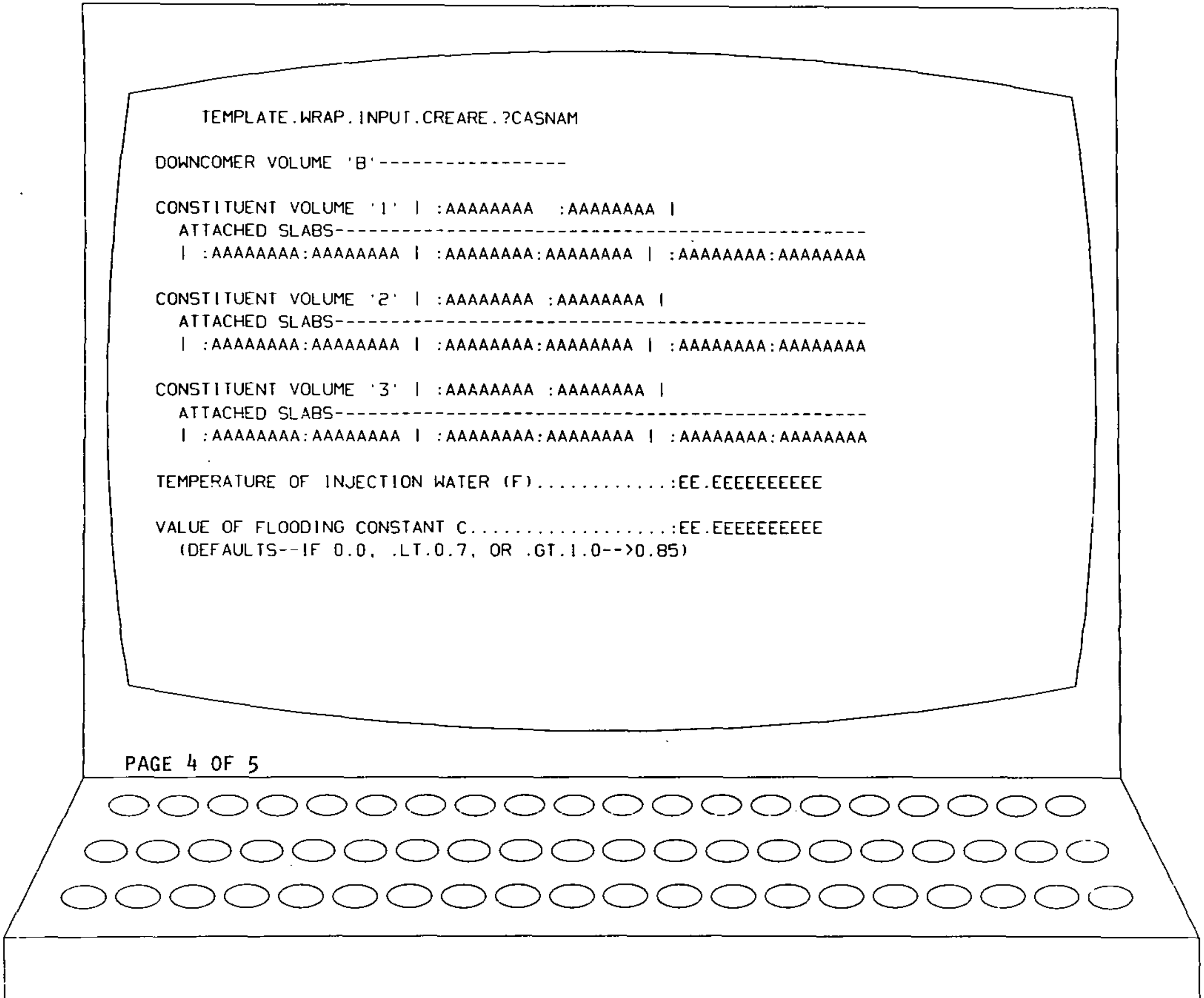
EACH OF THE "MAIN" VOLUMES ('A','B','C') MAY BE FURTHER SUB-
DIVIDED INTO UP TO 3 "CONSTITUENT" VOLUMES IN SERIES. ON
THE FOLLOWING PAGES, ASSIGN NAMES TO EACH OF THE CONSTITUENT
VOLUMES. ALSO ASSOCIATE UP TO 3 HEAT SLABS WITH EACH VOLUME.
IF MORE THAN ONE SLAB IS ASSOCIATED WITH A VOLUME, THE ARITH-
METIC MEAN OF THE SLAB PROPERTIES WILL BE USED.

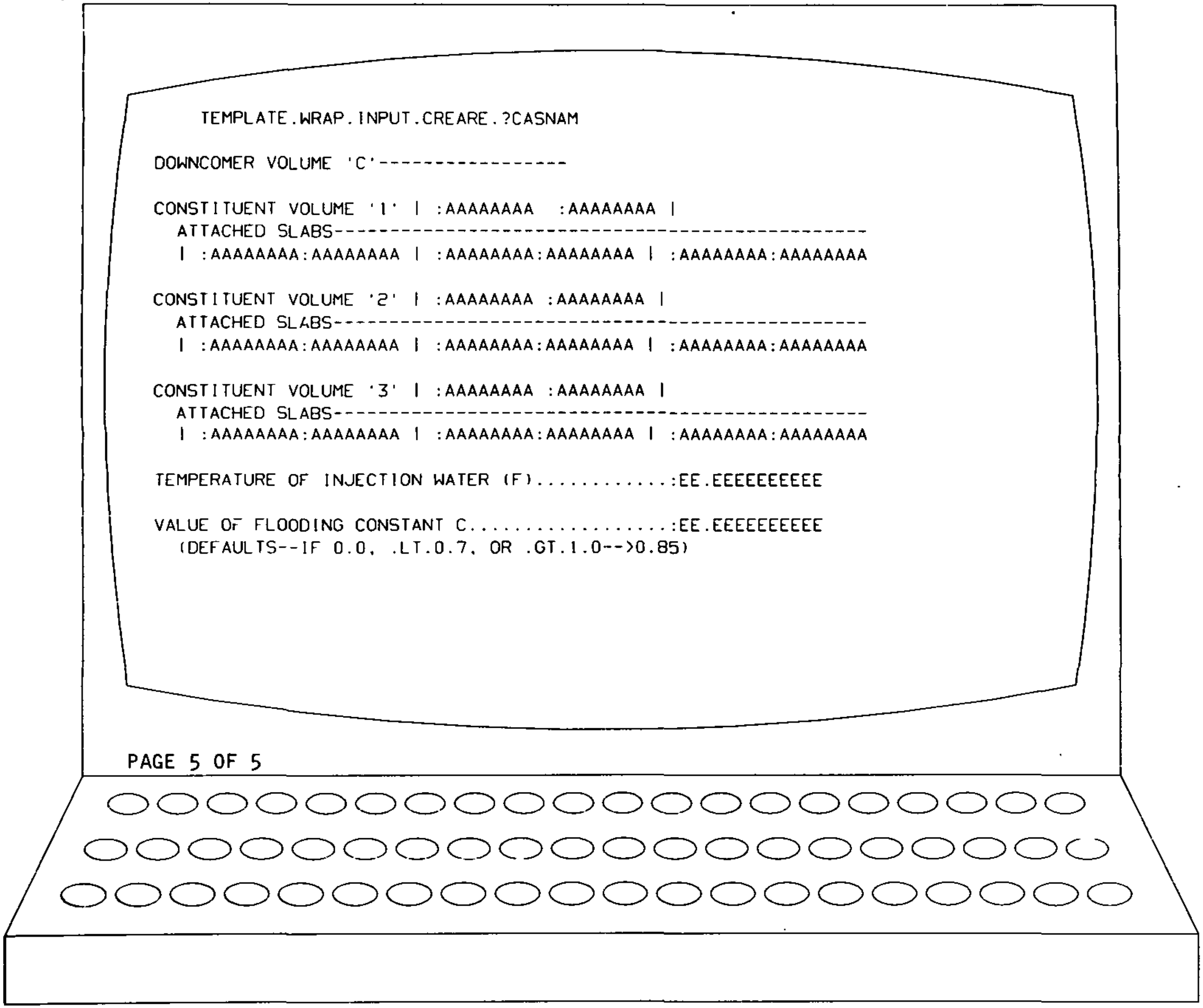
ALL NAMINGS USE THE PAIRED CONVENTION | ;NAME ;PARTNAME |

UNUSED NAMES MAY BE BLANKED OUT OR LEFT 'AAAAAAAA' EXCEPT
IF COMPONENT HAS SPECIFICALLY BLANK PARTNAME. IN THAT CASE
THE PARTNAME MUST BE BLANKED OUT.

PAGE 2 OF 5

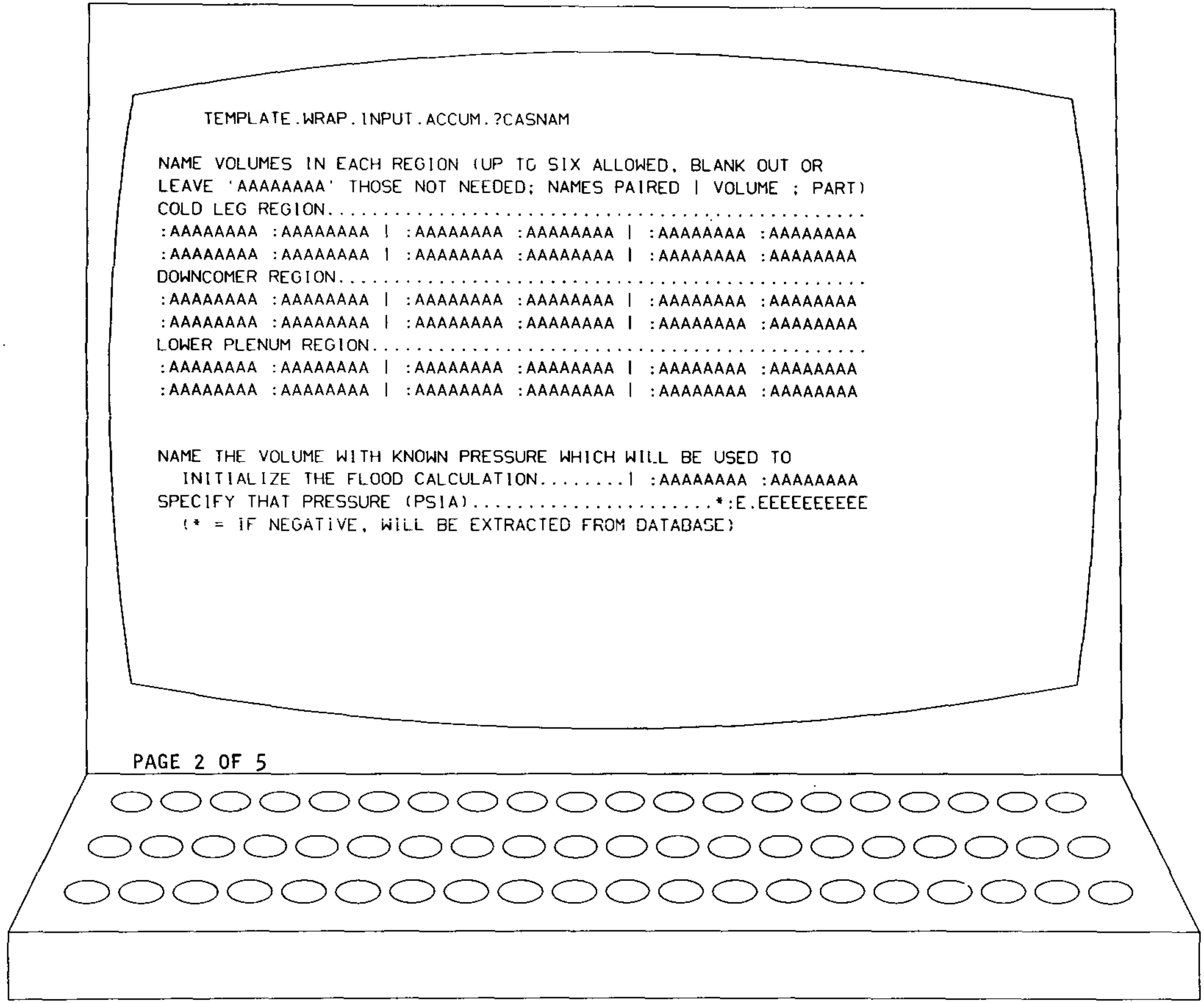

TEMPLATE.WRAP.INPUT.CREARE.?CASNAM
DOWNCOMER VOLUME 'A'-----------------
CONSTITUENT VOLUME '1' | :AAAAAAAA :AAAAAAAA |
ATTACHED SLABS---
| :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA
CONSTITUENT VOLUME '2' | :AAAAAAAA :AAAAAAAA |
ATTACHED SLABS---
| :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA
CONSTITUENT VOLUME '3' | :AAAAAAAA :AAAAAAAA |
ATTACHED SLABS---
| :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA
TEMPERATURE OF INJECTION WATER (F)............:EE.EEEEEEEEEE
VALUE OF FLOODING CONSTANT C..................:EE.EEEEEEEEEE
(DEFAULTS--IF 0.0, .LT.0.7, OR .GT.1.0-->0.85)
PAGE 3 OF 5

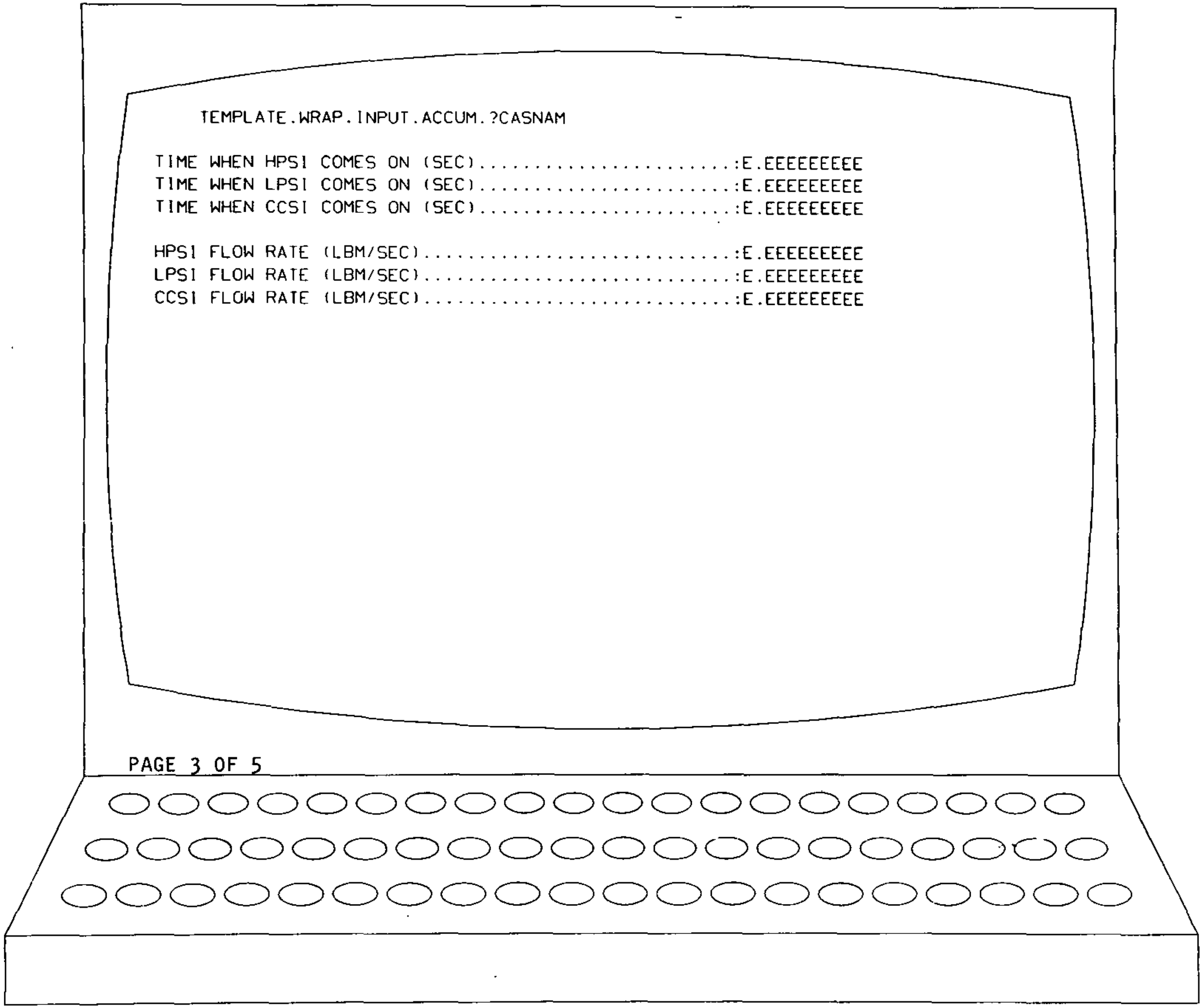

TEMPLATE.WRAP.INPUT.CREARE.?CASNAM
DOWNCOMER VOLUME 'B'-----------------
CONSTITUENT VOLUME '1' | :AAAAAAAA :AAAAAAAA |
ATTACHED SLABS---
| :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA
CONSTITUENT VOLUME '2' | :AAAAAAAA :AAAAAAAA |
ATTACHED SLABS---
| :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA
CONSTITUENT VOLUME '3' | :AAAAAAAA :AAAAAAAA |
ATTACHED SLABS---
| :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA
TEMPERATURE OF INJECTION WATER (F)............:EE.EEEEEEEEEE
VALUE OF FLOODING CONSTANT C..................:EE.EEEEEEEEEE
(DEFAULTS--IF 0.0, .LT.0.7, OR .GT.1.0-->0.85)
PAGE 4 OF 5


TEMPLATE.WRAP.INPUT.CREARE.?CASNAM
DOWNCOMER VOLUME 'C'-----------------
CONSTITUENT VOLUME '1' | :AAAAAAAA :AAAAAAAA |
ATTACHED SLABS--
| :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA
CONSTITUENT VOLUME '2' | :AAAAAAAA :AAAAAAAA |
ATTACHED SLABS--
| :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA
CONSTITUENT VOLUME '3' | :AAAAAAAA :AAAAAAAA |
ATTACHED SLABS--
| :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA | :AAAAAAAA:AAAAAAAA
TEMPERATURE OF INJECTION WATER (F)............:EE.EEEEEEEEEE
VALUE OF FLOODING CONSTANT C..................:EE.EEEEEEEEEE
(DEFAULTS--IF 0.0, .LT.0.7, OR .GT.1.0-->0.85)
PAGE 5 OF 5

```
    TEMPLATE.WRAP.INPUT.ACCUM.?CASNAM

QUALIFIER IS THE CASE NAME.
RECORD SPECIFIES REFILL/REFLOOD PARAMETERS FOR ACCUMULATORS.

AREA OF THE SURGE LINE (FT2)...............*:E.EEEEEEEEEE
FLOW PATH RESISTANCE FACTOR K..............*:E.EEEEEEEEEE
FLOW PATH INERTIA F(FT/FT2).................:E.EEEEEEEEEE
HEIGHT FROM NOZZLE TO TOP OF DOWNCOMER (FT).:E.EEEEEEEEEE
IDENTIFY VOLUME FOR ACCUMULATOR TANK PROPERTIES
  VOLUME NAME...............................:AAAAAAAA
  PART NAME.................................:AAAAAAAA
NUMBER OF TANKS (FLOW MULTIPLIER)...........:E.EEEEEEEEEE
PIPE HYDRAULIC DIAMETER (FT)...............*:E.EEEEEEEEEE
PIPE EQUIV. LENGTH (FT) (FOR FANNING FRICT).:E.EEEEEEEEEE
ELEV HEAD, TANK LIQ LEV TO INJ PT (FT)......:E.EEEEEEEEEE
MOMENTUM FLUX OPTION (1-YES,0-NO SUGGESTED).:E.EEEE
GAMMA FOR EXPANSION OF GAS..................:E.EEEEEEEEEE
AREA OF TANK FLUID SURFACE (FT2)...........*:E.EEEEEEEEEE
FLUID VISCOSITY (LBM/SEC-FT)...............*:E.EEEEEEEEEE

  (* = IF NEGATIVE, WILL BE EXTRACTED FROM DATABASE)
```

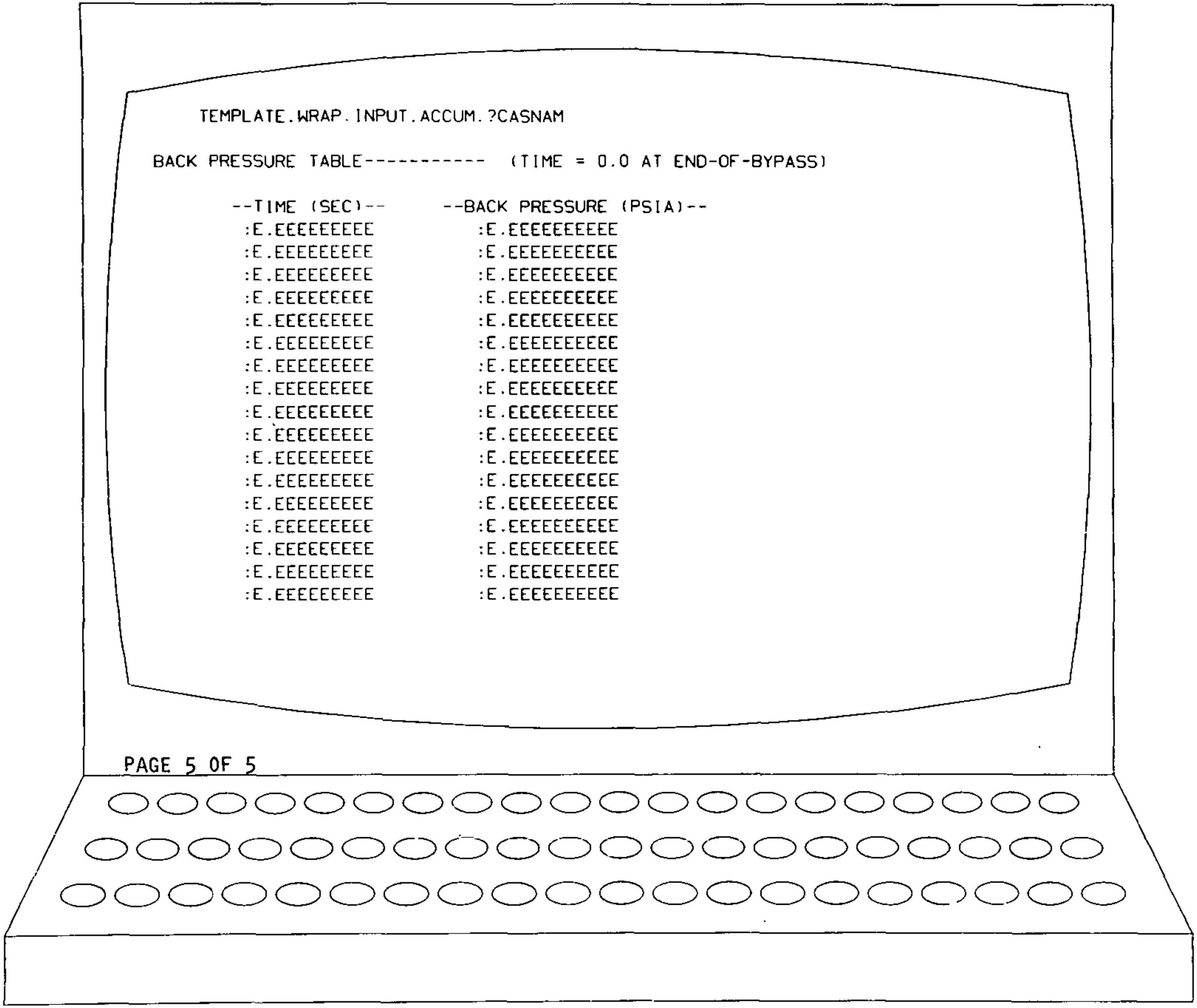
PAGE 1 OF 5


TEMPLATE.WRAP.INPUT.ACCUM.?CASNAM
NAME VOLUMES IN EACH REGION (UP TO SIX ALLOWED, BLANK OUT OR
LEAVE 'AAAAAAAA' THOSE NOT NEEDED; NAMES PAIRED | VOLUME ; PART)
COLD LEG REGION...
:AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA
:AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA
DOWNCOMER REGION..
:AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA
:AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA
LOWER PLENUM REGION...
:AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA
:AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA | :AAAAAAAA :AAAAAAAA
NAME THE VOLUME WITH KNOWN PRESSURE WHICH WILL BE USED TO
INITIALIZE THE FLOOD CALCULATION........| :AAAAAAAA :AAAAAAAA
SPECIFY THAT PRESSURE (PSIA).......................*:E.EEEEEEEEEE
(* = IF NEGATIVE, WILL BE EXTRACTED FROM DATABASE)
PAGE 2 OF 5


TEMPLATE.WRAP.INPUT.ACCUM.?CASNAM
TIME WHEN HPSI COMES ON (SEC).......................:E.EEEEEEEEE
TIME WHEN LPSI COMES ON (SEC).......................:E.EEEEEEEEE
TIME WHEN CCSI COMES ON (SEC).......................:E.EEEEEEEEE
HPSI FLOW RATE (LBM/SEC)..........................:E.EEEEEEEEE
LPSI FLOW RATE (LBM/SEC)..........................:E.EEEEEEEEE
CCSI FLOW RATE (LBM/SEC)..........................:E.EEEEEEEEE
PAGE 3 OF 5

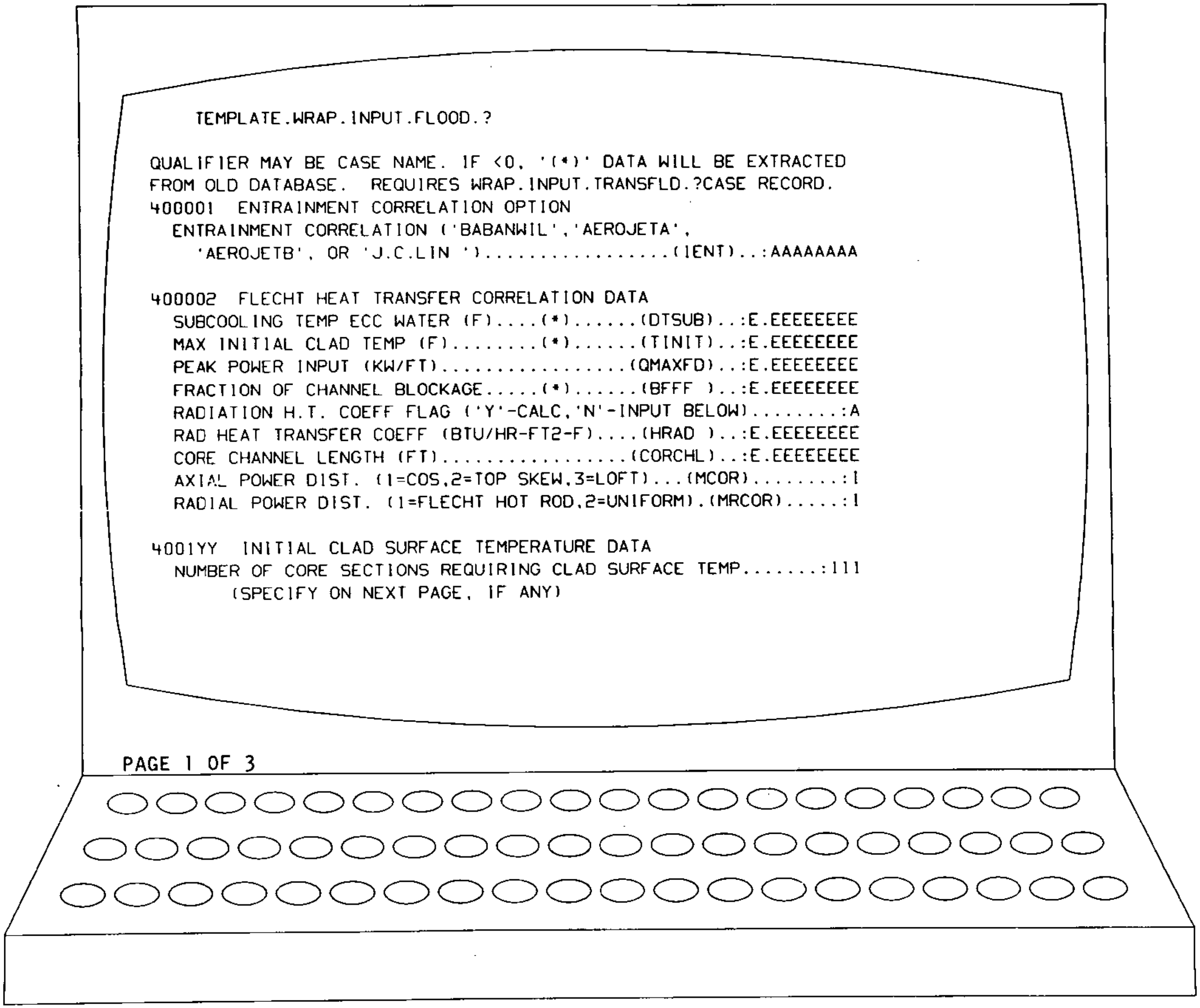
```
    TEMPLATE.WRAP.INPUT.ACCUM.?CASNAM

INPUT CONTROL PARAMETERS--
    PRINT INTERVAL (SEC).............................:E.EEEEEEEEEE
    TIME STEPS PER PRINT INTERVAL....................:IIIII
    TANK CUT-OFF VOLUME (FT3)...................*:E.EEEEEEEEEE
    TANK VOLUME FOR VALVE CLOSURE (FT3)...........:E.EEEEEEEEEE
    TIME TO CLOSE VALVE (SEC).....................:E.EEEEEEEEEE
        (* = IF NEGATIVE, WILL BE EXTRACTED FROM DATABASE)


NUMBER OF POINTS IN BACK PRESSURE TABLE...........:II
          IF 0, WILL BE EXTRACTED FROM DATABASE.
          IF >0, MUST BE FEWER THAN 20 POINTS WITH
                 TIME = 0.0 AT END-OF-BYPASS.
```

PAGE 4 OF 5


TEMPLATE.WRAP.INPUT.ACCUM.?CASNAM
BACK PRESSURE TABLE----------- (TIME = 0.0 AT END-OF-BYPASS)
--TIME (SEC)-- --BACK PRESSURE (PSIA)--
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
:E.EEEEEEEEE :E.EEEEEEEEEE
PAGE 5 OF 5

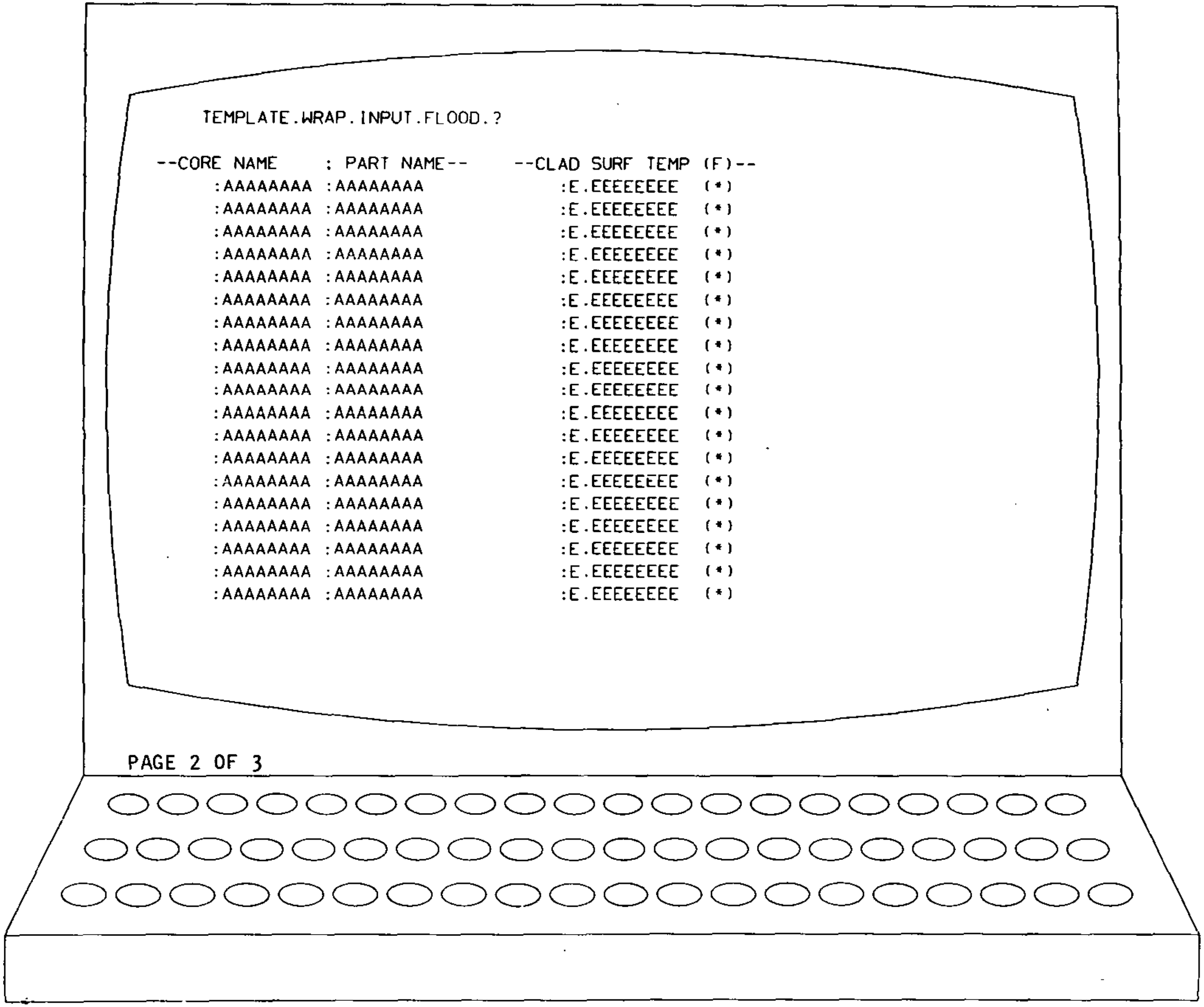
3.4 FLOOD

The FLOOD module is a reprogrammed version of RELAP4/MOD5-FLOOD, which is an option in RELAP. Further description of the REFLOOD calculational capability of WRAP can be found in Reference 2. Prior to executing FLOOD, the problem is renodalized because the blowdown nodalization generally does not conform to several rules for the FLOOD calculation.[6] The RENPRE module can be used for a portion of the renodalization. In addition to RENPRE input records, the input record whose template is shown on the following page is required.



```
TEMPLATE.WRAP.INPUT.FLOOD.?

QUALIFIER MAY BE CASE NAME. IF <0, '(*)' DATA WILL BE EXTRACTED
FROM OLD DATABASE.  REQUIRES WRAP.INPUT.TRANSFLD.?CASE RECORD.
400001  ENTRAINMENT CORRELATION OPTION
  ENTRAINMENT CORRELATION ('BABANWIL','AEROJETA',
    'AEROJETB', OR 'J.C.LIN ')................(IENT)..:AAAAAAAA

400002  FLECHT HEAT TRANSFER CORRELATION DATA
  SUBCOOLING TEMP ECC WATER (F)....(*)......(DTSUB)..:E.EEEEEEEE
  MAX INITIAL CLAD TEMP (F)........(*)......(TINIT)..:E.EEEEEEEE
  PEAK POWER INPUT (KW/FT).................(QMAXFD)..:E.EEEEEEEE
  FRACTION OF CHANNEL BLOCKAGE.....(*)......(BFFF )..:E.EEEEEEEE
  RADIATION H.T. COEFF FLAG ('Y'-CALC,'N'-INPUT BELOW)........:A
  RAD HEAT TRANSFER COEFF (BTU/HR-FT2-F)....(HRAD )..:E.EEEEEEEE
  CORE CHANNEL LENGTH (FT).................(CORCHL)..:E.EEEEEEEE
  AXIAL POWER DIST. (1=COS,2=TOP SKEW,3=LOFT)...(MCOR)........:I
  RADIAL POWER DIST. (1=FLECHT HOT ROD,2=UNIFORM).(MRCOR).....:I

4001YY  INITIAL CLAD SURFACE TEMPERATURE DATA
  NUMBER OF CORE SECTIONS REQUIRING CLAD SURFACE TEMP.......:III
       (SPECIFY ON NEXT PAGE, IF ANY)
```

PAGE 1 OF 3


TEMPLATE.WRAP.INPUT.FLOOD.?
--CORE NAME : PART NAME-- --CLAD SURF TEMP (F)--
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
:AAAAAAAA :AAAAAAAA :E.EEEEEEEE (*)
PAGE 2 OF 3

```
    TEMPLATE.WRAP.INPUT.FLOOD.?

400003  AEROJET A ENTRAINMENT CORRELATION DATA
        (REQUIRED ONLY IF IENT='AEROJETA')
  ENTRAINMENT FRACTION AT LIQUID LEVEL HC2....(EN2)..:E.EEEEEEEE
  LIQUID LEVEL (FT)...........................(HC1)..:E.EEEEEEEE
  LIQUID LEVEL (FT)...........................(HC2)..:E.EEEEEEEE

400004  CORE OUTLET ENTHALPY DATA
  CORE OUTLET ENTHALPY FLAG ('Y'-CALC,'N'-INPUT BELOW)........:A
  CORE OUTLET ENTHALPY (BTU/LBM).....(*)....(HCOUT)..:E.EEEEEEEE

400005  JUNCTION AND VOLUME NAMES              --NAME   ; PARTNAME--
  NAME OF CORE INLET JUNCTION......(JUNIN)..:AAAAAAAA:AAAAAAAA
  NAME OF CORE OUTLET JUNCTION....(JUNOUT)..:AAAAAAAA:AAAAAAAA
  NAME OF WATER SLIP JUNCTION.....(JUNWSL)..:AAAAAAAA:AAAAAAAA
  NAME OF STEAM SLIP JUNCTION.....(JUNSSL)..:AAAAAAAA:AAAAAAAA
  NAME OF CORE VOLUME..............(NCVOL)..:AAAAAAAA:AAAAAAAA
  NAME OF UPPER PLENUM VOLUME.....(NUPVOL)..:AAAAAAAA:AAAAAAAA
  NAME OF LOWER PLENUM VOLUME.....(NLPVOL)..:AAAAAAAA:AAAAAAAA
  NAME OF DOWNCOMER VOLUME........(NDCVOL)..:AAAAAAAA:AAAAAAAA

PAGE 3 OF 3
```

3.5 FRAP

A reprogrammed version of FRAP-T4-LACE[7,8] is used to analyze the thermal behavior of the hottest pin. Further information on this module is found in Reference 2. Input data are described on the following pages. In the WRAP system, many of the data records are created automatically from GAPCON, TWRAM, and FLOOD output by various interfaces. These records are described further in Section 4. For a stand-alone calculation, the user is required to create the FRAP.JOB and all of the FRAP.BASE records. Records named FRAP.OPTN are optional records allowing flexibility in the calculational procedure and are completed only if necessary for the particular problem of the user.

The following templates are used to prepare FRAP input:

FRAP.JOB.CASE.?JOBNAME

FRAP.BASE.DATA.PROB.?CASENAME

FRAP.BASE.DATA.TIME.?CASENAME

FRAP.BASE.DATA.FUEL.?CASENAME*

FRAP.BASE.DATA.PELLET.?CASENAME*

FRAP.BASE.DATA.NUMERIC.CONTROLS.?CASENAME

FRAP.BASE.DATA.CLAD.?CASENAME

FRAP.BASE.DATA.CHANL.?CASENAME

FRAP.BASE.DATA.THERMAL.PROP.?CASENAME

FRAP.BASE.DATA.RADIAL.?CASENAME

FRAP.BASE.DATA.RADMESH.?CASENAME*

FRAP.BASE.DATA.COMP.?CASENAME

FRAP.BASE.DATA.POWDIS.?CASENAME

FRAP.BASE.DATA.INTEMP.?CASENAME

FRAP.BASE.DATA.POWER.HISTORY.?CASENAME*

FRAP.BASE.DATA.COOLANT.HISTORY.?CASENAME

FRAP.BASE.DATA.GASPLEN.?CASENAME*

---

* Template names whose corresponding records are created partially or in total by various interface routines.

FRAP.BASE.DATA.STRAIN.?CASENAME*

FRAP.OPTN.DATA.VOID.?CASENAME

FRAP.OPTN.DATA.TWODHT.?CASENAME*

FRAP.OPTN.DATA.TIMESTEP.?CASENAME

FRAP.OPTN.DATA.AXNOD.?CASENAME

FRAP.OPTN.DATA.FASTFLX.?CASENAME

FRAP.OPTN.DATA.SHTCBAL.?CASENAME

FRAP.OPTN.DATA.PRINT.?CASENAME

FRAP.OPTN.DATA.DIALS.?CASENAME

FRAP.OPTN.DATA.GAPMULT.?CASENAME

FRAP.OPTN.DATA.MULTFAC.?CASENAME

FRAP.OPTN.DATA.REFLOOD.SPECS.?CASENAME

FRAP.OPTN.DATA.REFLOOD.PARAMS.?CASENAME*

FRAP.OPTN.DATA.ANSDEC.?CASENAME*

FRAP.OPTN.DATA.AZIMPOW.?CASENAME

FRAP.OPTN.DATA.FILMBOIL.?CASENAME

FRAP.OPTN.DATA.FLOWCHNL.?CASENAME

FRAP.OPTN.DATA.COOL0.?CASENAME

FRAP.OPTN.DATA.COOL1.?CASENAME

FRAP.OPTN.DATA.COOL2.?CASENAME

FRAP.OPTN.DATA.COOL3.?CASENAME

FRAP.OPTN.DATA.COOLZONE.?ZONE NUMBER.?CASENAME

FRAP.OPTN.DATA.GAPCOND.?CASENAME*

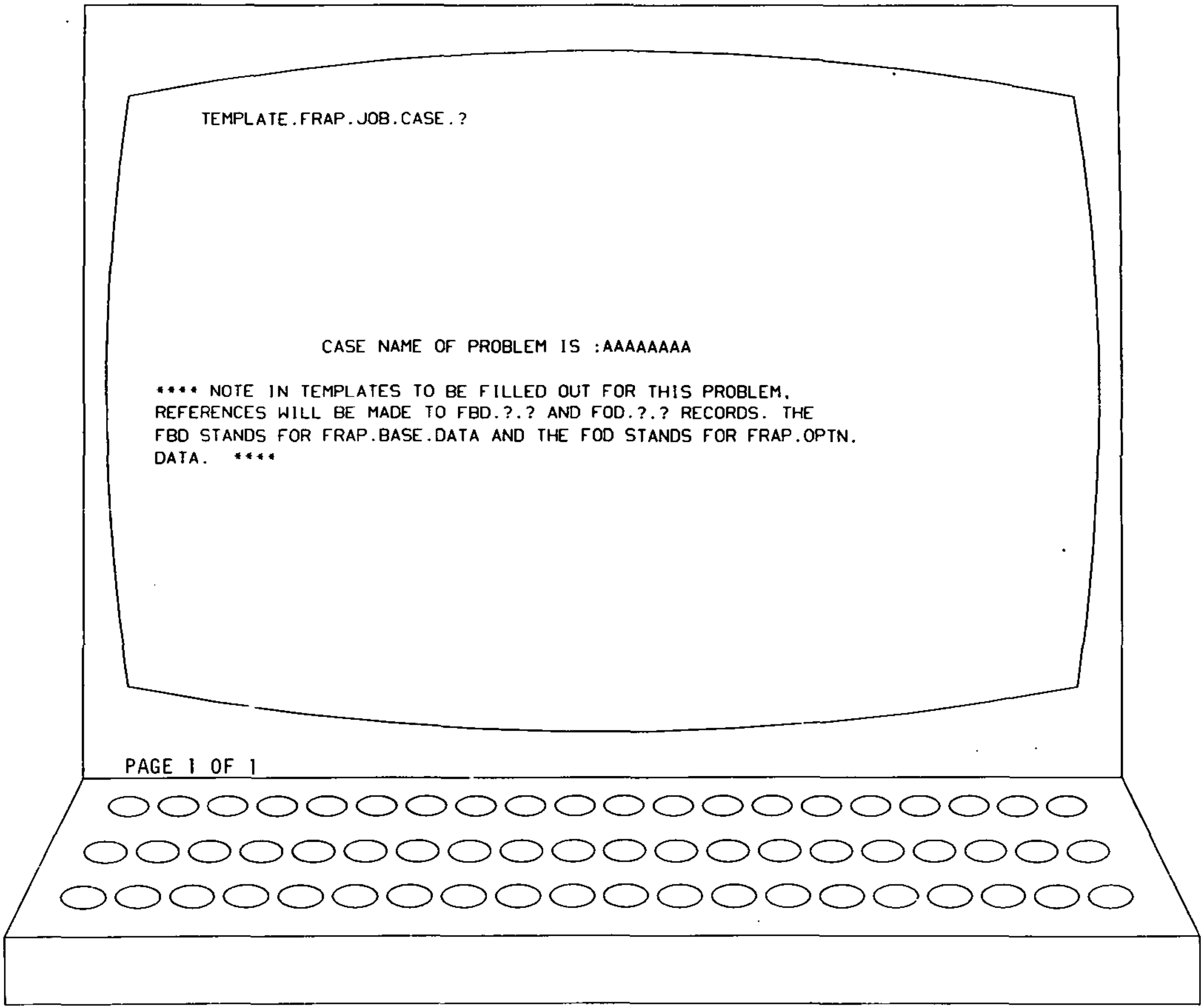
FRAP.OPTN.DATA.SWITCH.?CASENAME*

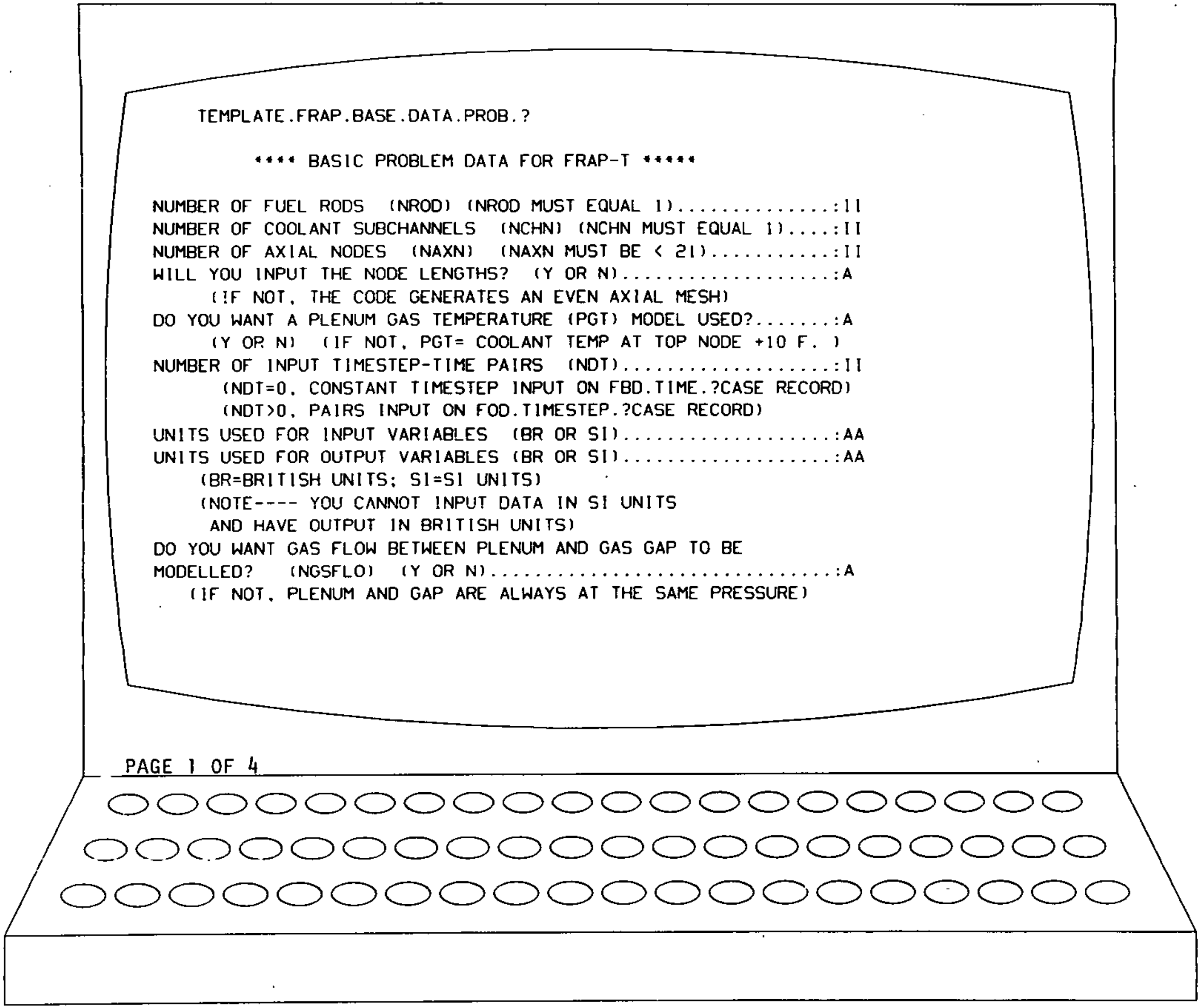
FRAP.OPTN.DATA.LACEOPTS.?CASENAME

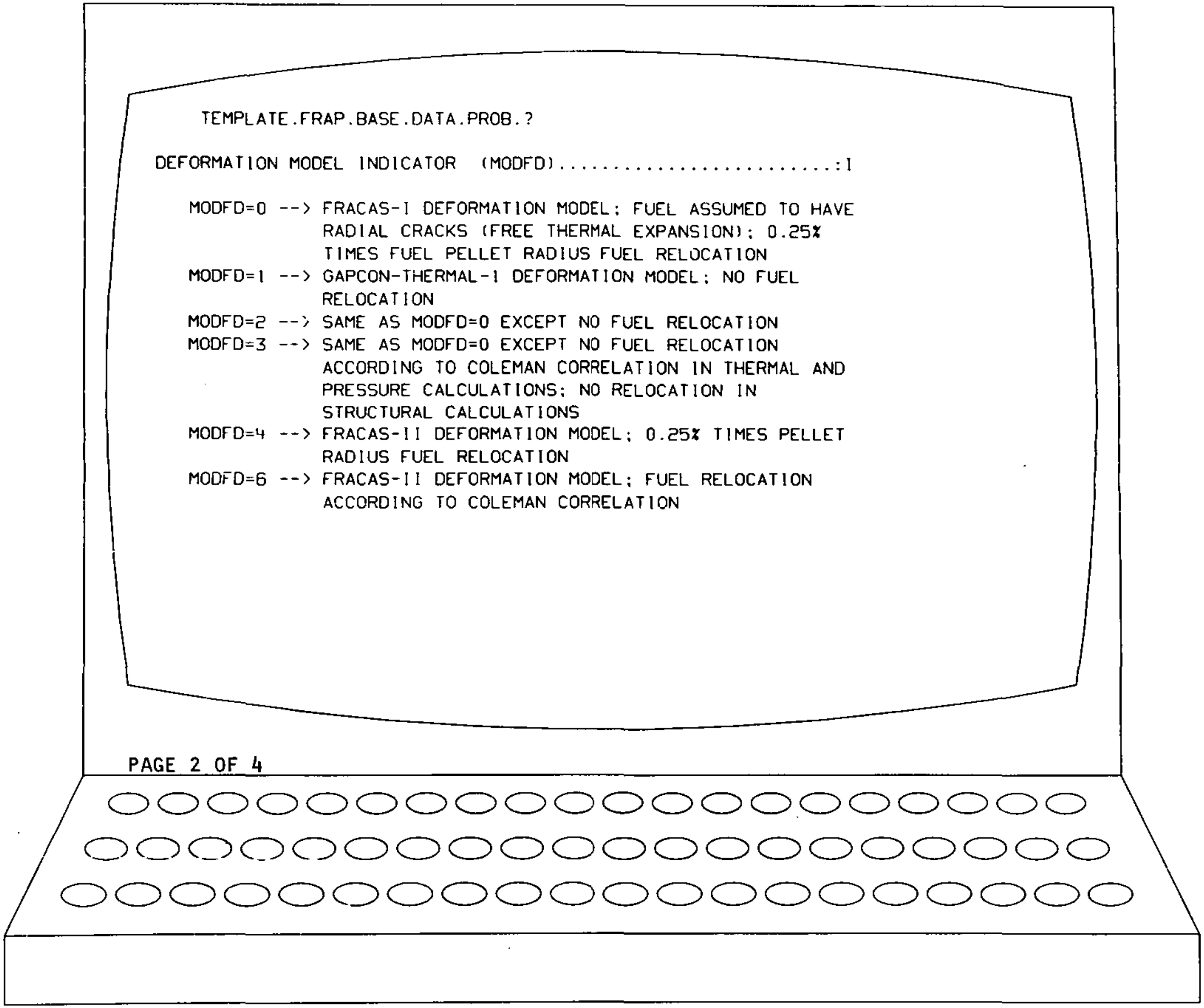
FRAP.OPTN.DATA.LACCLDF.?CASENAME

---

* Template names whose corresponding records are created partially or in total by various interface routines.

