APPENDIX F

CONTAINMENT ANALYSIS

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F.1 TREATMENT OF NUREG/CR-4551 APET EVENTS IN THE NORTH ANNA IPE CONTAINMENT ANALYSIS

This section will discuss how the North Anna IPE treated the NUREG/CR-4551 APET categories.

F.1.1 Size and Location of RCS Break When the Core Uncovers

PDS heading "Transient or LOCA Type" distinguishes LOCA initiated sequences from transient sequences and furthermore separates large LOCAs from medium/small LOCAs.

PDS heading "Containment Bypass" distinguishes SGTRs and Event V bypass sequences.

F.1.2 Has the Reaction Been Brought Under Control

Whether or not an ATWS occurs is not considered a major event for the overall accident progression since after core uncovery begins the power level drops to decay heating levels and accident progression proceeds generally in the same manner for ATWS and non-ATWS sequences. Consequently, ATWS events were not grouped into separate PDS.

F.1.3 For SGTR Are the Secondary System SRVs Stuck Open

For all SGTR core damage sequences we conservatively assume that a continuously open release pathway exists from the primary system to the environment.

F.1.4 Status of ECCS

PDS heading "Status of In-vessel Injection" classifies sequences based on the status of the low pressure system. The four possibilities considered are:

1) LPI failed
2) LPI available but cannot inject because RCS pressure is too high (deadheaded)
3) LPI on (but core damage still occurs - e.g., for large LOCA without successful accumulator injection)
4) LPI available after power recovery

F.1.5 RCS Depressurization By the Operators

RCS depressurization using the pressurizer PORVs is considered in the core damage event trees. This is then used to define RCS pressure under grouping heading "RCS Pressure."

F.1.6 Status of Sprays

The status of the Recirculation Sprays and of Containment Heat Removal are considered in the core damage event trees and are used as grouping criteria ("Containment Recirculation Sprays" and "Containment Heat Removal") in the PDS grouping.

F.1.7 Status of Fan Coolers

The fan coolers at North Anna are not designed for operation in a severe accident environment or with substantial quantities of water on the Containment floor (where the fans are located). Hence, fan cooler operation was not considered at any time in the North Anna IPE.

F.1.8 Status of AC Power

The plant damage event trees assess the probability of power recovery over various time periods for SBO and loss of switchgear room cooling sequences including prior to 1) core uncovery 2) core damage 3) vessel failure and 4) long term Containment failure from gradual steam over-pressurization. These characteristics were used for grouping into PDS classes under PDS heading "Power Recovery."

F.1.9 RWST Injected Into Containment

Within the plant damage event trees the injection of the RWST into containment is implicitly included in the evaluation of the operability of the Recirculation Sprays and for vessel injection in the recirculation mode.

Whether or not the reactor cavity receives a supply of cooling water depends upon whether the Recirculation Sprays are operating.

RWST water is supplied to the sump either by Quench Spray injection or by vessel injection and leakage from the RCS through a break or through the pressurizer PORVs.

F.1.10 Heat Removal from the Steam Generators

Operation of the motor driven or turbine driven AFW systems are evaluated in the plant damage event trees.

F.1.11 Did the Operators Depressurize the Secondary Before the Core Uncovers

Depressurization of the is considered in the plant damage event trees for small and intermediate LOCA initiators and for SGTR initiators. Whether or not the operators depressurize the secondary system for SGTR sequences influences whether or not the broken SG fills with water and causes failure of the secondary relief valves.

F.1.12 Cooling for the RCP Seals

Seal cooling is evaluated in the plant damage event trees.

F.1.13 Initial Containment Leak or Isolation Failure

The third heading in the plant state grouping logic diagram discriminates between sequences with failure to isolate and those where Containment isolation is intact.

F.1.14 Event V-Break Location Under Water

The probability that the break location is submerged in the safeguards building is evaluated in the special CET for the Event V sequences (plant damage state 24).

F.1.15 RCS Pressure at the Start Core Degradation

RCS pressure during core damage and at vessel failure are considered as a separate heading in the PDS grouping logic diagram: RCS pressure during core damage/at vessel failure.

F.1.16 Do the PORVs or SRVs Stick Open

A stuck open pressurizer PORV or SRV is evaluated in the plant damage event trees in Event Q - "RCS Boundary Intact." Success or failure under this event tree heading is one of the parameters used to define the RCS pressure under PDS grouping heading "RCS Pressure..."

F.1.17 Temperature Induced RCP Seal Failure

RCP Seal failure is considered in the T4 event tree and is one of the parameters used to determine RCS pressure for sequence assignment to PDS groups under heading "RCS Pressure..."

F.1.18 Is the RCS Depressurized Before Breach By Opening the Pressurizer PORVs

Opening the PORVs to initiate feed and bleed or for RCS depressurization is considered in the plant damage event trees and is a parameter used to classify sequences into PDS groups based on RCS pressure under heading "RCS Pressure..."

F.1.19 Temperature Induced SGTR

Temperature induced SGTR is considered in the DET for CET event "Mode of Induced Primary System Failure."

F.1.20 Temperature Induced Hot Leg or Surge Line Break

Temperature induced hot leg or surge line breaks are considered in the DET for CET event "Mode of Induced Primary System Failure."

F.1.21 AC Power Available Early

The availability of AC power is considered in the following time periods for grouping into plant damage states:

A. always available
B. never available
C. not available prior to core damage but recovered prior to vessel failure
D. not available prior to vessel failure but recovered prior to Containment