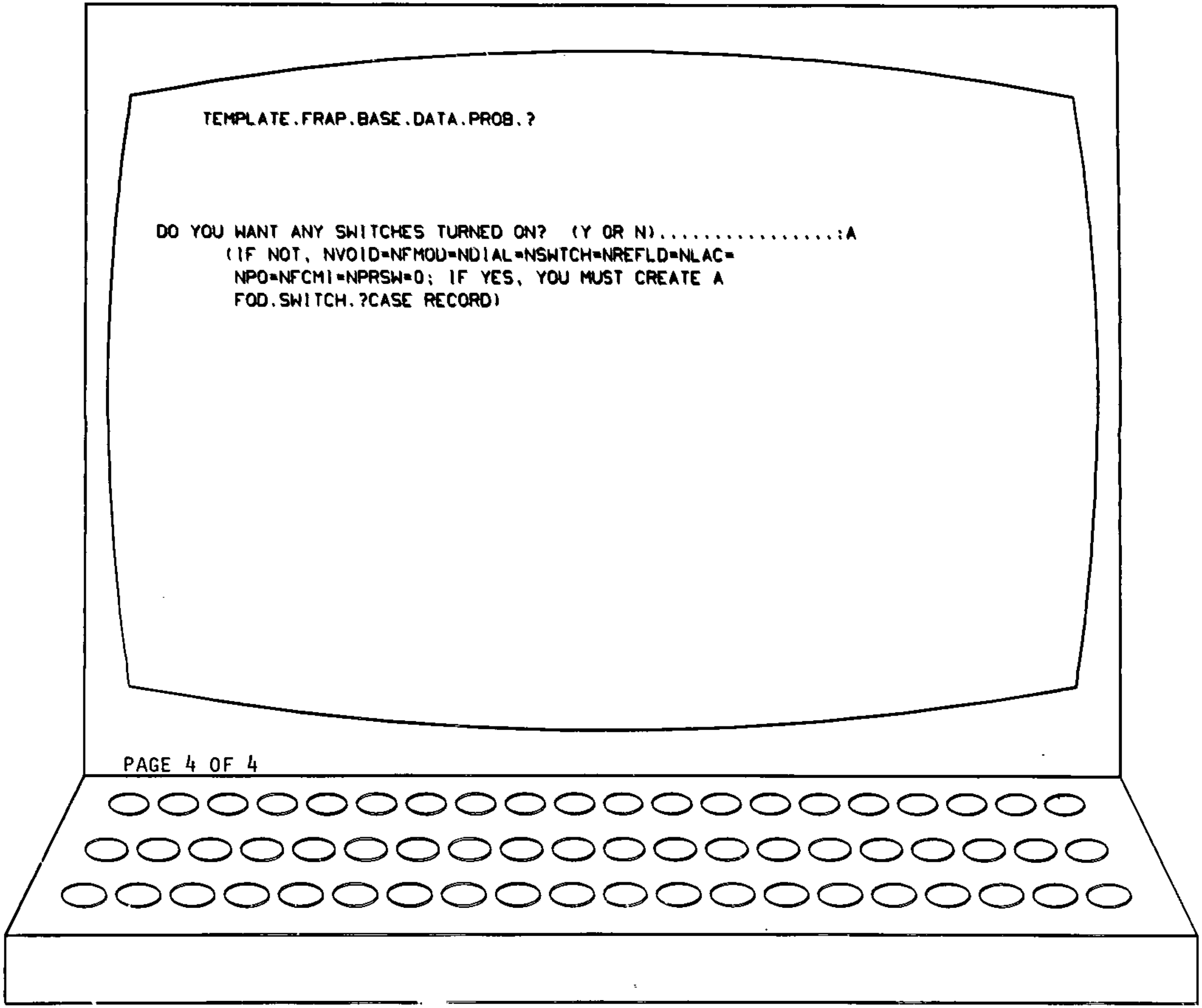

TEMPLATE.FRAP.JOB.CASE.?
CASE NAME OF PROBLEM IS :AAAAAAAA
**** NOTE IN TEMPLATES TO BE FILLED OUT FOR THIS PROBLEM, REFERENCES WILL BE MADE TO FBD.?.? AND FOD.?.? RECORDS. THE FBD STANDS FOR FRAP.BASE.DATA AND THE FOD STANDS FOR FRAP.OPTN. DATA. ****
PAGE 1 OF 1


TEMPLATE.FRAP.BASE.DATA.PROB.?
**** BASIC PROBLEM DATA FOR FRAP-T *****
NUMBER OF FUEL RODS (NROD) (NROD MUST EQUAL 1)..............:II
NUMBER OF COOLANT SUBCHANNELS (NCHN) (NCHN MUST EQUAL 1)....:II
NUMBER OF AXIAL NODES (NAXN) (NAXN MUST BE < 21)...........:II
WILL YOU INPUT THE NODE LENGTHS? (Y OR N)...................:A
(IF NOT, THE CODE GENERATES AN EVEN AXIAL MESH)
DO YOU WANT A PLENUM GAS TEMPERATURE (PGT) MODEL USED?.......:A
(Y OR N) (IF NOT, PGT= COOLANT TEMP AT TOP NODE +10 F.)
NUMBER OF INPUT TIMESTEP-TIME PAIRS (NDT)...................:II
(NDT=0, CONSTANT TIMESTEP INPUT ON FBD.TIME.?CASE RECORD)
(NDT>0, PAIRS INPUT ON FOD.TIMESTEP.?CASE RECORD)
UNITS USED FOR INPUT VARIABLES (BR OR SI)...................:AA
UNITS USED FOR OUTPUT VARIABLES (BR OR SI)...................:AA
(BR=BRITISH UNITS; SI=SI UNITS)
(NOTE---- YOU CANNOT INPUT DATA IN SI UNITS
AND HAVE OUTPUT IN BRITISH UNITS)
DO YOU WANT GAS FLOW BETWEEN PLENUM AND GAS GAP TO BE
MODELLED? (NGSFLO) (Y OR N).............................:A
(IF NOT, PLENUM AND GAP ARE ALWAYS AT THE SAME PRESSURE)
PAGE 1 OF 4


TEMPLATE.FRAP.BASE.DATA.PROB.?
DEFORMATION MODEL INDICATOR (MODFD)........................:1
MODFD=0 --> FRACAS-I DEFORMATION MODEL; FUEL ASSUMED TO HAVE RADIAL CRACKS (FREE THERMAL EXPANSION); 0.25% TIMES FUEL PELLET RADIUS FUEL RELOCATION
MODFD=1 --> GAPCON-THERMAL-1 DEFORMATION MODEL; NO FUEL RELOCATION
MODFD=2 --> SAME AS MODFD=0 EXCEPT NO FUEL RELOCATION
MODFD=3 --> SAME AS MODFD=0 EXCEPT NO FUEL RELOCATION ACCORDING TO COLEMAN CORRELATION IN THERMAL AND PRESSURE CALCULATIONS; NO RELOCATION IN STRUCTURAL CALCULATIONS
MODFD=4 --> FRACAS-II DEFORMATION MODEL; 0.25% TIMES PELLET RADIUS FUEL RELOCATION
MODFD=6 --> FRACAS-II DEFORMATION MODEL; FUEL RELOCATION ACCORDING TO COLEMAN CORRELATION
PAGE 2 OF 4

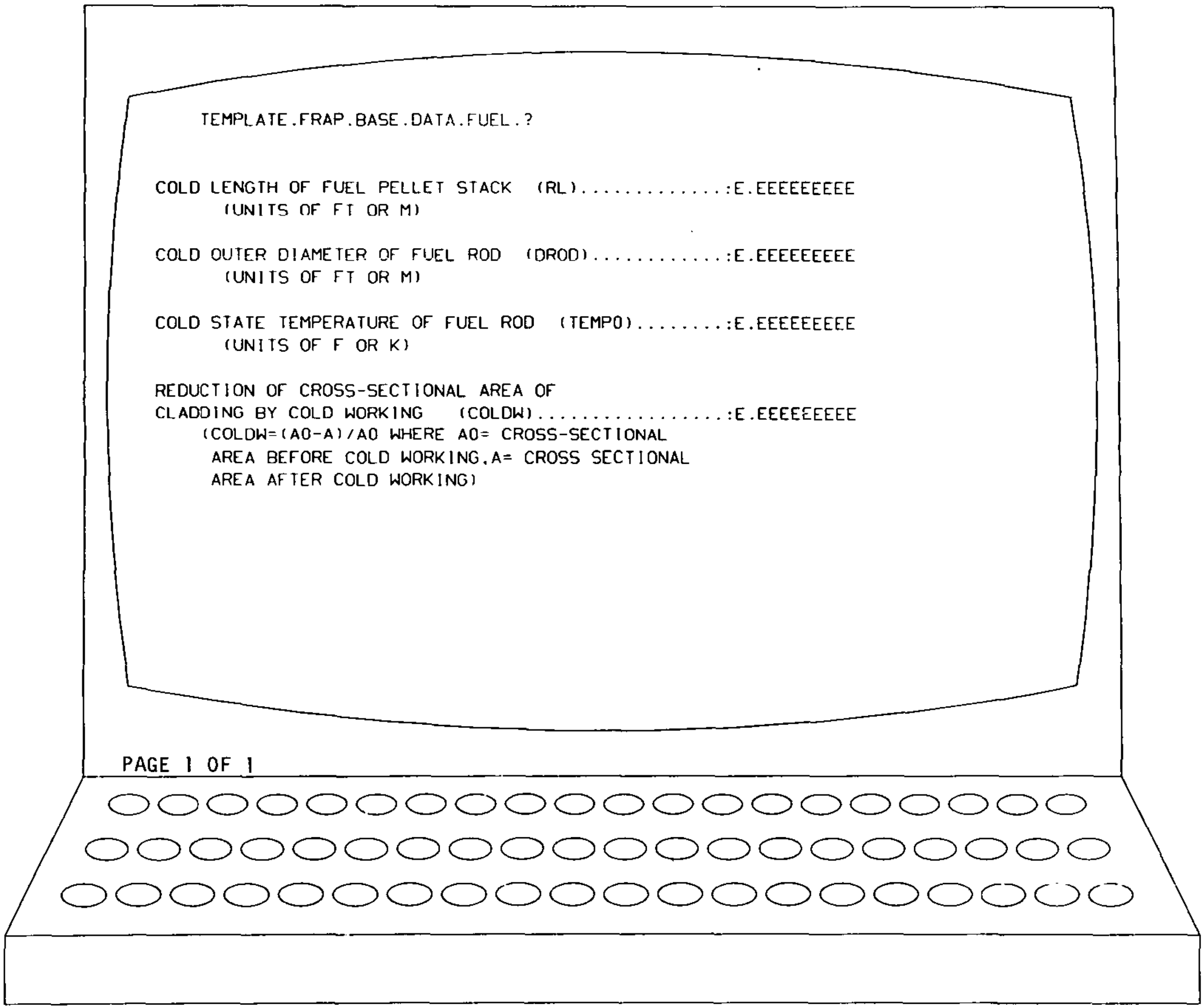
```
    TEMPLATE.FRAP.BASE.DATA.PROB.?

METAL-WATER REACTION MODEL INDICATOR  (MODMW)................:1
     MODMW=0 --> CATHCART MODEL (BE)
     MODMW=1 --> NO MODEL
     MODMW=2 --> BAKER-JUST MODEL
GAP CONDUCTANCE MODEL INDICATOR  (MODGPC)....................:1
     MODGPC=0 --> ROSS AND STOUTE MODEL
     MODGPC=1 --> MACDONALD-BROUGHTON MODEL (ONLY FOR
                  UNPRESSURIZED FUEL RODS)
FAST NEUTRON FLUX PROFILE  (NFASTF)..........................:11
     NFASTF=0 --> SAME PROFILE AS POWER
     NFASTF=N --> N NORMALIZED FLUX VS. ELEVATION PAIRS
                  TO BE INPUT ON FOD.FASTFLX.?CASE RECORD
DECAY HEAT ADDITION INDICATOR  (MPDCAY)......................:1
     MPDCAY=0 --> DECAY HEAT NOT ADDED TO INPUT FUEL POWER
     MPDCAY=1 --> DECAY HEAT ADDED TO POWER (CALCULATED
                  ACCORDING TO ANS FORMULA (FOD.ANSDEC.?CASE)
WRITE FORCING FUNCTION TO DISK (NFRIDW)  (Y OR N)............:A
DIMENSION INDICATOR FOR HEAT CONDUCTION  (NDIM)..............:1
     NDIM=0 --> RADIAL HEAT CONDUCTION ONLY
     NDIM=1 --> RADIAL-AZIMUTHAL CONDUCTION AT ONE OR MORE NODES
```

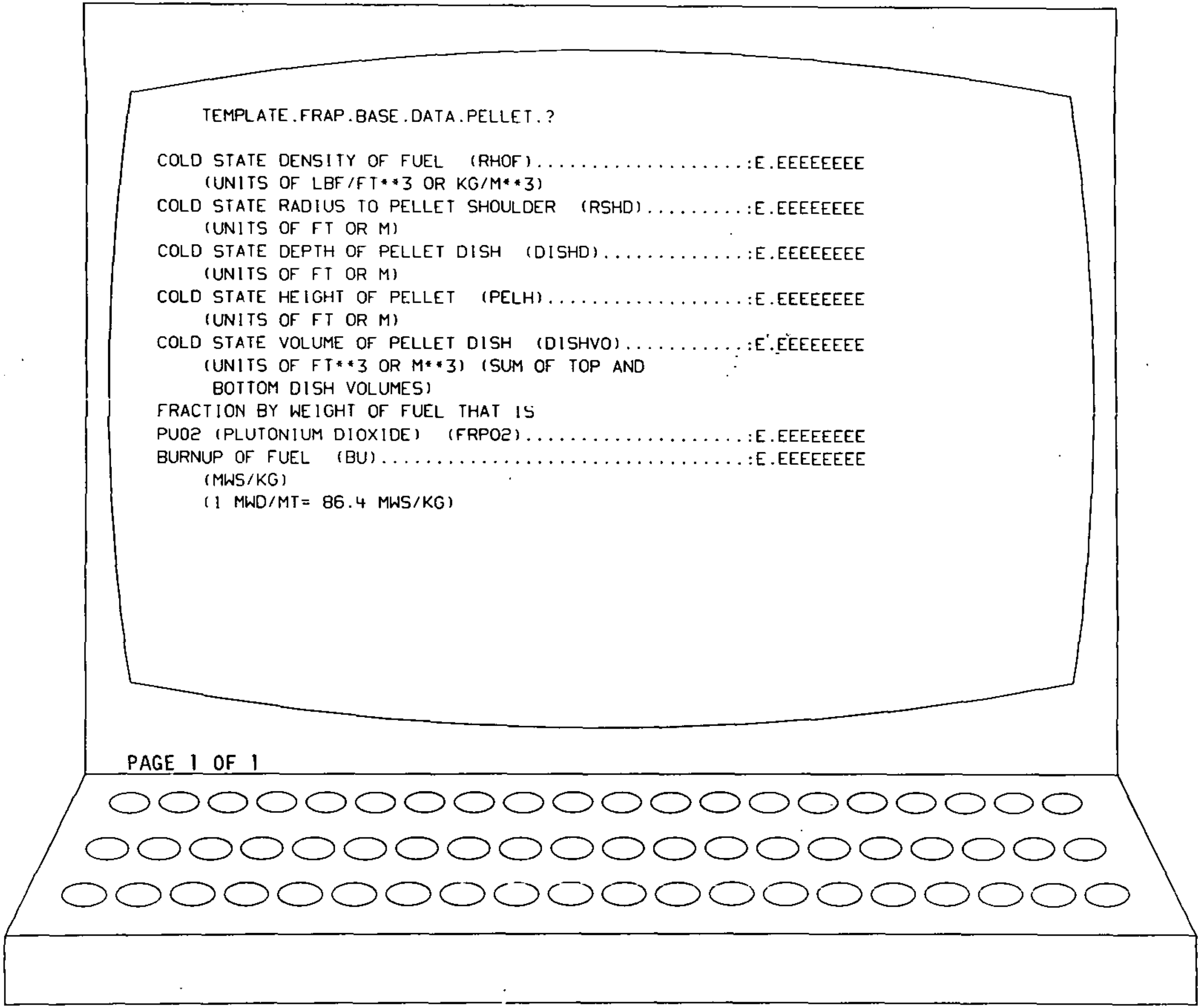
PAGE 3 OF 4


TEMPLATE.FRAP.BASE.DATA.PROB.?
DO YOU WANT ANY SWITCHES TURNED ON? (Y OR N)..................:A
(IF NOT, NVOID=NFMOD=NDIAL=NSWTCH=NREFLD=NLAC=
NPO=NFCMI=NPRSW=0; IF YES, YOU MUST CREATE A
FOD.SWITCH.?CASE RECORD)
PAGE 4 OF 4

```
TEMPLATE.FRAP.BASE.DATA.TIME.?


INITIAL PROBLEM TIME  (SECONDS)  (TO)................:E.EEEEEEE
    (IF RESTARTING, 'TO' CAN EQUAL 0.00 IF PREVIOUS
     IS USED TO SET UP INITIAL CONDITIONS FOR PRESENT
     RUN OR 'TO' CAN EQUAL THE END TIME OF THE PREVIOUS
     CALCULATION)
FINAL PROBLEM TIME  (SECONDS)  (TMAX)................:E.EEEEEEE
TIME STEP SIZE  (SECONDS)  (DT)......................:E.EEEEEEE
PROBLEM TIME INTERVALS AT WHICH CALCULATED FUEL
ROD STATE WILL BE PRINTED  (SECONDS)  (DTPO)........:E.EEEEEEE
    (IF PRINT IS DESIRED AT EACH TIME STEP, SET DTPO=0.)
    (CODE USES THIS VARIABLE ONLY IF PRINTOUT-TIME PAIRS
     ARE NOT INPUT (I.E. NPO=0 ON FOD.SWITCH.?CASE RECORD)
```

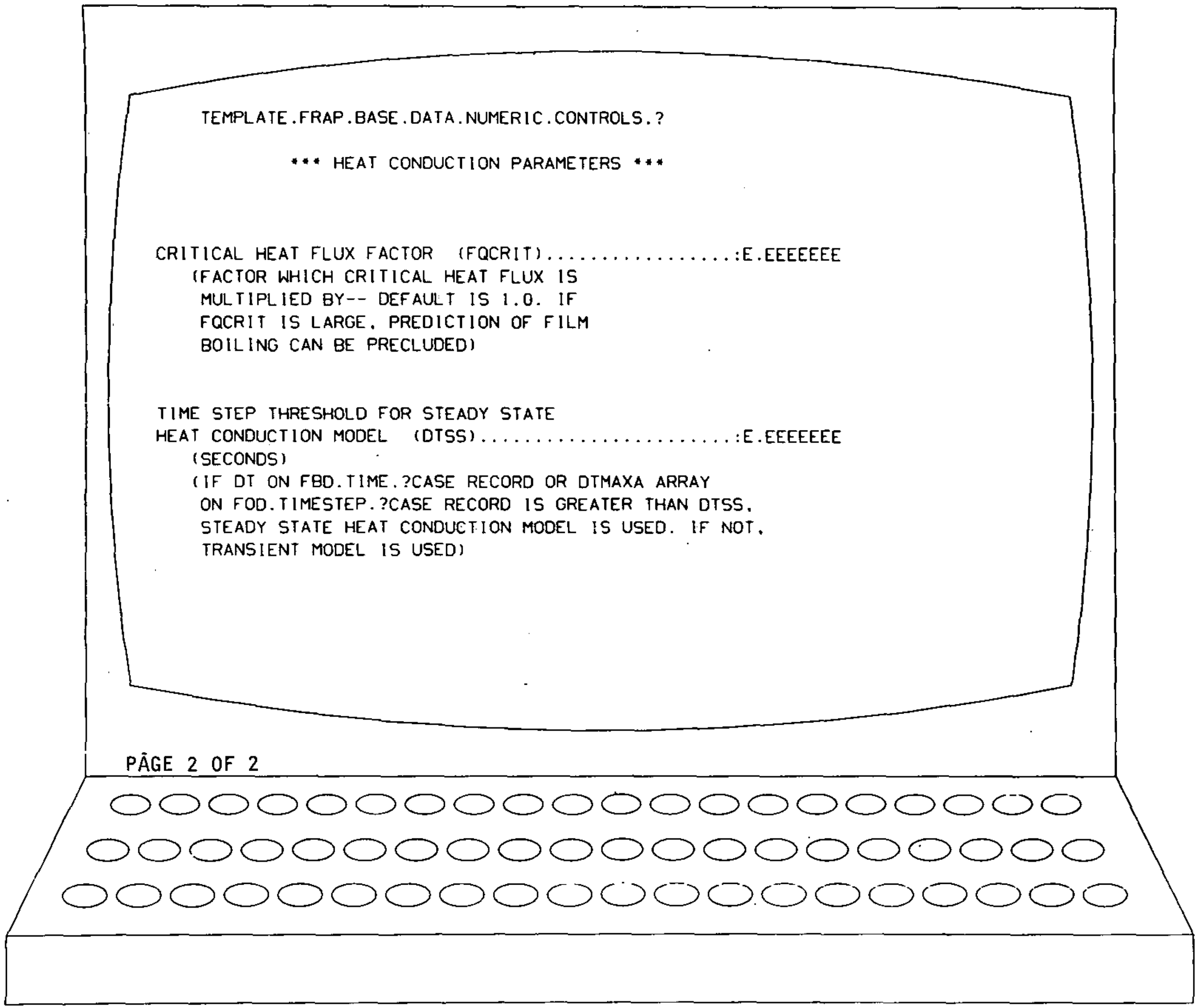
PAGE 1 OF 1

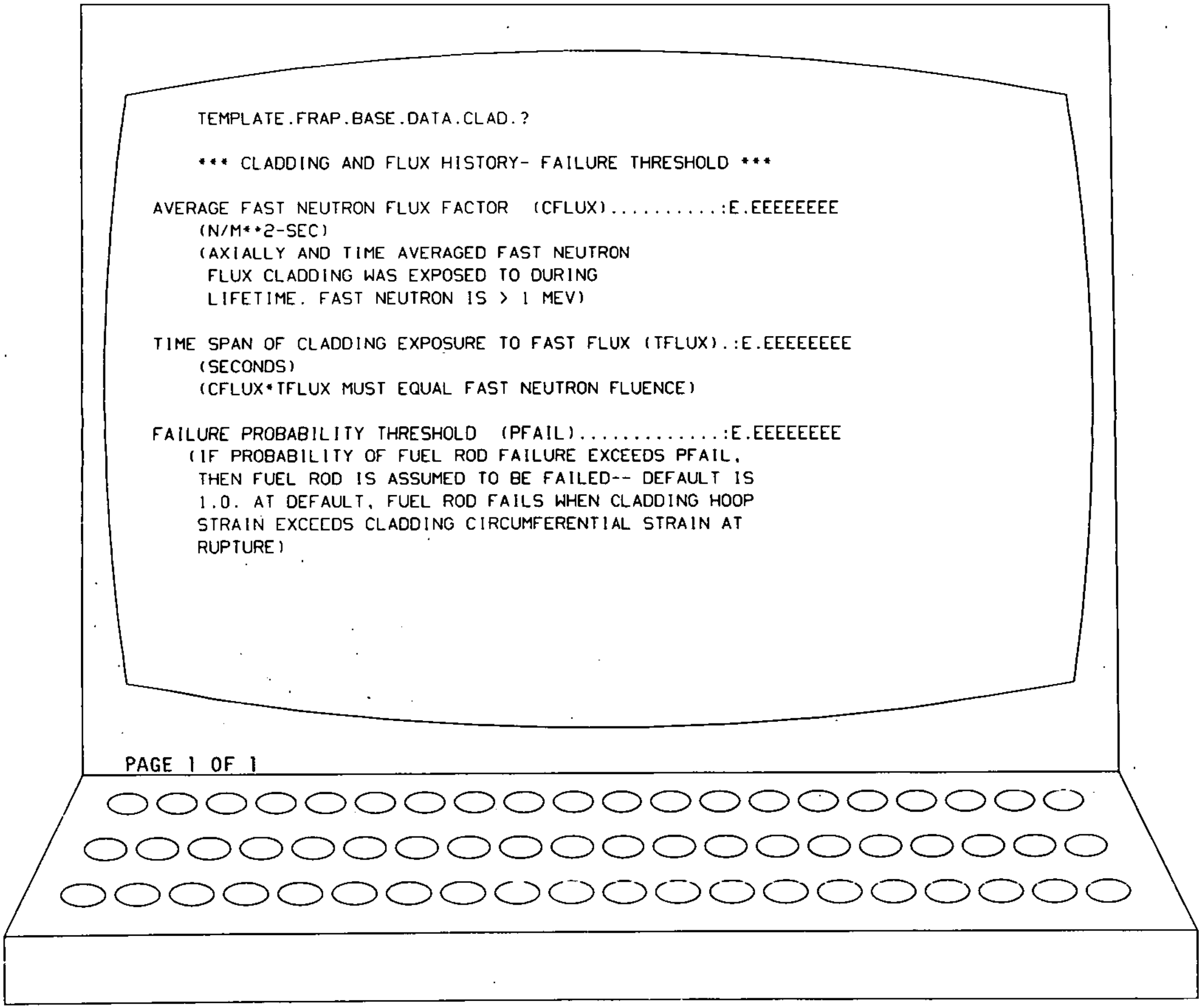

TEMPLATE.FRAP.BASE.DATA.FUEL.?
COLD LENGTH OF FUEL PELLET STACK (RL).............:E.EEEEEEEEE
(UNITS OF FT OR M)
COLD OUTER DIAMETER OF FUEL ROD (DROD)............:E.EEEEEEEEE
(UNITS OF FT OR M)
COLD STATE TEMPERATURE OF FUEL ROD (TEMPO)........:E.EEEEEEEEE
(UNITS OF F OR K)
REDUCTION OF CROSS-SECTIONAL AREA OF
CLADDING BY COLD WORKING (COLDW)..................:E.EEEEEEEEE
(COLDW=(A0-A)/A0 WHERE A0= CROSS-SECTIONAL
AREA BEFORE COLD WORKING,A= CROSS SECTIONAL
AREA AFTER COLD WORKING)
PAGE 1 OF 1

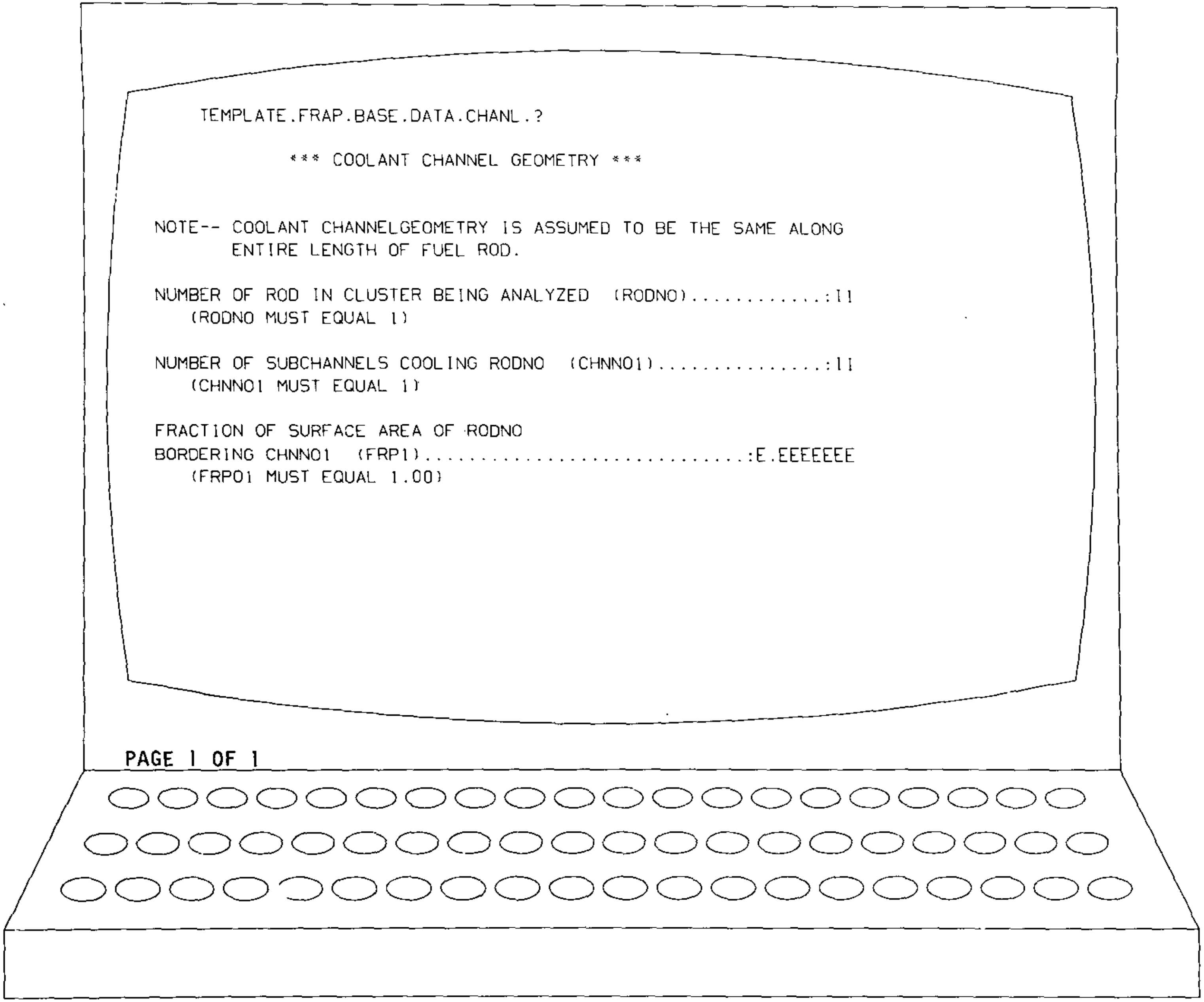

TEMPLATE.FRAP.BASE.DATA.PELLET.?
COLD STATE DENSITY OF FUEL (RHOF)...................:E.EEEEEEEE
(UNITS OF LBF/FT**3 OR KG/M**3)
COLD STATE RADIUS TO PELLET SHOULDER (RSHD).........:E.EEEEEEEE
(UNITS OF FT OR M)
COLD STATE DEPTH OF PELLET DISH (DISHD).............:E.EEEEEEEE
(UNITS OF FT OR M)
COLD STATE HEIGHT OF PELLET (PELH)..................:E.EEEEEEEE
(UNITS OF FT OR M)
COLD STATE VOLUME OF PELLET DISH (DISHVO)...........:E.EEEEEEEE
(UNITS OF FT**3 OR M**3) (SUM OF TOP AND
BOTTOM DISH VOLUMES)
FRACTION BY WEIGHT OF FUEL THAT IS
PUO2 (PLUTONIUM DIOXIDE) (FRPO2)....................:E.EEEEEEEE
BURNUP OF FUEL (BU).................................:E.EEEEEEEE
(MWS/KG)
(1 MWD/MT= 86.4 MWS/KG)
PAGE 1 OF 1

```
    TEMPLATE.FRAP.BASE.DATA.NUMERIC.CONTROLS.?

      *** CONVERGENCE CRITERION FOR CALCULATIONS ***

PRESSURE CONVERGENCE CRITERION  (PRSACC)............:E.EEEEEEE
   (MINIMUM FRACTIONAL DIFFERENCE IN INTERNAL
    FUEL ROD PRESSURE AT EVERY NODE CALCULATED
    BY TWO SUCCESSIVE ITERATIONS BEFORE
    CONVERGENCE IS DECLARED-- DEFAULT IS 0.001)

TEMPERATURE CONVERGENCE CRITERION  (TMPACC).........:E.EEEEEEE
   (MINIMUM FRACTIONAL DIFFERENCE IN TEMPERATURE
    AT A NODE CALCULATED BY TWO SUCCESSIVE ITERATIONS
    BEFORE CONVERGENCE IS DECLARED--DEFAULT IS 0.001)

NOTE---  IF PRSACC IS GREATER THAN 1.0, EXPLICIT SOLUTION METHOD
IS USED. NO ITERATIONS ARE PERFORMED, ACCURACY CONTROLLED BY
TIME STEP. IF IMPLICIT SOLUTION METHOD ENCOUNTERS CONVERGENCE
DIFFICULTIES, EXPLICIT SOLUTION METHOD SHOULD BE CONSIDERED.
```

PAGE 1 OF 2

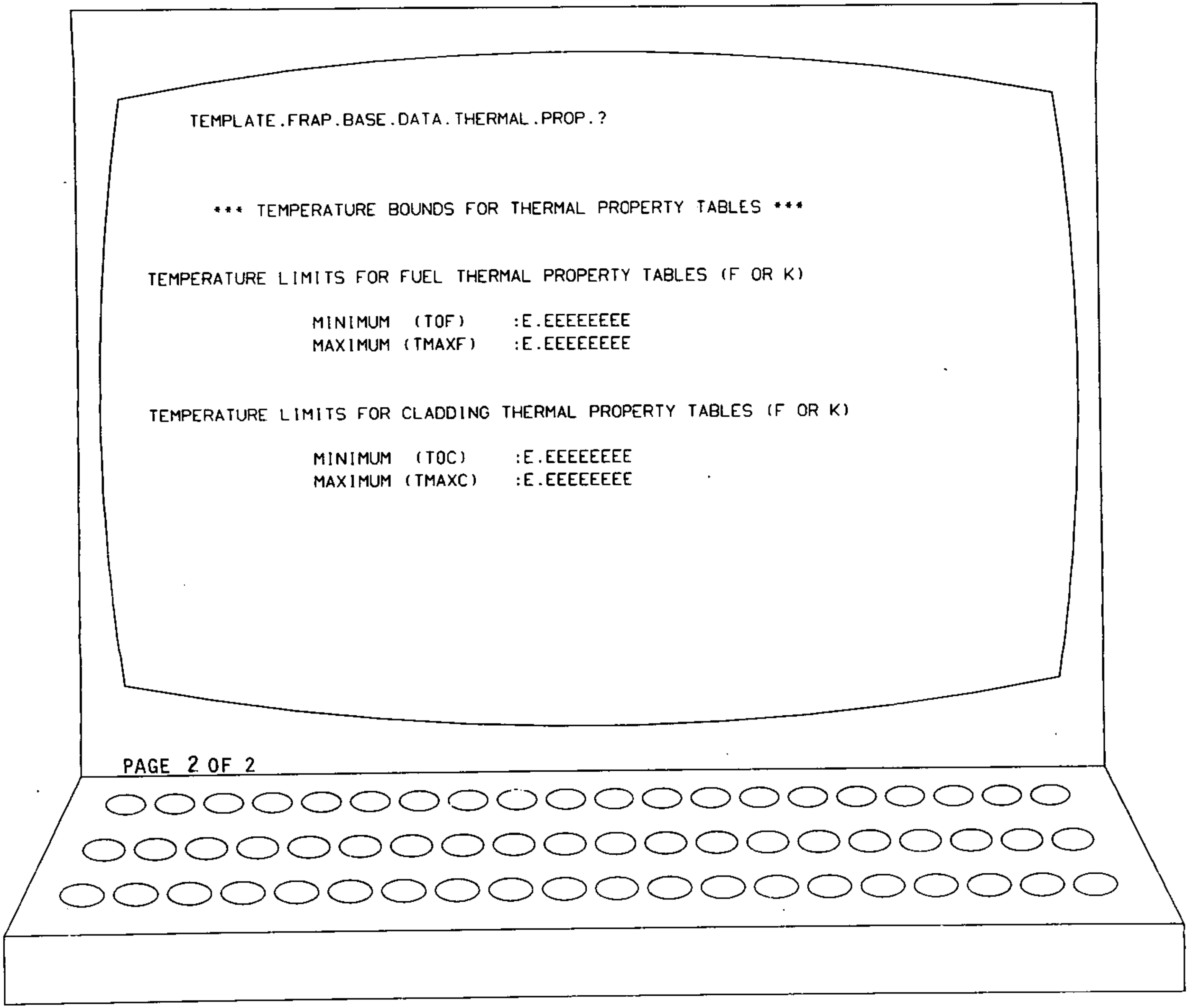

TEMPLATE.FRAP.BASE.DATA.NUMERIC.CONTROLS.?
*** HEAT CONDUCTION PARAMETERS ***
CRITICAL HEAT FLUX FACTOR (FQCRIT)..................:E.EEEEEEE
(FACTOR WHICH CRITICAL HEAT FLUX IS
MULTIPLIED BY-- DEFAULT IS 1.0. IF
FQCRIT IS LARGE, PREDICTION OF FILM
BOILING CAN BE PRECLUDED)
TIME STEP THRESHOLD FOR STEADY STATE
HEAT CONDUCTION MODEL (DTSS).......................:E.EEEEEEE
(SECONDS)
(IF DT ON FBD.TIME.?CASE RECORD OR DTMAXA ARRAY
ON FOD.TIMESTEP.?CASE RECORD IS GREATER THAN DTSS,
STEADY STATE HEAT CONDUCTION MODEL IS USED. IF NOT,
TRANSIENT MODEL IS USED)
PÂGE 2 OF 2

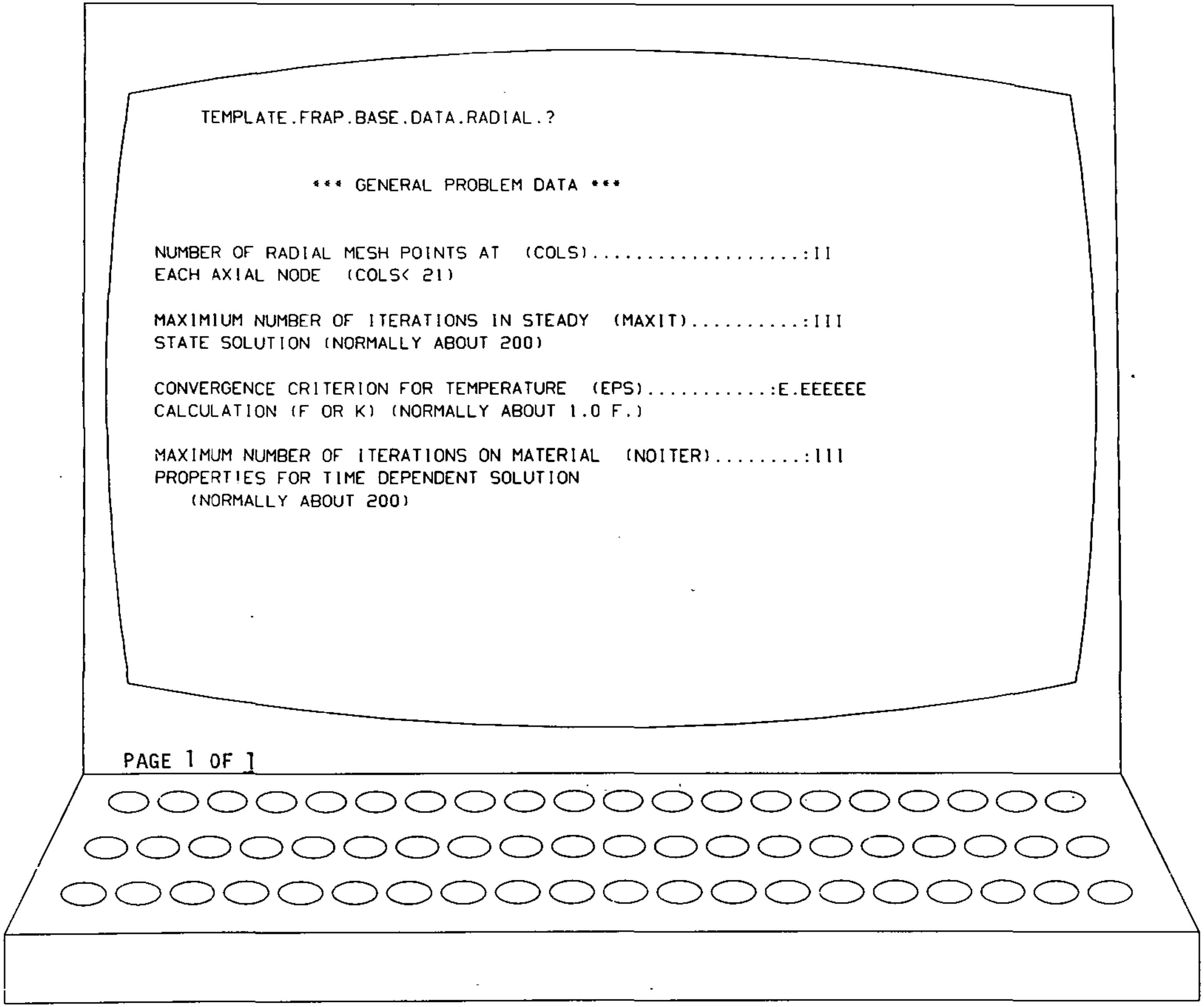

TEMPLATE.FRAP.BASE.DATA.CLAD.?
*** CLADDING AND FLUX HISTORY- FAILURE THRESHOLD ***
AVERAGE FAST NEUTRON FLUX FACTOR (CFLUX)..........:E.EEEEEEEE
(N/M**2-SEC)
(AXIALLY AND TIME AVERAGED FAST NEUTRON
FLUX CLADDING WAS EXPOSED TO DURING
LIFETIME. FAST NEUTRON IS > 1 MEV)
TIME SPAN OF CLADDING EXPOSURE TO FAST FLUX (TFLUX).:E.EEEEEEEE
(SECONDS)
(CFLUX*TFLUX MUST EQUAL FAST NEUTRON FLUENCE)
FAILURE PROBABILITY THRESHOLD (PFAIL).............:E.EEEEEEEE
(IF PROBABILITY OF FUEL ROD FAILURE EXCEEDS PFAIL,
THEN FUEL ROD IS ASSUMED TO BE FAILED-- DEFAULT IS
1.0. AT DEFAULT, FUEL ROD FAILS WHEN CLADDING HOOP
STRAIN EXCEEDS CLADDING CIRCUMFERENTIAL STRAIN AT
RUPTURE)
PAGE 1 OF 1

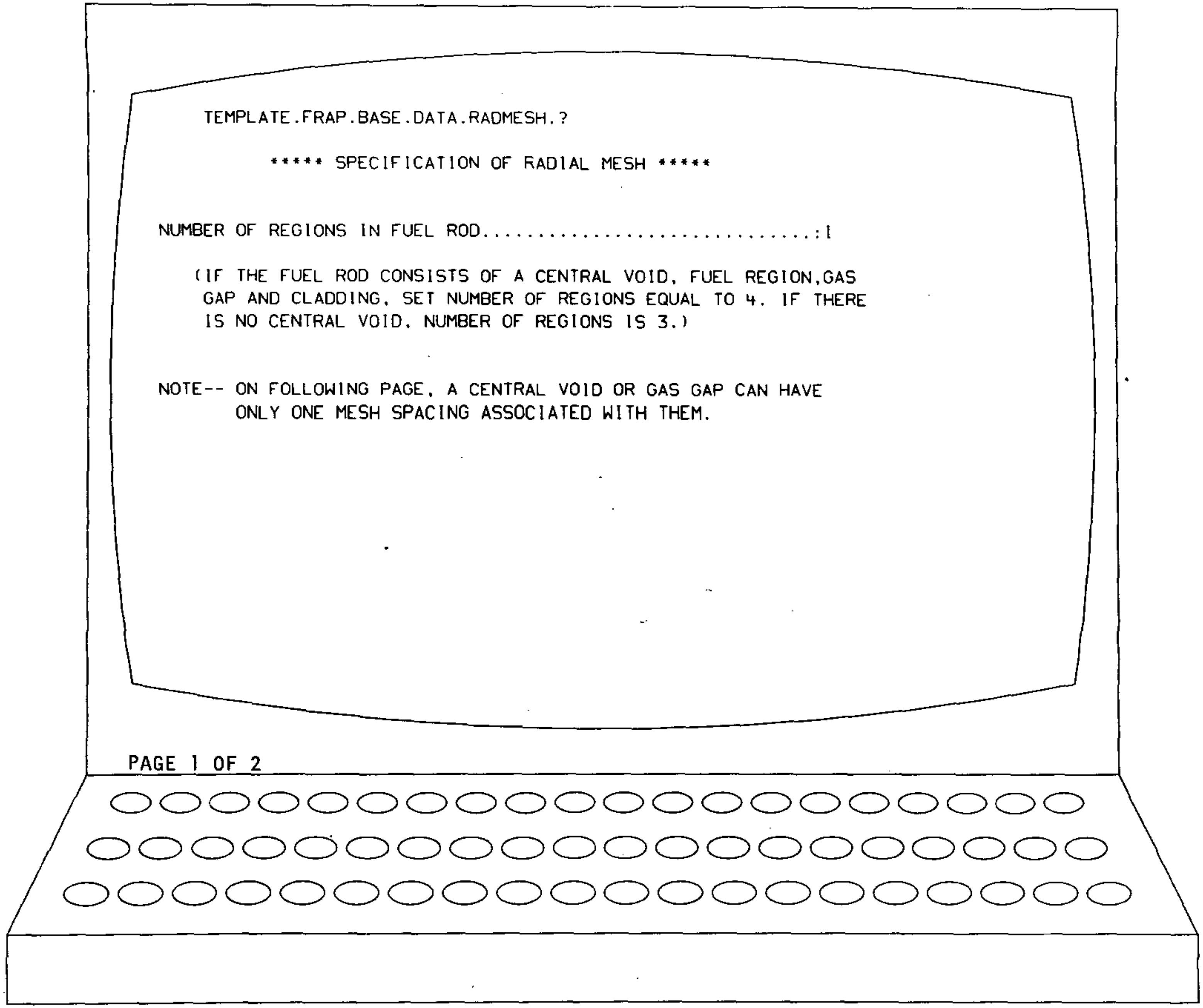

TEMPLATE.FRAP.BASE.DATA.CHANL.?
*** COOLANT CHANNEL GEOMETRY ***
NOTE-- COOLANT CHANNELGEOMETRY IS ASSUMED TO BE THE SAME ALONG
ENTIRE LENGTH OF FUEL ROD.
NUMBER OF ROD IN CLUSTER BEING ANALYZED (RODNO)............:II
(RODNO MUST EQUAL 1)
NUMBER OF SUBCHANNELS COOLING RODNO (CHNNO1)...............:II
(CHNNO1 MUST EQUAL 1)
FRACTION OF SURFACE AREA OF RODNO
BORDERING CHNNO1 (FRP1)............................:E.EEEEEEE
(FRPO1 MUST EQUAL 1.00)
PAGE 1 OF 1

```
    TEMPLATE.FRAP.BASE.DATA.THERMAL.PROP.?

   **** HEAT TRANSFER PARAMETER TABLE SPECIFICATIONS ****

FRAP GENERATES TABLES CONTAINING FUEL AND CLADDING THERMAL
PROPERTIES VS TEMPERATURE


NUMBER OF THERMAL CONDUCTIVITY VS  (NKF)..................:III
TEMPERATURE PAIRS GENERATED FOR FUEL (NORMALLY NKF=100)

NUMBER OF SPECIFIC HEAT VS TEMPERATURE  (NSF)............:III
PAIRS TO BE GENERATED FOR FUEL  (NORMALLY NSF=NKF)

NUMBER OF THERMAL CONDUCTIVITY VS  (NKC)..................:III
TEMPERATURE PAIRS GENERATED FOR CLADDING (NORMALLY NKC=50)

NUMBER OF SPECIFIC HEAT VS TEMPERATURE  (NSC)............:III
PAIRS TO BE GENERATED FOR CLADDING (NORMALLY NSC=NKC)

DO YOU WANT THERMAL PROPERTY TABLES PRINTED?  (IDEBUG)....:A
   (Y OR N)
```

PAGE 1 OF 2

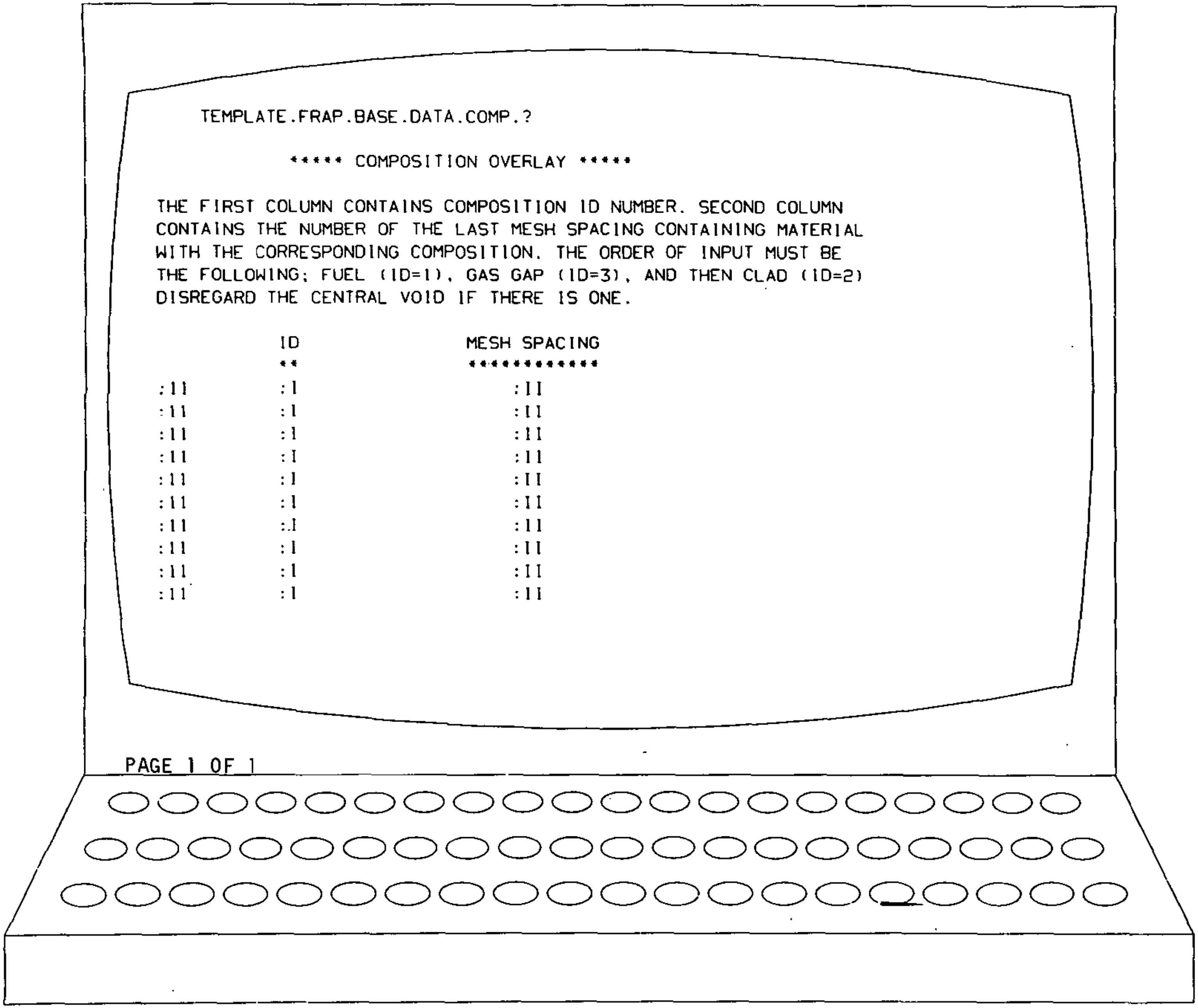

TEMPLATE.FRAP.BASE.DATA.THERMAL.PROP.?
*** TEMPERATURE BOUNDS FOR THERMAL PROPERTY TABLES ***
TEMPERATURE LIMITS FOR FUEL THERMAL PROPERTY TABLES (F OR K)
MINIMUM (TOF) :E.EEEEEEEE
MAXIMUM (TMAXF) :E.EEEEEEEE
TEMPERATURE LIMITS FOR CLADDING THERMAL PROPERTY TABLES (F OR K)
MINIMUM (TOC) :E.EEEEEEEE
MAXIMUM (TMAXC) :E.EEEEEEEE
PAGE 2 OF 2

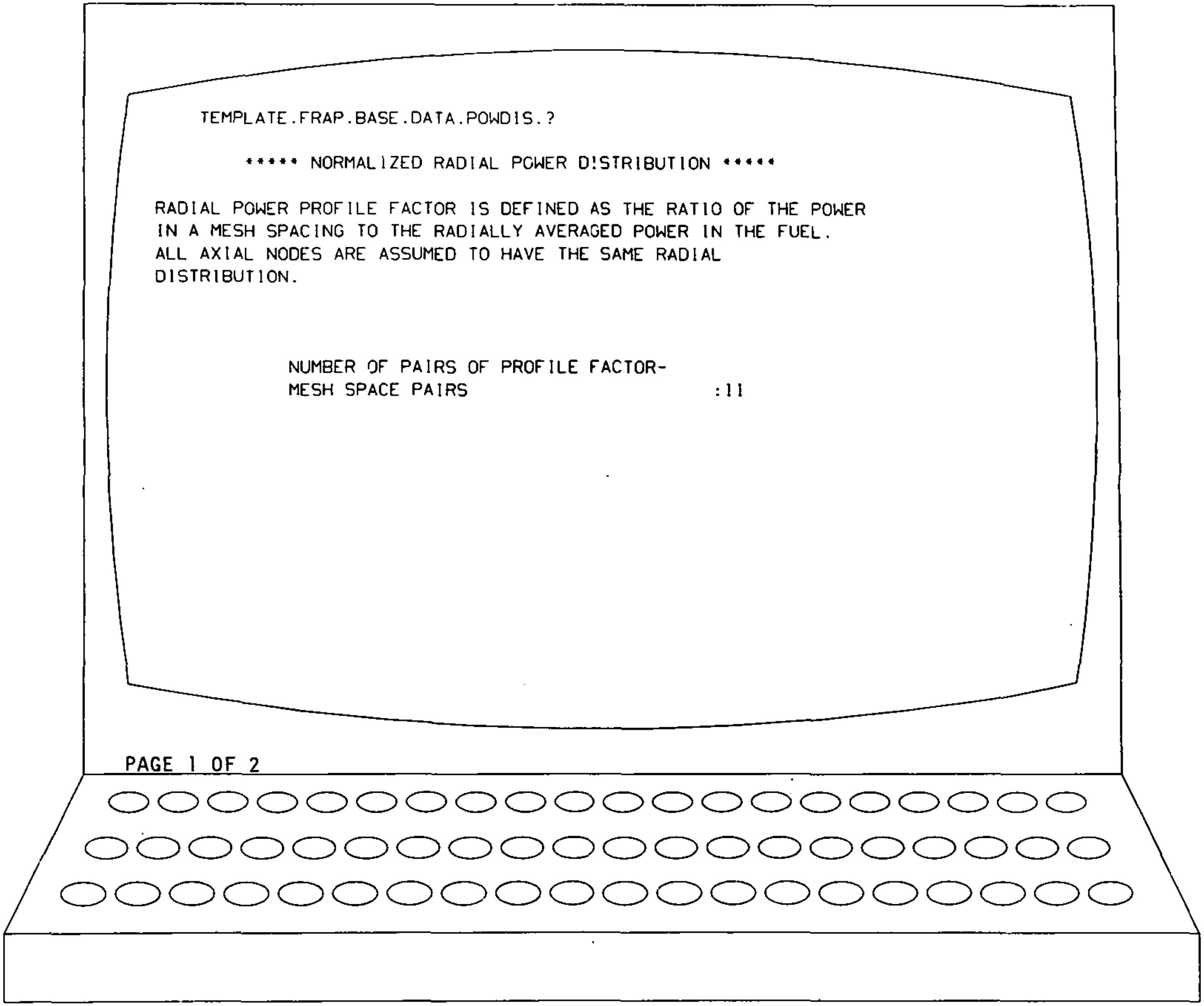

TEMPLATE.FRAP.BASE.DATA.RADIAL.?
*** GENERAL PROBLEM DATA ***
NUMBER OF RADIAL MESH POINTS AT (COLS)....................:II
EACH AXIAL NODE (COLS< 21)
MAXIMIUM NUMBER OF ITERATIONS IN STEADY (MAXIT)..........:III
STATE SOLUTION (NORMALLY ABOUT 200)
CONVERGENCE CRITERION FOR TEMPERATURE (EPS)...........:E.EEEEEE
CALCULATION (F OR K) (NORMALLY ABOUT 1.0 F.)
MAXIMUM NUMBER OF ITERATIONS ON MATERIAL (NOITER)........:III
PROPERTIES FOR TIME DEPENDENT SOLUTION
(NORMALLY ABOUT 200)
PAGE 1 OF 1


TEMPLATE.FRAP.BASE.DATA.RADMESH.?
***** SPECIFICATION OF RADIAL MESH *****
NUMBER OF REGIONS IN FUEL ROD.............................:1
(IF THE FUEL ROD CONSISTS OF A CENTRAL VOID, FUEL REGION,GAS GAP AND CLADDING, SET NUMBER OF REGIONS EQUAL TO 4. IF THERE IS NO CENTRAL VOID, NUMBER OF REGIONS IS 3.)
NOTE-- ON FOLLOWING PAGE, A CENTRAL VOID OR GAS GAP CAN HAVE ONLY ONE MESH SPACING ASSOCIATED WITH THEM.
PAGE 1 OF 2

```
TEMPLATE.FRAP.BASE.DATA.RADMESH.?


NUMBER OF MESH SPACINGS OVERLAYING INNERMOST REGION..........:II
   (FUEL REGION FOR 3 REGION ROD; VOID FOR 4 REGION ROD)
RADIUS OF INNERMOST REGION  (FT OR M)...............:E.EEEEEEEEE

NUMBER OF MESH SPACINGS OVERLAYING SECOND REGION.............:II
   (GAS GAP IN 3 REGION ROD; FUEL IN 4 REGION ROD)
RADIUS OF SECOND REGION  (FT OR M).................:E.EEEEEEEEE

NUMBER OF MESH SPACINGS OVEPRLAYING THIRD REGION.............:II
   (CLADDING IN 3 REGION ROD; GAS GAP IN 4 REGION ROD)
RADIUS OF THIRD REGION  (FT OR M)..................:E.EEEEEEEEE

IF NECESSARY,
NUMBER OF MESH SPACINGS OVERLAYING FOURTH REGION.............:II
   (CLADDING)
RADIUS OF FOURTH REGION  (FT OR M).................:E.EEEEEEEEE
```

PAGE 2 OF 2


TEMPLATE.FRAP.BASE.DATA.COMP.?
***** COMPOSITION OVERLAY *****
THE FIRST COLUMN CONTAINS COMPOSITION ID NUMBER. SECOND COLUMN
CONTAINS THE NUMBER OF THE LAST MESH SPACING CONTAINING MATERIAL
WITH THE CORRESPONDING COMPOSITION. THE ORDER OF INPUT MUST BE
THE FOLLOWING; FUEL (ID=1), GAS GAP (ID=3), AND THEN CLAD (ID=2)
DISREGARD THE CENTRAL VOID IF THERE IS ONE.
ID
**
MESH SPACING
****
:11 :1 :II
:11 :1 :II
:11 :1 :II
:11 :1 :II
:11 :1 :II
:11 :1 :II
:11 :1 :II
:11 :1 :II
:11 :1 :II
:11 :1 :II
PAGE 1 OF 1


TEMPLATE.FRAP.BASE.DATA.POWDIS.?
***** NORMALIZED RADIAL POWER DISTRIBUTION *****
RADIAL POWER PROFILE FACTOR IS DEFINED AS THE RATIO OF THE POWER
IN A MESH SPACING TO THE RADIALLY AVERAGED POWER IN THE FUEL.
ALL AXIAL NODES ARE ASSUMED TO HAVE THE SAME RADIAL
DISTRIBUTION.
NUMBER OF PAIRS OF PROFILE FACTOR-
MESH SPACE PAIRS :11
PAGE 1 OF 2

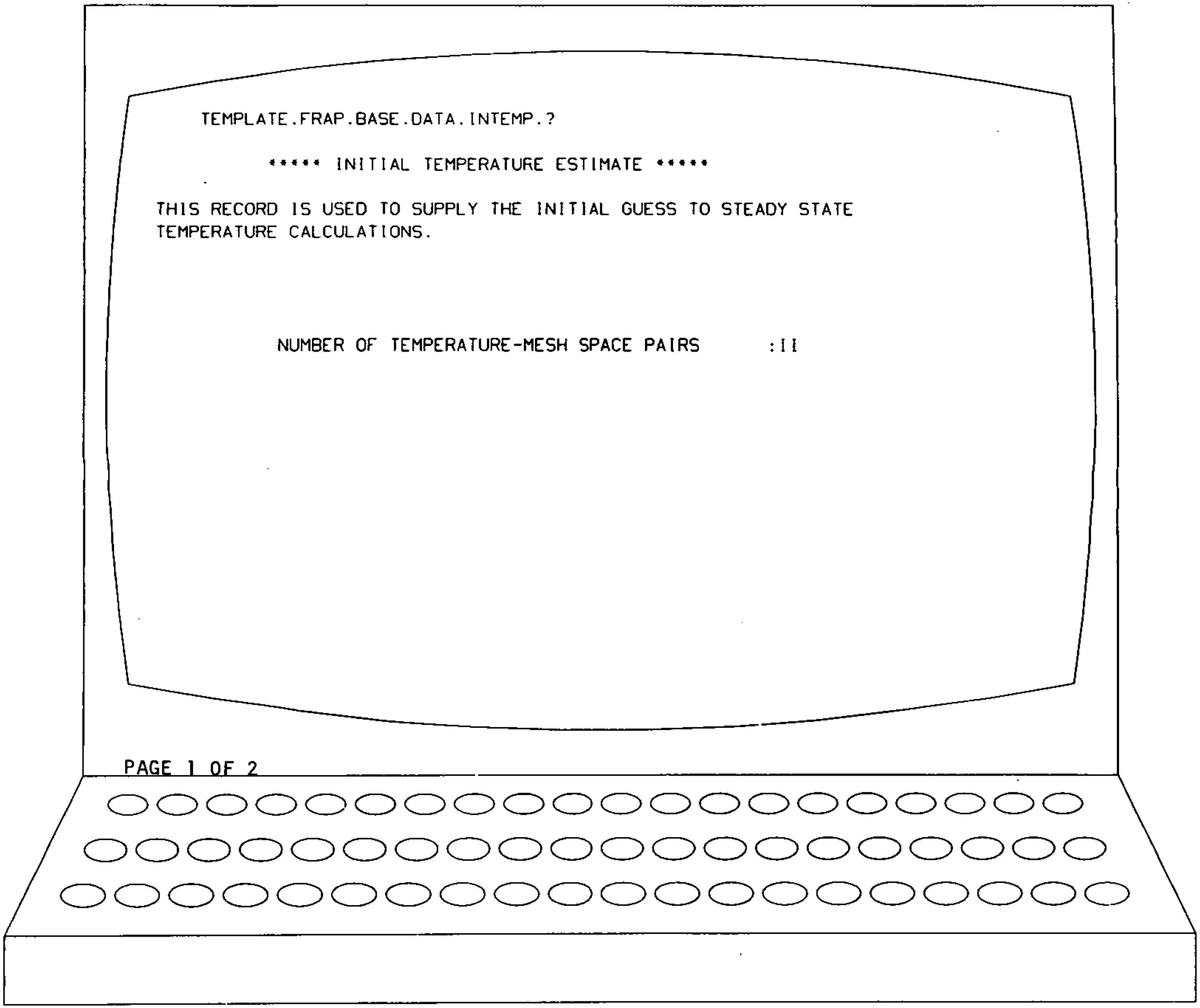
TEMPLATE.FRAP.BASE.DATA.POWDIS.?

***** RADIAL POWER PROFILE FACTORS *****

NOTE-- THE FIRST COLUMN CONTAINS THE RADIAL POWER PROFILE FACTOR. THE SECOND COLUMN CONTAINS THE FARTHEST TO THE OUTSIDE MESH SPACING FOR WHICH THE CORRESPONDING FACTOR APPLIES.

	FACTOR	MESH #		FACTOR	MESH #
	******	******		******	******
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II
:II	:E.EEEEEEE	:II	:II	:E.EEEEEEE	:II

PAGE 2 OF 2


TEMPLATE.FRAP.BASE.DATA.INTEMP.?
***** INITIAL TEMPERATURE ESTIMATE *****
THIS RECORD IS USED TO SUPPLY THE INITIAL GUESS TO STEADY STATE TEMPERATURE CALCULATIONS.
NUMBER OF TEMPERATURE-MESH SPACE PAIRS :II
PAGE 1 OF 2

```
TEMPLATE.FRAP.BASE.DATA.INTEMP.?

     ***** INITIAL TEMPERATURE BY RADIAL REGION *****

NOTE-- THE FIRST COLUMN CONTAINS THE INITIAL TEMPERATURE (F OR
       K) OF A REGION. THE SECOND COLUMN CONTAINS THE NUMBER OF
       THE MESH POINT ON THE RIGHT BOUNDARY OF THE REGION AT
       THE CORRESPONDING TEMPERATURE.

       TEMPERATURE     MESH POINT          TEMPERATURE     MESH POINT
       ***********     **********          ***********     **********
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II
:11    :E.EEEEEEE         :II         :11  :E.EEEEEEE         :II

PAGE 2 OF 2
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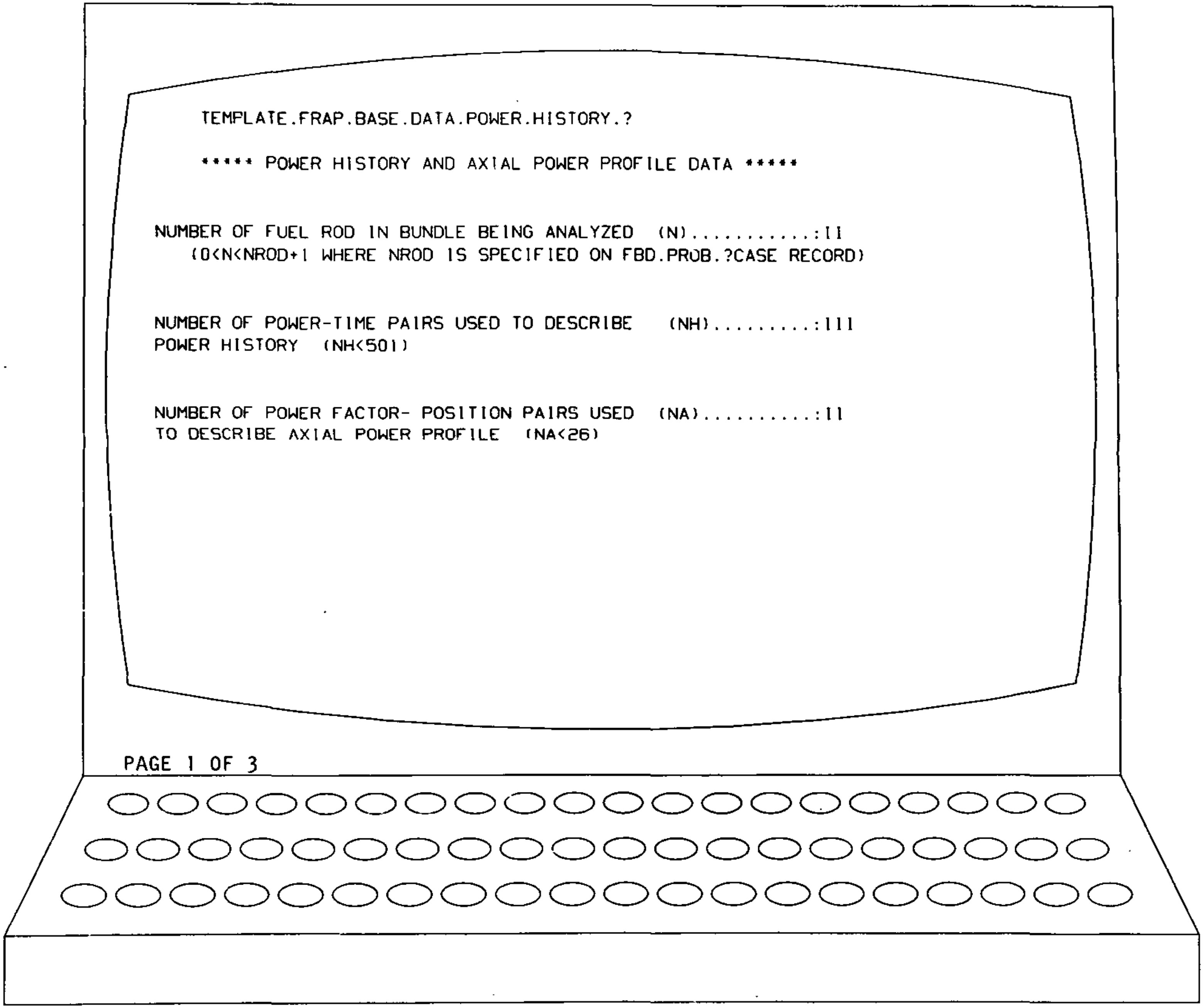

TEMPLATE.FRAP.BASE.DATA.POWER.HISTORY.?
***** POWER HISTORY AND AXIAL POWER PROFILE DATA *****
NUMBER OF FUEL ROD IN BUNDLE BEING ANALYZED (N)...........:II
(0<N<NROD+1 WHERE NROD IS SPECIFIED ON FBD.PROB.?CASE RECORD)
NUMBER OF POWER-TIME PAIRS USED TO DESCRIBE (NH).........:III
POWER HISTORY (NH<501)
NUMBER OF POWER FACTOR- POSITION PAIRS USED (NA)..........:II
TO DESCRIBE AXIAL POWER PROFILE (NA<26)
PAGE 1 OF 3

```
TEMPLATE.FRAP.BASE.DATA.POWER.HISTORY.?

                    POWER HISTORY PAIRS

THERE SHOULD BE NH (PREVIOUS PAGE) PAIRS. THE FIRST COLUMN
CONTAINS THE AVERAGE LINEAR POWER IN FUEL ROD (KW/FT OR KW/M)
AT TIME (SECONDS) INDICATED IN SECOND COLUMN. IF MPDCAY (FBD.
PROB.?CASE RECORD) EQUALS 1, THE POWER SHOULD NOT INCLUDE HEAT
GENERATION DUE TO DECAY OF FISSION PRODUCTS.

          AVERAGE POWER            TIME
          *************            ****
:11       :E.EEEEEEEEE          :E.EEEEEEEE
:11       :E.EEEEEEEEE          :E.EEEEEEEE
:11       :E.EEEEEEEEE          :E.EEEEEEEE
:11       :E.EEEEEEEEE          :E.EEEEEEEE
:11       :E.EEEEEEEEE          :E.EEEEEEEE
:11       :E.EEEEEEEEE          :E.EEEEEEEE
:11       :E.EEEEEEEEE          :E.EEEEEEEE
:11       :E.EEEEEEEEE          :E.EEEEEEEE
:11       :E.EEEEEEEEE          :E.EEEEEEEE
```

```
TEMPLATE.FRAP.BASE.DATA.POWER.HISTORY.?

        NORMALIZED AXIAL POWER DISTRIBUTION


THE FIRST COLUMN CONTAINS THE AXIAL POWER PROFILE FACTOR AT THE
ELEVATION (FT OR M) INDICATED IN THE SECOND COLUMN. THIS
ELEVATION NEED NOT CORRESPOND TO THE ELEVATION OF AN AXIAL NODE.


        AXIAL POWER FACTOR          ELEVATION
        ******************          *********
:11        :E.EEEEEEEE              :E.EEEEEEEE
:11        :E.EEEEEEEE              :E.EEEEEEEE
:11        :E.EEEEEEEE              :E.EEEEEEEE
:11        :E.EEEEEEEE              :E.EEEEEEEE
:11        :E.EEEEEEEE              :E.EEEEEEEE
:11        :E.EEEEEEEE              :E.EEEEEEEE
:11        :E.EEEEEEEE              :E.EEEEEEEE
:11        :E.EEEEEEEE              :E.EEEEEEEE
:11        :E.EEEEEEEE              :E.EEEEEEEE
:11        :E.EEEEEEEE              :E.EEEEEEEE
```

PAGE 3 OF 3

TEMPLATE.FRAP.BASE.DATA.COOLANT.HISTORY.?

**** COOLANT CONDITION HISTORY AND CORRELATION OPTIONS ****

THIS RECORD CONTAINS OPTIONS FOR INPUT OF COOLANT PARAMETER HISTORY AND VARIOUS HEAT TRANSFER CORRELATIONS. THE COOLANT INPUT SWITCH INDICATES WHICH COOLANT OPTION RECORD WILL BE READ.

COOLANT INPUT SWITCH (NSWC)....................:1

NSWC=0 --> HISTORIES OF VESSEL PLENA ENTHALPY, CORE PRESSURE AND MASS FLUX ARE SPECIFIED. COMPLETE FOD.COOL0.?CASE

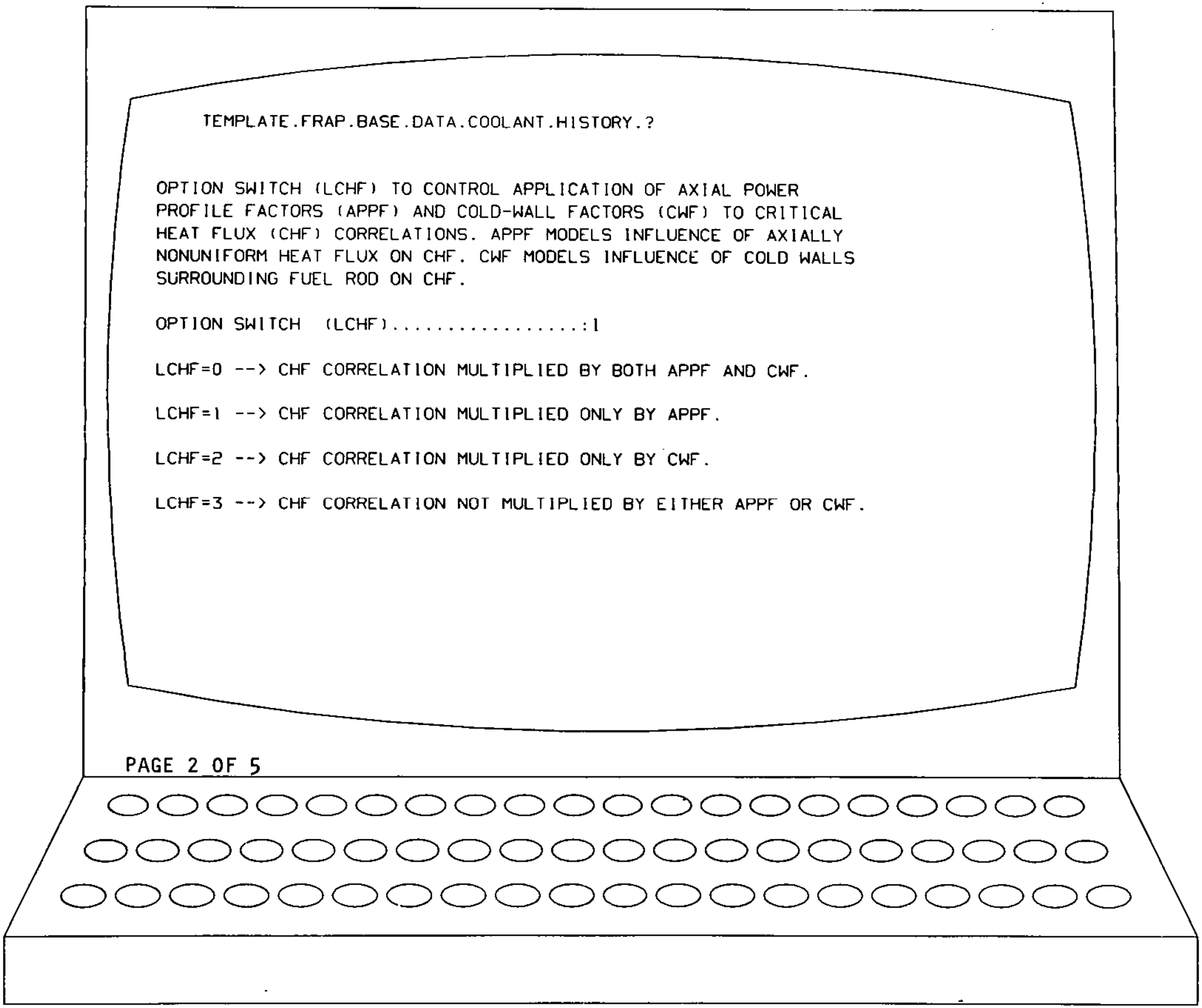
NSWC=1 --> HISTORIES OF VESSEL PLENA ENTHALPY,CORE PRESSURE,MASS FLUX AND CORE ENTHALPY ARE SPECIFIED. COMPLETE FOD. COOL1.?CASE RECORD

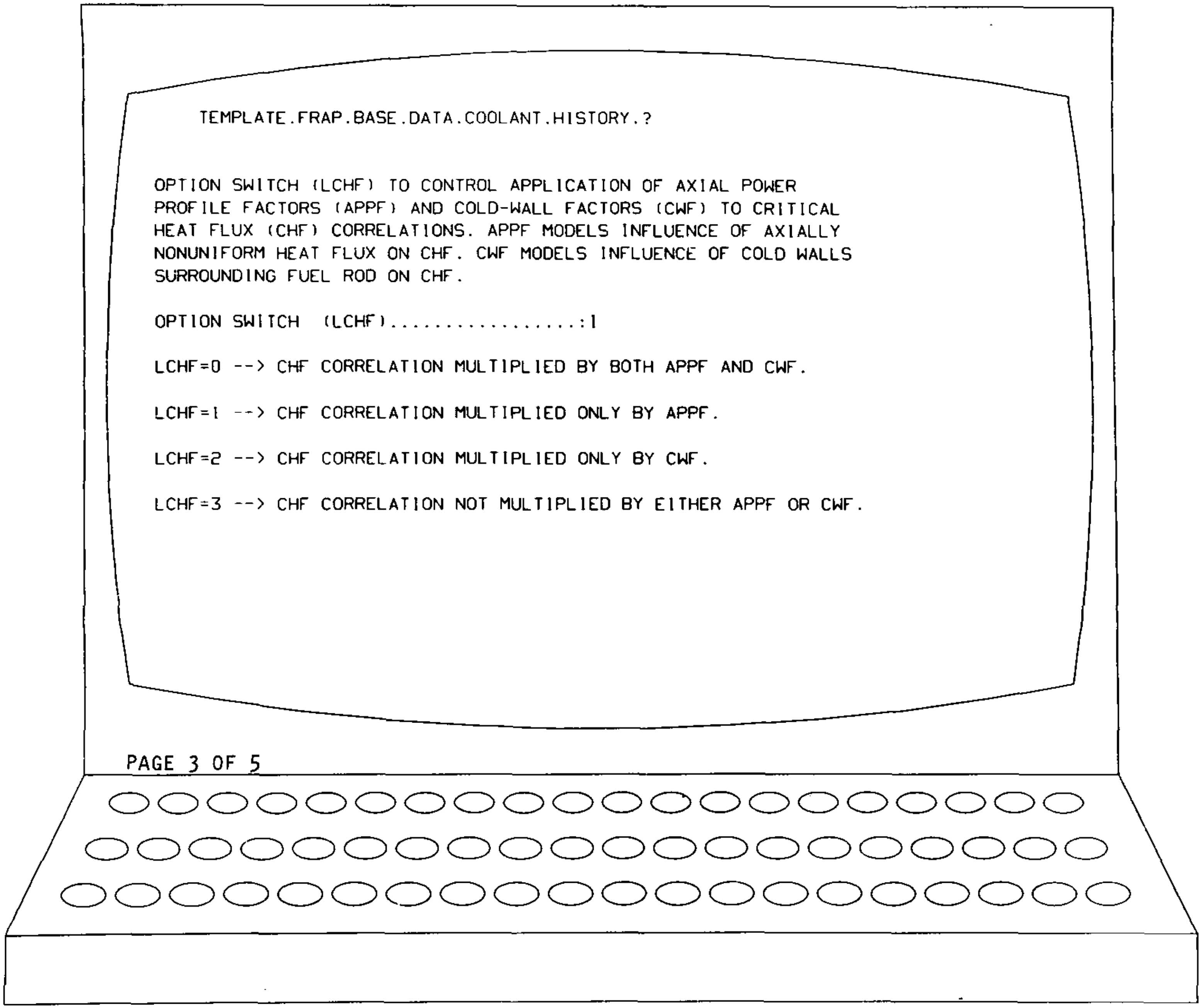
NSWC=2 --> TRANSIENT COOLANT CONDITIONS ARE READ FROM TAPE. COMPLETE FOD.COOL2.?CASE RECORD

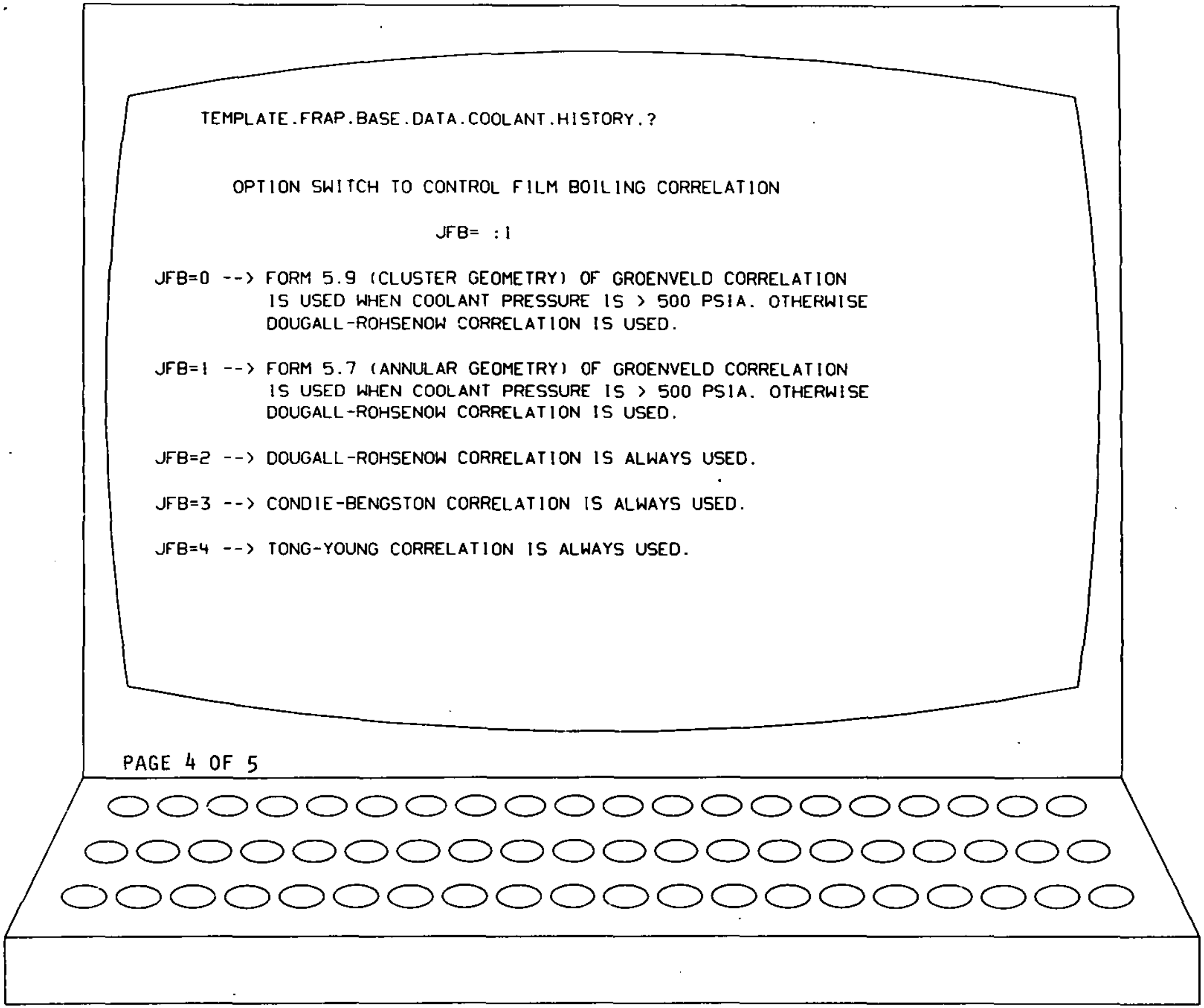
NSWC=3 --> FUEL ROD COOLING SPECIFIED BY PRESCRIBING HEAT TRANSFER COEFFICIENT AND BULK TEMPERATURE HISTORIES. COMPLETE FOD.COOL3.?CASE RECORD

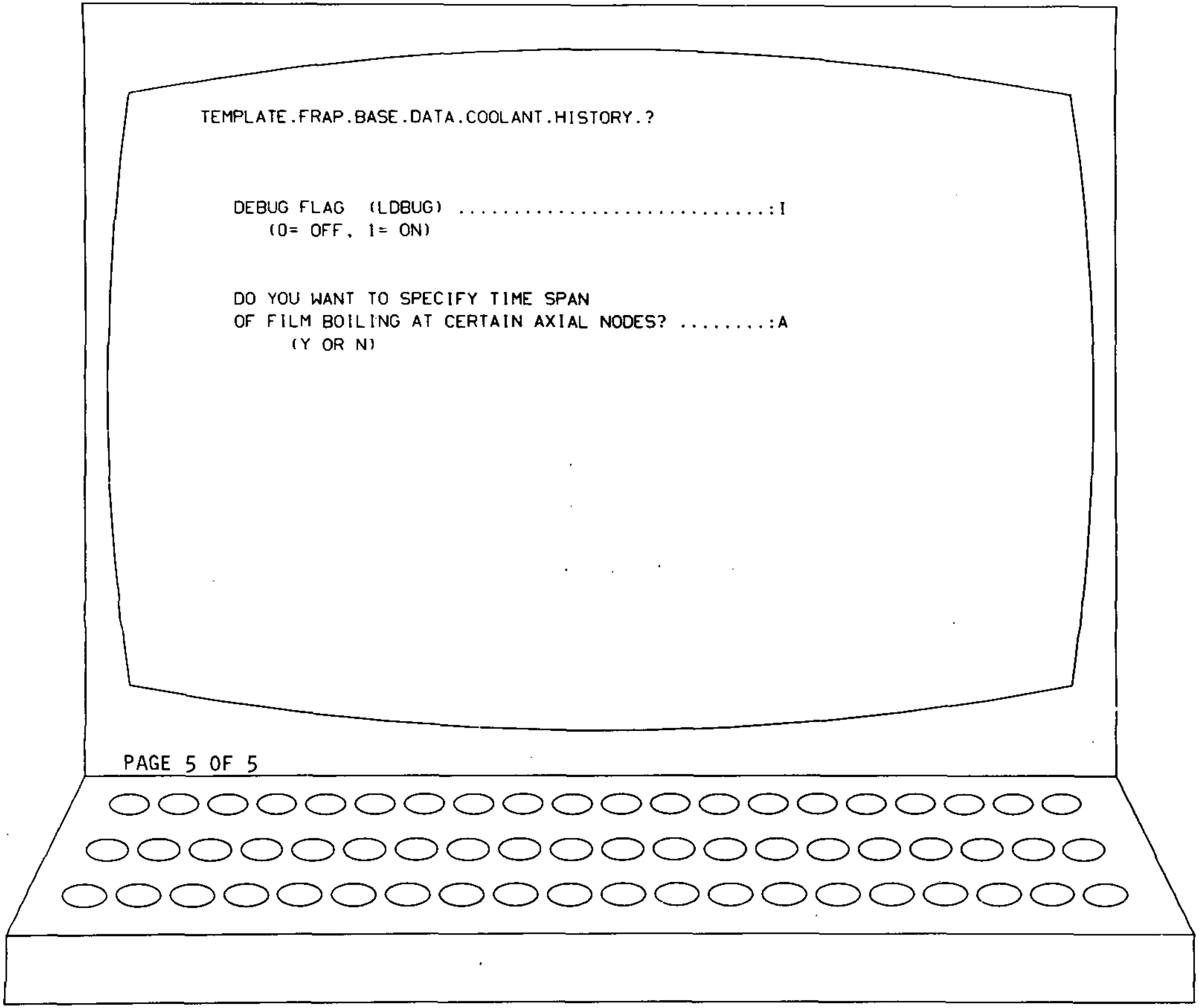
NSWC=4 --> TRANSIENT HEAT TRANSFER COEFFICIENTS AND COOLANT TEMPERATURES READ FROM TAPE. COMPLETE FOD.COOL2.?CASE

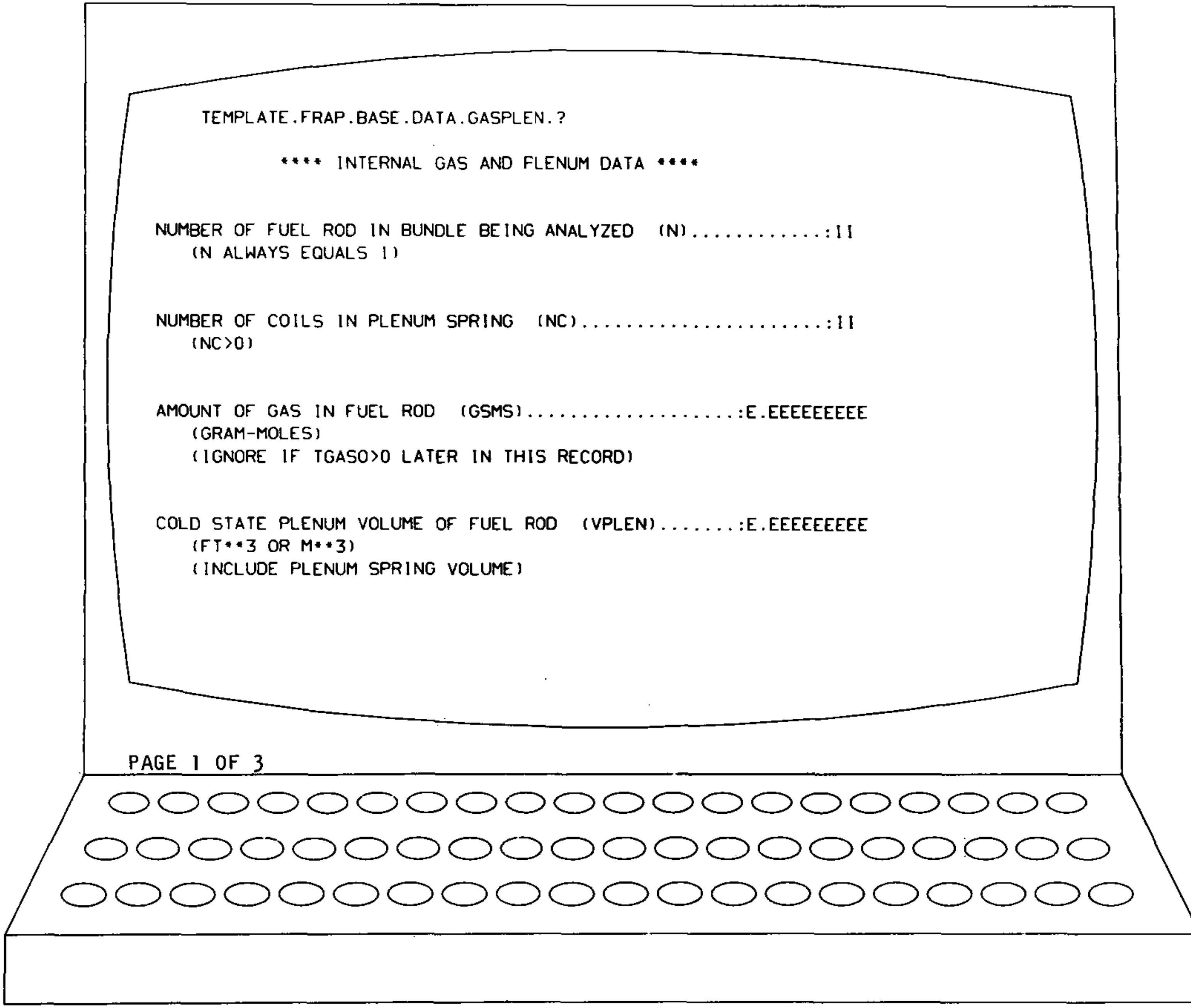
PAGE 1 OF 5

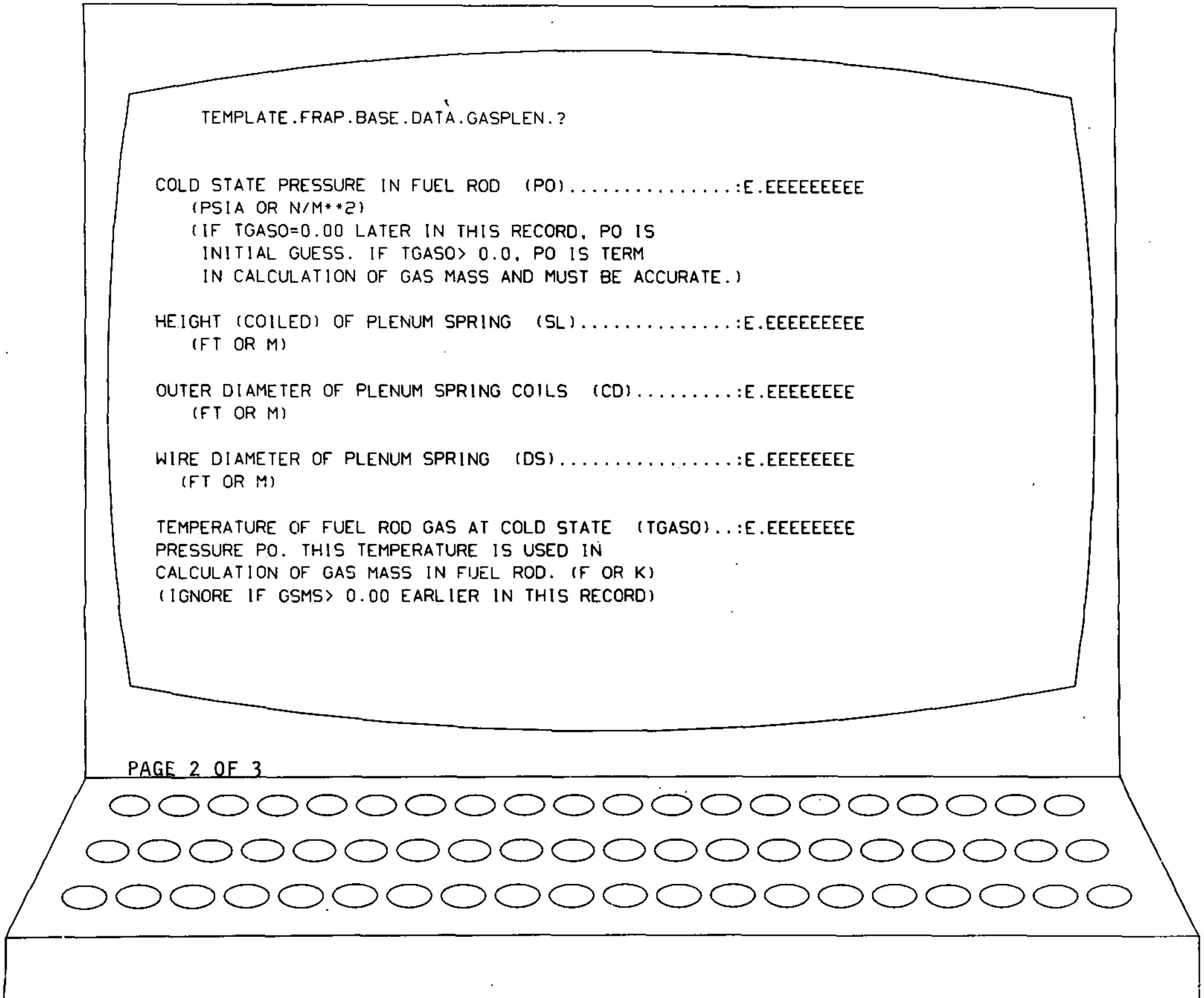

TEMPLATE.FRAP.BASE.DATA.COOLANT.HISTORY.?
OPTION SWITCH (LCHF) TO CONTROL APPLICATION OF AXIAL POWER PROFILE FACTORS (APPF) AND COLD-WALL FACTORS (CWF) TO CRITICAL HEAT FLUX (CHF) CORRELATIONS. APPF MODELS INFLUENCE OF AXIALLY NONUNIFORM HEAT FLUX ON CHF. CWF MODELS INFLUENCE OF COLD WALLS SURROUNDING FUEL ROD ON CHF.
OPTION SWITCH (LCHF)..................:1
LCHF=0 --> CHF CORRELATION MULTIPLIED BY BOTH APPF AND CWF.
LCHF=1 --> CHF CORRELATION MULTIPLIED ONLY BY APPF.
LCHF=2 --> CHF CORRELATION MULTIPLIED ONLY BY CWF.
LCHF=3 --> CHF CORRELATION NOT MULTIPLIED BY EITHER APPF OR CWF.
PAGE 2 OF 5


TEMPLATE.FRAP.BASE.DATA.COOLANT.HISTORY.?
OPTION SWITCH (LCHF) TO CONTROL APPLICATION OF AXIAL POWER PROFILE FACTORS (APPF) AND COLD-WALL FACTORS (CWF) TO CRITICAL HEAT FLUX (CHF) CORRELATIONS. APPF MODELS INFLUENCE OF AXIALLY NONUNIFORM HEAT FLUX ON CHF. CWF MODELS INFLUENCE OF COLD WALLS SURROUNDING FUEL ROD ON CHF.
OPTION SWITCH (LCHF)..................:1
LCHF=0 --> CHF CORRELATION MULTIPLIED BY BOTH APPF AND CWF.
LCHF=1 --> CHF CORRELATION MULTIPLIED ONLY BY APPF.
LCHF=2 --> CHF CORRELATION MULTIPLIED ONLY BY CWF.
LCHF=3 --> CHF CORRELATION NOT MULTIPLIED BY EITHER APPF OR CWF.
PAGE 3 OF 5


TEMPLATE.FRAP.BASE.DATA.COOLANT.HISTORY.?
OPTION SWITCH TO CONTROL FILM BOILING CORRELATION
JFB= :1
JFB=0 --> FORM 5.9 (CLUSTER GEOMETRY) OF GROENVELD CORRELATION IS USED WHEN COOLANT PRESSURE IS > 500 PSIA. OTHERWISE DOUGALL-ROHSENOW CORRELATION IS USED.
JFB=1 --> FORM 5.7 (ANNULAR GEOMETRY) OF GROENVELD CORRELATION IS USED WHEN COOLANT PRESSURE IS > 500 PSIA. OTHERWISE DOUGALL-ROHSENOW CORRELATION IS USED.
JFB=2 --> DOUGALL-ROHSENOW CORRELATION IS ALWAYS USED.
JFB=3 --> CONDIE-BENGSTON CORRELATION IS ALWAYS USED.
JFB=4 --> TONG-YOUNG CORRELATION IS ALWAYS USED.
PAGE 4 OF 5


TEMPLATE.FRAP.BASE.DATA.COOLANT.HISTORY.?
DEBUG FLAG (LDBUG) ....:I
(0= OFF, 1= ON)
DO YOU WANT TO SPECIFY TIME SPAN
OF FILM BOILING AT CERTAIN AXIAL NODES? ....:A
(Y OR N)
PAGE 5 OF 5


TEMPLATE.FRAP.BASE.DATA.GASPLEN.?
**** INTERNAL GAS AND PLENUM DATA ****
NUMBER OF FUEL ROD IN BUNDLE BEING ANALYZED (N).............:II
(N ALWAYS EQUALS 1)
NUMBER OF COILS IN PLENUM SPRING (NC)......................:II
(NC>0)
AMOUNT OF GAS IN FUEL ROD (GSMS)...................:E.EEEEEEEEE
(GRAM-MOLES)
(IGNORE IF TGASO>0 LATER IN THIS RECORD)
COLD STATE PLENUM VOLUME OF FUEL ROD (VPLEN).......:E.EEEEEEEEE
(FT**3 OR M**3)
(INCLUDE PLENUM SPRING VOLUME)
PAGE 1 OF 3



TEMPLATE.FRAP.BASE.DATA.GASPLEN.?

COLD STATE PRESSURE IN FUEL ROD (PO)...............:E.EEEEEEEEE
(PSIA OR N/M**2)
(IF TGASO=0.00 LATER IN THIS RECORD, PO IS
INITIAL GUESS. IF TGASO> 0.0, PO IS TERM
IN CALCULATION OF GAS MASS AND MUST BE ACCURATE.)

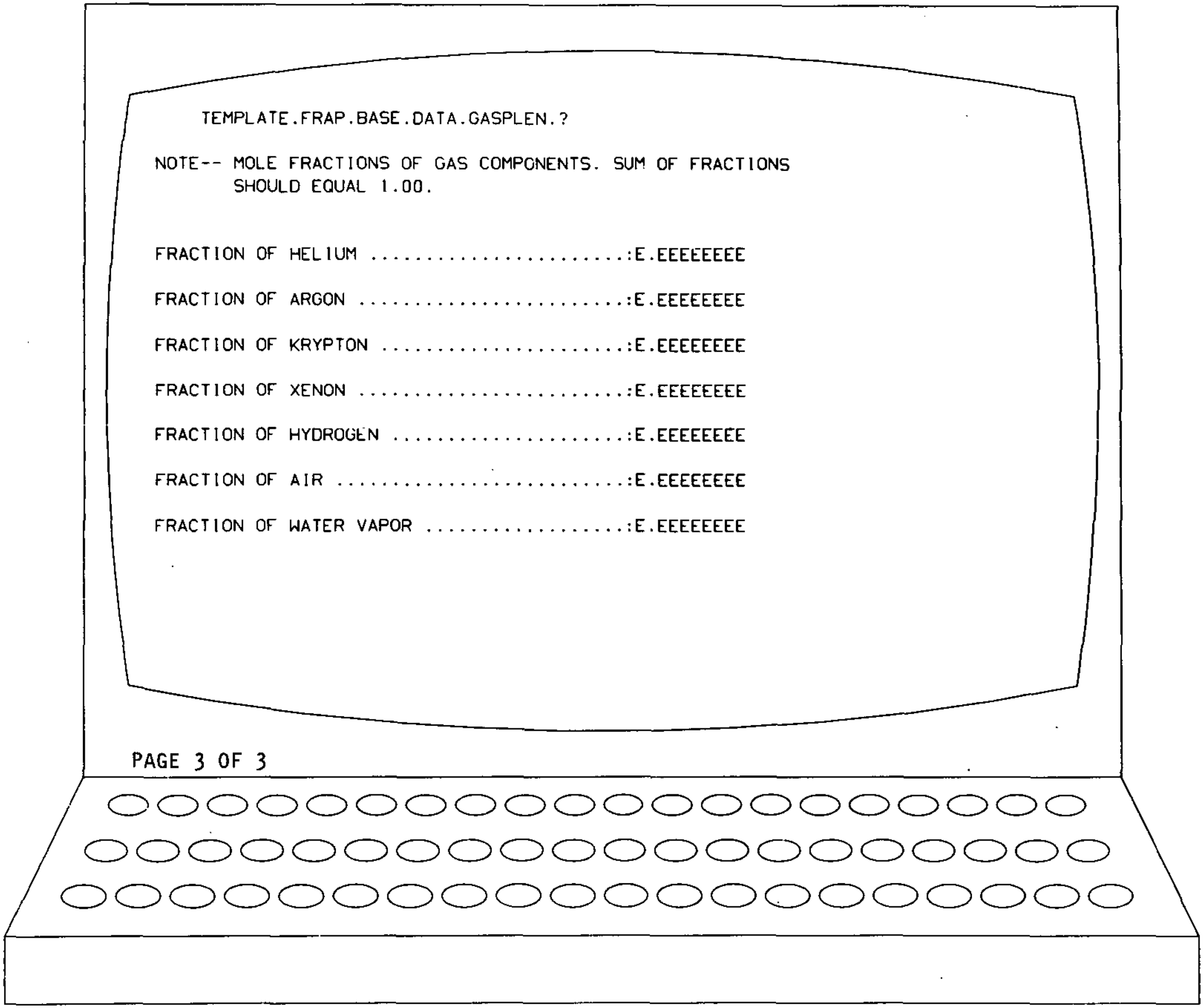
HEIGHT (COILED) OF PLENUM SPRING (SL)..............:E.EEEEEEEEE
(FT OR M)

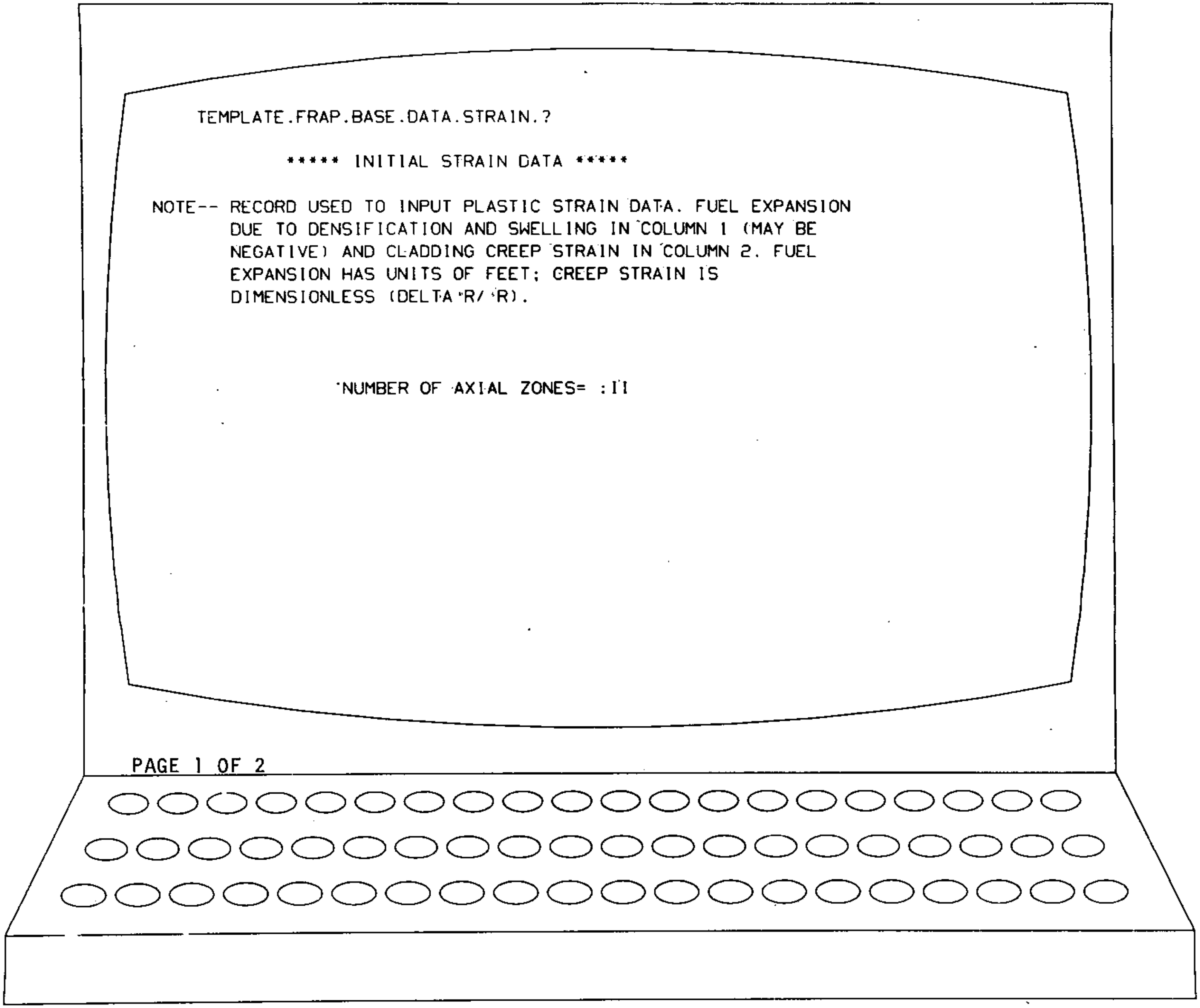
OUTER DIAMETER OF PLENUM SPRING COILS (CD).........:E.EEEEEEEE
(FT OR M)

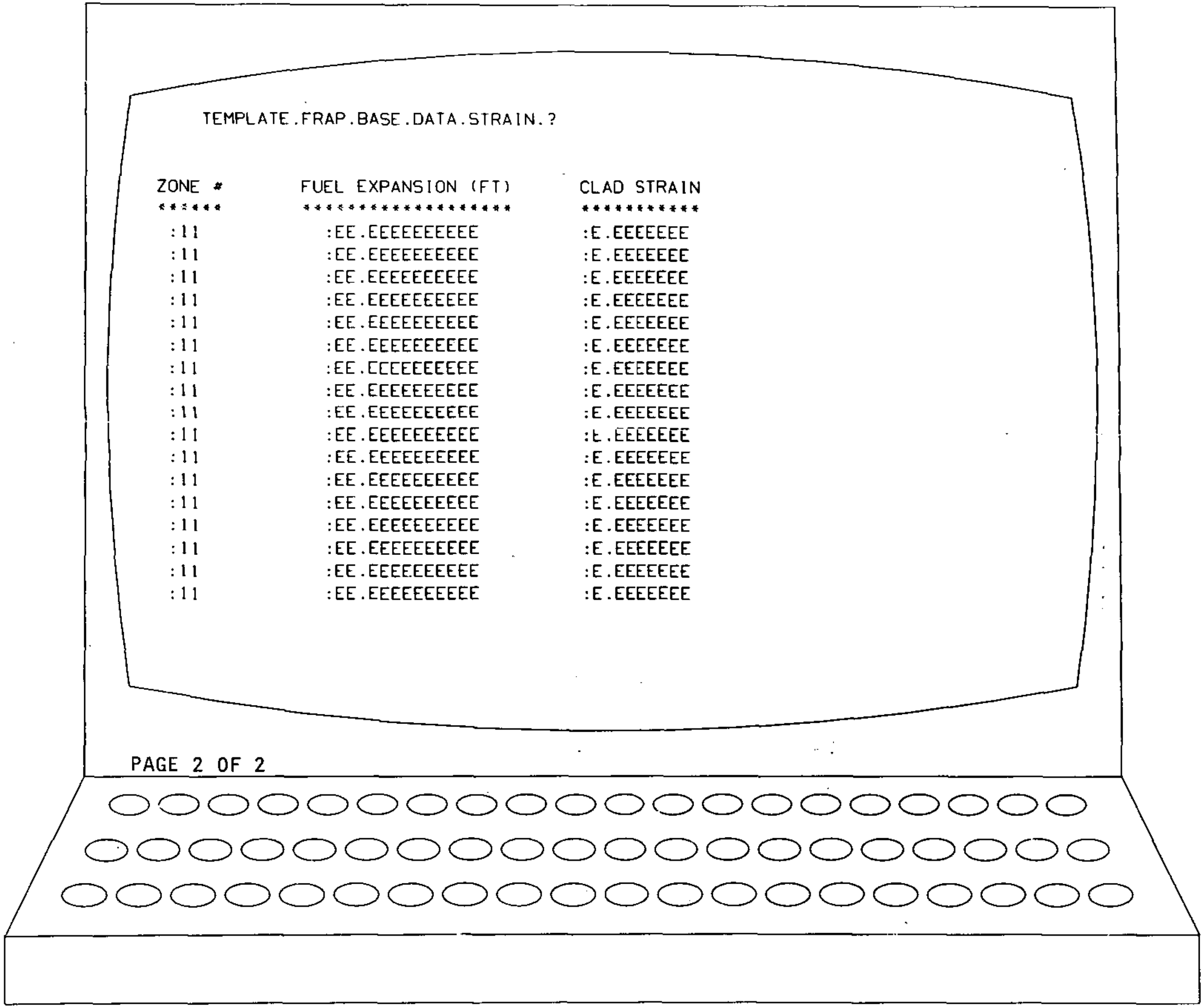
WIRE DIAMETER OF PLENUM SPRING (DS)................:E.EEEEEEEE
(FT OR M)

TEMPERATURE OF FUEL ROD GAS AT COLD STATE (TGASO)..:E.EEEEEEEE
PRESSURE PO. THIS TEMPERATURE IS USED IN
CALCULATION OF GAS MASS IN FUEL ROD. (F OR K)
(IGNORE IF GSMS> 0.00 EARLIER IN THIS RECORD)

PAGE 2 OF 3


TEMPLATE.FRAP.BASE.DATA.GASPLEN.?
NOTE-- MOLE FRACTIONS OF GAS COMPONENTS. SUM OF FRACTIONS SHOULD EQUAL 1.00.
FRACTION OF HELIUM ....:E.EEEEEEEE
FRACTION OF ARGON ....:E.EEEEEEEE
FRACTION OF KRYPTON ....:E.EEEEEEEE
FRACTION OF XENON ....:E.EEEEEEEE
FRACTION OF HYDROGEN ....:E.EEEEEEEE
FRACTION OF AIR ....:E.EEEEEEEE
FRACTION OF WATER VAPOR ....:E.EEEEEEEE
PAGE 3 OF 3


TEMPLATE.FRAP.BASE.DATA.STRAIN.?
***** INITIAL STRAIN DATA *****
NOTE-- RECORD USED TO INPUT PLASTIC STRAIN DATA. FUEL EXPANSION
DUE TO DENSIFICATION AND SWELLING IN COLUMN 1 (MAY BE
NEGATIVE) AND CLADDING CREEP STRAIN IN COLUMN 2. FUEL
EXPANSION HAS UNITS OF FEET; CREEP STRAIN IS
DIMENSIONLESS (DELTA R/ R).
NUMBER OF AXIAL ZONES= :II
PAGE 1 OF 2


TEMPLATE.FRAP.BASE.DATA.STRAIN.?
ZONE #
******
FUEL EXPANSION (FT)
****
CLAD STRAIN
****
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
:11 :EE.EEEEEEEEEE :E.EEEEEEE
PAGE 2 OF 2

```
TEMPLATE.FRAP.OPTN.DATA.VOID.?


DISTANCE FROM BOTTOM OF FUEL
STACK TO BOTTOM OF CENTRAL VOID  (ZVOID1)..........:E.EEEEEEEE
   (UNITS OF FT OR M)


DISTANCE FROM BOTTOM OF FUEL
STACK TO TOP OF CENTRAL VOID  (ZVOID2).............:E.EEEEEEEE
   (UNITS OF FT OR M)


NOTE--- IF CENTRAL VOID EXTENDS ENTIRE LENGTH OF FUEL STACK,
SET ZVOID1=0.00 AND ZVOID2=STACK LENGTH OR DELETE RECORD
ENTIRELY-- CODE WILL AUTOMATICALLY ASSIGN THE VOID LENGTH
EQUAL TO THE STACK LENGTH BY DEFAULT. BE SURE YOU DELETE THE
RECORD NAME AND NOT MERELY LEAVE THE ENTRIES BLANK.

PAGE 1 OF 1
```

TEMPLATE.FRAP.OPTN.DATA.TWODHT.?

*** USE ONLY IF NDIM>0 ON FBD.PROB.?CASE RECORD ***

TIME AT WHICH MULTIDIMENSIONAL HEAT
CONDUCTION CALCULATIONS ARE TO START (TIMMD)........:E.EEEEEEE
(SECONDS)

OFFSET OF FUEL STACK CENTERLINE
FROM LONGITUDINAL AXIS (DOFSET)...................:E.EEEEEEE
(FT OR M)

AZIMUTHAL ANGLE ALONG WHICH FUEL PELLET
SHIFTED TOWARD CLADDING INSIDE SURFACE (DOFANG)....:E.EEEEEEE
(DEGREES)
(LEAVE BLANK IF DOFSET= 0.00)

PAGE 1 OF 3

```
TEMPLATE.FRAP.OPTN.DATA.TWODHT.?


NUMBER OF AZIMUTHAL SECTORS IN HEAT
CONDUCTION CALCULATIONS  (NAZ)..............................:II

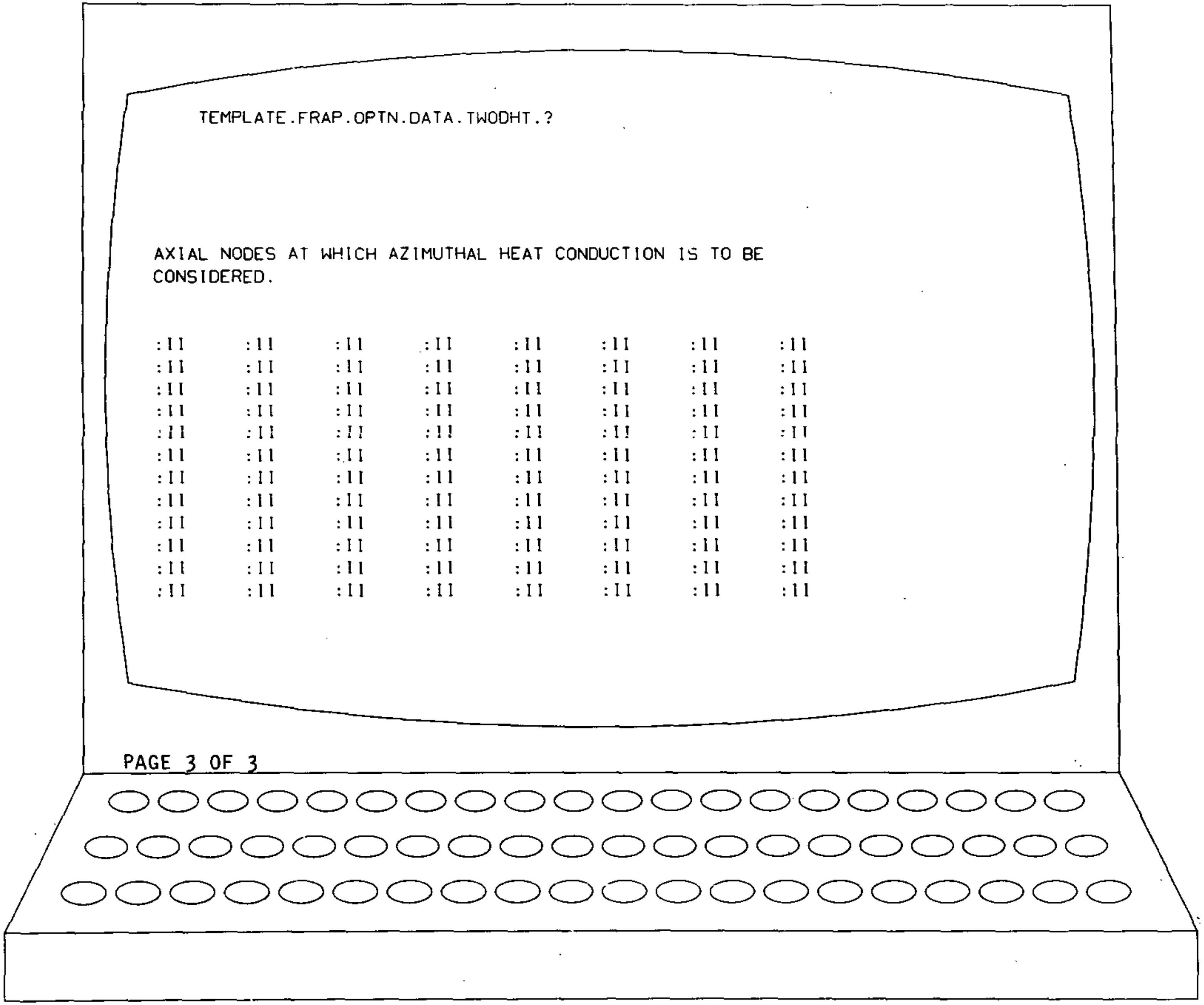
NUMBER OF AXIAL NODES AT WHICH AZIMUTHAL
HEAT CONDUCTION IS TO BE CONSIDERED  (NAZN).................:II

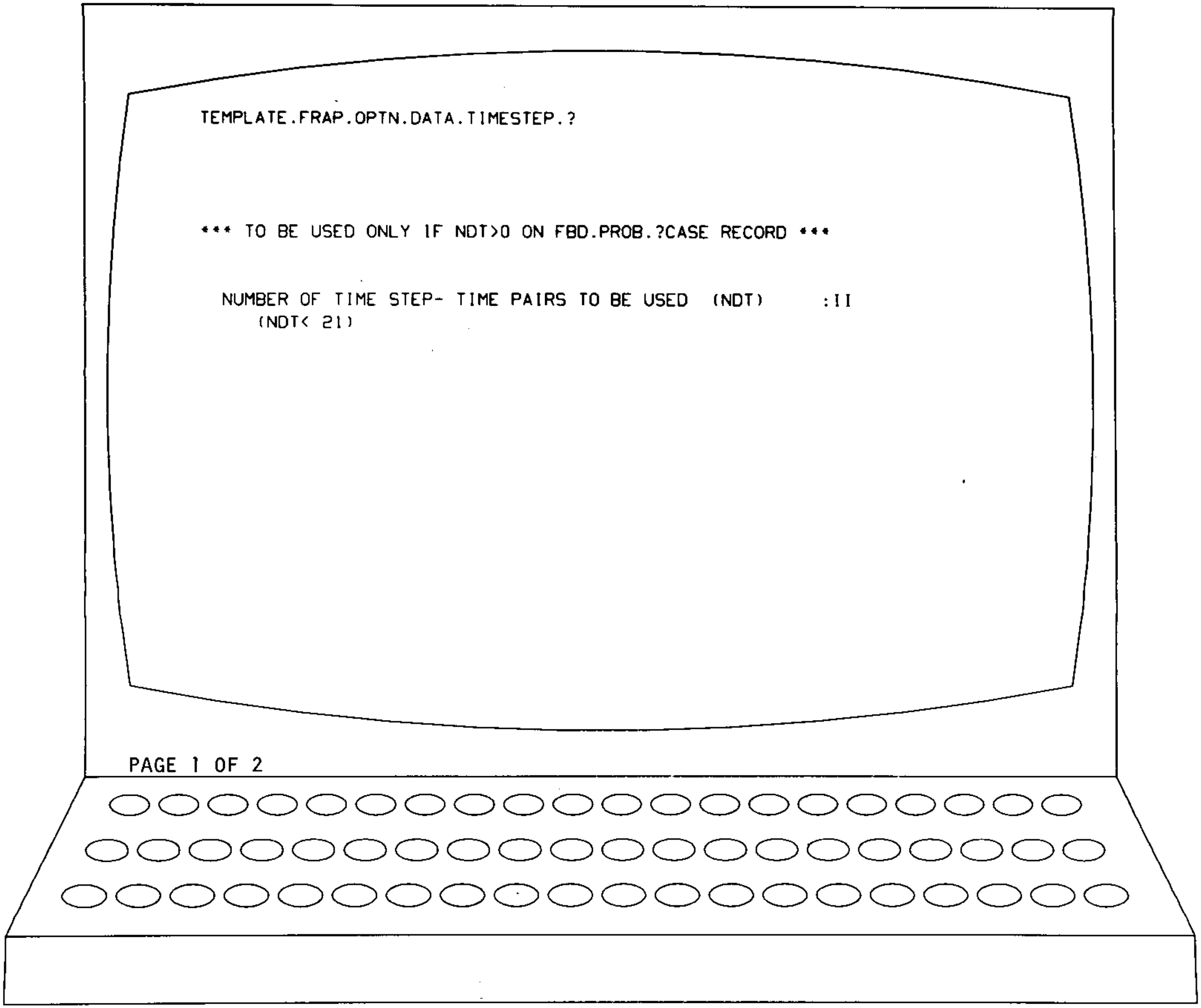
SYMMETRY INDICATOR  (NSYMM).................................:II
   NSYMM=0 --> TWOFOLD SYMMETRY- TEMPERATURE DISTRIBUTION
               COMPUTED IN QUARTER OF FUEL ROD

   NSYMM=1 --> ONE FOLD SYMMETRY- TEMPERATURE DISTRIBUTION
               COMPUTED IN HALF OF FUEL ROD

   NSYMM=2 --> NO SYMMETRY
```

PAGE 2 OF 3


TEMPLATE.FRAP.OPTN.DATA.TWODHT.?
AXIAL NODES AT WHICH AZIMUTHAL HEAT CONDUCTION IS TO BE CONSIDERED.
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
:II :II :II :II :II :II :II :II
PAGE 3 OF 3


TEMPLATE.FRAP.OPTN.DATA.TIMESTEP.?
*** TO BE USED ONLY IF NDT>0 ON FBD.PROB.?CASE RECORD ***
NUMBER OF TIME STEP- TIME PAIRS TO BE USED (NDT) :II
(NDT< 21)
PAGE 1 OF 2

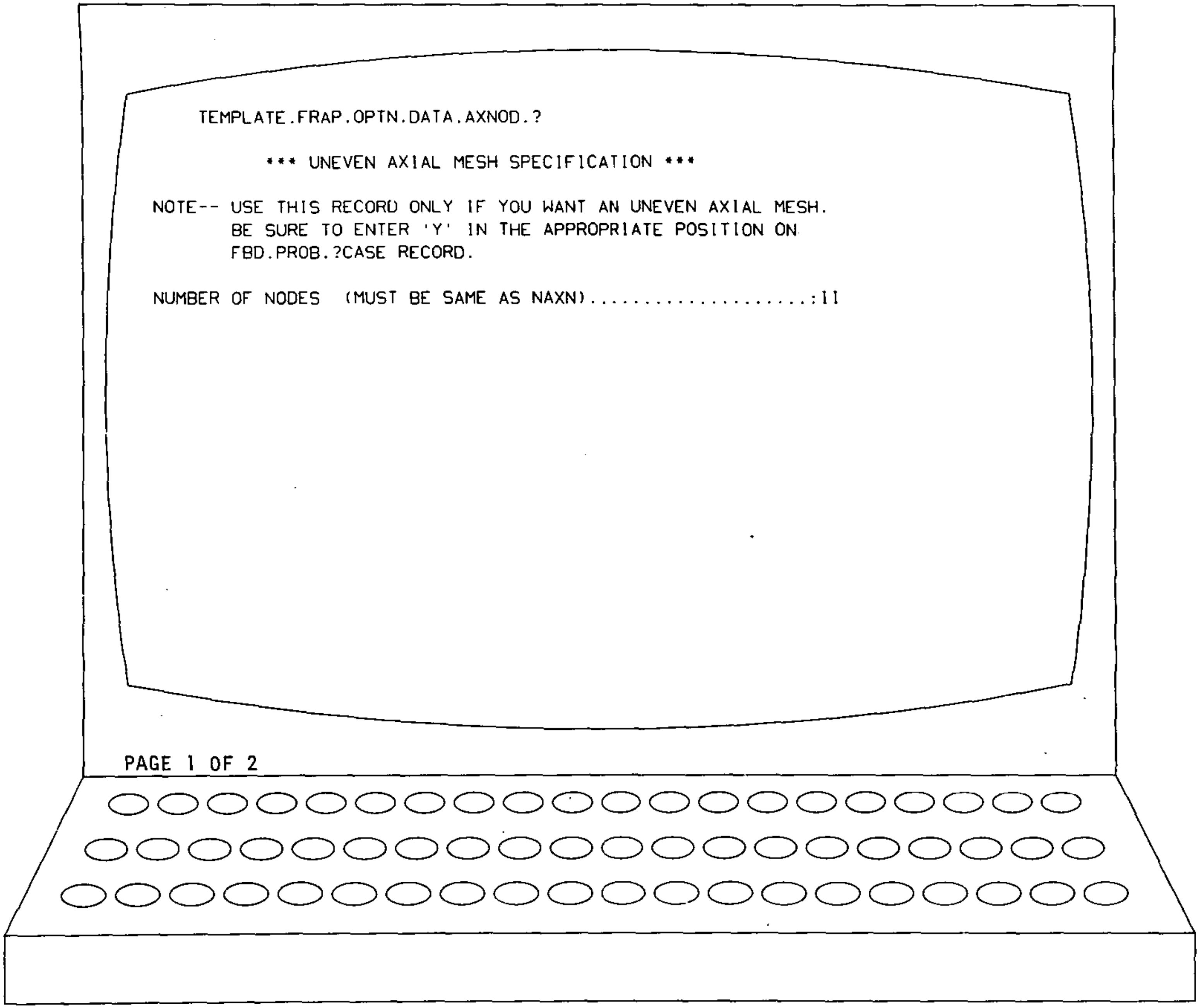
TEMPLATE.FRAP.OPTN.DATA.TIMESTEP.?

*** TIME STEP- TIME PAIRS ***

VALUES IN THE FIRST COLUMN ARE THE MAXIMUM TIME STEP SIZES (SECONDS) DESIRED AT THE TIMES (SECONDS) SPECIFIED IN THE SECOND COLUMN. LINEAR INTERPOLATION IS PERFORMED FOR INTERMEDIATE TIMES. IF MULTIDIMENSIONAL HEAT CONDUCTION IS BEING COMPUTED, TIME STEPS SHOULD NOT EXCEED ABOUT 0.02 SEC FOR NUMERICAL STABILITY.

TIMESTEPS	TIMES
*********	*****
:E.EEEEEEE	:E.EEEEEEE
:E.EEEEEEE	:E.EEEEEEE
:E.EEEEEEE	:E.EEEEEEE
:E.EEEEEEE	:E.EEEEEEE
:E.EEEEEEE	:E.EEEEEEE
:E.EEEEEEE	:E.EEEEEEE
:E.EEEEEEE	:E.EEEEEEE
:E.EEEEEEE	:E.EEEEEEE

PAGE 2 OF 2


TEMPLATE.FRAP.OPTN.DATA.AXNOD.?
*** UNEVEN AXIAL MESH SPECIFICATION ***
NOTE-- USE THIS RECORD ONLY IF YOU WANT AN UNEVEN AXIAL MESH.
BE SURE TO ENTER 'Y' IN THE APPROPRIATE POSITION ON
FBD.PROB.?CASE RECORD.
NUMBER OF NODES (MUST BE SAME AS NAXN)....................:11
PAGE 1 OF 2

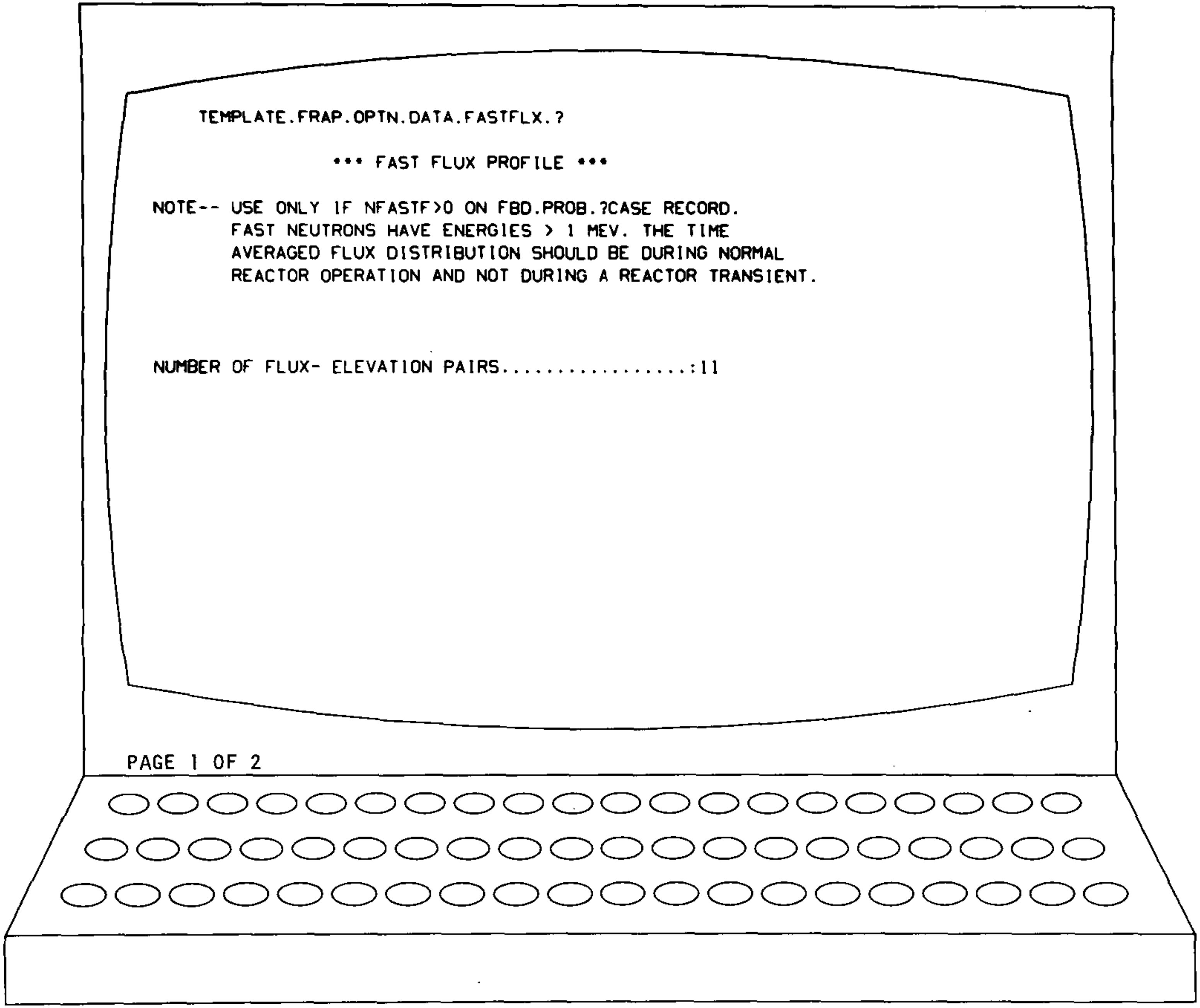
```
TEMPLATE.FRAP.OPTN.DATA.AXNOD.?

        **** SPECIFICATION OF NODE LENGTHS ****

NOTE-- NODE LENGTHS HAVE UNITS OF FEET OR METERS.

            LENGTH                  LENGTH                LENGTH
            ******                  ******                ******
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
:11    :E.EEEEEEEE     :11   :E.EEEEEEEE     :11   :E.EEEEEEEE
```

PAGE 2 OF 2



TEMPLATE.FRAP.OPTN.DATA.FASTFLX.?

*** FAST FLUX PROFILE ***

NOTE-- USE ONLY IF NFASTF>0 ON FBD.PROB.?CASE RECORD.
FAST NEUTRONS HAVE ENERGIES > 1 MEV. THE TIME
AVERAGED FLUX DISTRIBUTION SHOULD BE DURING NORMAL
REACTOR OPERATION AND NOT DURING A REACTOR TRANSIENT.

NUMBER OF FLUX- ELEVATION PAIRS.................:11

PAGE 1 OF 2

```
    TEMPLATE.FRAP.OPTN.DATA.FASTFLX.?

              **** FLUX RATIO VS ELEVATION ****

NOTE-- THE FLUX RATIO IN FIRST COLUMN SHOULD EQUAL THE RATIO OF
       THE FAST NEUTRON FLUX TO THE AXIALLY AVERAGED NEUTRON
       FLUX AT CORRESPONDING ELEVATION (FT OR M) IN SECOND
COLUMN.

       FLUX RATIO      ELEVATION          FLUX RATIO      ELEVATION
       **********      *********          **********      *********
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
:11   :E.EEEEEEE     :E.EEEEEEE   :11   :E.EEEEEEE     :E.EEEEEEE
```

PAGE 2 OF 2

```
    TEMPLATE.FRAP.OPTN.DATA.SHTCBAL.?

      *** SURFACE HEAT TRANSFER COEFFICIENT MULTIPLIER ***

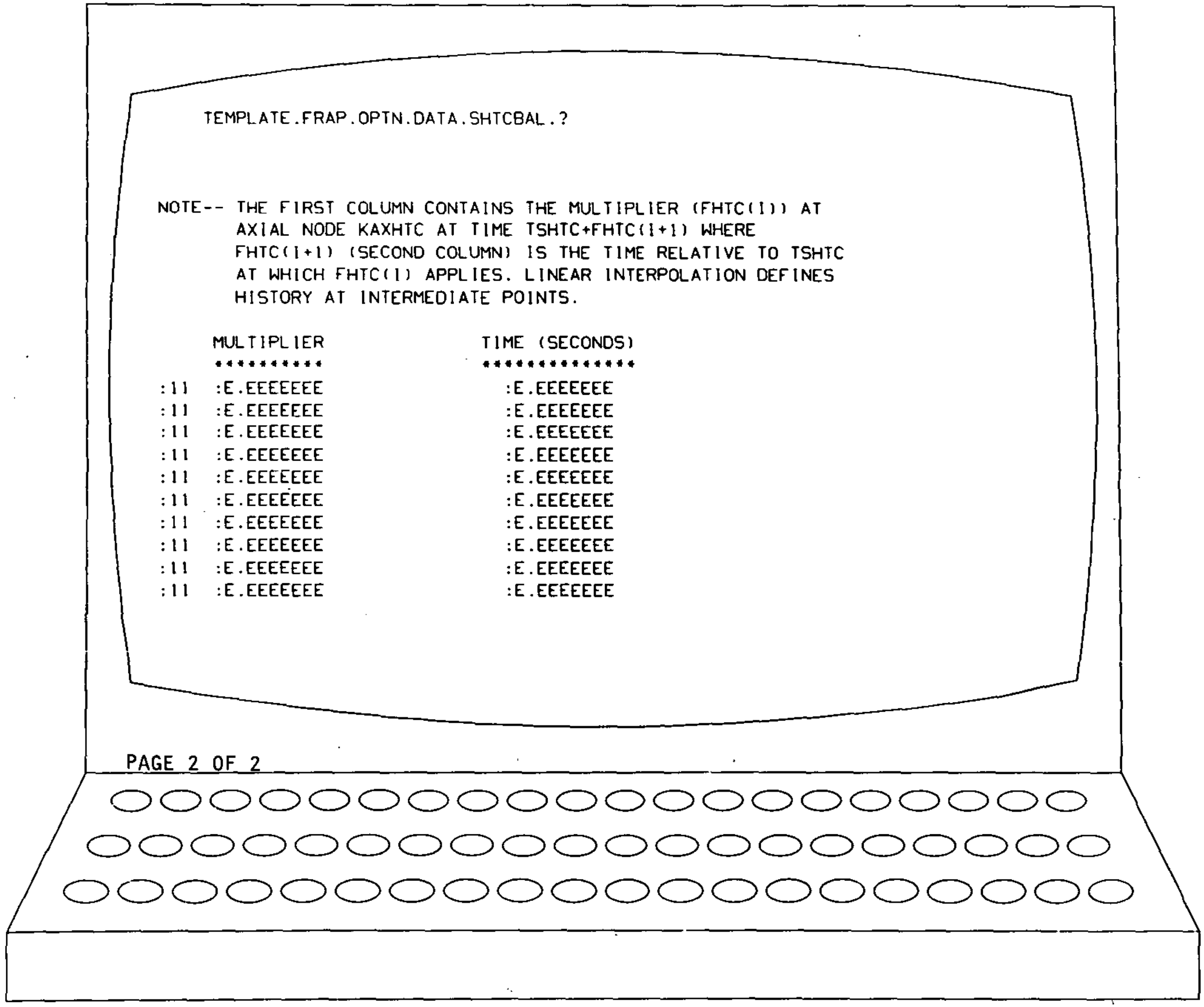
NOTE-- USED ONLY IF NSWTCH>0 ON FOD.SWITCH.?CASE RECORD.
       SPECIFICATION OF HEAT TRANSFER COEFFICIENT MULTIPLIER
       TO ACCOUNT FOR BALLOONING OF NEIGHBORING FUEL ROD.

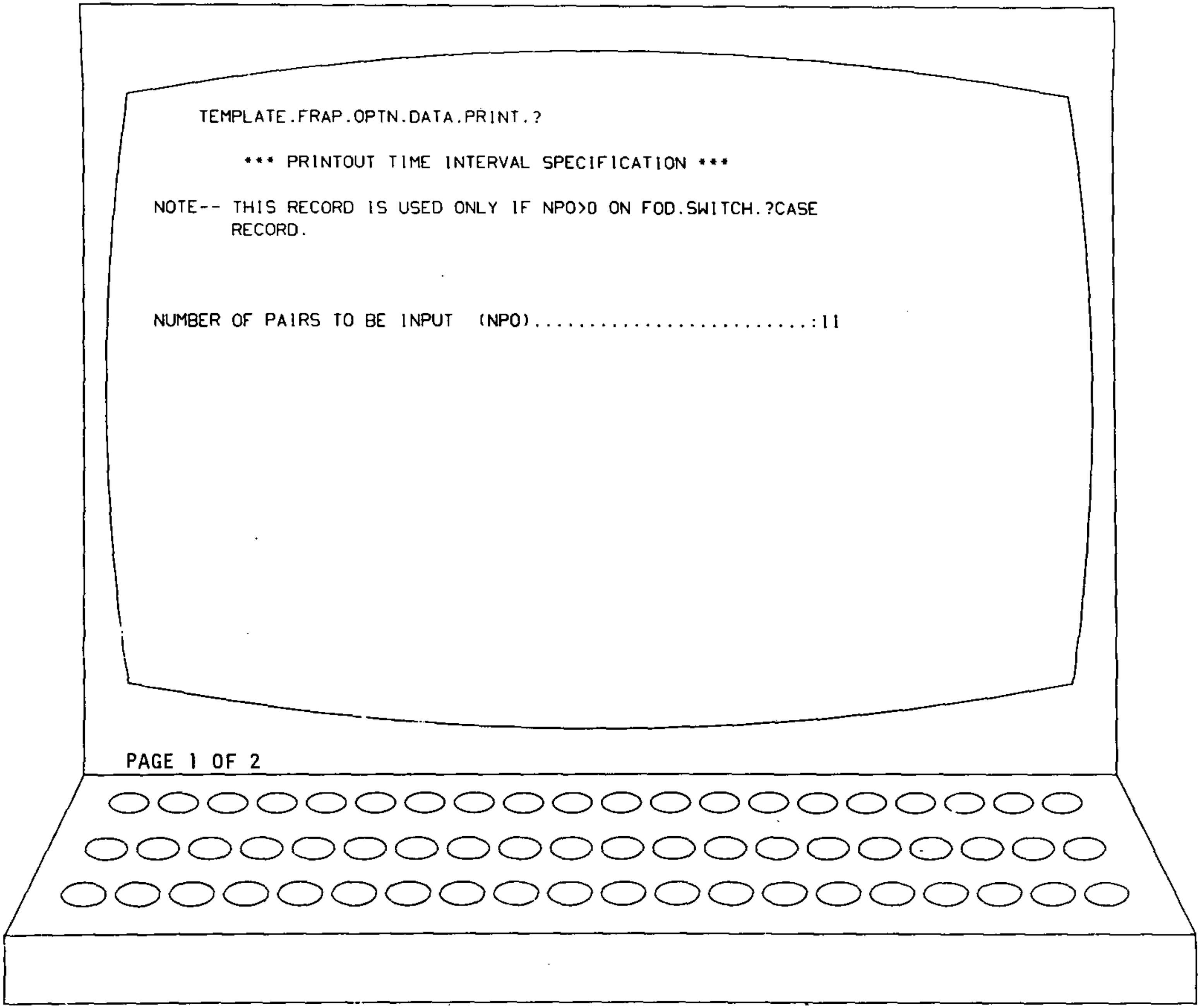
AXIAL NODE AT WHICH SURFACE HEAT
TRANSFER COEFFICIENT TO BE MODIFIED  (KAXHTC)..............:II

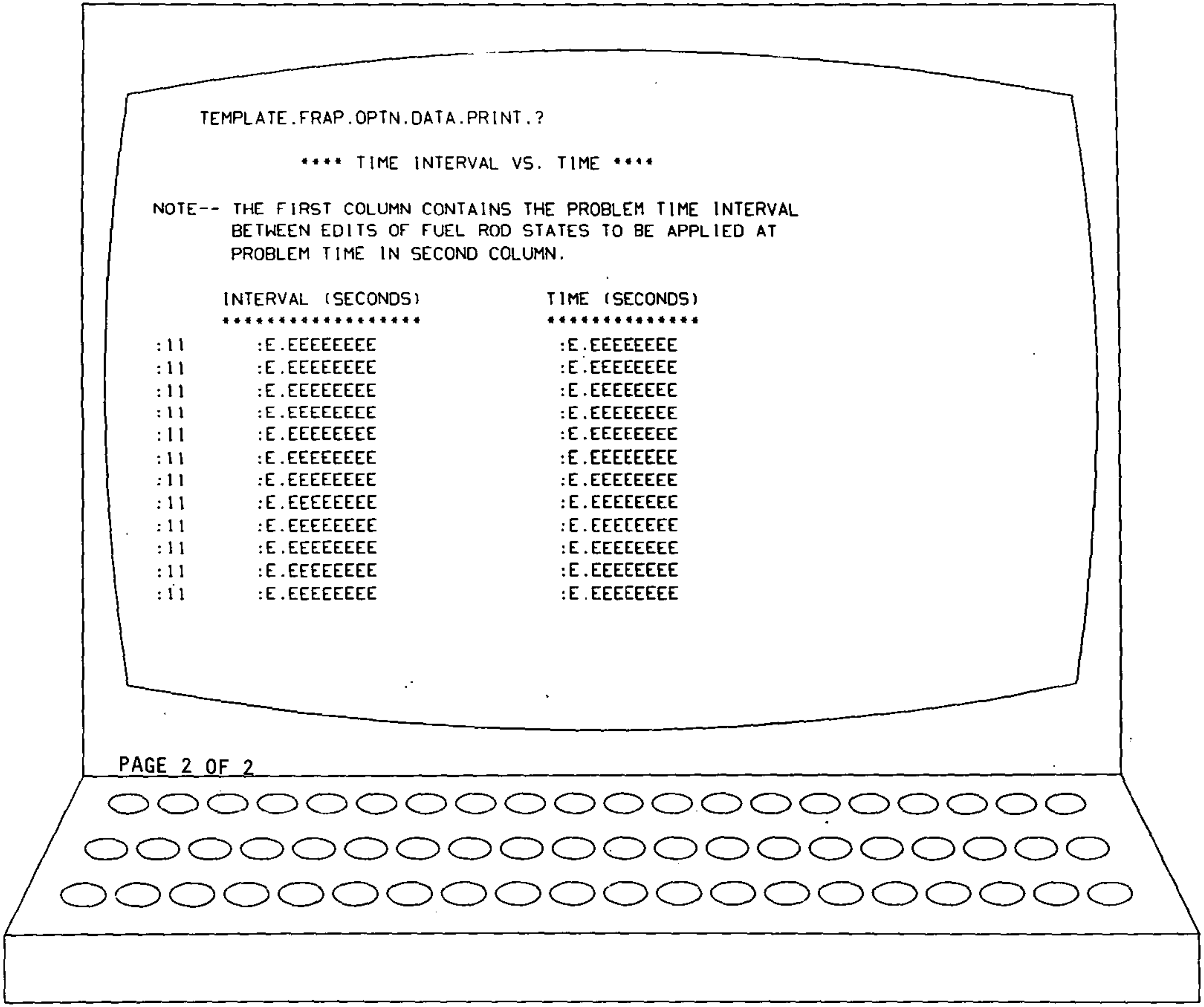
NUMBER OF MULTIPLIER - TIME PAIRS USED TO
SPECIFY HISTORY OF MULTIPLIER ON SURFACE HTC  (NPAIRS).....:II

TIME AT WHICH MODIFICATION OF
SURFACE HTC IS TO START  (TSHTC)....................:E.EEEEEEE
   (SECONDS)
```

PAGE 1 OF 2


TEMPLATE.FRAP.OPTN.DATA.SHTCBAL.?
NOTE-- THE FIRST COLUMN CONTAINS THE MULTIPLIER (FHTC(I)) AT AXIAL NODE KAXHTC AT TIME TSHTC+FHTC(I+1) WHERE FHTC(I+1) (SECOND COLUMN) IS THE TIME RELATIVE TO TSHTC AT WHICH FHTC(I) APPLIES. LINEAR INTERPOLATION DEFINES HISTORY AT INTERMEDIATE POINTS.
MULTIPLIER
****
TIME (SECONDS)
****
:11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE
PAGE 2 OF 2


TEMPLATE.FRAP.OPTN.DATA.PRINT.?
*** PRINTOUT TIME INTERVAL SPECIFICATION ***
NOTE-- THIS RECORD IS USED ONLY IF NPO>0 ON FOD.SWITCH.?CASE RECORD.
NUMBER OF PAIRS TO BE INPUT (NPO)........................:11
PAGE 1 OF 2


TEMPLATE.FRAP.OPTN.DATA.PRINT.?
**** TIME INTERVAL VS. TIME ****
NOTE-- THE FIRST COLUMN CONTAINS THE PROBLEM TIME INTERVAL
BETWEEN EDITS OF FUEL ROD STATES TO BE APPLIED AT
PROBLEM TIME IN SECOND COLUMN.
INTERVAL (SECONDS)
****
TIME (SECONDS)
****
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
:11 :E.EEEEEEEE :E.EEEEEEEE
PAGE 2 OF 2

```
    TEMPLATE.FRAP.OPTN.DATA.DIALS.?

                 *** CALCULATION DIALS ***

NOTE-- THIS RECORD USED ONLY IF NDIAL>0 ON FOD.SWITCH.?CASE
       RECORD. IT IS USED TO SPECIFY MODELS TO WHICH
       MULTIPLICATION OR ADDITION FACTORS ARE TO BE APPLIED.


DO YOU WANT TO ADJUST GAP CONDUCTANCE  (NDHGAP)............:A
CALCULATIONS?  (Y OR N)
DO YOU WANT TO ADJUST FUEL THERMAL  (NDFCON)...............:A
CONDUCTIVITY?  (Y OR N)
DO YOU WANT TO ADJUST TRANSITION FLOW FILM  (NDHFB1).......:A
BOILING HEAT TRANSFER COEFFICIENT?  (Y OR N)
DO YOU WANT TO ADJUST STABLE FLOW FILM  (NDHFB2)...........:A
BOILING HEAT TRANSFER COEFFICIENT?  (Y OR N)
DO YOU WANT TO ADJUST POOL FILM BOILING  (NDHFB3)..........:A
HEAT TRANSFER COEFFICIENT?  (Y OR N)
DO YOU WANT TO ADJUST FREE CONVECTION HEAT  (NDHFB4).......:A
TRANSFER COEFFICIENT?  (Y OR N)

PAGE 1 OF 1
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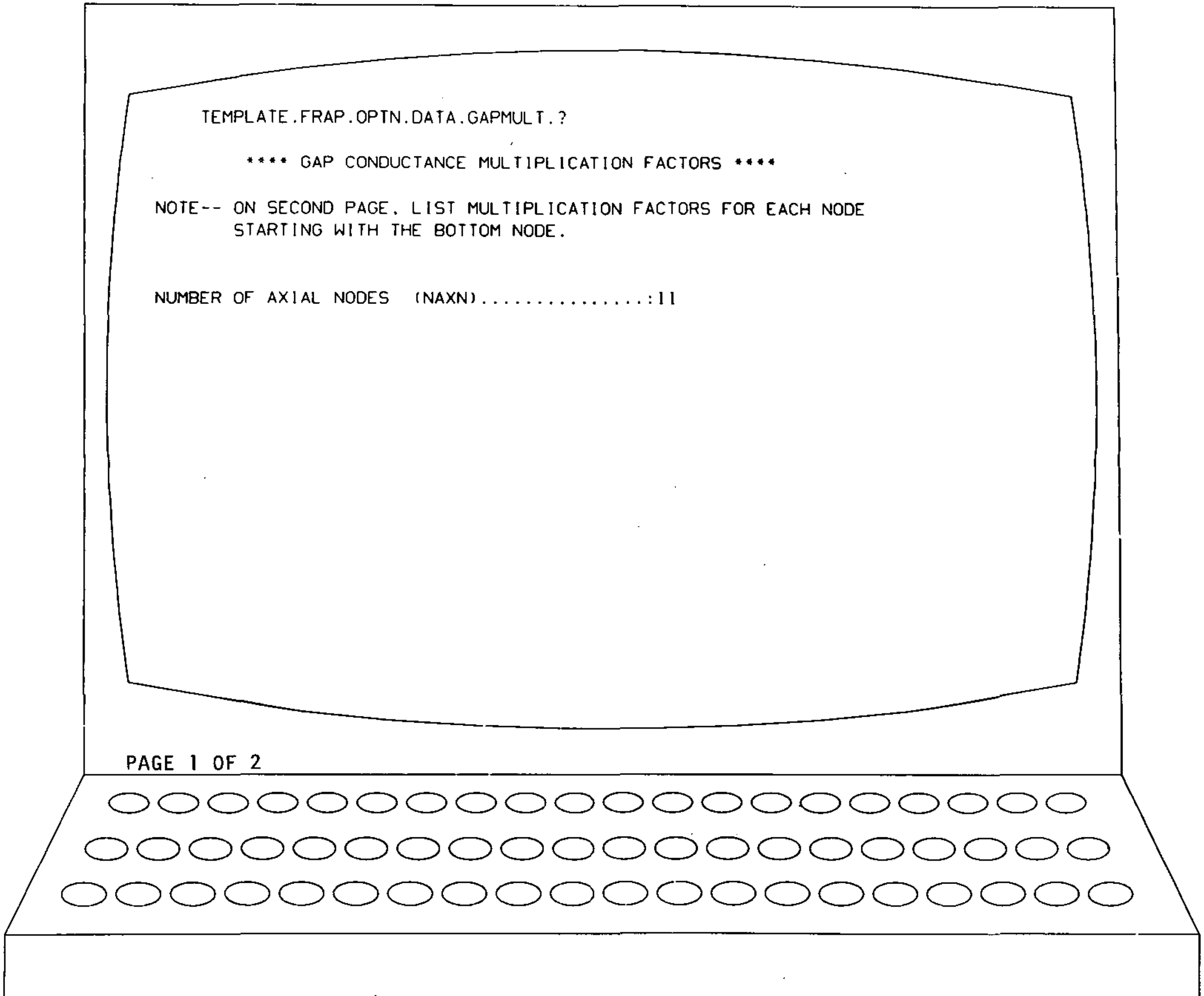
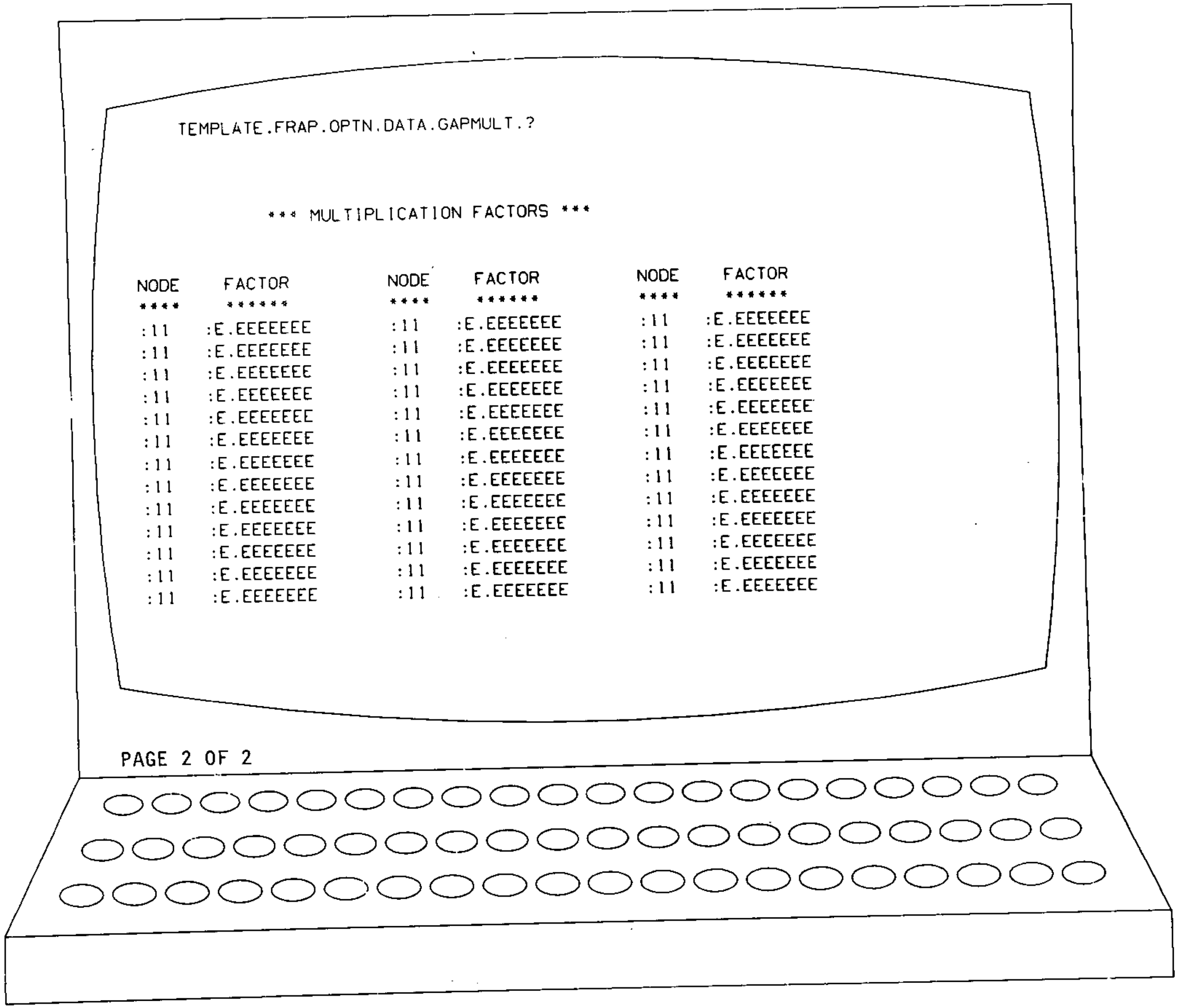

TEMPLATE.FRAP.OPTN.DATA.GAPMULT.?
**** GAP CONDUCTANCE MULTIPLICATION FACTORS ****
NOTE-- ON SECOND PAGE, LIST MULTIPLICATION FACTORS FOR EACH NODE
STARTING WITH THE BOTTOM NODE.
NUMBER OF AXIAL NODES (NAXN)...............:11
PAGE 1 OF 2


TEMPLATE.FRAP.OPTN.DATA.GAPMULT.?
*** MULTIPLICATION FACTORS ***
NODE FACTOR NODE FACTOR NODE FACTOR
**** ****** **** ****** **** ******
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
:11 :E.EEEEEEE :11 :E.EEEEEEE :11 :E.EEEEEEE
PAGE 2 OF 2

```
    TEMPLATE.FRAP.OPTN.DATA.MULTFAC.?

         *** ADDITION AND MULTIPLICATION FACTORS ***

ADDITION TERM TO FUEL THERMAL CONDUCTIVITY  (FFCON)..:E.EEEEEEE
    (WATTS/M-K)  (IGNORE IF NDFCON=0 ON FOD.DIALS.?CASE
                  RECORD)
MULTIPLICATION FACTOR TO BE APPLIED TO  (FHFB1)......:E.EEEEEEE
TRANSITION FLOW FILM BOILING HEAT TRANSFER COEFFICIENT
    (IGNORE IF NDHFB1=0 ON FOD.DIALS.?CASE RECORD)
MULTIPLICATION FACTOR TO BE APPLIED TO  (FHFB2)......:E.EEEEEEE
STABLE FLOW FILM BOILING HEAT TRANSFER COEFFICIENT
    (IGNORE IF NDHFB2=0 ON FOD.DIALS.?CASE RECORD)
MULTIPLICATION FACTOR TO BE APPLIED TO  (FHFB3)......:E.EEEEEEE
POOL FILM BOILING HEAT TRANSFER COEFFICIENT
    (IGNORE IF NDHFB3=0 ON FOD.DIALS.?CASE RECORD)
MULTIPLICATION FACTOR TO BE APPLIED TO  (FHFB4)......:E.EEEEEEE
FREE CONVECTION HEAT TRANSFER COEFFICIENT
    (IGNORE IF NDHFB4=0 ON FOD.DIALS.?CASE RECORD)

PAGE 1 OF 1
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```
TEMPLATE.FRAP.OPTN.DATA.REFLOOD.SPECS.?

FLECHT CORRELATION SPECIFICATION  (NFLEC)............:1

PROBLEM TIME AT WHICH THE CORE IS DRY AND
BEGINS ADIABATIC HEATUP (SEC) ............(EMPYTM)...:E.EEEEEEEE

PROBLEM TIME AT THE INITIATION OF
REFLOOD  (SEC) ..........................(REFDTM)...:E.EEEEEEEE

DO YOU WANT THE CODE TO CALCULATE THE
RADIATION HEAT TRANSFER COEFFICIENT? (Y OR N)........:A

RADIATION HEAT TRANSFER COEFFICIENT ......(HRAD).....:E.EEEEEEEE
(BTU/HR-FT**2-F) (IGNORE IF CODE WILL CALCULATE IT)

LINE OF DEMARCATION .....................(LODMRK)...:AAAA
(RUPT= RUPTURE PLANE;,LIQL= LIQUID LEVEL)

FLOW CHANNEL HYDRAULIC DIAMETER (FT)......(HYDIAM)...:E.EEEEEEEE

FLOW CHANNEL AREA PER FUEL ROD (FT**2) ...(FLXSEC)...:E.EEEEEEEE

PAGE 1 OF 1
```

TEMPLATE.FRAP.OPTN.DATA.REFLOOD.PARAMS.?

**** REFLOOD PARAMETERS RECORD ****

NUMBER OF TEMPERATURE-TIME PAIRS (NBR1)= :III

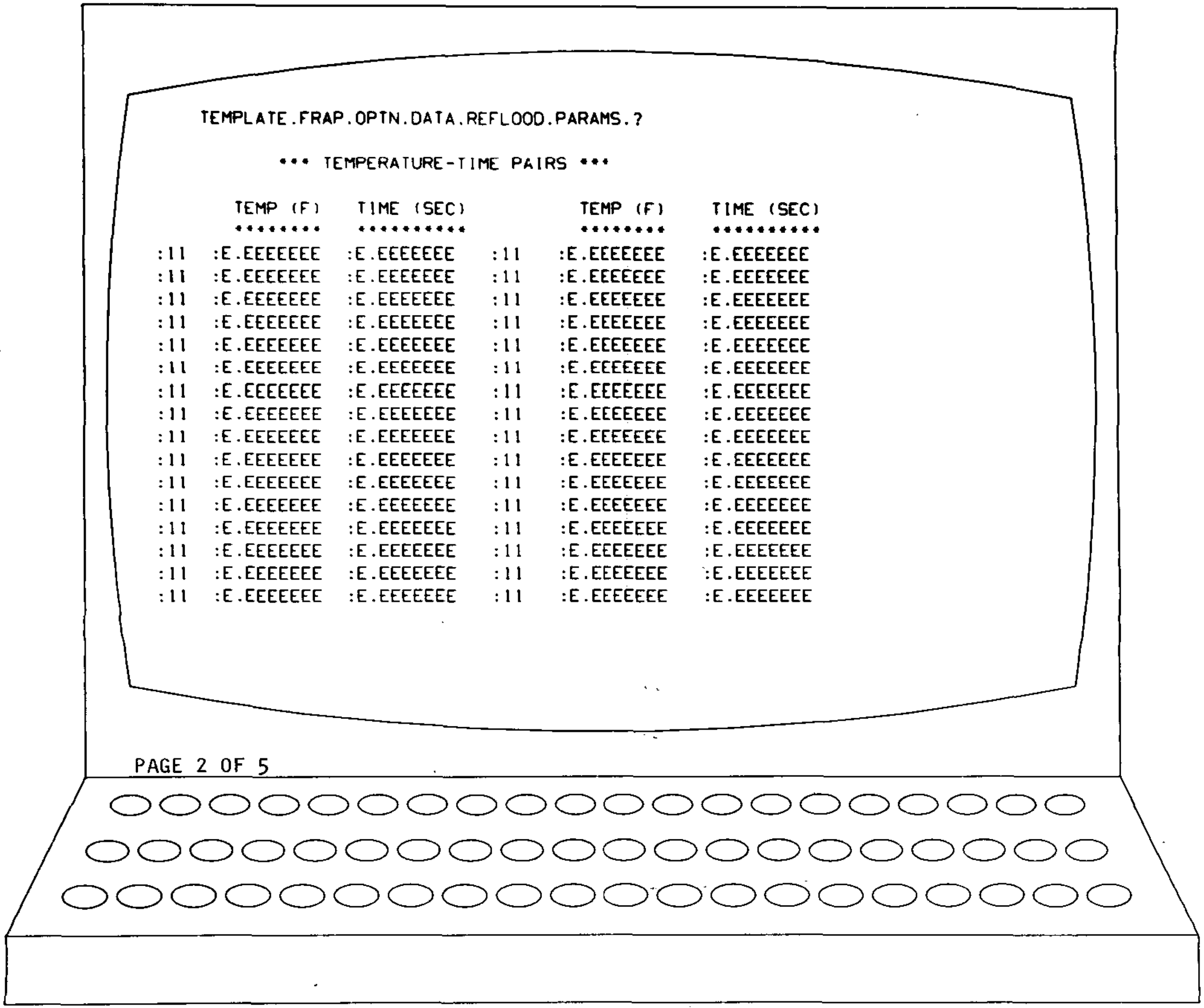
NUMBER OF FLOOD RATE-TIME PAIRS (NBR2)= :III

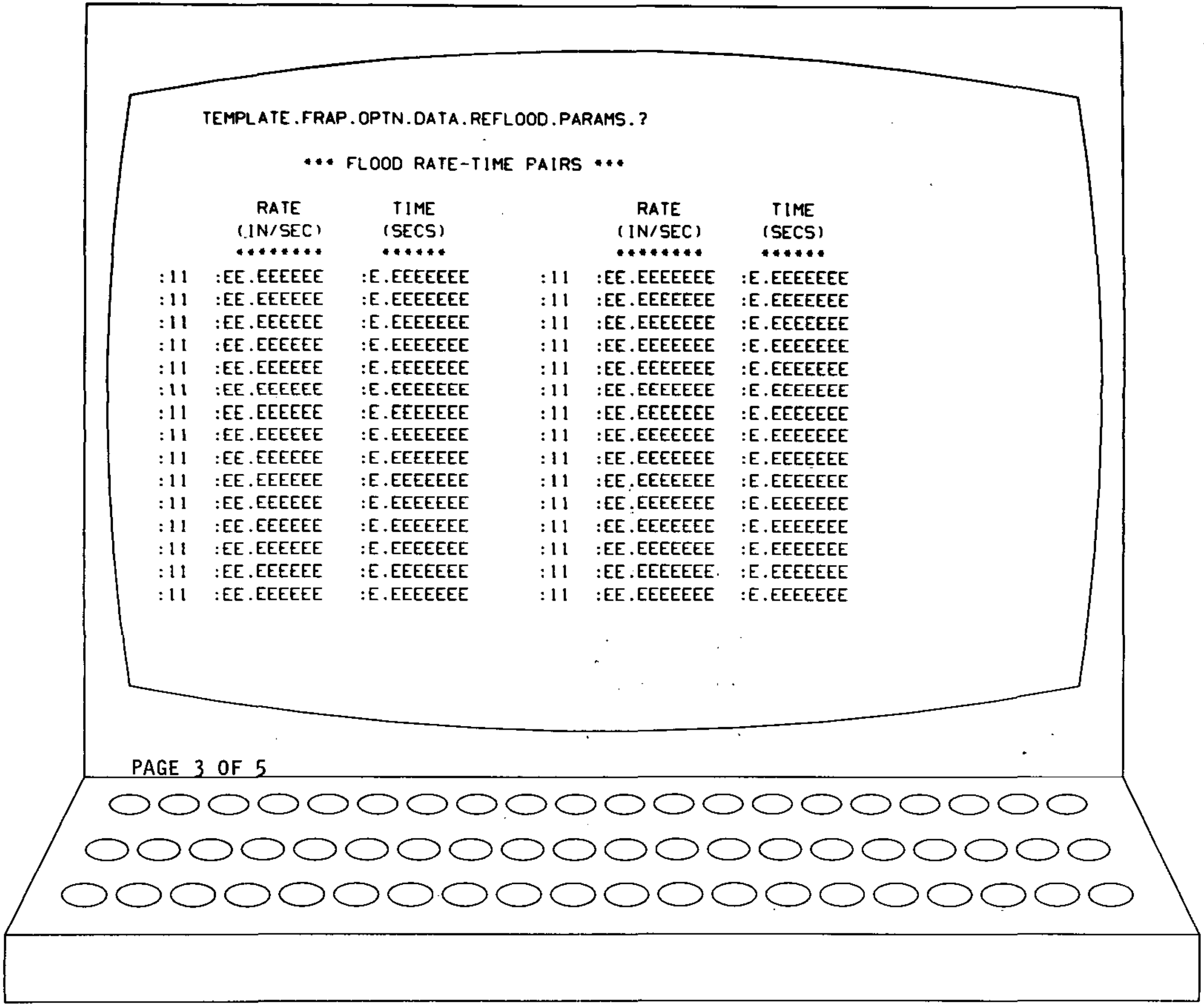
NUMBER OF PRESSURE-TIME PAIRS (NBR4)= :III

NUMBER OF COLLAPSED LEVEL-TIME PAIRS (NBR5)= :III
(NECESSARY ONLY IF USING LIN GENERALIZED
FLECHT CORRELATION (NFLEC=0))

```
***************************************************************
******* NOTE--- ALL TIMES ON SUCCEEDING PAGES REFER TO ********
*******        TIME FROM BEGINNING OF REFLOOD-- NOT   ********
*******        TIME FROM BEGINNING OF PROBLEM.        ********
***************************************************************
```

PAGE 1 OF 5


TEMPLATE.FRAP.OPTN.DATA.REFLOOD.PARAMS.?
*** TEMPERATURE-TIME PAIRS ***
TEMP (F) TIME (SEC) TEMP (F) TIME (SEC)
******** ********** ******** **********
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
PAGE 2 OF 5

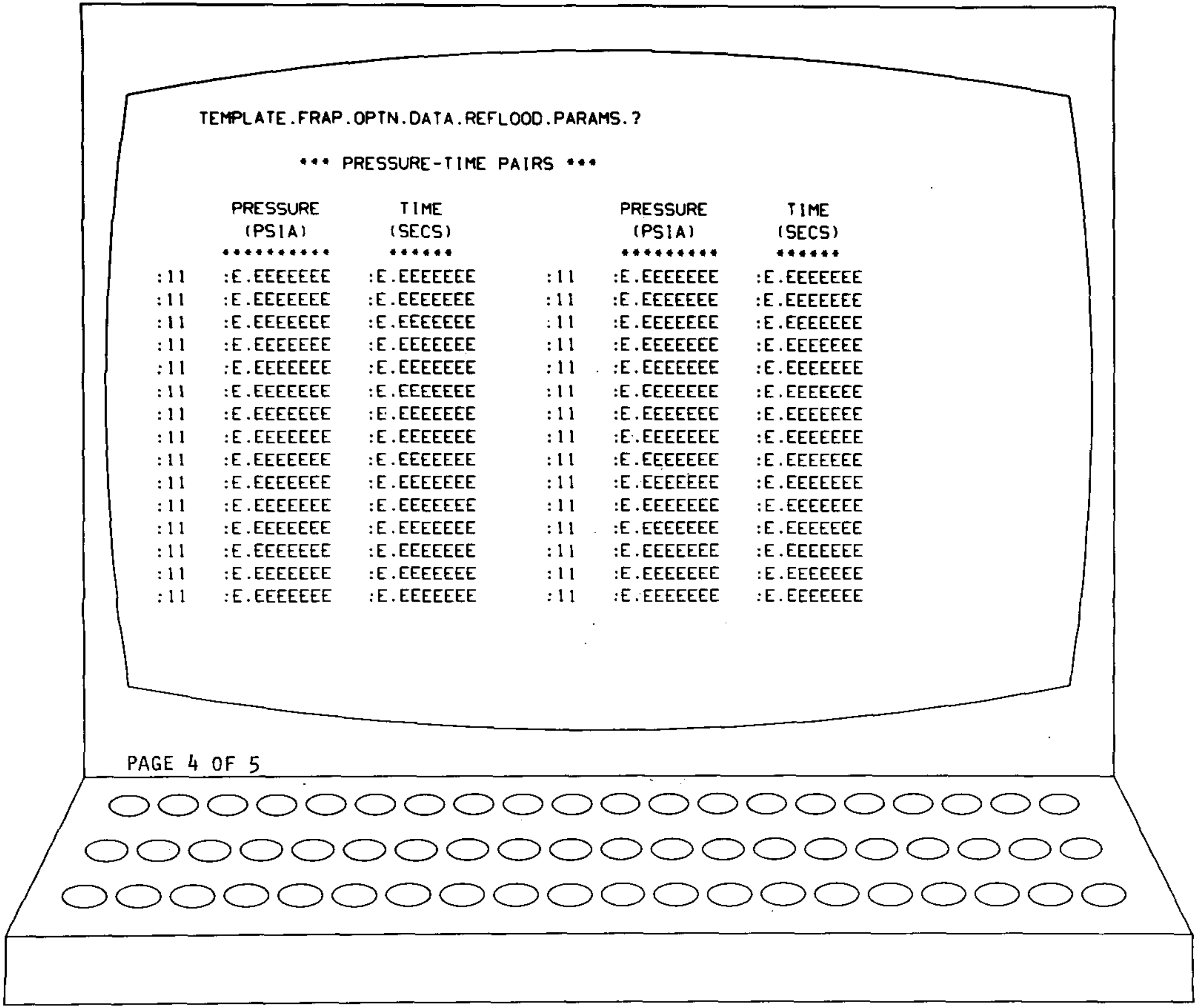


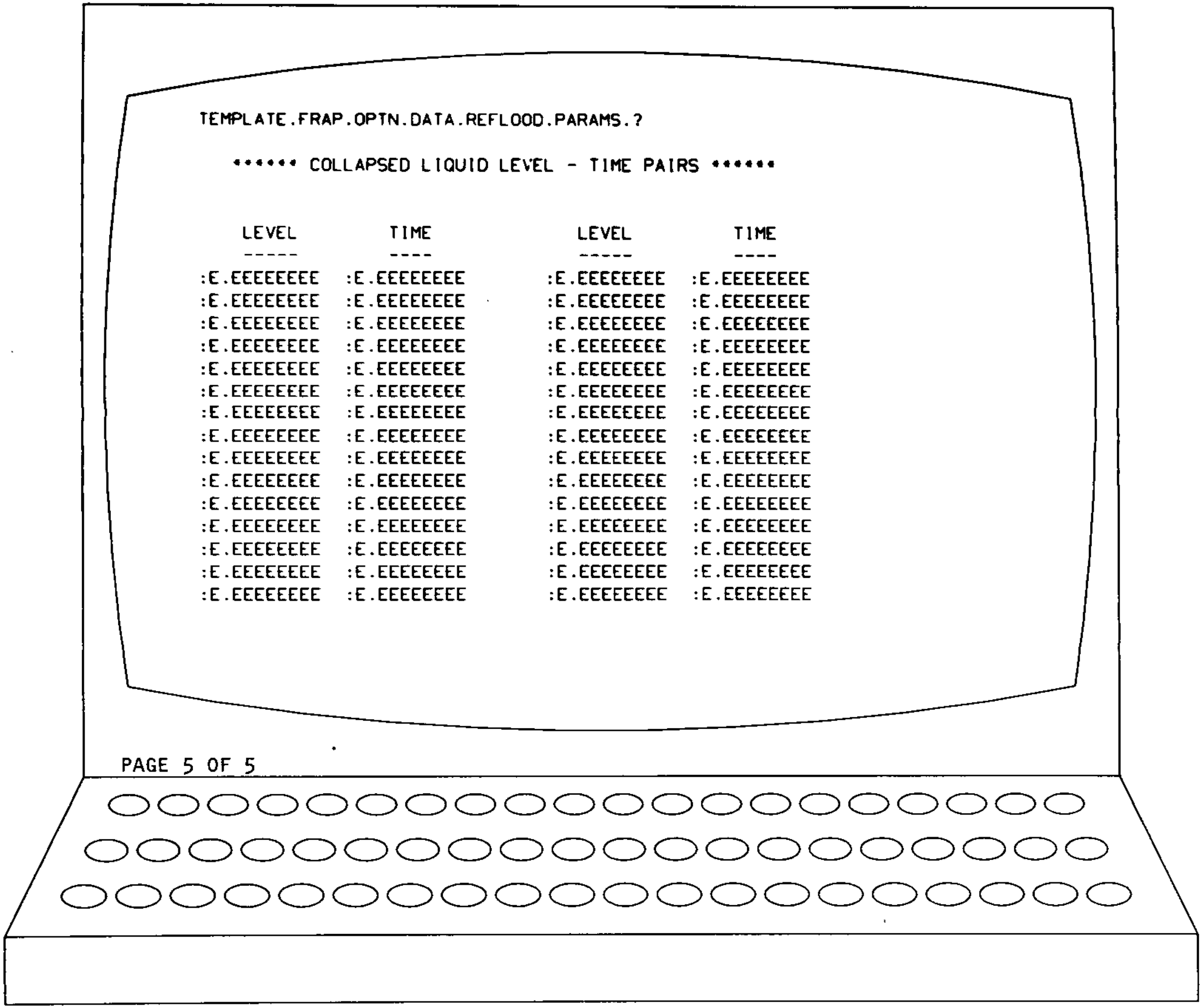
```
TEMPLATE.FRAP.OPTN.DATA.REFLOOD.PARAMS.?

          *** FLOOD RATE-TIME PAIRS ***

        RATE        TIME                 RATE        TIME
      (IN/SEC)     (SECS)              (IN/SEC)     (SECS)
      ********     ******              ********     ******
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
:11  :EE.EEEEEE  :E.EEEEEEE     :11  :EE.EEEEEEE  :E.EEEEEEE
```

PAGE 3 OF 5


TEMPLATE.FRAP.OPTN.DATA.REFLOOD.PARAMS.?
*** PRESSURE-TIME PAIRS ***
PRESSURE (PSIA) TIME (SECS) PRESSURE (PSIA) TIME (SECS)
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
:11 :E.EEEEEEE :E.EEEEEEE :11 :E.EEEEEEE :E.EEEEEEE
PAGE 4 OF 5



TEMPLATE.FRAP.OPTN.DATA.REFLOOD.PARAMS.?

****** COLLAPSED LIQUID LEVEL - TIME PAIRS ******

LEVEL	TIME	LEVEL	TIME
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE
:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE	:E.EEEEEEEE

PAGE 5 OF 5

```
TEMPLATE.FRAP.OPTN.DATA.ANSDEC.?

      ***** ANS DECAY HEAT FORMULA PARAMETERS *****

NOTE-- THIS RECORD IS USED ONLY IF MPDCAY ON FBD.PPROB.?CASE
       RECORD IS NOT ZERO.


AVERAGE LINEAR POWER JUST PRIOR TO  (POWOP)........:E.EEEEEEE
ACCIDENT INITIATION (KW/FT OR KW/M)

TIME SPAN FOR WHICH FUEL ROD WAS AT  (TIMOP).......:E.EEEEEEE
OPERATING POWER (SECONDS)

FACTOR APPLIED TO POWER GIVEN BY ANS  (FPDCAY).....:E.EEEEEEE
DECAY HEAT FORMULA
```

PAGE 1 OF 1

TEMPLATE.FRAP.OPTN.DATA.AZIMPOW.?

**** AZIMUTHAL POWER DESCRIPTION ****

NOTE-- USED ONLY IF NDIM>0 ON FBD.PROB.?CASE RECORD.

NUMBER OF RADIAL POWER PROFILE DISTRIBUTIONS (NAAZP).......:II
AS A FUNCTION OF AZIMUTHAL ANGLE TO SPECIFY
AZIMUTHAL POWER VARIATION (NAAZP<11)

NUMBER OF PAIRS OF RELATIVE POWER VS RADIUS (NRAZP).......:II
IN EACH RADIAL POWER PROFILE (2<NRAZP<16)

NOTE-- EACH FOLLOWING PAGE CONTAINS INFORMATION ON ONE RADIAL
POWER PROFILE.

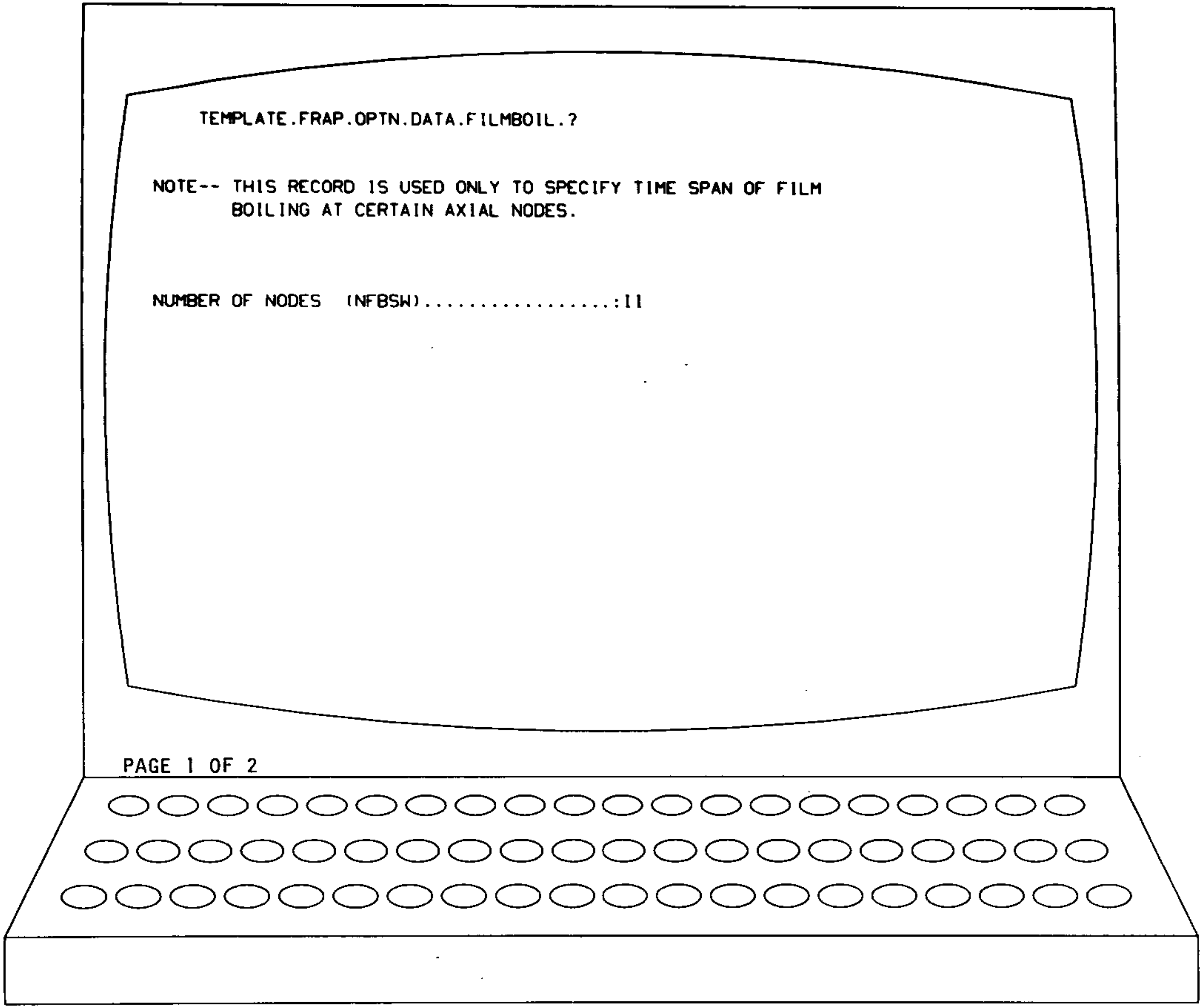
PAGE 1 OF 2

```
    TEMPLATE.FRAP.OPTN.DATA.AZIMPOW.?

AZIMUTHAL ANGLE OF RADIAL POWER PROFILE NUMBER :11 ...:E.EEEEEEE
   (DEGREES)
   (FIRST ANGLE MUST BE 0.00; LAST ANGLE MUST BE 90.
    DEGREES IF NSYMM=0 ON FOD.TWODHT.?CASE RECORD OR
    180. DEGREES IF NSYMM=1)


          RADIAL POWER FACTOR          RADIUS (FT OR M)
          *******************          ****************
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
:22          :E.EEEEEEE                   :E.EEEEEEE
```

PAGE 2 OF 2


TEMPLATE.FRAP.OPTN.DATA.FILMBOIL.?
NOTE-- THIS RECORD IS USED ONLY TO SPECIFY TIME SPAN OF FILM
BOILING AT CERTAIN AXIAL NODES.
NUMBER OF NODES (NFBSW)..................:11
PAGE 1 OF 2

```
    TEMPLATE.FRAP.OPTN.DATA.FILMBOIL.?

NOTE-- TIME IS IN SECONDS.

        NODE NUMBER        START TIME        END TIME
        ***********        **********        ********
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE
:II          :II           :E.EEEEEEEE       :E.EEEEEEEE

PAGE 2 OF 2
```

```
TEMPLATE.FRAP.OPTN.DATA.FLOWCHNL.?

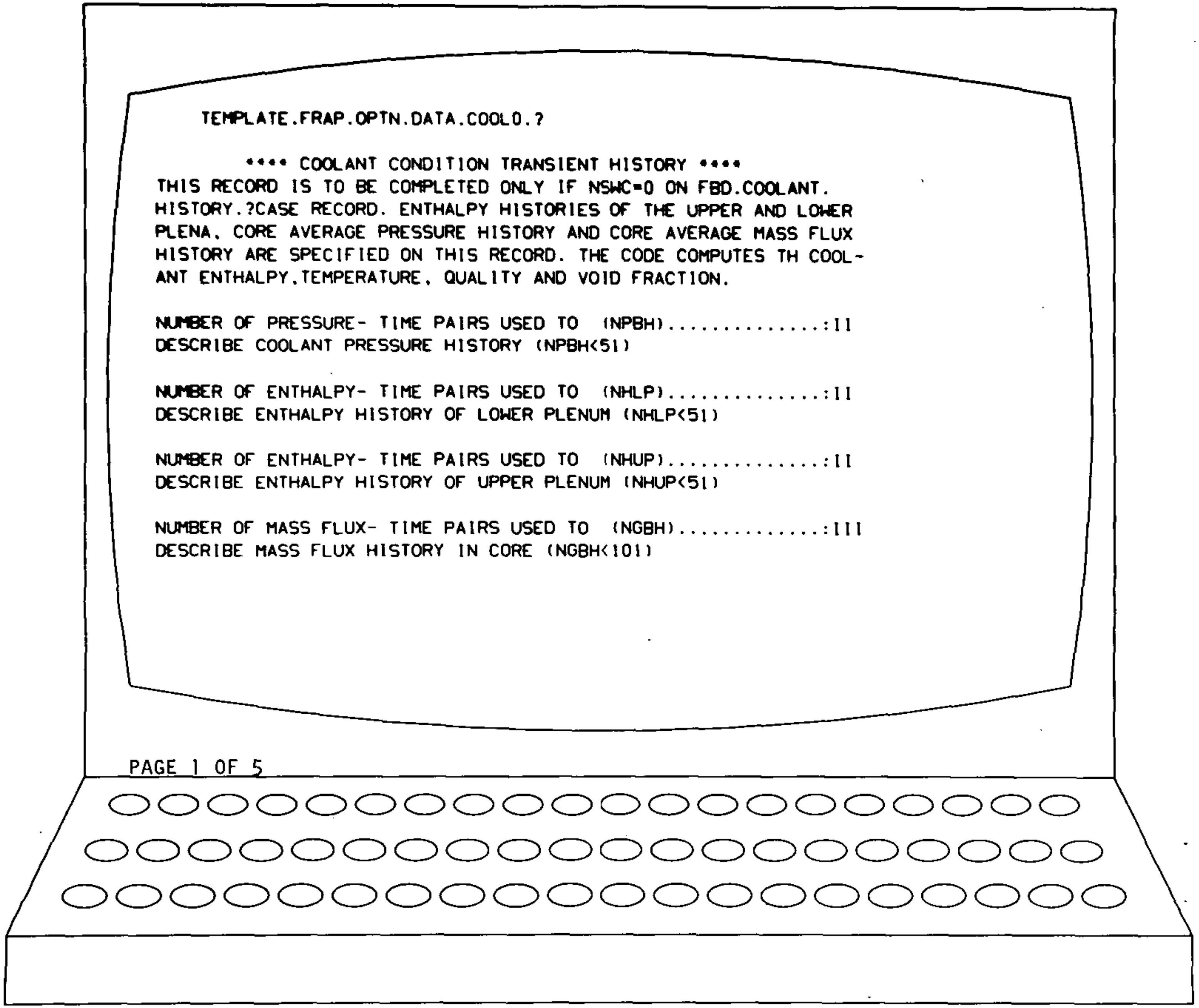
          **** FLOW CHANNEL DATA ****

HEATED EQUIVALENT DIAMETER OF FLOW CHANNEL  (DHE)...:E.EEEEEEEEE
    (DHE=4*FLOW AREA/HEATED PERIMETER) (FT OR M)

HYDRAULIC DIAMETER OF FLOW CHANNEL  (DHY)...........:E.EEEEEEEEE
    (DHY=4*FLOW AREA/WETTED PERIMETER) (FT OR M)

CROSS SECTIONAL AREA OF FLOW CHANNEL  (ACHN)........:E.EEEEEEEEE
    (FT**2 OR M**2)

PAGE 1 OF 1
```


TEMPLATE.FRAP.OPTN.DATA.COOL0.?
**** COOLANT CONDITION TRANSIENT HISTORY ****
THIS RECORD IS TO BE COMPLETED ONLY IF NSWC=0 ON FBD.COOLANT. HISTORY.?CASE RECORD. ENTHALPY HISTORIES OF THE UPPER AND LOWER PLENA, CORE AVERAGE PRESSURE HISTORY AND CORE AVERAGE MASS FLUX HISTORY ARE SPECIFIED ON THIS RECORD. THE CODE COMPUTES TH COOL- ANT ENTHALPY,TEMPERATURE, QUALITY AND VOID FRACTION.
NUMBER OF PRESSURE- TIME PAIRS USED TO (NPBH)..............:II
DESCRIBE COOLANT PRESSURE HISTORY (NPBH<51)
NUMBER OF ENTHALPY- TIME PAIRS USED TO (NHLP)..............:II
DESCRIBE ENTHALPY HISTORY OF LOWER PLENUM (NHLP<51)
NUMBER OF ENTHALPY- TIME PAIRS USED TO (NHUP)..............:II
DESCRIBE ENTHALPY HISTORY OF UPPER PLENUM (NHUP<51)
NUMBER OF MASS FLUX- TIME PAIRS USED TO (NGBH).............:III
DESCRIBE MASS FLUX HISTORY IN CORE (NGBH<101)
PAGE 1 OF 5

TEMPLATE.FRAP.OPTN.DATA.COOLO.?

**** PRESSURE HISTORY OF COOLANT ****

NOTE-- PRESSURE HAS UNITS OF PSIA OR N/M**2
TIME HAS UNITS OF SECONDS

	PRESSURE ********	TIME ****		PRESSURE ********	TIME ****
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE

PAGE 2 OF 5

```
TEMPLATE.FRAP.OPTN.DATA.COOLO.?

     **** ENTHALPY HISTORY OF LOWER PLENUM ****

NOTE-- LOWER PLENUM CONTAINS THE COOLANT SURROUNDING THE BOTTOM
       OF THE FUEL RODS. ENTHALPY HAS UNITS OF BTU/LBM OR
       J/KG. TIME HAS UNITS OF SECONDS.

         ENTHALPY       TIME              ENTHALPY     TIME
         ********       ****              ********     ****
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE
:II   :E.EEEEEEEE  :E.EEEEEEEE  :II  :E.EEEEEEEE  :E.EEEEEEEE

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```

```
     TEMPLATE.FRAP.OPTN.DATA.COOL0.?

            **** ENTHALPY HISTORY OF UPPER PLENUM ****

NOTE-- UPPER PLENUM CONTAINS THE COOLANT SURROUNDING THE TOP OF
       THE FUEL RODS. ENTHALPY HAS UNITS OF BTU/LBM OR J/KG.
       TIME HAS UNITS OF SECONDS.

        ENTHALPY          TIME           ENTHALPY       TIME
        ********          ****           ********       ****
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
:11  :E.EEEEEEEE   :E.EEEEEEEE  :11  :E.EEEEEEEE  :E.EEEEEEEE
```

PAGE 4 OF 5

```
TEMPLATE.FRAP.OPTN.DATA.COOLO.?

        **** MASS FLUX HISTORY OF COOLANT ****

NOTE-- MASS FLUX HAS UNITS OF LBM/HR-FT**2 OR KG/SEC-M**2.
       TIME HAS UNITS OF SECONDS.


       MASS FLUX        TIME            MASS FLUX       TIME
       *********        ****            *********       ****
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
:11   :E.EEEEEEEE   :E.EEEEEEEE   :11  :E.EEEEEEEE   :E.EEEEE
```

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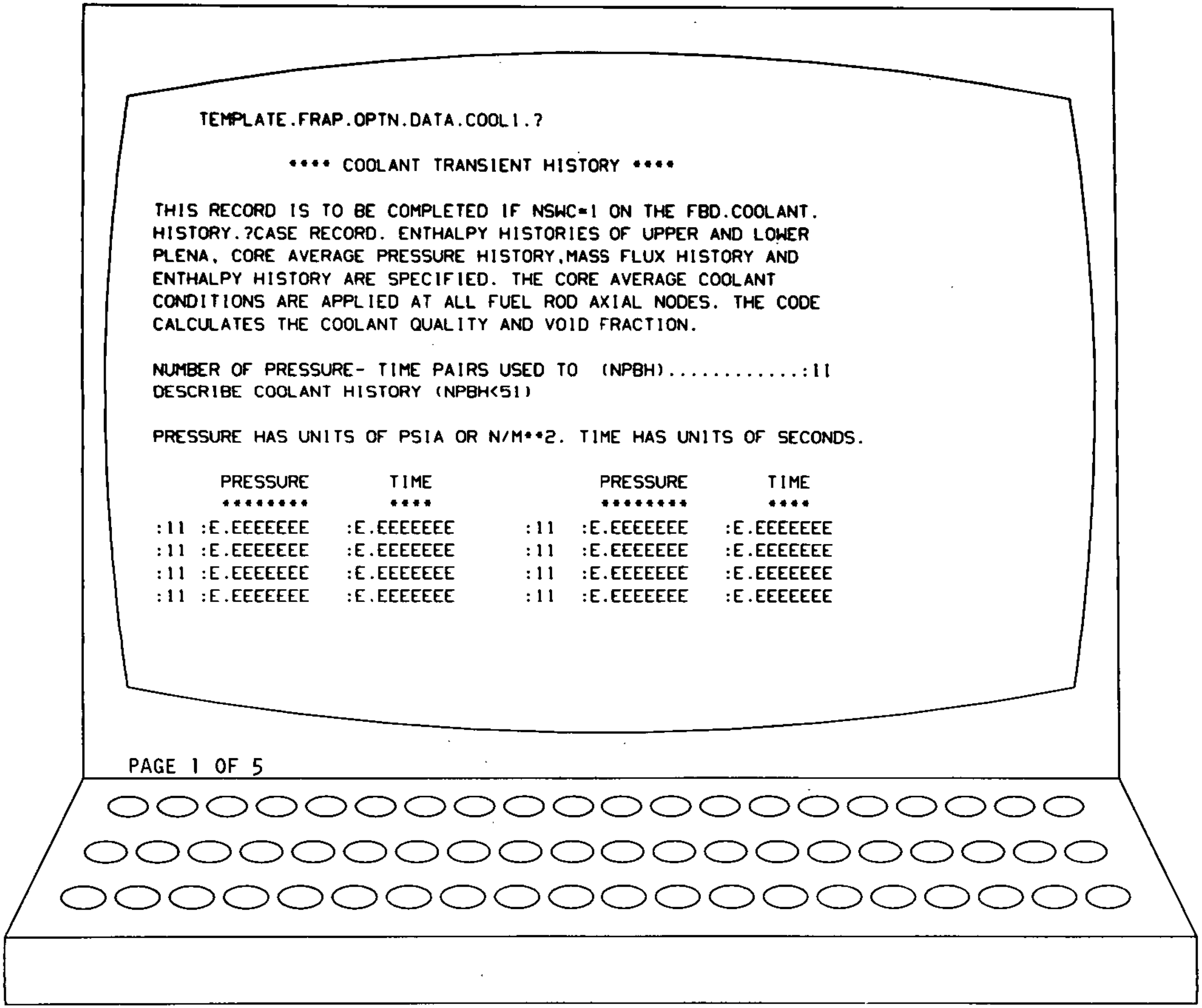
TEMPLATE.FRAP.OPTN.DATA.COOL1.?
**** COOLANT TRANSIENT HISTORY ****
THIS RECORD IS TO BE COMPLETED IF NSWC=1 ON THE FBD.COOLANT.
HISTORY.?CASE RECORD. ENTHALPY HISTORIES OF UPPER AND LOWER
PLENA, CORE AVERAGE PRESSURE HISTORY,MASS FLUX HISTORY AND
ENTHALPY HISTORY ARE SPECIFIED. THE CORE AVERAGE COOLANT
CONDITIONS ARE APPLIED AT ALL FUEL ROD AXIAL NODES. THE CODE
CALCULATES THE COOLANT QUALITY AND VOID FRACTION.
NUMBER OF PRESSURE- TIME PAIRS USED TO (NPBH)............:II
DESCRIBE COOLANT HISTORY (NPBH<51)
PRESSURE HAS UNITS OF PSIA OR N/M**2. TIME HAS UNITS OF SECONDS.
PRESSURE TIME PRESSURE TIME
******** **** ******** ****
:II :E.EEEEEEE :E.EEEEEEE :II :E.EEEEEEE :E.EEEEEEE
:II :E.EEEEEEE :E.EEEEEEE :II :E.EEEEEEE :E.EEEEEEE
:II :E.EEEEEEE :E.EEEEEEE :II :E.EEEEEEE :E.EEEEEEE
:II :E.EEEEEEE :E.EEEEEEE :II :E.EEEEEEE :E.EEEEEEE
PAGE 1 OF 5

TEMPLATE.FRAP.OPTN.DATA.COOL1.?

**** ENTHALPY HISTORY OF LOWER PLENUM ****

NOTE-- LOWER PLENUM CONTAINS COOLANT SURROUNDING BOTTOM OF FUEL RODS. ENTHALPY HAS UNITS OF BTU/LBM OR J/KG. TIME HAS UNITS OF SECONDS.

NUMBER OF ENTHALPY- TIME PAIRS USED TO (NHLP).............:11
DESCRIBE ENTHALPY HISTORY OF LOWER PLENUM (NHLP<51)

	ENTHALPY	TIME		ENTHALPY	TIME
	********	****		********	****
:11	:E.EEEEEEE	:E.EEEEEEE	:11	:E.EEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEE	:E.EEEEEEE	:11	:E.EEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEE	:E.EEEEEEE	:11	:E.EEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEE	:E.EEEEEEE	:11	:E.EEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEE	:E.EEEEEEE	:11	:E.EEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEE	:E.EEEEEEE	:11	:E.EEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEE	:E.EEEEEEE	:11	:E.EEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEE	:E.EEEEEEE	:11	:E.EEEEEEE	:E.EEEEEEE

PAGE 2 OF 5

```
    TEMPLATE.FRAP.OPTN.DATA.COOL1.?

          **** ENTHALPY HISTORY OF UPPER PLENUM ***

NOTE-- UPPER PLENUM CONTAINS THE COOLANT SURROUNDING THE TOP OF
       THE FUEL RODS. ENTHALPY HAS UNITS OF BTU/LBM OR J/KG.
       TIME HAS UNITS OF SECONDS.

NUMBER OF ENTHALPY- TIME PAIRS USED TO  (NHUP).............:11
DESCRIBE ENTHALPY HISTORY OF UPPER PLENUM (NHUP<51)


        ENTHALPY      TIME              ENTHALPY      TIME
        ********      ****              ********      ****
:11   :E.EEEEEEE   :E.EEEEEEE     :11  :E.EEEEEEE   :E.EEEEEEE
:11   :E.EEEEEEE   :E.EEEEEEE     :11  :E.EEEEEEE   :E.EEEEEEE
:11   :E.EEEEEEE   :E.EEEEEEE     :11  :E.EEEEEEE   :E.EEEEEEE
:11   :E.EEEEEEE   :E.EEEEEEE     :11  :E.EEEEEEE   :E.EEEEEEE
:11   :E.EEEEEEE   :E.EEEEEEE     :11  :E.EEEEEEE   :E.EEEEEEE
:11   :E.EEEEEEE   :E.EEEEEEE     :11  :E.EEEEEEE   :E.EEEEEEE
:11   :E.EEEEEEE   :E.EEEEEEE     :11  :E.EEEEEEE   :E.EEEEEEE
:11   :E.EEEEEEE   :E.EEEEEEE     :11  :E.EEEEEEE   :E.EEEEEEE

PAGE 3 OF 5
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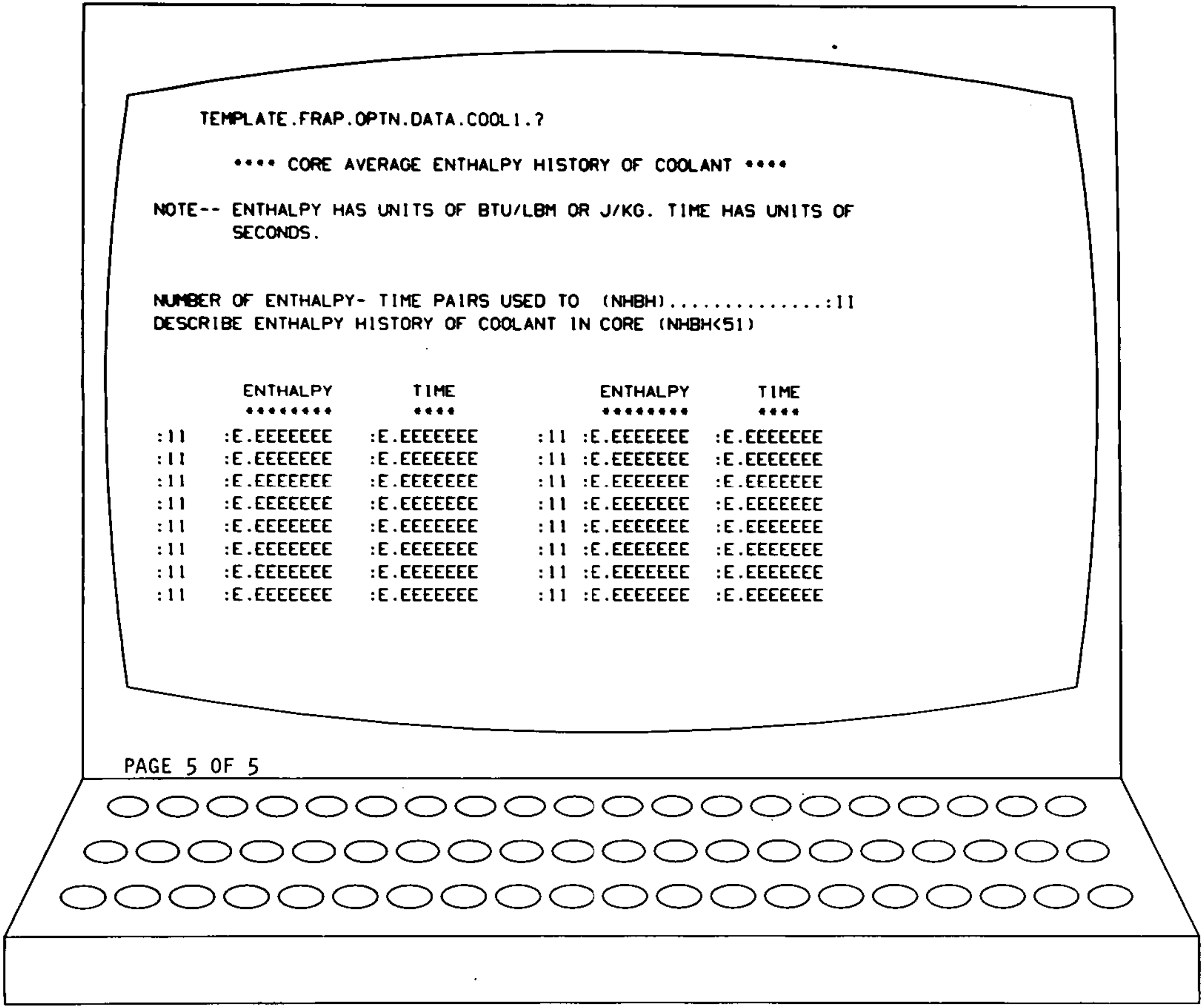
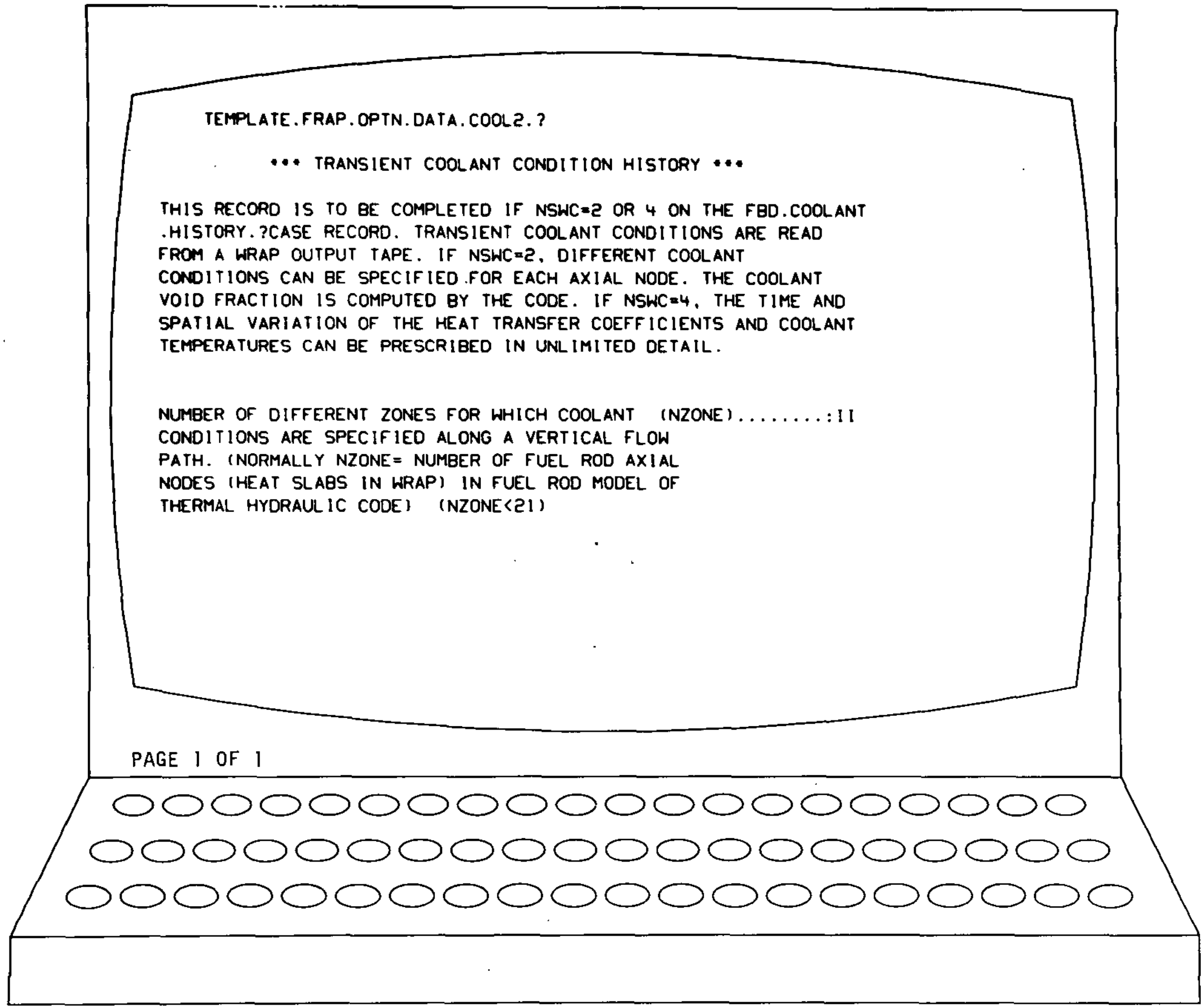
```
    TEMPLATE.FRAP.OPTN.DATA.COOL1.?

             **** MASS FLUX HISTORY OF COOLANT ****

NOTE-- MASS FLUX HAS UNITS OF LBM/HR-FT**2 OR KG/SEC-M**2.
       TIME HAS UNITS OF SECONDS.

NUMBER OF MASS FLUX- TIME PAIRS USED TO  (NGBH).............:II
DESCRIBE MASS FLUX HISTORY IN CORE (NGBH<51)


      MASS FLUX       TIME              MASS FLUX       TIME
      *********       ****              *********       ****
:II  :E.EEEEEEE  :E.EEEEEEE     :II  :E.EEEEEEE  :E.EEEEEEE
:II  :E.EEEEEEE  :E.EEEEEEE     :II  :E.EEEEEEE  :E.EEEEEEE
:II  :E.EEEEEEE  :E.EEEEEEE     :II  :E.EEEEEEE  :E.EEEEEEE
:II  :E.EEEEEEE  :E.EEEEEEE     :II  :E.EEEEEEE  :E.EEEEEEE
:II  :E.EEEEEEE  :E.EEEEEEE     :II  :E.EEEEEEE  :E.EEEEEEE
:II  :E.EEEEEEE  :E.EEEEEEE     :II  :E.EEEEEEE  :E.EEEEEEE
:II  :E.EEEEEEE  :E.EEEEEEE     :II  :E.EEEEEEE  :E.EEEEEEE
:II  :E.EEEEEEE  :E.EEEEEEE     :II  :E.EEEEEEE  :E.EEEEEEE
:II  :E.EEEEEEE  :E.EEEEEEE     :II  :E.EEEEEEE  :E.EEEEEEE

PAGE 4 OF 5
```



```
TEMPLATE.FRAP.OPTN.DATA.COOL1.?

     **** CORE AVERAGE ENTHALPY HISTORY OF COOLANT ****

NOTE-- ENTHALPY HAS UNITS OF BTU/LBM OR J/KG. TIME HAS UNITS OF
       SECONDS.


NUMBER OF ENTHALPY- TIME PAIRS USED TO  (NHBH)..............:II
DESCRIBE ENTHALPY HISTORY OF COOLANT IN CORE (NHBH<51)


          ENTHALPY       TIME              ENTHALPY     TIME
          ********       ****              ********     ****
:II    :E.EEEEEEE    :E.EEEEEEE     :II  :E.EEEEEEE   :E.EEEEEEE
:II    :E.EEEEEEE    :E.EEEEEEE     :II  :E.EEEEEEE   :E.EEEEEEE
:II    :E.EEEEEEE    :E.EEEEEEE     :II  :E.EEEEEEE   :E.EEEEEEE
:II    :E.EEEEEEE    :E.EEEEEEE     :II  :E.EEEEEEE   :E.EEEEEEE
:II    :E.EEEEEEE    :E.EEEEEEE     :II  :E.EEEEEEE   :E.EEEEEEE
:II    :E.EEEEEEE    :E.EEEEEEE     :II  :E.EEEEEEE   :E.EEEEEEE
:II    :E.EEEEEEE    :E.EEEEEEE     :II  :E.EEEEEEE   :E.EEEEEEE
:II    :E.EEEEEEE    :E.EEEEEEE     :II  :E.EEEEEEE   :E.EEEEEEE
```

PAGE 5 OF 5



TEMPLATE.FRAP.OPTN.DATA.COOL2.?

*** TRANSIENT COOLANT CONDITION HISTORY ***

THIS RECORD IS TO BE COMPLETED IF NSWC=2 OR 4 ON THE FBD.COOLANT .HISTORY.?CASE RECORD. TRANSIENT COOLANT CONDITIONS ARE READ FROM A WRAP OUTPUT TAPE. IF NSWC=2, DIFFERENT COOLANT CONDITIONS CAN BE SPECIFIED FOR EACH AXIAL NODE. THE COOLANT VOID FRACTION IS COMPUTED BY THE CODE. IF NSWC=4, THE TIME AND SPATIAL VARIATION OF THE HEAT TRANSFER COEFFICIENTS AND COOLANT TEMPERATURES CAN BE PRESCRIBED IN UNLIMITED DETAIL.

NUMBER OF DIFFERENT ZONES FOR WHICH COOLANT (NZONE)........:II
CONDITIONS ARE SPECIFIED ALONG A VERTICAL FLOW
PATH. (NORMALLY NZONE= NUMBER OF FUEL ROD AXIAL
NODES (HEAT SLABS IN WRAP) IN FUEL ROD MODEL OF
THERMAL HYDRAULIC CODE) (NZONE<21)

PAGE 1 OF 1

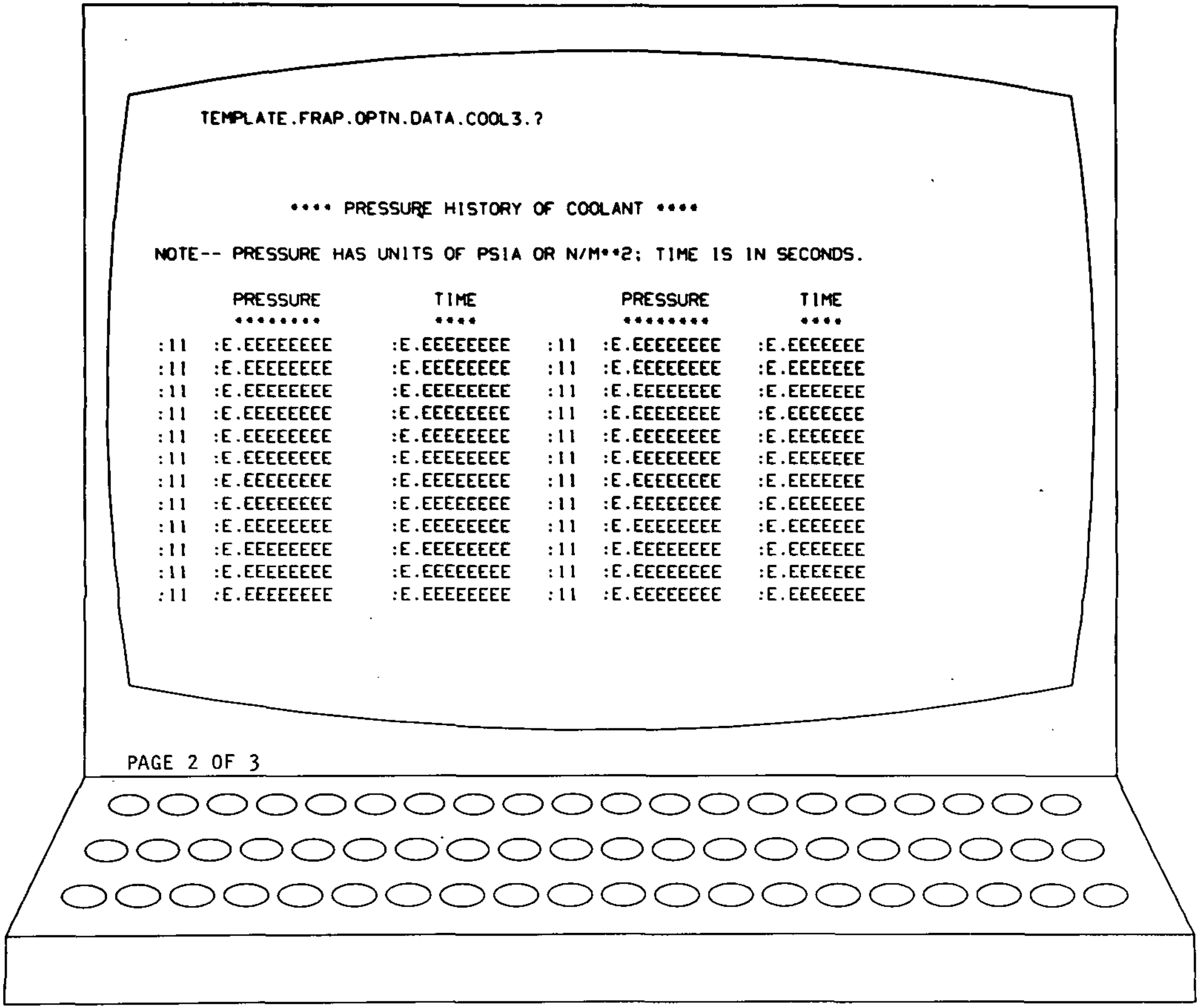
TEMPLATE.FRAP.OPTN.DATA.COOL3.?

**** TRANSIENT COOLANT CONDITIONS ****

THIS RECORD IS TO BE COMPLETED IF NSWC=3 ON THE FBD.COOLANT.
HISTORY.?CASE RECORD. FUEL ROD COOLING IS SPECIFIED BY
PRESCRIBING HEAT TRANSFER COEFFICIENT AND BULK TEMPERATURE
HISTORIES.

NUMBER OF PRESSURE- TIME PAIRS USED TO (NPBH)..............:11
DESCRIBE THE COOLANT PRESSURE HISTORY (NPBH< 51)

PAGE 1 OF 3



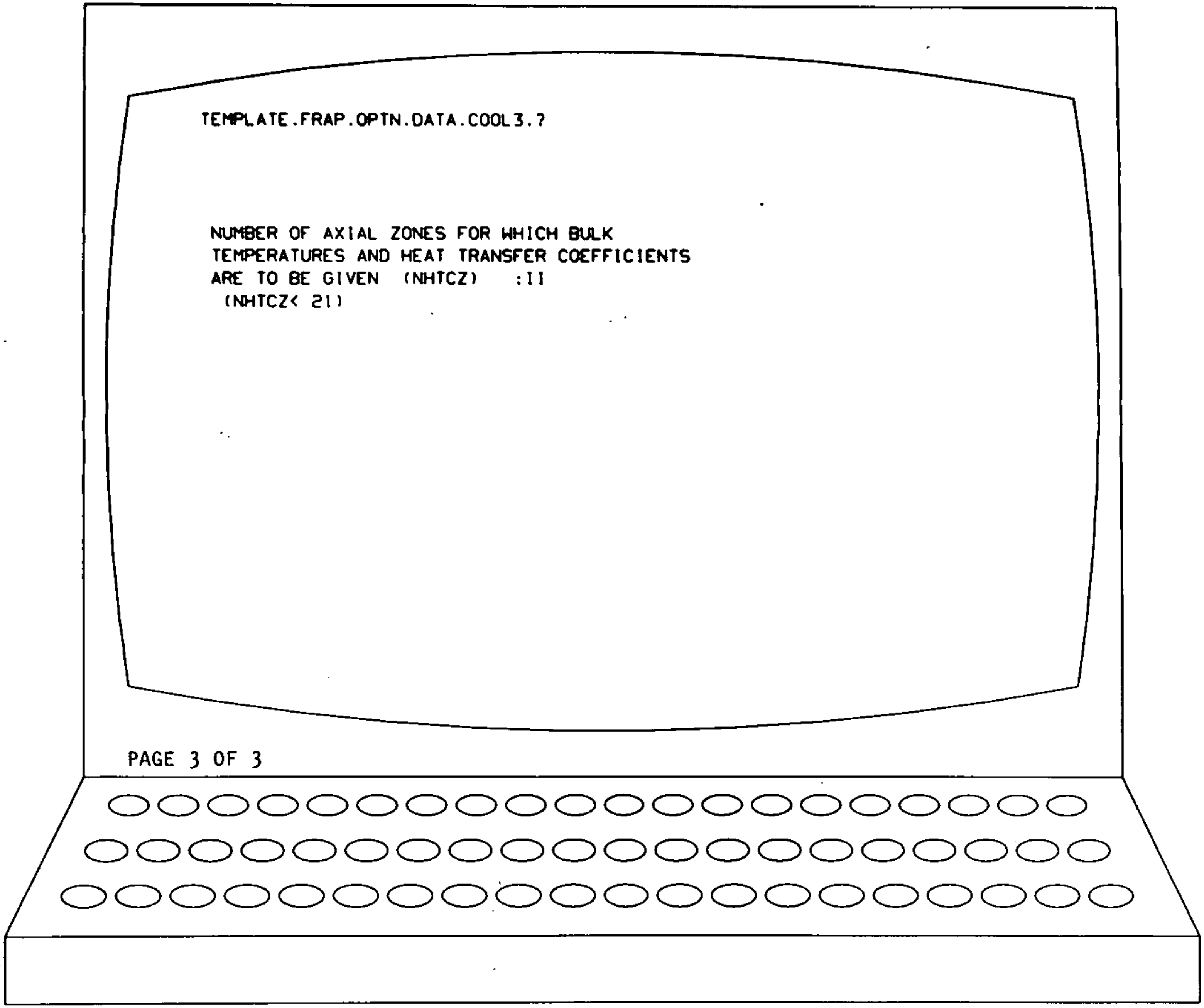
TEMPLATE.FRAP.OPTN.DATA.COOL3.?

**** PRESSURE HISTORY OF COOLANT ****

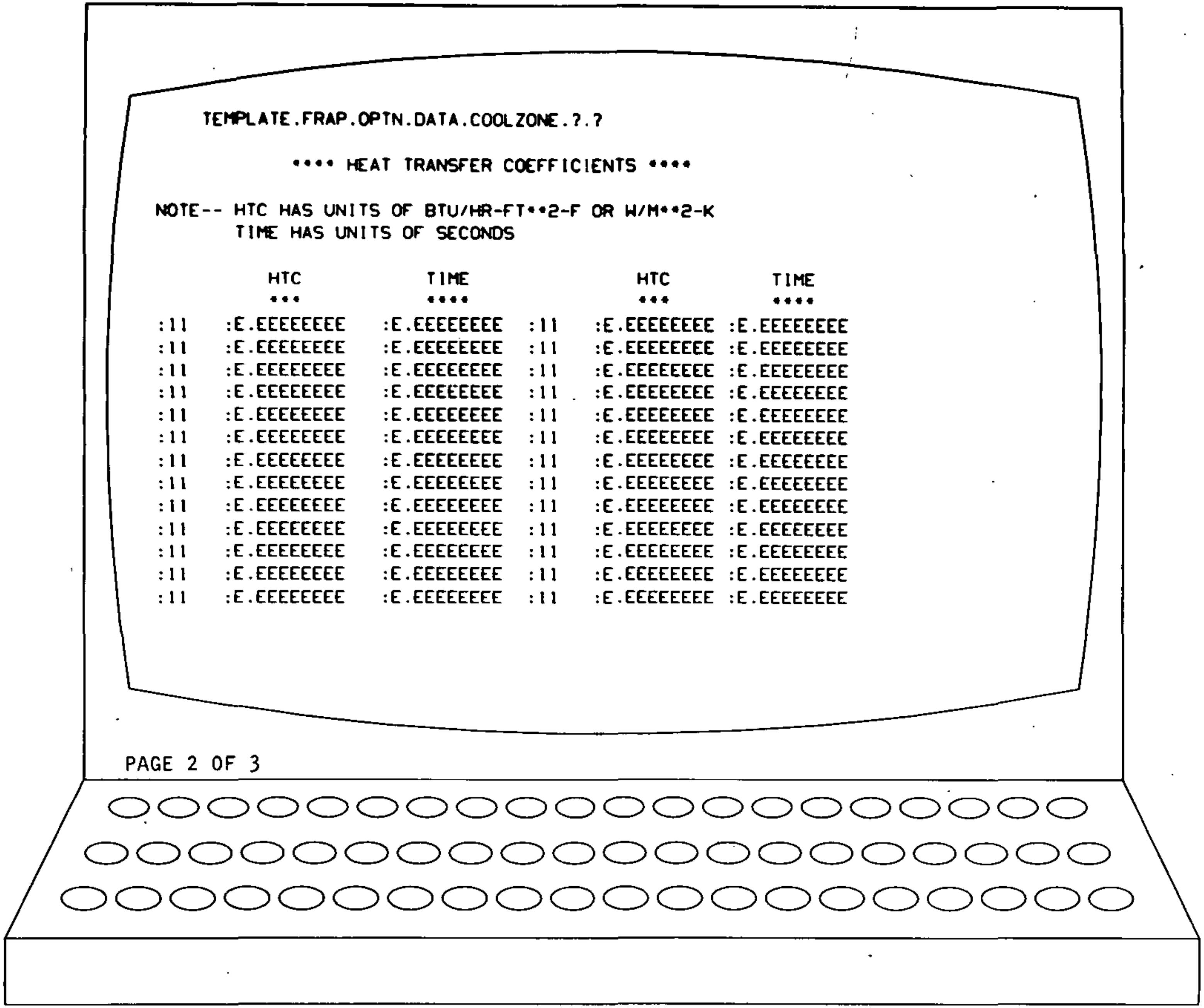
NOTE-- PRESSURE HAS UNITS OF PSIA OR N/M**2; TIME IS IN SECONDS.

	PRESSURE ********	TIME ****		PRESSURE ********	TIME ****
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE

PAGE 2 OF 3


TEMPLATE.FRAP.OPTN.DATA.COOL3.?
NUMBER OF AXIAL ZONES FOR WHICH BULK
TEMPERATURES AND HEAT TRANSFER COEFFICIENTS
ARE TO BE GIVEN (NHTCZ) :11
(NHTCZ< 21)
PAGE 3 OF 3

```
TEMPLATE.FRAP.OPTN.DATA.COOLZONE.?.?

     **** COOLANT HISTORY DATA FOR VERTICAL ZONE ****

NUMBER OF HEAT TRANSFER COEFFICIENT- TIME  (NHPRS)..........:II
PAIRS SPECIFIED FOR THIS ZONE (NHPRS<50)

NUMBER OF BULK TEMPERATURE-TIME PAIRS  (NTPRS)..............:II
SPECIFIED FOR THIS ZONE (NTPRS<50)

ELEVATION OF TOP BOUNDARY OF THIS ZONE  (ZP)..........:E.EEEEEE
   (FT OR M)
   (TOP BOUNDARY OF TOP ZONE MUST HAVE ZP
    EQUAL TO OR GREATER THAN THE ACTIVE
    FUEL STACK LENGTH. BOTTOM OF FUEL STACK
    IS ASSUMED TO BE AT ELEVATION 0.00)

PAGE 1 OF 3
```



TEMPLATE.FRAP.OPTN.DATA.COOLZONE.?.?

**** HEAT TRANSFER COEFFICIENTS ****

NOTE-- HTC HAS UNITS OF BTU/HR-FT**2-F OR W/M**2-K
TIME HAS UNITS OF SECONDS

	HTC	TIME		HTC	TIME
	***	****		***	****
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE
:II	:E.EEEEEEEE	:E.EEEEEEEE	:II	:E.EEEEEEEE	:E.EEEEEEEE

PAGE 2 OF 3

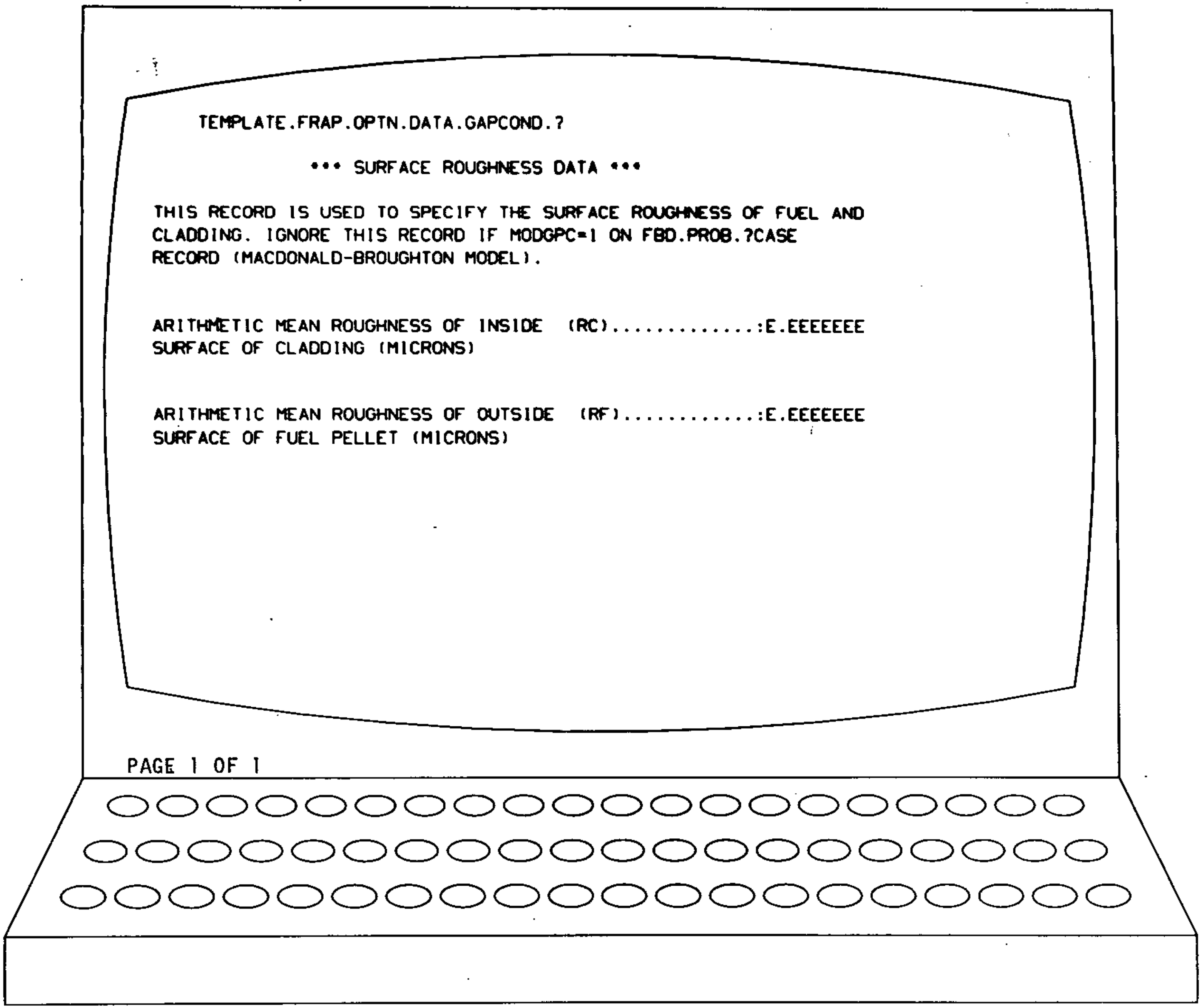
TEMPLATE.FRAP.OPTN.DATA.COOLZONE.?.?

**** BULK TEMPERATURE HISTORY ****

NOTE-- TEMPERATURE HAS UNITS OF F OR K; TIME IS IN SECONDS

	TEMPERATURE ***********	TIME ****		TEMPERATURE ***********	TIME ****
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEEE

PAGE 3 OF 3



TEMPLATE.FRAP.OPTN.DATA.GAPCOND.?

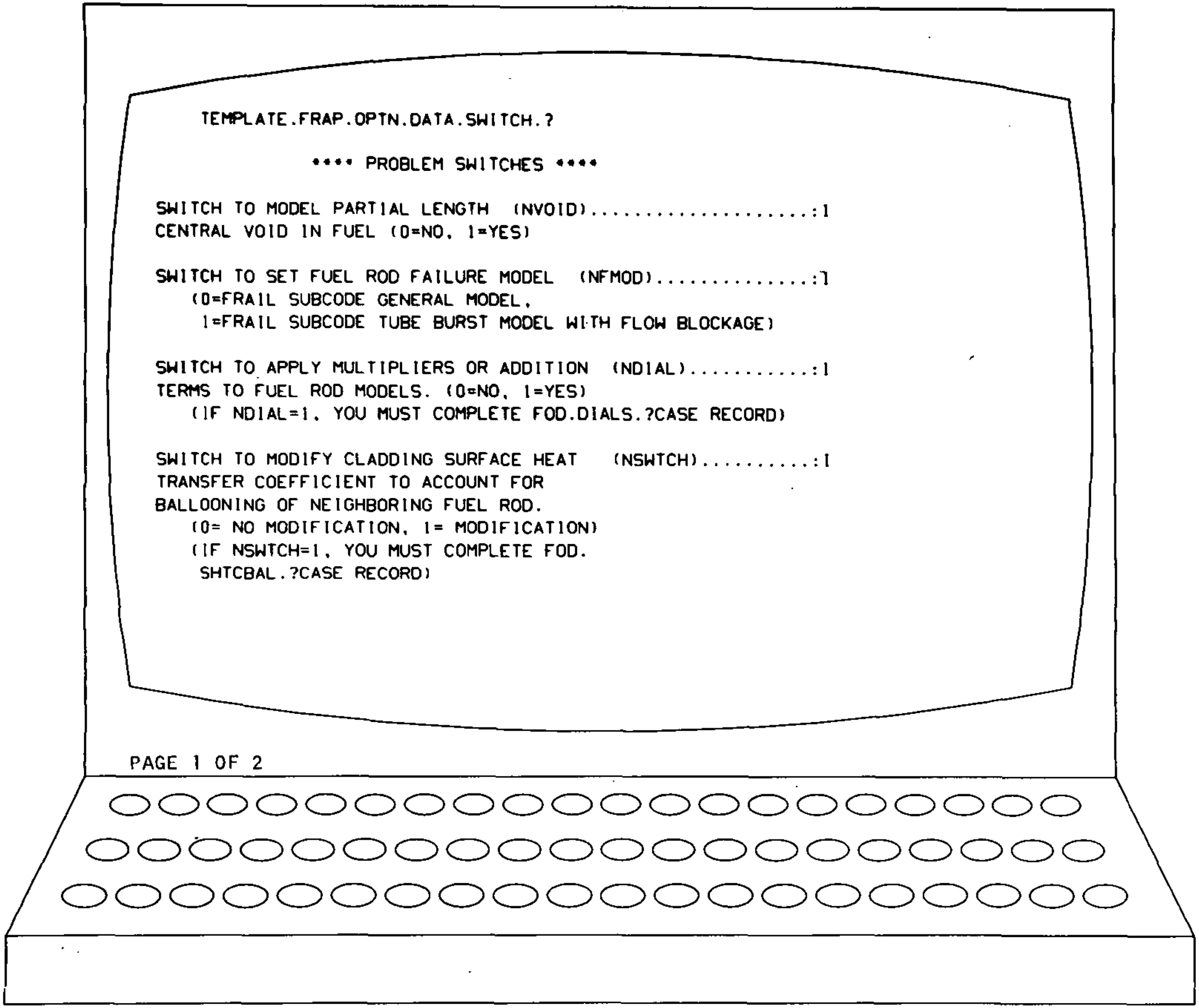
*** SURFACE ROUGHNESS DATA ***

THIS RECORD IS USED TO SPECIFY THE SURFACE ROUGHNESS OF FUEL AND CLADDING. IGNORE THIS RECORD IF MODGPC=1 ON FBD.PROB.?CASE RECORD (MACDONALD-BROUGHTON MODEL).

ARITHMETIC MEAN ROUGHNESS OF INSIDE (RC).............:E.EEEEEEE
SURFACE OF CLADDING (MICRONS)

ARITHMETIC MEAN ROUGHNESS OF OUTSIDE (RF)............:E.EEEEEEE
SURFACE OF FUEL PELLET (MICRONS)

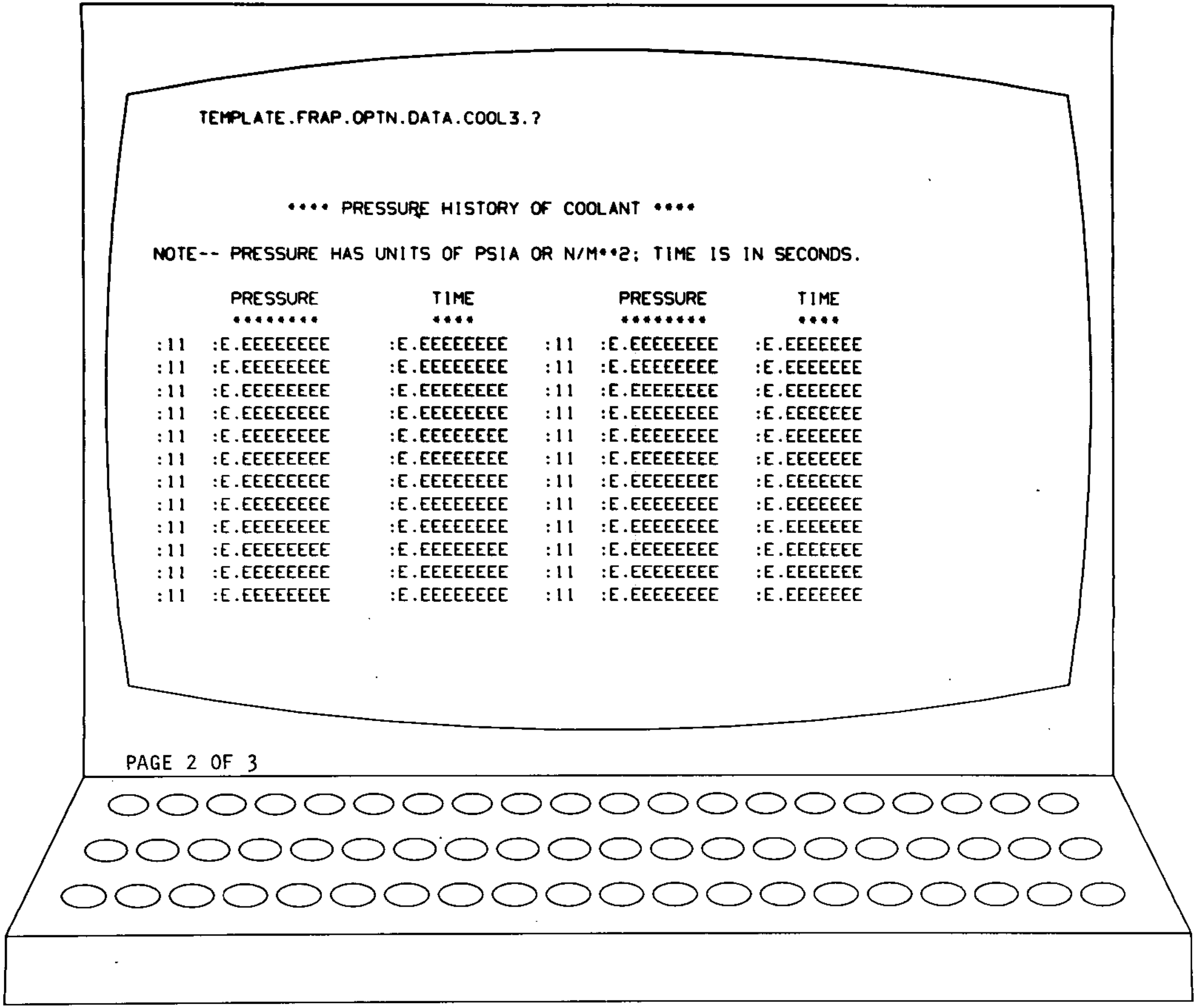
PAGE 1 OF 1



```
    TEMPLATE.FRAP.OPTN.DATA.SWITCH.?

               **** PROBLEM SWITCHES ****

SWITCH TO MODEL PARTIAL LENGTH  (NVOID)....................:1
CENTRAL VOID IN FUEL (0=NO, 1=YES)

SWITCH TO SET FUEL ROD FAILURE MODEL  (NFMOD)..............:1
   (0=FRAIL SUBCODE GENERAL MODEL,
    1=FRAIL SUBCODE TUBE BURST MODEL WITH FLOW BLOCKAGE)

SWITCH TO APPLY MULTIPLIERS OR ADDITION  (NDIAL)...........:1
TERMS TO FUEL ROD MODELS. (0=NO, 1=YES)
   (IF NDIAL=1, YOU MUST COMPLETE FOD.DIALS.?CASE RECORD)

SWITCH TO MODIFY CLADDING SURFACE HEAT   (NSWTCH)..........:1
TRANSFER COEFFICIENT TO ACCOUNT FOR
BALLOONING OF NEIGHBORING FUEL ROD.
   (0= NO MODIFICATION, 1= MODIFICATION)
   (IF NSWTCH=1, YOU MUST COMPLETE FOD.
    SHTCBAL.?CASE RECORD)

PAGE 1 OF 2
```

```
TEMPLATE.FRAP.OPTN.DATA.SWITCH.?

SWITCH TO COMPUTE CLADDING SURFACE HEAT  (NREFLD)...........:I
TRANSFER COEFFICIENT DURING REFLOODING OF
CORE (0=NO,1=YES)
   (IF NREFLD=1, YOU MUST COMPLETE FOD.REFLOOD.
    ?CASE RECORD)

SWITCH TO TURN ON LACE MODELS  (NLAC).......................:I
   (0=NO,1=YES)

SWITCH TO ALLOW THE SPECIFICATION OF PROBLEM  (NPO).........:I
TIME INTERVALS AT WHICH FUEL ROD STATE IS TO BE
PRINTED (0=NO,1=YES; IF YES, COMPLETE FOD.PRINT.?CASE RECORD)

SWITCH TO FORCE CALCULATIONS OF FRACAS SUBCODE  (NFCMI).....:I
AFTER CLADDING FAILURE IS PREDICTED (0=NO,1=YES)

INTERNAL POWER RAMP SWITCH  (NPRSW).........................:I
AT START, FRAP-T GENERATES POWER RAMP THAT INCREASES FUEL
ROD POWER FROM ZERO TO FULL POWER. IF FUEL-CLADDING CONTACT AT
FULL POWER IS NOT EXPECTED,BYPASS RAMP. (0=RAMP,1=NO RAMP)
```

PAGE 2 OF 2



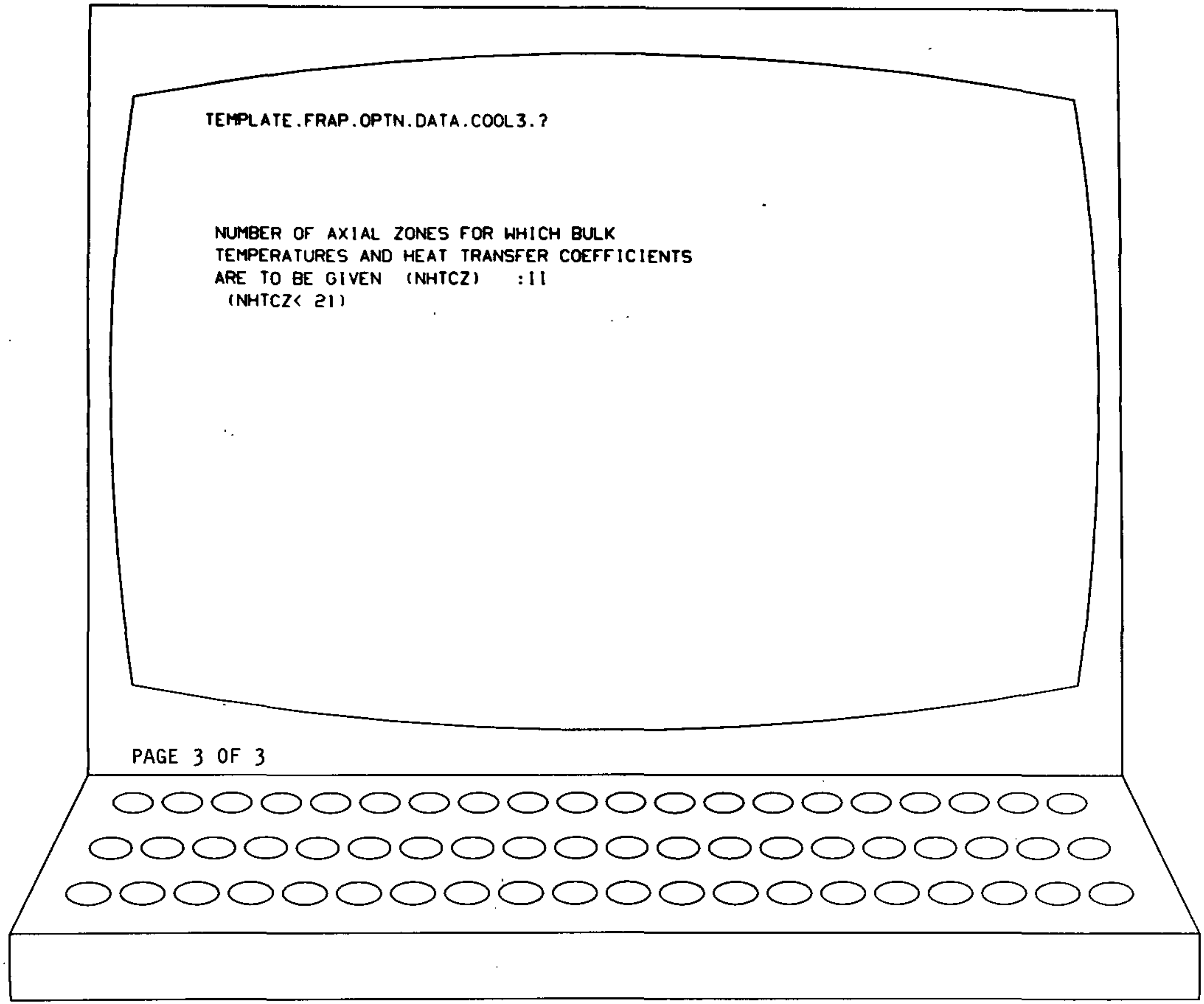
TEMPLATE.FRAP.OPTN.DATA.COOL3.?

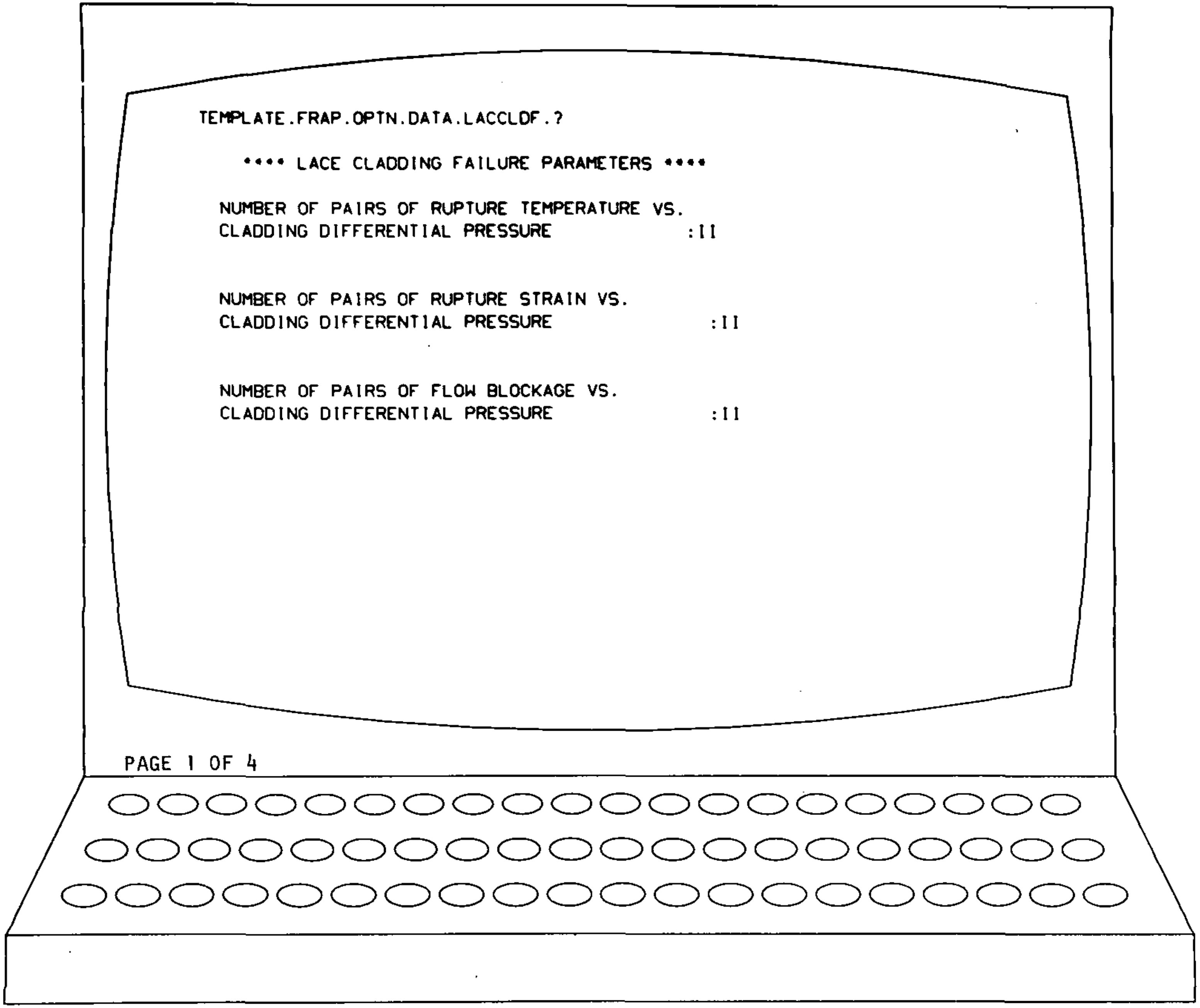
**** PRESSURE HISTORY OF COOLANT ****

NOTE-- PRESSURE HAS UNITS OF PSIA OR N/M**2; TIME IS IN SECONDS.

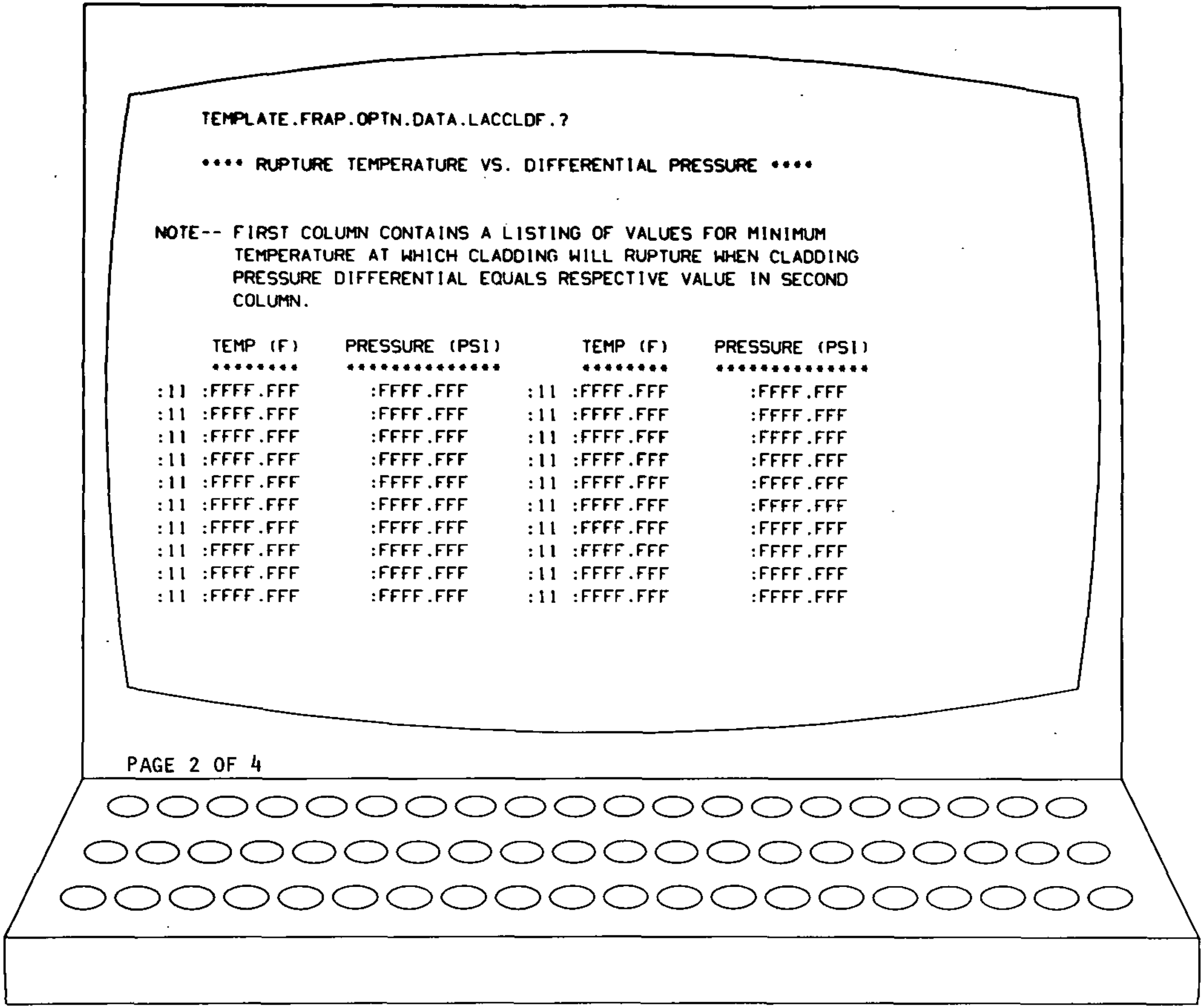
	PRESSURE ********	TIME ****		PRESSURE ********	TIME ****
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE
:11	:E.EEEEEEEE	:E.EEEEEEEE	:11	:E.EEEEEEEE	:E.EEEEEEE

PAGE 2 OF 3


TEMPLATE.FRAP.OPTN.DATA.COOL3.?
NUMBER OF AXIAL ZONES FOR WHICH BULK
TEMPERATURES AND HEAT TRANSFER COEFFICIENTS
ARE TO BE GIVEN (NHTCZ) :11
(NHTCZ< 21)
PAGE 3 OF 3



TEMPLATE.FRAP.OPTN.DATA.LACCLDF.?
**** LACE CLADDING FAILURE PARAMETERS ****
NUMBER OF PAIRS OF RUPTURE TEMPERATURE VS.
CLADDING DIFFERENTIAL PRESSURE :II
NUMBER OF PAIRS OF RUPTURE STRAIN VS.
CLADDING DIFFERENTIAL PRESSURE :II
NUMBER OF PAIRS OF FLOW BLOCKAGE VS.
CLADDING DIFFERENTIAL PRESSURE :II
PAGE 1 OF 4



TEMPLATE.FRAP.OPTN.DATA.LACCLDF.?

**** RUPTURE TEMPERATURE VS. DIFFERENTIAL PRESSURE ****

NOTE-- FIRST COLUMN CONTAINS A LISTING OF VALUES FOR MINIMUM TEMPERATURE AT WHICH CLADDING WILL RUPTURE WHEN CLADDING PRESSURE DIFFERENTIAL EQUALS RESPECTIVE VALUE IN SECOND COLUMN.

	TEMP (F)	PRESSURE (PSI)		TEMP (F)	PRESSURE (PSI)
	********	**************		********	**************
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF
:11	:FFFF.FFF	:FFFF.FFF	:11	:FFFF.FFF	:FFFF.FFF

PAGE 2 OF 4

```
TEMPLATE.FRAP.OPTN.DATA.LACCLDF.?

     **** RUPTURE STRAIN VS. DIFFERENTIAL PRESSURE ****

NOTE-- FIRST COLUMN CONTAINS LISTING OF VALUES FOR THE CLADDING
       RUPTURE STRAIN IF CLAD RUPTURE OCCURS AT RESPECTIVE
       CLADDING PRESSURE DIFFERENTIAL IN SECOND COLUMN.

        STRAIN      PRESSURE (PSI)        STRAIN      PRESSURE (PSI)
        ******      **************        ******      **************
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF
:11 :E.EEEEEEE      :FFFF.FFF     :11  :E.EEEEEEE      :FFFF.FFF

PAGE 3 OF 4
```

TEMPLATE.FRAP.OPTN.DATA.LACCLDF.?

**** FLOW BLOCKAGE VS. DIFFERENTIAL PRESSURE ****

NOTE-- FIRST COLUMN CONTAINS A LISTING OF VALUES FOR FLOW BLOCKAGE IF CLAD RUPTURE OCCURS AT RESPECTIVE CLADDING DIFFERENTIAL PRESSURE IN SECOND COLUMN.

	FLBLKG (%)	PRESS (PSI)		FLBLKG (%)	PRESS (PSI)
	**********	***********		**********	***********
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF
:11	:FFF.FFFF	:FFFF.FFF	:11	:FFF.FFFF	:FFFF.FFF

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3.6 RENPRE

The RENPRE module automatically performs much of the tedious task of renoding a problem. This module is particularly useful for the renoding procedure required when passing from the end of refill to the FLOOD module. The user only has to specify the components of the reactor which require modification by creating records with the templates described in this section. RENPRE then searches all the WRAP input records and alters them accordingly. Any data required for a new component which can be uniquely determined from previous data will be computed by the module. There is, however, certain data which can only be provided by the user. The new WRAP records created by RENPRE will contain conspicuously false data (e.g. 7.86332E+65 for real variables) in locations where this data should be entered by the user.

The following templates are used to prepare RENPRE input:

WRAP.INPUT.RENODE.GENERAL.?JOBNAME

WRAP.INPUT.RENODE.?CASENAME.SINGLE.VOLUME.TO.SERIES.?NUMBER

WRAP.INPUT.RENODE.?CASENAME.SINGLE.SLAB.TO.STACK.?NUMBER

WRAP.INPUT.RENODE.?CASENAME.SERIES.OF.VOLUMES.TO.SINGLE.?NUMBER

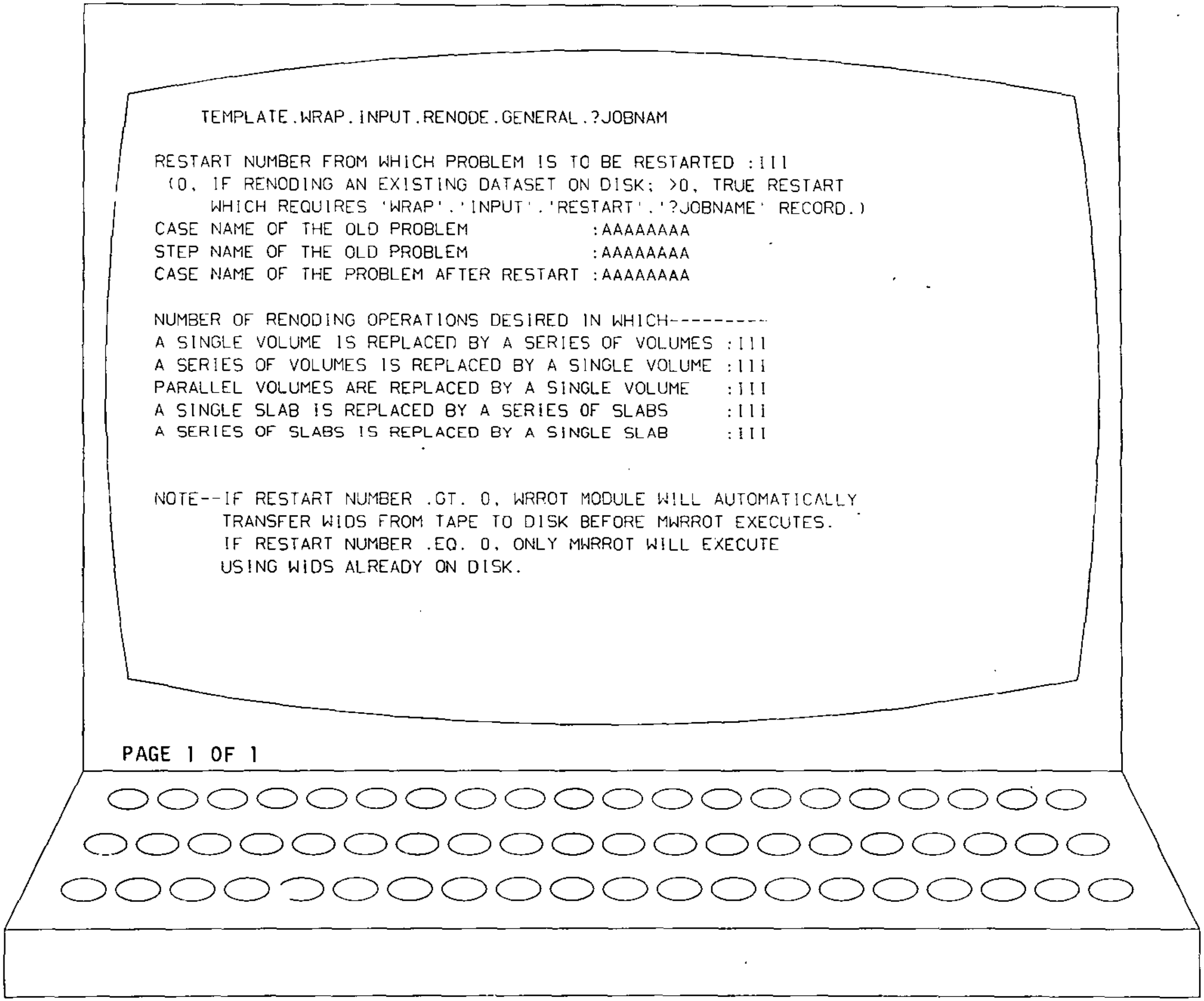
WRAP.INPUT.RENODE.?CASENAME.PARALLEL.VOLUMES.TO.SINGLE.?NUMBER

WRAP.INPUT.RENODE.?CASENAME.STACK.OF.SLABS.TO.SINGLE.?NUMBER

WRAP.INPUT.RENODE.?CASENAME.JUNCTION.CHANGE

WRAP.INPUT.RENODE.?CASENAME.SLAB.CHANGE

WRAP.INPUT.RENODE.?CASENAME.FLOOD.



```
TEMPLATE.WRAP.INPUT.RENODE.GENERAL.?JOBNAM

RESTART NUMBER FROM WHICH PROBLEM IS TO BE RESTARTED :III
 (0, IF RENODING AN EXISTING DATASET ON DISK; >0, TRUE RESTART
    WHICH REQUIRES 'WRAP'.'INPUT'.'RESTART'.'?JOBNAME' RECORD.)
CASE NAME OF THE OLD PROBLEM           :AAAAAAAA
STEP NAME OF THE OLD PROBLEM           :AAAAAAAA
CASE NAME OF THE PROBLEM AFTER RESTART :AAAAAAAA

NUMBER OF RENODING OPERATIONS DESIRED IN WHICH---------
A SINGLE VOLUME IS REPLACED BY A SERIES OF VOLUMES :III
A SERIES OF VOLUMES IS REPLACED BY A SINGLE VOLUME :III
PARALLEL VOLUMES ARE REPLACED BY A SINGLE VOLUME   :III
A SINGLE SLAB IS REPLACED BY A SERIES OF SLABS     :III
A SERIES OF SLABS IS REPLACED BY A SINGLE SLAB     :III


NOTE--IF RESTART NUMBER .GT. 0, WRROT MODULE WILL AUTOMATICALLY
      TRANSFER WIDS FROM TAPE TO DISK BEFORE MWRROT EXECUTES.
      IF RESTART NUMBER .EQ. 0, ONLY MWRROT WILL EXECUTE
      USING WIDS ALREADY ON DISK.
```

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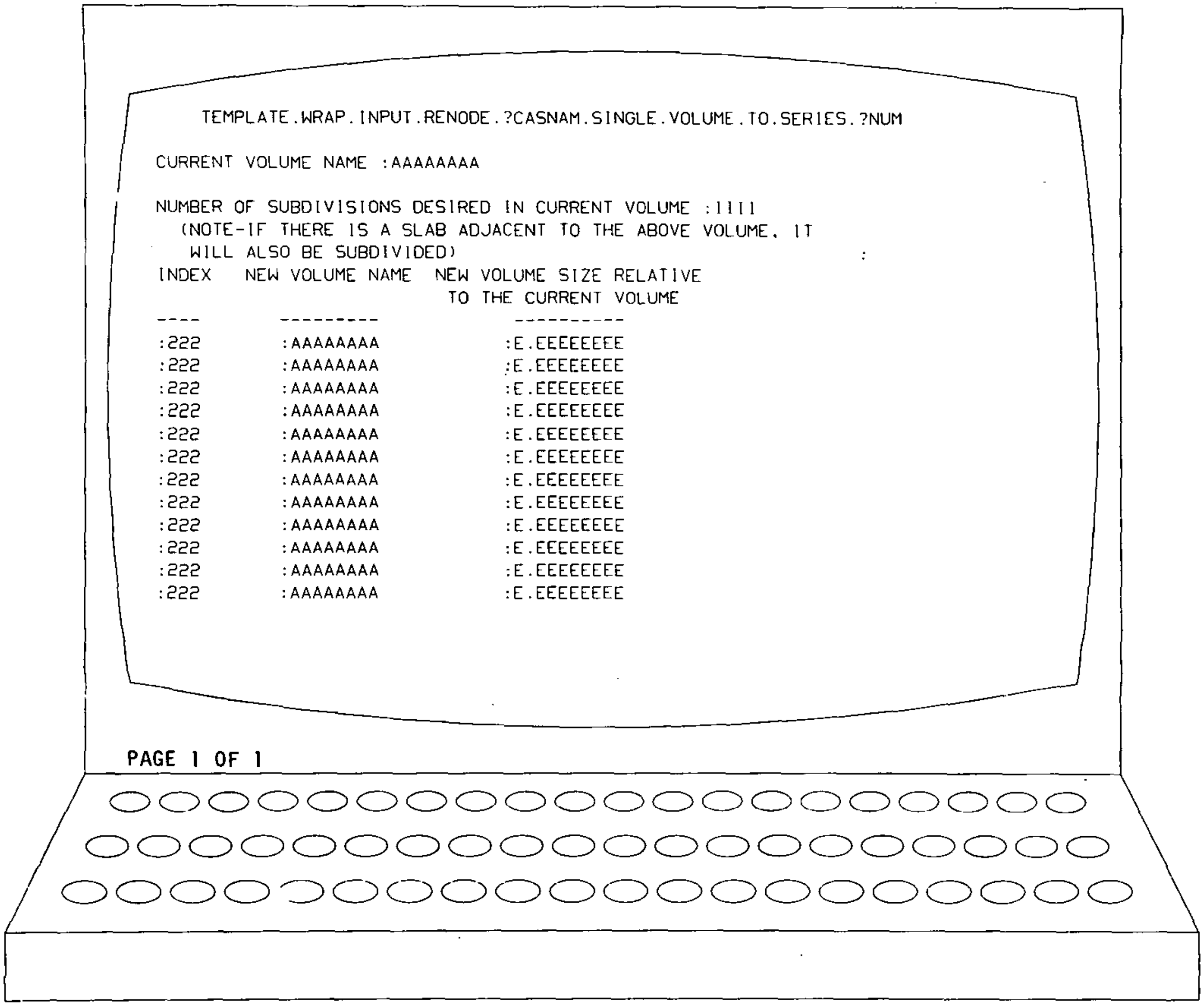


```
    TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.SINGLE.VOLUME.TO.SERIES.?NUM

CURRENT VOLUME NAME :AAAAAAAA

NUMBER OF SUBDIVISIONS DESIRED IN CURRENT VOLUME :IIII
  (NOTE-IF THERE IS A SLAB ADJACENT TO THE ABOVE VOLUME, IT
   WILL ALSO BE SUBDIVIDED)
INDEX   NEW VOLUME NAME  NEW VOLUME SIZE RELATIVE
                           TO THE CURRENT VOLUME
----       ---------          ----------
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
:222       :AAAAAAAA          :E.EEEEEEEE
```

PAGE 1 OF 1

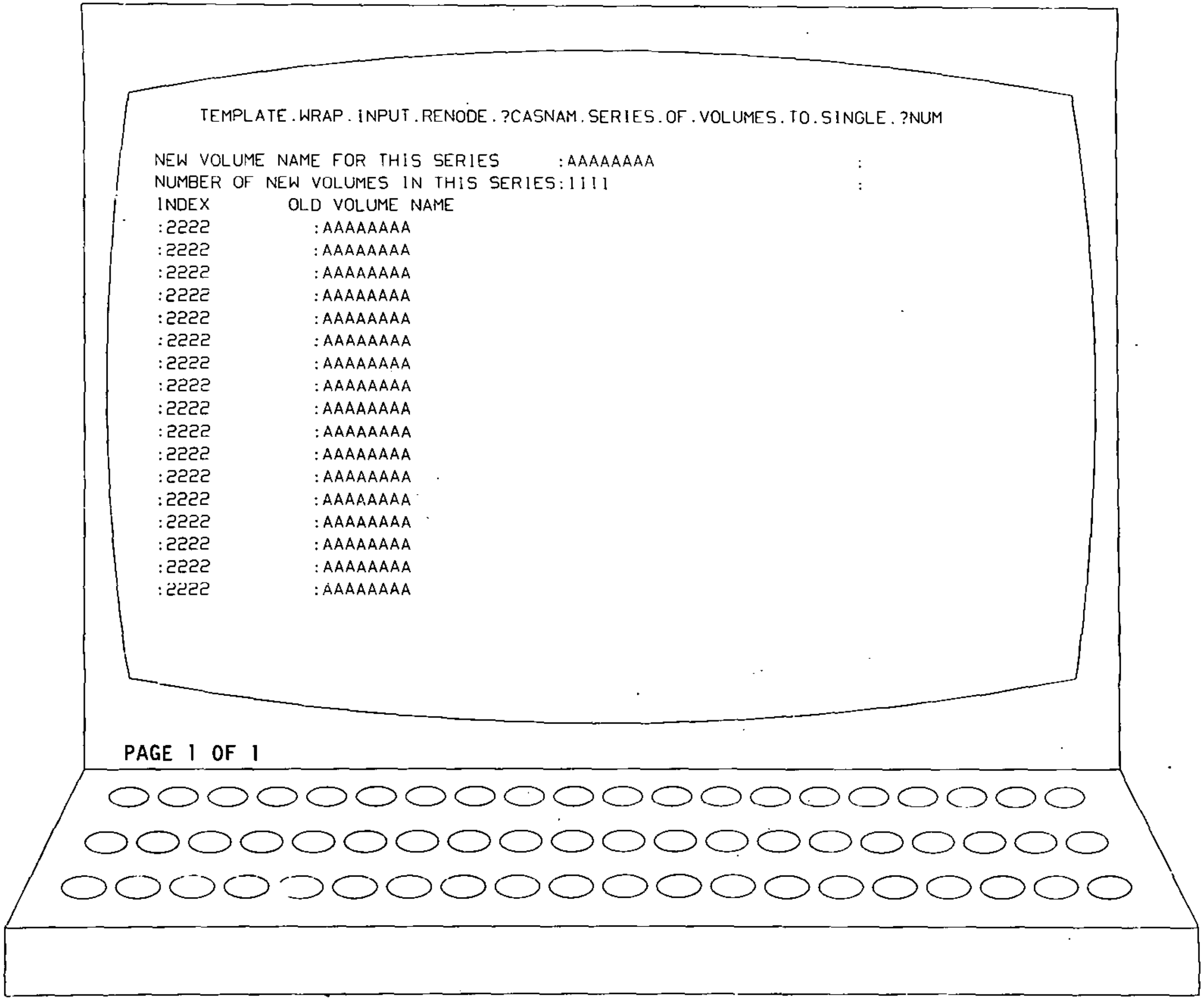
TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.SINGLE.SLAB.TO.STACK.?NUM

CURRENT SLAB NAME :AAAAAAAA

NUMBER OF SUBDIVISIONS DESIRED IN CURRENT SLAB :IIII

INDEX	NEW SLAB NAME	NEW SLAB SIZE RELATIVE TO THE CURRENT SLAB
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE
:222	:AAAAAAAA	:E.EEEEEEEE

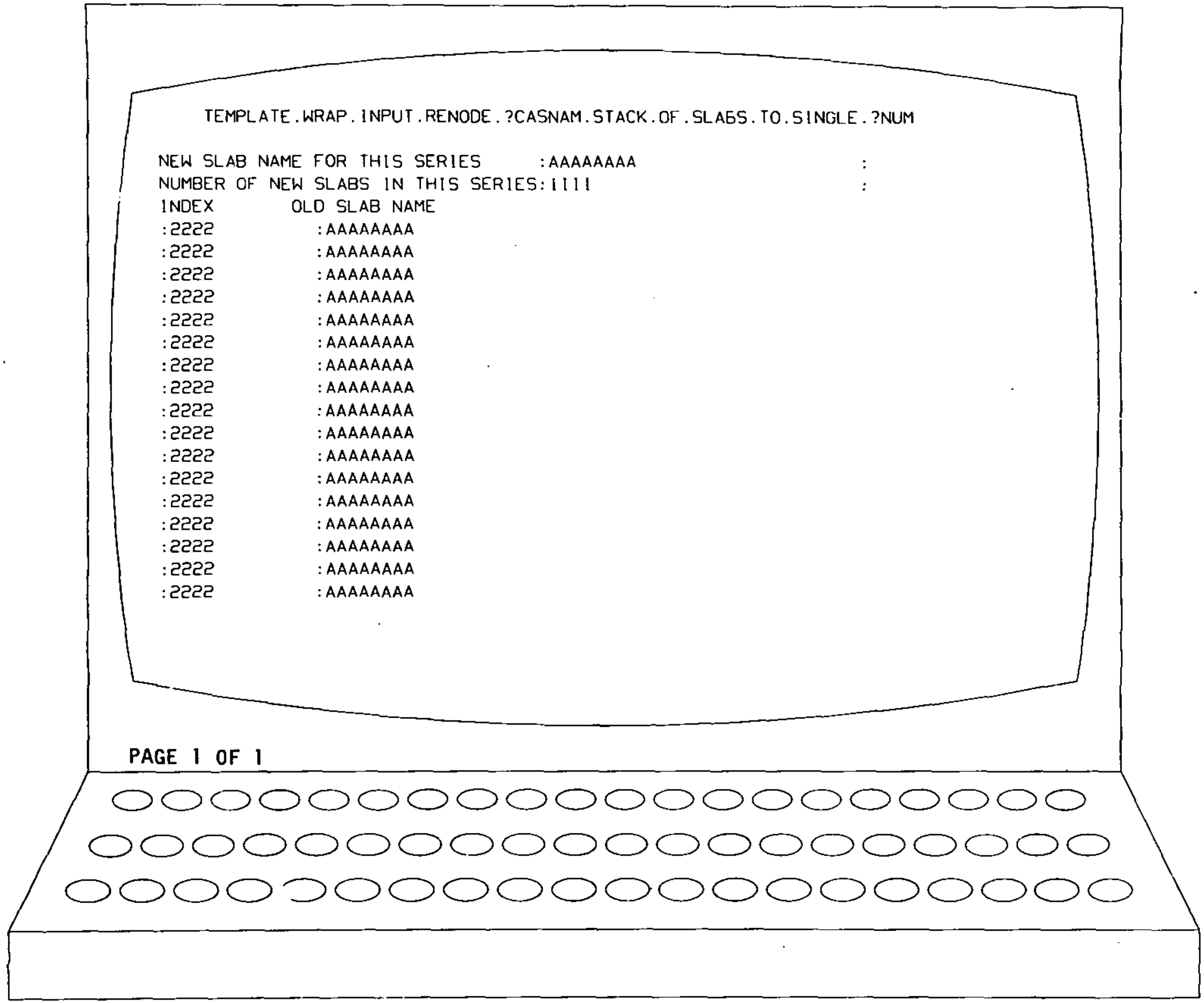
PAGE 1 OF 1


TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.SERIES.OF.VOLUMES.TO.SINGLE.?NUM
NEW VOLUME NAME FOR THIS SERIES :AAAAAAAA :
NUMBER OF NEW VOLUMES IN THIS SERIES:1111 :
INDEX OLD VOLUME NAME
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
PAGE 1 OF 1

```
TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.PARALLEL.VOLUMES.TO.SINGLE.?NUM

NEW NAME DESIRED FOR COLLAPSED VOLUMES:AAAAAAAA
NUMBER OF CURRENT VOLUMES TO BE COLLAPSED:IIII
      INDEX          CURRENT VOLUME NAME
                      (TO BE COLLAPSED)
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA
      :222                :AAAAAAAA

PAGE 1 OF 1
```


TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.STACK.OF.SLABS.TO.SINGLE.?NUM
NEW SLAB NAME FOR THIS SERIES :AAAAAAAA :
NUMBER OF NEW SLABS IN THIS SERIES:IIII :
INDEX OLD SLAB NAME
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
:2222 :AAAAAAAA
PAGE 1 OF 1

TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.JUNCTION.CHANGE

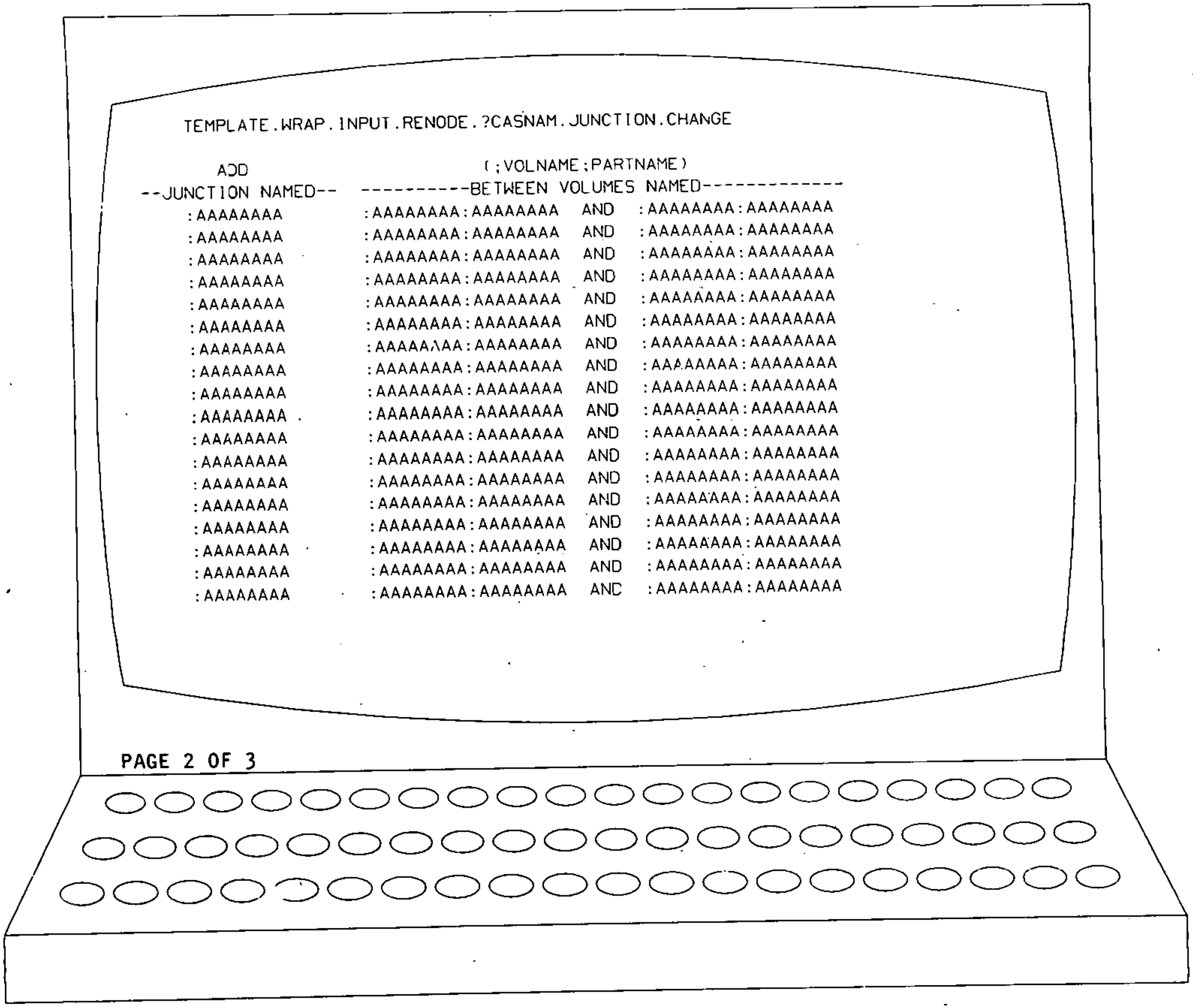
QUALIFIER MUST BE THE CASE NAME.

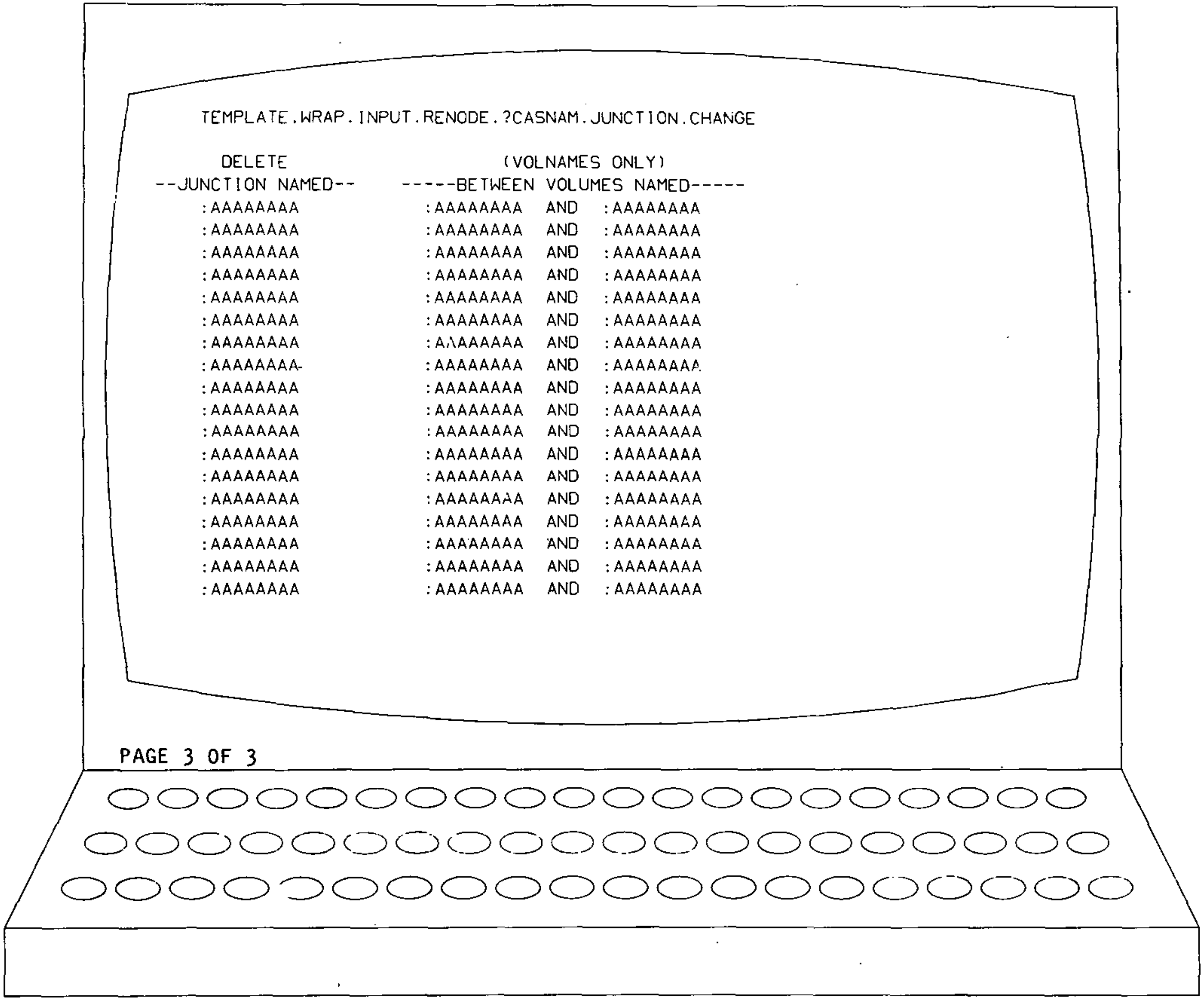
USE THIS RECORD TO SPECIFY THE ADDITION OR DELETION OF JUNCTIONS BETWEEN VOLUMES. IN THE ADDITION MODE, JUNCTIONS MAY BE ADDED BETWEEN 'OLD' VOLUMES (VOLUMES IN THE OLD NODALIZATION CARRIED OVER INTO THE NEW) AND/OR 'NEW' VOLUMES (NEWLY NAMED VOLUMES APPEARING IN THE RENODING). IN THE DELETION MODE, ONLY THOSE JUNCTIONS EXISING BETWEEN 'OLD' VOLUMES IN THE ORIGINAL NODALIZATION MAY BE REMOVED. JUST SPECIFY THE NAMES CORRECTLY.

TOTAL NUMBER OF JUNCTIONS TO BE ADDED................:III

TOTAL NUMBER OF JUNCTIONS TO BE DELETED..............:III

FOR LEAK AND FILL JUNCTIONS, ONE OF THE NAMED VOLUMES SHOULD BE LEFT BLANK.


TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.JUNCTION.CHANGE
ADD
(;VOLNAME;PARTNAME)
--JUNCTION NAMED--
----------BETWEEN VOLUMES NAMED-------------
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
:AAAAAAAA :AAAAAAAA:AAAAAAAA AND :AAAAAAAA:AAAAAAAA
PAGE 2 OF 3


TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.JUNCTION.CHANGE
DELETE
(VOLNAMES ONLY)
--JUNCTION NAMED--
-----BETWEEN VOLUMES NAMED-----
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
:AAAAAAAA :AAAAAAAA AND :AAAAAAAA
PAGE 3 OF 3

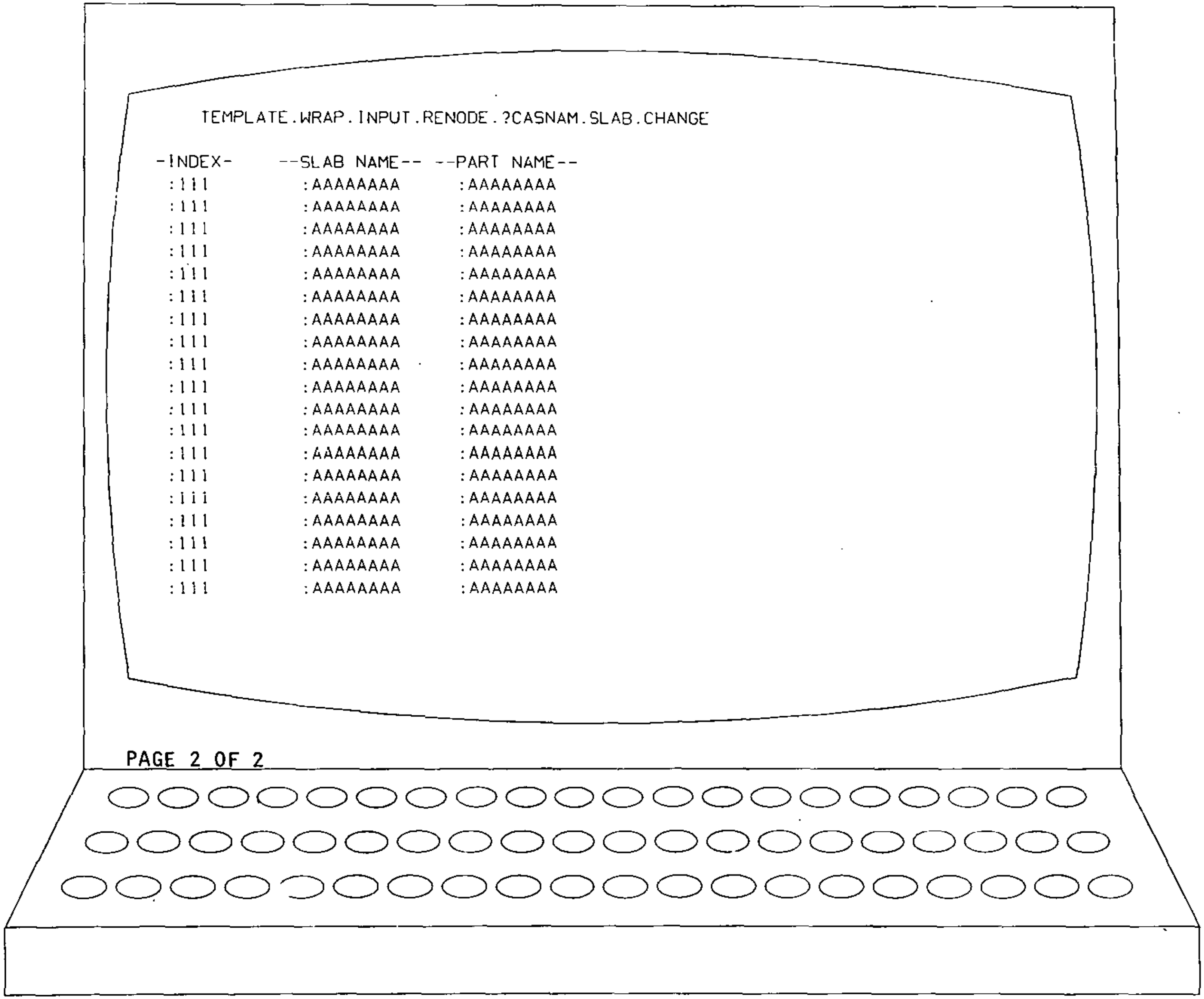
TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.SLAB.CHANGE

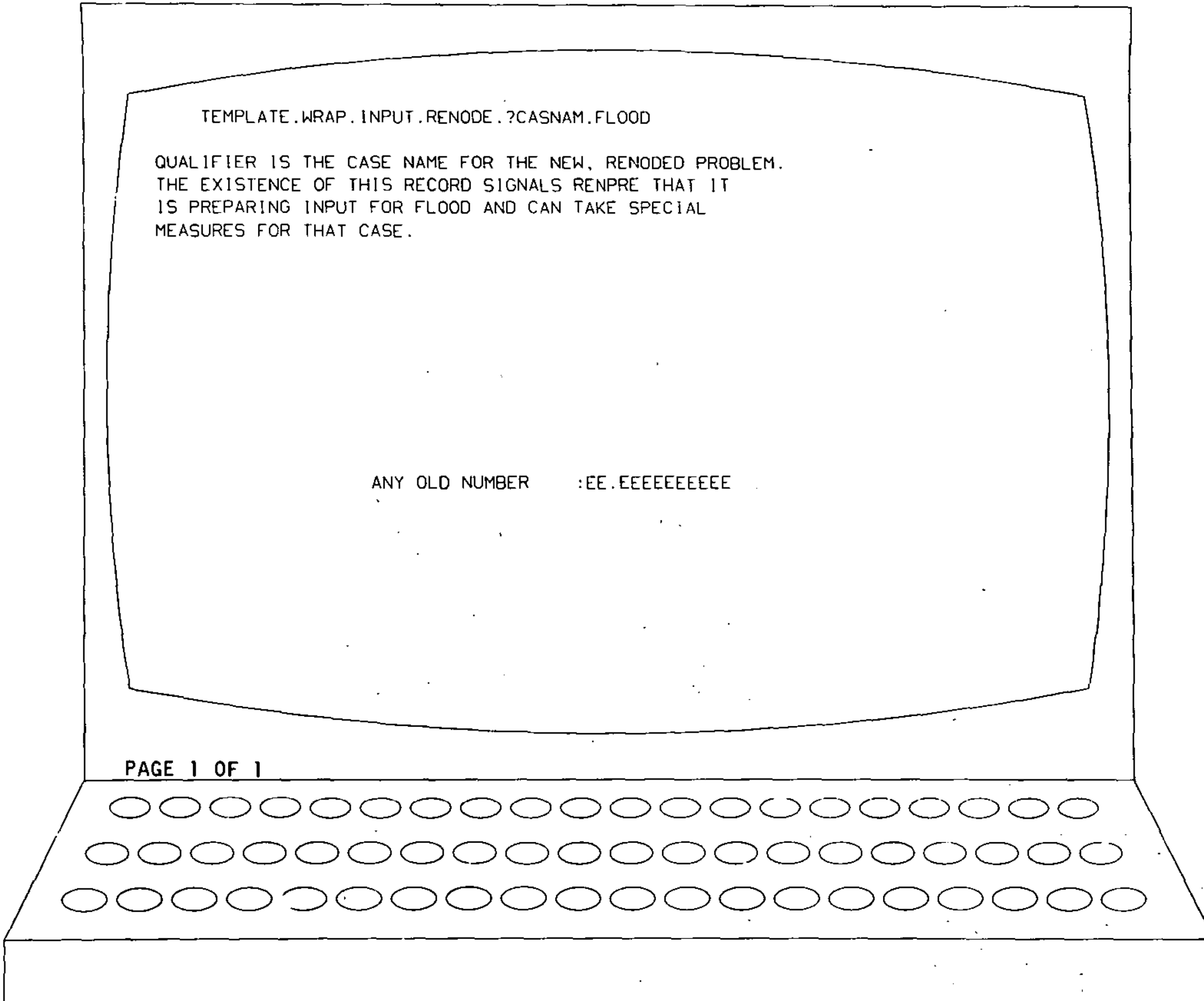
QUALIFIER MUST BE THE CASE NAME.

USE THIS RECORD TO SPECIFY THOSE SLABS WHICH ARE TO BE DELETED OUTRIGHT FROM THE OLD NODALIZATION. THOSE SLABS WHICH TAKE PART IN THE ACTUAL RENODALIZATION PROCESS SHOULD BE DEFINED ELSEWHERE.

NUMBER OF SLABS TO BE DELETED.......................:III

PAGE 1 OF 2


TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.SLAB.CHANGE
-INDEX- --SLAB NAME-- --PART NAME--
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
:111 :AAAAAAAA :AAAAAAAA
PAGE 2 OF 2


TEMPLATE.WRAP.INPUT.RENODE.?CASNAM.FLOOD
QUALIFIER IS THE CASE NAME FOR THE NEW, RENODED PROBLEM.
THE EXISTENCE OF THIS RECORD SIGNALS RENPRE THAT IT
IS PREPARING INPUT FOR FLOOD AND CAN TAKE SPECIAL
MEASURES FOR THAT CASE.
ANY OLD NUMBER :EE.EEEEEEEEEE
PAGE 1 OF 1

4. INPUT DATA FOR MODULE INTERFACES

Interface routines have been written to automatically transfer data between particular WRAP modules to eliminate hand transfer of data. Manual intervention in this process is minimized by requiring only one record to be created for each of the interfaces. In all cases, the routines will read an appropriate input record, if the record exists, and overwrite any existing data with data automatically passed from a previously executed module. If the record does not exist, the interface routine will create the record with the appropriate data included, and the user must complete the remainder of the record. More information on interfaces can be found in Reference 2.

4.1 GAPCON/WRAPIT

The user invokes the GAPCON/WRAPIT interface by creating a record with the WRAP.INPUT.GAPCON.RELAP.INTERFAC.?JOBNAME template (see the following pages for the template). Creation of this record automatically links the GAPCON library with the WRAPIT module. Within WRAPIT, the interface routine.

1) Accesses data in the GAPCON library

2) Reads selected WRAP input records

3) Writes the records which have been updated with the GAPCON data out to the job dataset.

In particular, the updated input involves records by using the WRAP.PART.?PRTNAM.HEATSLAB.DESC.?SLABNAME and WRAP.INPUT.SLABGEOM.?GEOMNAM templates.[10] The actual data passed are described in a later section.

TEMPLATE.WRAP.INPUT.GAPCON.RELAP.INTERFAC.?

1ST QUALIFIER = ?JOB = JOB NAME

OPTIONAL RECORD--THIS RECORD MUST BE INPUT IF GAPCON IS TO BE
LINKED TO RELAP; IF NOT, THIS RECORD MAY BE
OMITTED.

NUMBER OF GAPCON PINS (I.E. GAPCON CASES) REFERENCED IN THE
GAPCON LIBRARY (AS LISTED ON THE FOLLOWING PAGES) :II

NOTE--NORMALLY A SINGLE 'STACK' OF HEAT SLABS WILL
BE ASSOCIATED WITH A GIVEN GAPCON CASE NAME.

```
TEMPLATE.WRAP.INPUT.GAPCON.RELAP.INTERFAC.?

PIN NAME--GAPCON LIBRARY CASE NAME :AAAAAAAA

  NUMBER OF CORE FUEL PINS REPRESENTED WITH  ABOVE PIN :IIIII

  NUMBER OF HEAT SLABS
     USING DATA FROM THE ABOVE NAMED GAPCON CASE :II

  HFAT SLABS FOR WHICH SELECTED GAPCON DATA IS
     PASSED TO RELAP--         PART NAME    SLAB NAME
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
                     :222      :AAAAAAAA    :AAAAAAAA
```

PAGE 2 OF 2

4.2 TWRAM/FRAP

The TWRAM/FRAP interface is invoked by creating a record with the WRAP.FRAP.INTERFAC.SPEC.?JOBNAME template displayed on the following pages. The interface module will read the TWRAM plot tape created during the blowdown calculation and create several FRAP input records containing hydraulic parameters. Because FRAP contains two options for the type of data to accept from the interface, both types are created, and the user retains the option to use either type. With one option, the user will allow FRAP to accept the following transient data:

1) Fluid enthalpy, temperature, and pressure in the upper and lower plena

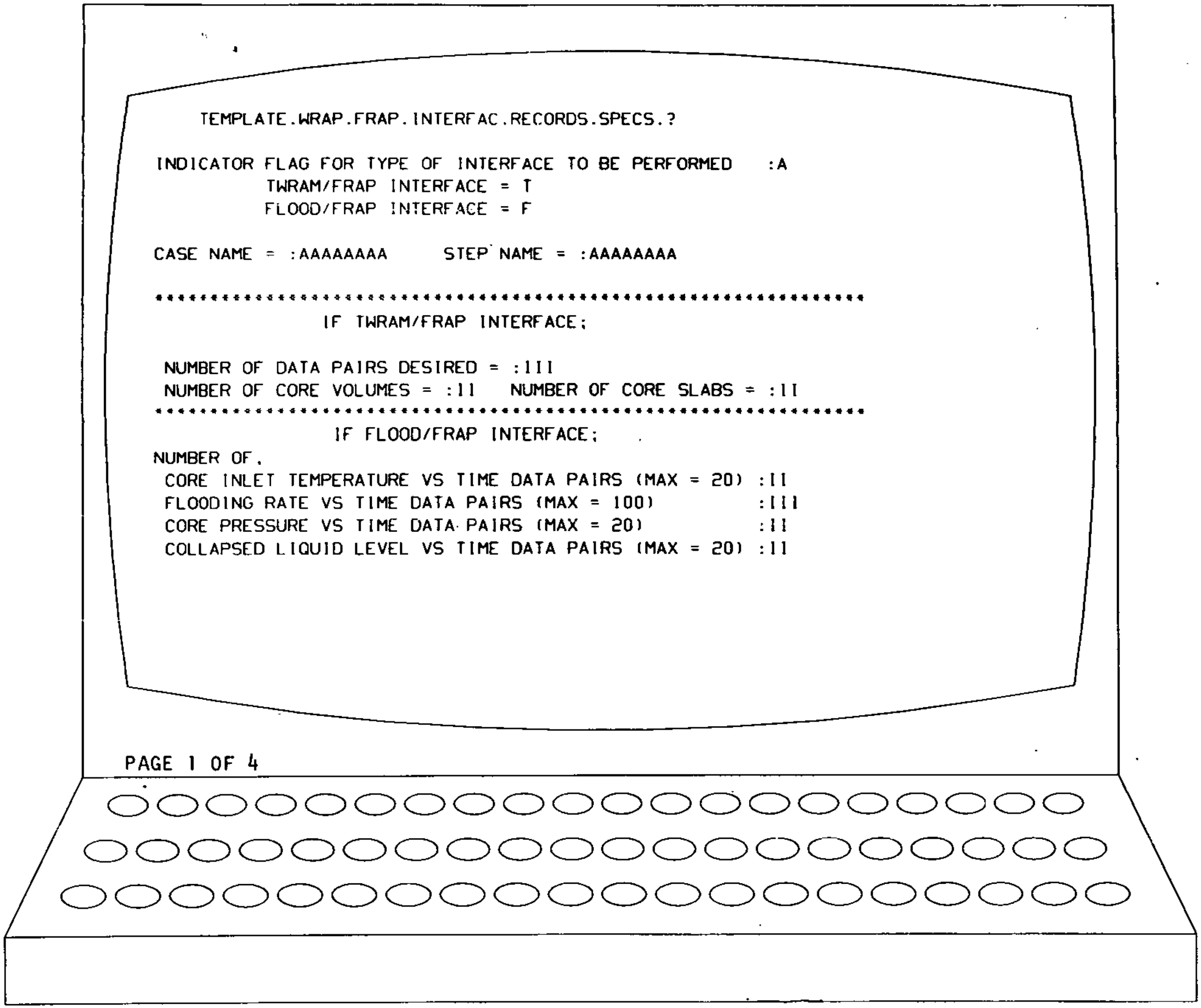
2) Fluid enthalpy, temperature, pressure, and mass flow rate in each core volume represented in the blowdown calculation.

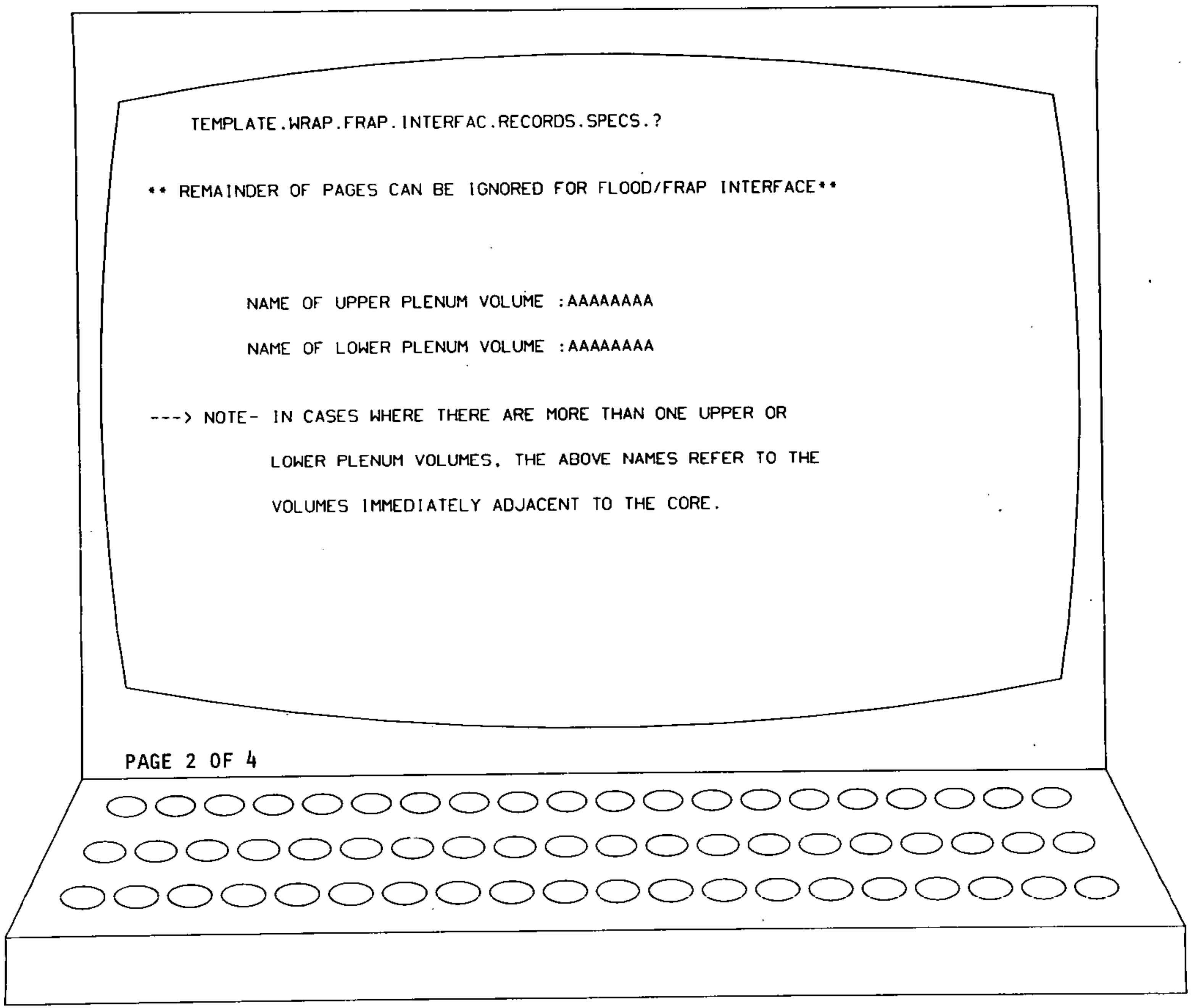
From this data, FRAP calculates the time-dependent and axially variant heat transfer coefficients. Invoking the second option allows FRAP to accept

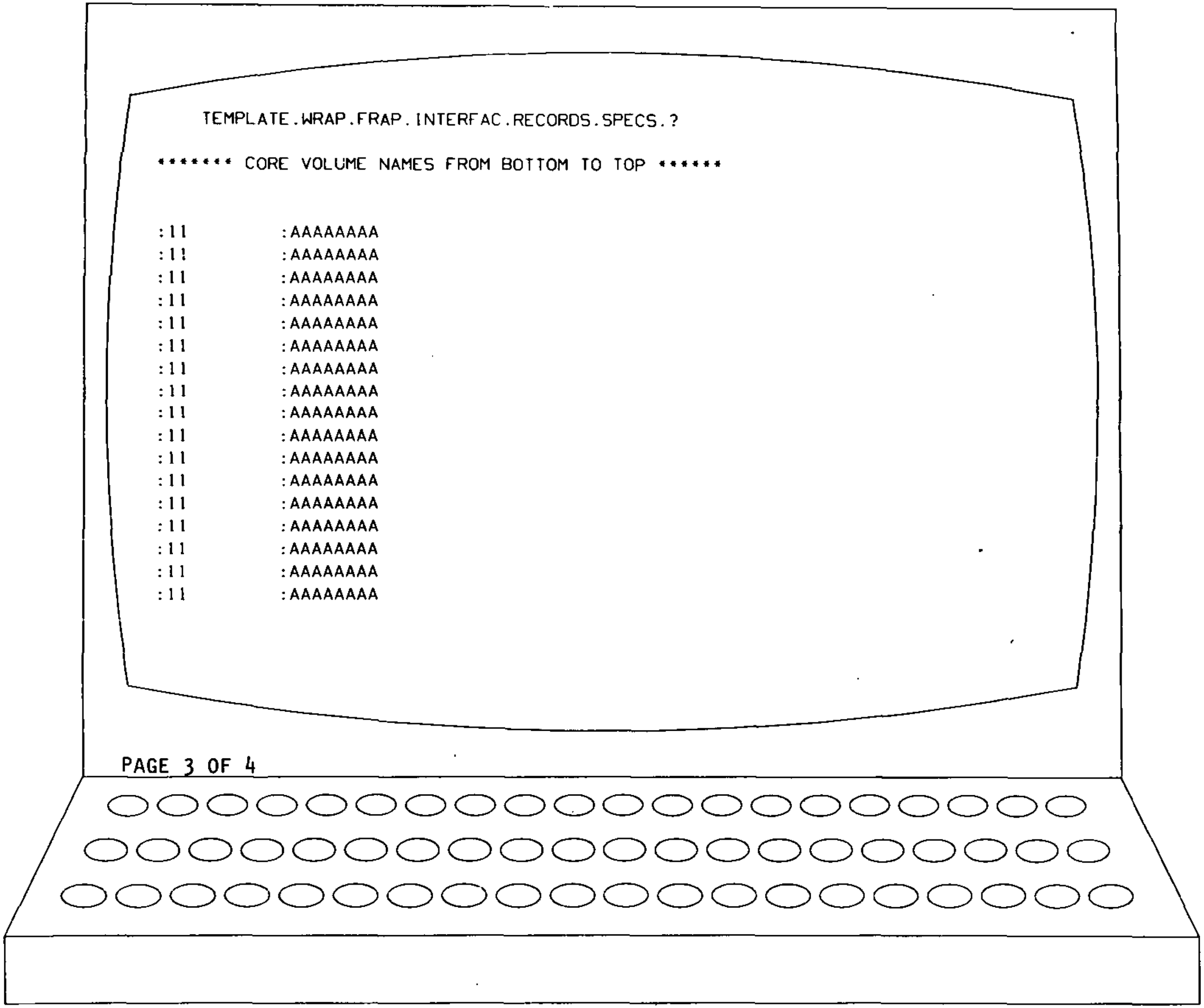
1) Axially dependent heat transfer coefficients

2) Fluid pressures and temperatures in each core volume represented in the blowdown calculation.

For both options, the transient power history is passed by reading the existing power history record and writing a new record containing the actual power history to the job data set.


TEMPLATE.WRAP.FRAP.INTERFAC.RECORDS.SPECS.?
INDICATOR FLAG FOR TYPE OF INTERFACE TO BE PERFORMED :A
TWRAM/FRAP INTERFACE = T
FLOOD/FRAP INTERFACE = F
CASE NAME = :AAAAAAAA STEP NAME = :AAAAAAAA
****
IF TWRAM/FRAP INTERFACE;
NUMBER OF DATA PAIRS DESIRED = :III
NUMBER OF CORE VOLUMES = :II NUMBER OF CORE SLABS = :II
****
IF FLOOD/FRAP INTERFACE;
NUMBER OF,
CORE INLET TEMPERATURE VS TIME DATA PAIRS (MAX = 20) :II
FLOODING RATE VS TIME DATA PAIRS (MAX = 100) :III
CORE PRESSURE VS TIME DATA PAIRS (MAX = 20) :II
COLLAPSED LIQUID LEVEL VS TIME DATA PAIRS (MAX = 20) :II
PAGE 1 OF 4


TEMPLATE.WRAP.FRAP.INTERFAC.RECORDS.SPECS.?
** REMAINDER OF PAGES CAN BE IGNORED FOR FLOOD/FRAP INTERFACE**
NAME OF UPPER PLENUM VOLUME :AAAAAAAA
NAME OF LOWER PLENUM VOLUME :AAAAAAAA
---> NOTE- IN CASES WHERE THERE ARE MORE THAN ONE UPPER OR
LOWER PLENUM VOLUMES, THE ABOVE NAMES REFER TO THE
VOLUMES IMMEDIATELY ADJACENT TO THE CORE.
PAGE 2 OF 4


TEMPLATE.WRAP.FRAP.INTERFAC.RECORDS.SPECS.?
******* CORE VOLUME NAMES FROM BOTTOM TO TOP ******
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
:11 :AAAAAAAA
PAGE 3 OF 4

TEMPLATE.WRAP.FRAP.INTERFAC.RECORDS.SPECS.?

******* CORE SLAB NAMES FROM BOTTOM TO TOP *******

```
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
:11      :AAAAAAAA
```

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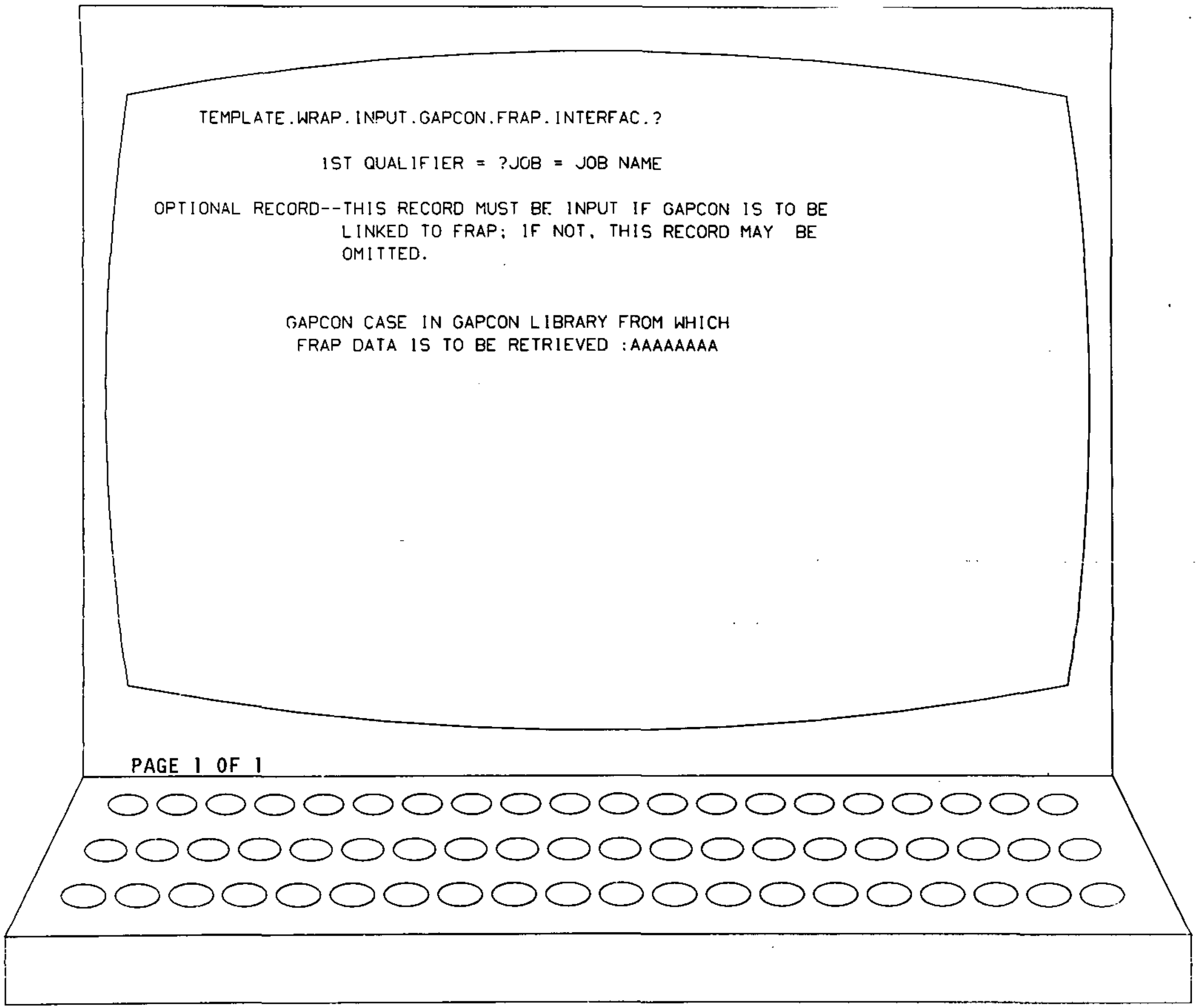
4.3 GAPCON/FRAP

The GAPCON/FRAP interface works in the same way as the GAPCON/WRAPIT interface and is invoked by creating the record with the WRAP.INPUT. GAPCON.FRAP.INTERFAC.?JOBNAME template. Data passed by this interface include cold pin dimensions, the gap gas pressure and constitution, and the axial power profile. Also transferred is the fuel deformation due to densification and clad deformation due to creep because the FRAP code does not calculate these initial conditions. This information is passed via a record by using the FRAP.BASE.DATA.STRAIN.?CASE template which has no analog in the normal FRAP-T4-LACE input.


TEMPLATE.WRAP.INPUT.GAPCON.FRAP.INTERFAC.?
1ST QUALIFIER = ?JOB = JOB NAME
OPTIONAL RECORD--THIS RECORD MUST BE INPUT IF GAPCON IS TO BE LINKED TO FRAP; IF NOT, THIS RECORD MAY BE OMITTED.
GAPCON CASE IN GAPCON LIBRARY FROM WHICH FRAP DATA IS TO BE RETRIEVED :AAAAAAAA
PAGE 1 OF 1

4.4 FLOOD/FRAP

The FLOOD/FRAP interface uses the same input template as the TWRAM/FRAP interface. There are only four time-dependent quantities passed from the FLOOD transient:

1) Core inlet temperature

2) Flooding rate

3) Core pressure

4) Collapsed liquid level.

Values determined by the interface are written by using the FRAP. OPTN.DATA.REFLOOD.PARAMS.?CASE template. The user is allowed to select the number of data points for each quantity because the flood rate data are more oscillatory than the others and may require more detailed history information.

5. GAPCON DATA LIBRARY

A necessary part of the linking together of GAPCON, WRAPIT, and FRAP in the WRAP-EM system is a data library in which GAPCON fuel conditions may be stored and from which WRAPIT and FRAP may retrieve data. This section gives a detailed description of that library. Explanations of the data elements are given from the perspective of each of the three codes.

5.1 Fuel Rod Geometry

GAPCON - cold* diameter of the fuel pellet.

- cold cladding inside diameter.

- cold cladding outside diameter.

- pin plenum V_{plen} — both FRAP and WRAPIT allow for a hold-down spring in the upper plenum volume. GAPCON does not. Thus, in FRAP and WRAPIT, a portion of their pin plenum volume is occupied by the spring volume. In WRAPIT and FRAP, the spring volume is calculated from input values of length of coiled spring, number of coil, outside coil diameter of spring, and spring wire diameter.

- radius of fuel pellet shoulder for axial expansion (radius of fuel pellet dish).

- allows the option of a central void, secondary cladding, and crud on the cladding surface. Only the central void option is allowed in the FRAP model. While WRAPIT can handle these concepts by specification of an inner slab radius and additional materials in the heat slab description, their inclusion (i.e., increasing heat slab detail) can significantly lengthen TWRAM execution time. Thus, while these quantities may be of interest in a GAPCON stand-alone calculation (and indeed they may be used in a stand-alone execution), they are not permitted in cases written to the GAPCON library.

FRAP - cold diameter of the fuel pellet — same.

- cold cladding inside diameter — same.

---

* Cold as used here and throughout this section means the initial values as input to GAPCON.

- cold cladding outside diameter — same.

- pin plenum - $V_{plen} + V_{spring}$.

- radius of fuel pellet shoulder for axial expansion — same.

WRAPIT - cold diameter of the fuel pellet — same.

- cold claddding inside diameter — same.

- cold cladding outside diameter — same.

- pin plenum volume — $V_{plen} + V_{spring}$.

- radius of fuel pellet shoulder for axial expansion — same.

- WRAPIT considers the heat slabs in any stack to represent the sum of all the pins. Thus, the pin plenum volume must be multiplied by the number of pins represented by a given stack.

5.2 Power

GAPCON - Each GAPCON calculation is performed at a specific power level and axial power profile for the pin. GAPCON input includes reactor power history, radial peaking factor, local peaking factor, axial peaking factors, number of bundles, number of rods per bundle, and rod length. The reactor power history and axial peaking factor are input to GAPCON as named records. The power history record name, final reactor power, radial peaking factor, local peaking factor, bundles, number of rods per bundle, and rod length are placed in the GAPCON library.

FRAP - Only the axial power distribution for the hot pin calculation and the rod length is passed to FRAP.

WRAPIT - Only reactor power, number of bundles, and number of rods per bundle are retrieved from the GAPCON library for use in WRAPIT.

5.3 Fuel Density

GAPCON - as manufactured fuel fractional density.

FRAP - same.

WRAPIT - same.

5.4 Gap Heat Transfer Factors

GAPCON - emissivity of fuel.

- emissivity of cladding interior surfaces.
- average surface roughness of fuel.
- average surface roughness of cladding.
- final* fission gas pressure.

FRAP - emissivity of fuel — not passed.

- emissivity of cladding surface — not passed.
- average surface roughness of fuel — same.
- average surface roughness of cladding — same.
- final fission gas pressure — GAPCON fission gap pressure is used as the initial fission gas pressure in FRAP.

WRAPIT - emissivity of fuel — same.

- emissivity of cladding interior surface — same.
- average surface roughness of fuel — not used.
- average surface roughness of cladding — not used.
- final fission gas pressure — not used.

5.5 Fission Gas Composition

GAPCON - final mole fraction of helium.

- final mole fraction of argon.
- final mole fraction of krypton.
- final mole fraction of xenon.

---

* Final as used here and throughout this section means the value at the end time in GAPCON.

- final mole fraction of hydrogen.

- final mole fraction of nitrogen.

- can also consider the sorbed gas content of the oxide fuel; however, WRAPIT and FRAP do not have this capability. Thus, while sorbed gas can be included in GAPCON stand-alone calculations, it is not permitted in cases written to the GAPCON library.

FRAP - allows specification of steam. This is not allowed if the codes are linked.

WRAPIT - same as FRAP.

5.6 Gram Moles of Fission Gas

GAPCON - final number of g-moles of fission gas as a function of axial position, M_{gap_i}.

- final number of g-moles of fission gas in pin plenum M_{plen}.

- g-moles in rod — FRAP input requires the number of g-moles of fission gas in the rod. This represents the sum

$$\sum_{length} M_{gap_i} + M_{plen}.$$

WRAPIT - g-moles of gas in pin gap and plenum.

In WRAPIT the data for g-moles of gas in the pin gap may be interpolated from GAPCON. In addition, for the top heat slab in the stack, the g-moles of fission gas in the pin plenum must be added to the g-moles in the gap of the top section. WRAPIT considers the heat slabs in any stack to represent the sum of all the pins. Thus, the pin volume must be multiplied by the number of pins in a given stack.

5.7 Changes in Fuel and Cladding Radii (values placed in library will be a function of axial position)

GAPCON - final change in fuel radius due to relocation.

- final change in fuel radius due to densification.

- final change in fuel radius due to swelling.

- final change in clad radius due to creep (not present if using pressure differences to calculate elastic deflection).

FRAP - final change in fuel radius due to densification and relocation is passed. Swelling is calculated within FRAP.

- initial cladding plastic strain — same as final change in clad radius due to creep.

WRAPIT - initial fuel swelling — sum of changes in fuel radius due to relocation, densification, and swelling.

- initial cladding plastic strain — same as final change in clad radius due to creep.

5.8 Fuel Conditions

GAPCON - fraction by weight of fuel that is PuO_2.

- burnup of fuel.

- time span at which fuel was at operating power.

FRAP - same.

WRAPIT - data not applicable.

REFERENCES

1. M. M. Anderson, WRAP - A Water Reactor Analysis Package. USNRC Report DPST-NUREG-77-1, E. I. du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC, 1977. Available for purchase from Technical Information Center, Oak Ridge, TN 37830.

2. M. V. Gregory and F. Beranek, The PWR Loss-of-Coolant Accident Analysis Capability of the WRAP-EM System," USNRC Report NUREG/CR-1645 (DPST-NUREG-80-1), E. I. du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC, 1979. Available for purchase from National Technical Information Service, Springfield, VA 22161.

3. R. R. Beckmeyer, et al., User's Guide for the BWR LOCA Analysis Capability of the WRAP-EM System. USNRC Report NUREG/CR-0714 (DPST-NUREG-78-3), E. I. du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC, 1979. Available for purchase from National Technical Information Service, Springfield, VA 22161.

4. C. E. Beyer, et al., GAPCON-THERMAL-2: A Computer Program for Calculating the Thermal Behavior of an Oxide Fuel Rod. USNRC Reports BNWL-1897 and BNWL-1898, Battelle Pacific Northwest Laboratories, Richland, WA, 1975. Available for purchase from National Technical Information Service, Springfield, VA 22161.

5. D. A. Sharp, The PWR Steady-State Capability of WRAP - A Water Reactor Analysis Package. USNRC Report DPST-NUREG-77-3, E. I. du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC, 1975. Available for purchase from Technical Information Center, Oak Ridge, TN 37830.

6. RELAP4/MOD5 - A Computer Program for Transient Thermal-Hydraulic Analysis of Nuclear Reactors and Related Systems - User's Manual. USNRC Report ANCR-NUREG-1335, Idaho National Engineering Laboratory, Aerojet Nuclear Company, Idaho Falls, ID, 1976. Available for purchase from National Technical Information Service, Springfield, VA 22161.

7. L. J. Siefken, A Computer Code for the Transient Analysis of Oxide Fuel Rods. USNRC Report NUREG/CR-0840 (CDAP-TR-027), Idaho National Engineering Laboratory, EG&G, Idaho, Inc., Idaho Falls, ID, 1978. Available for purchase from National Technical Information Service, Springfield, VA 22161.

8. M. P. Bohn, et al., The Licensing Audit Calculation (LACE) Models in the FRAP-T4 Code - Description and Development Assessment. USNRC Report EGG-CDAP-5144, Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, ID, 1980. Available from EG&G Idaho, Inc., Idaho Falls, ID 83401.

9. H. C. Honeck, The JOSHUA System. USERDA Report DP-1380, E. I. du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC, 1975. Available for purchase from National Technical Information Service, Springfield, VA, 22161.

10. M. V. Gregory, User's Guide to Input for WRAP - A Water Reactor Analysis Package. USNRC Report DPST-NUREG-77-2, E. I. du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC, 1977. Available for purchase from Technical Information Center, Oak Ridge, TN 37830.

11. G. W. Johnson and L. H. Sullivan, LPWR 'EM' Models for RELAP4/MOD5, USNRC Report CDAP-TR-78-034, Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, ID, 1978. Available from EG&G Idaho, Inc., Idaho Falls, ID 83401.

12. RELAP/MOD6 - A Computer Program for Transient Thermal-Hydraulic Analysis of Nuclear Reactors and Related Systems - User's Manual, USDOE Report CDAP-TR-003, Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, ID, 1978. Available from EG&G Idaho, Inc., Idaho Falls, ID 83401.

APPENDIX

During the development of WRAP, new models have been inserted which require input not included in previous WRAP documentation.[3,10] This appendix includes templates that have been developed to invoke the new options. A description of the new input for each template follows:

WRAP. INPUT.STMGEN.?CASENAME - Used to invoke the natural convection steam generator model allowing heat transfer from the secondary side to the primary.[11] This input is particularly important during reflood.

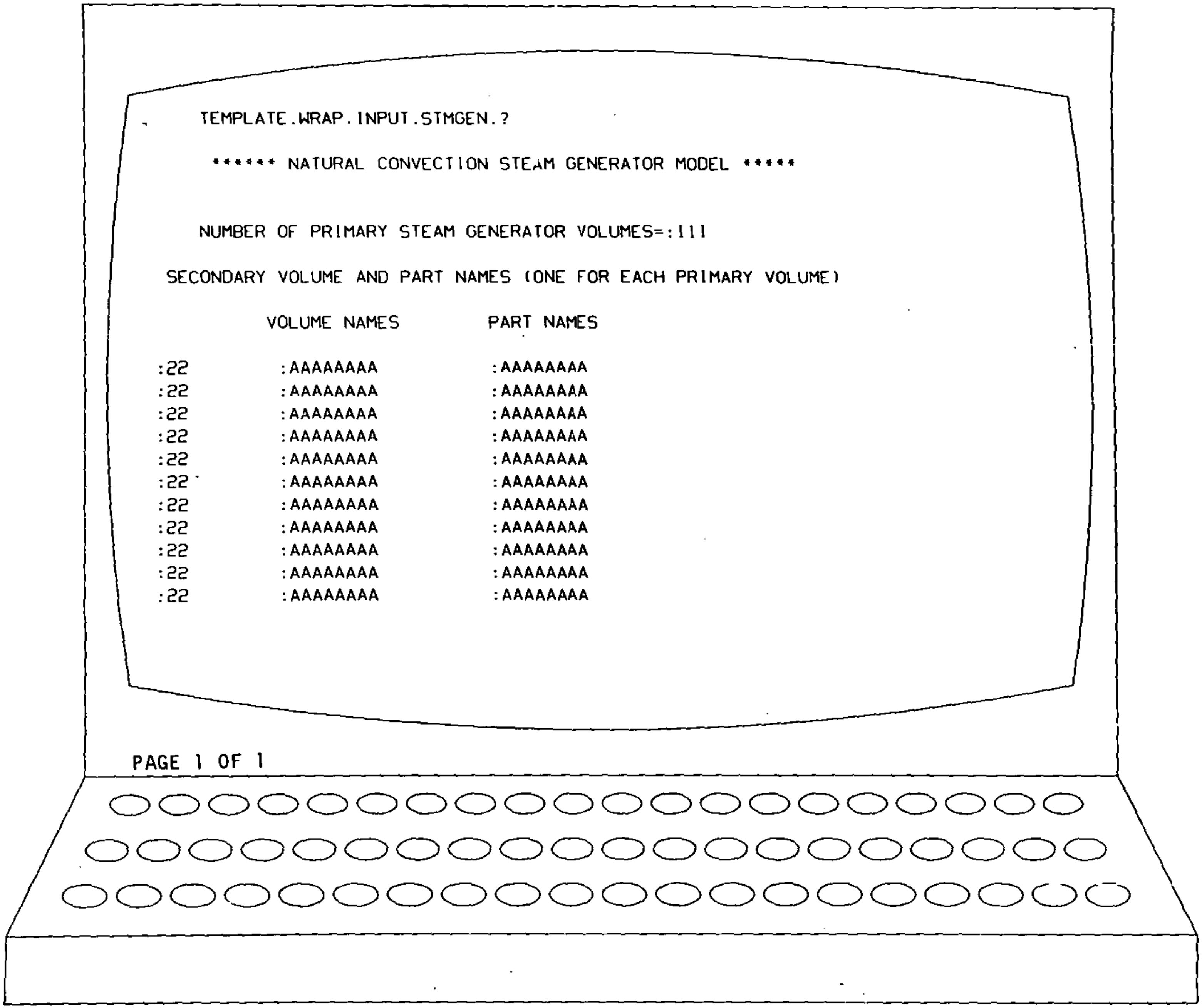
WRAP.INPUT.SLIP.?CASENAME - Used to invoke the dispersed slip flow model.[12]

WRAP.INPUT.POLYTROP.?CASENAME - Used to invoke the polytropic gas expansion model in the accumulators.[12] This input allows the gas in the accumulator to be at a different temperature than the water.

WRAP.INPUT.PWREM.PENALTY.?CASENAME - Used to simulate steam binding problems at the accumulator inlet junction.[11]

WRAP.INPUT.PMPVARIN.?CASENAME - Used to allow a speed dependent moment-of-inertia for pumps.[12]

WRAP.INPUT.BYPSRCH.?CASENAME - Used to preclude the check for end of bypass until after a user designated time.


TEMPLATE.WRAP.INPUT.STMGEN.?
****** NATURAL CONVECTION STEAM GENERATOR MODEL *****
NUMBER OF PRIMARY STEAM GENERATOR VOLUMES=:111
SECONDARY VOLUME AND PART NAMES (ONE FOR EACH PRIMARY VOLUME)
VOLUME NAMES
PART NAMES
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
:22 :AAAAAAAA :AAAAAAAA
PAGE 1 OF 1

```
TEMPLATE.WRAP.INPUT.SLIP.?CASE

        ***** SLIP OPTION PARAMETERS *****

CARD TYPE 060001


     MULTIPLIER FOR LIMIT FOR BEGINNING
     OF TRANSITION TO DISPERSED FLOW
     CORRELATIONS  (SLVMXX)................:E.EEEEEEEE

     MULTIPLIER FOR LOW VOID FRACTION
     CORRELATION  (SLVM1)..................:E.EEEEEEEE

     MULTIPLIER FOR HIGH VOID FRACTION
     CORRELATION  (SLVM2)..................:E.EEEEEEEE
```

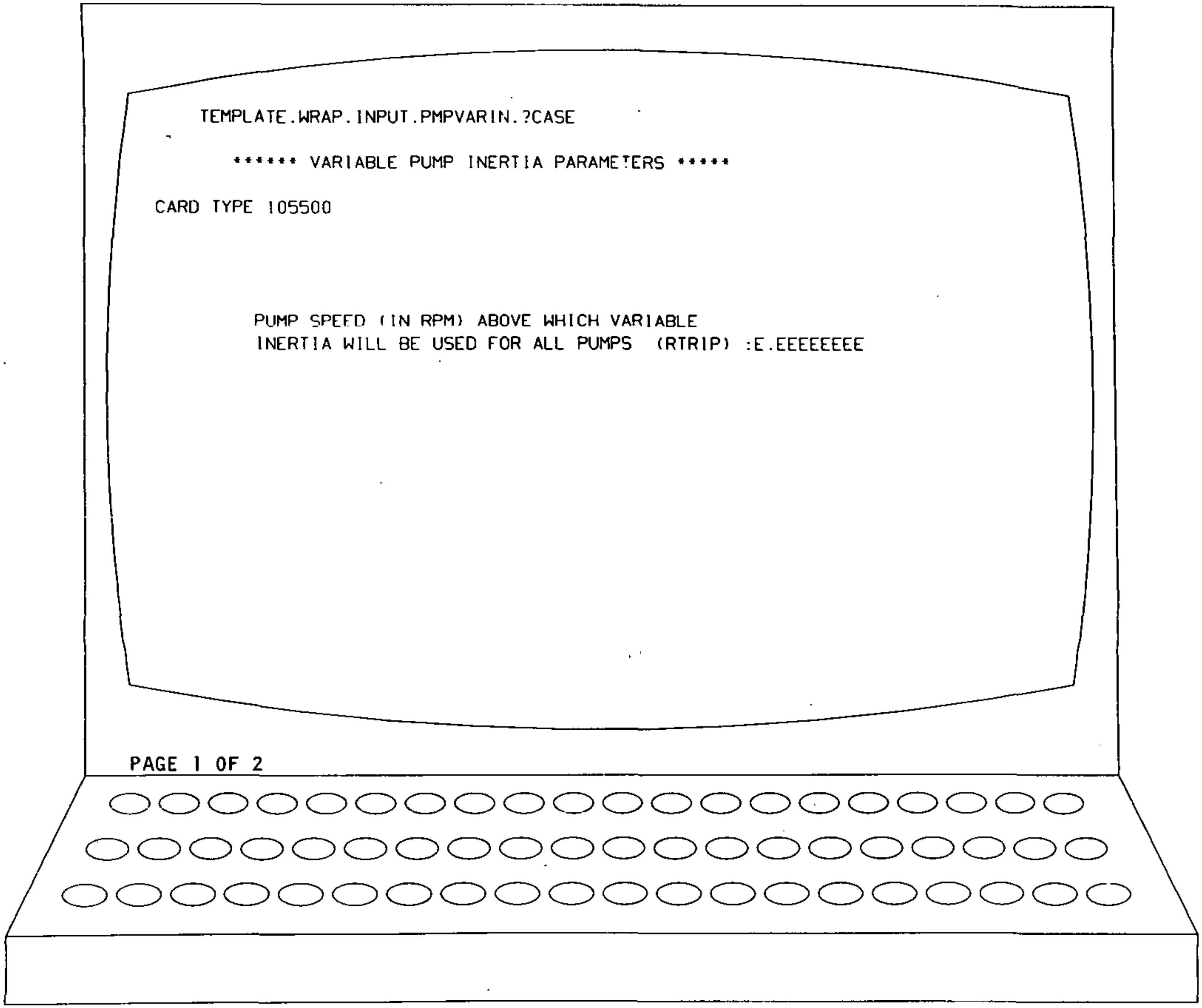
PAGE 1 OF 1

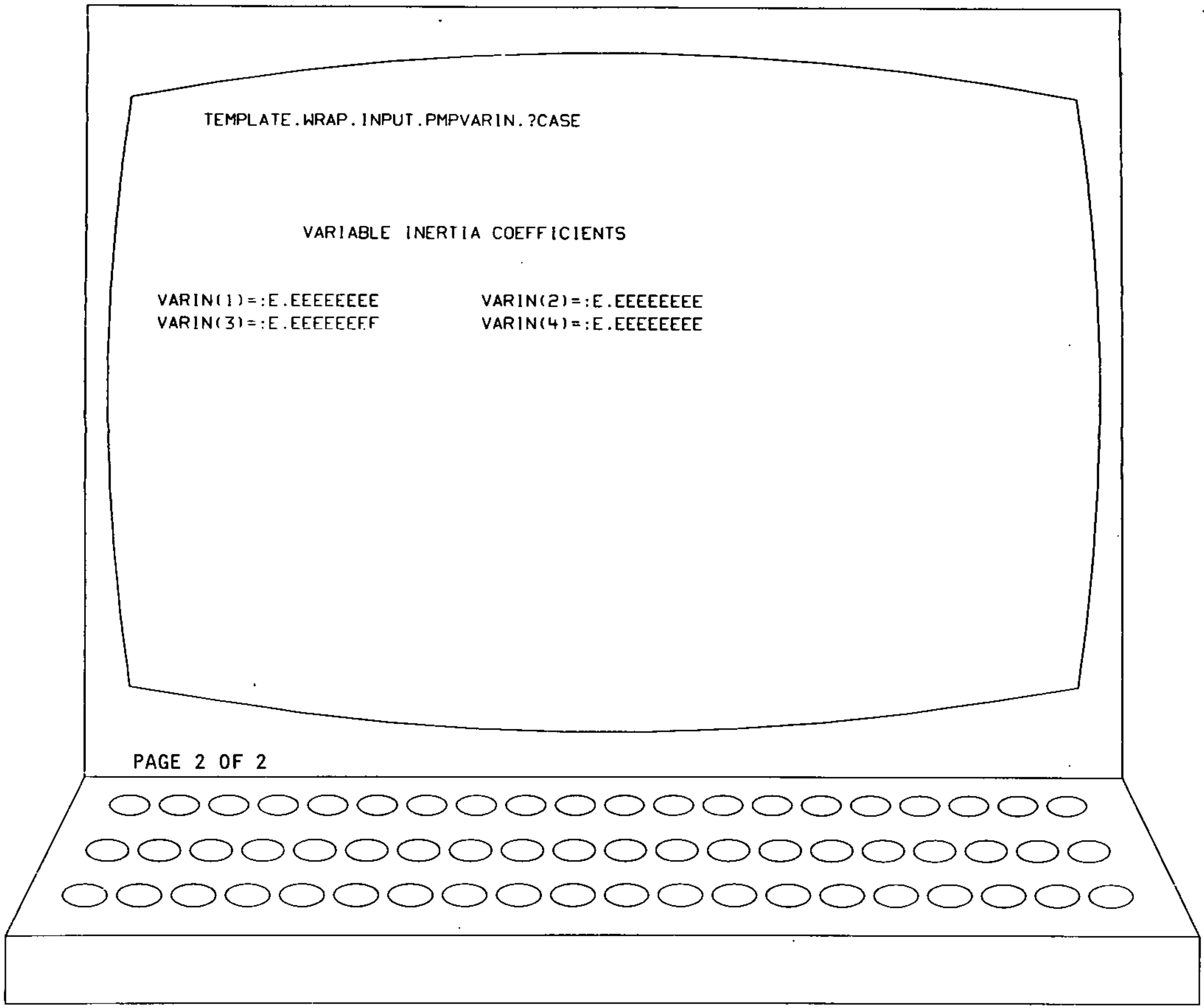
```
TEMPLATE.WRAP.INPUT.POLYTROP.?

     ***** POLYTROPIC GAS EXPANSION MODEL *****

POLYTROPIC GAS EXPANSION COEFFICIENT (POLY)= :EE.EEEEEEEE

NUMBER OF VOLUMES WHICH USE THIS MODEL (NACV)= :II

NAMES OF VOLUMES AND PARTS USING THIS MODEL--

            VOLUME NAMES        PART NAMES

:22          :AAAAAAAA          :AAAAAAAA
:22          :AAAAAAAA          :AAAAAAAA
:22          :AAAAAAAA          :AAAAAAAA
:22          :AAAAAAAA          :AAAAAAAA
:22          :AAAAAAAA          :AAAAAAAA
:22          :AAAAAAAA          :AAAAAAAA
:22          :AAAAAAAA          :AAAAAAAA
:22          :AAAAAAAA          :AAAAAAAA
:22          :AAAAAAAA          :AAAAAAAA
:22          :AAAAAAAA          :AAAAAAAA
```

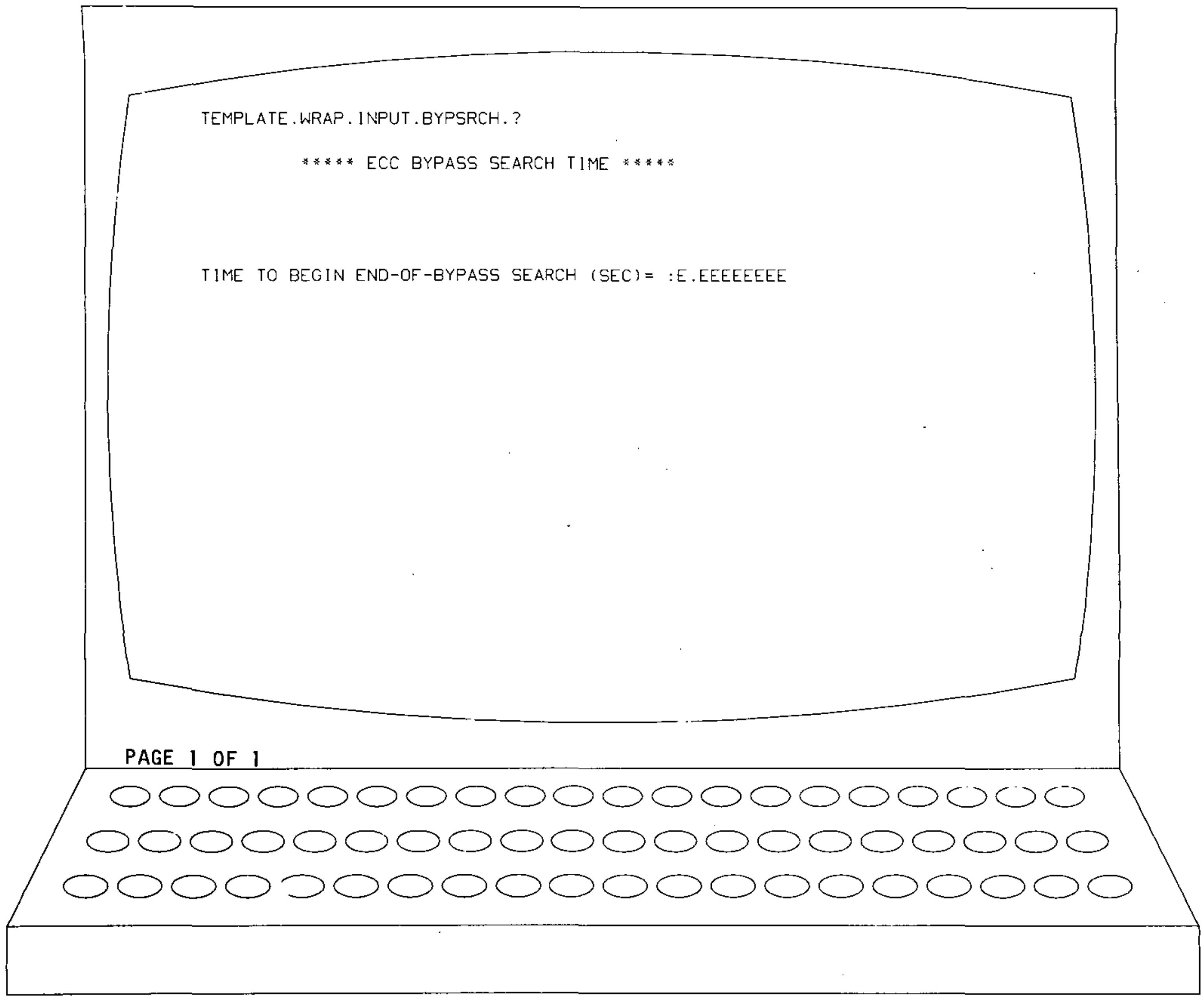
PAGE 1 OF 1

```
    TEMPLATE.WRAP.INPUT.PWREM.PENALTY.?CASE

           ***** DELTA-P PENALTY PARAMETERS *****

CARD TYPE 260010

       JUNCTION WHERE PRESSURE PENALTY IS TO BE APPLIED

       JUNCTION NAME :AAAAAAAA      PART NAME :AAAAAAAA


       TIME (SEC)               PENALTY (PSI)

      :E.EEEEEEEE                :E.EEEEEEEE
      :E.EEEEEEEE                :E.EEEEEEEE
      :E.EEEEEEEE                :E.EEEEEEEE


NOTE-- ANY TIME INPUT GREATER THAN 10000. SEC WILL BE OVERRIDDEN
        INTERNALLY BY THE TIME AT WHICH THE ACTION OCCURS WHICH
        SHOULD PHYSICALLY CAUSE THE PRESSURE TO CHANGE.
```

PAGE 1 OF 1


TEMPLATE.WRAP.INPUT.PMPVARIN.?CASE
****** VARIABLE PUMP INERTIA PARAMETERS *****
CARD TYPE 105500
PUMP SPEED (IN RPM) ABOVE WHICH VARIABLE
INERTIA WILL BE USED FOR ALL PUMPS (RTRIP) :E.EEEEEEEE
PAGE 1 OF 2


TEMPLATE.WRAP.INPUT.PMPVARIN.?CASE
VARIABLE INERTIA COEFFICIENTS
VARIN(1)=:E.EEEEEEEE
VARIN(2)=:E.EEEEEEEE
VARIN(3)=:E.EEEEEEEF
VARIN(4)=:E.EEEEEEEE
PAGE 2 OF 2


TEMPLATE.WRAP.INPUT.BYPSRCH.?
***** ECC BYPASS SEARCH TIME *****
TIME TO BEGIN END-OF-BYPASS SEARCH (SEC)= :E.EEEEEEEE
PAGE 1 OF 1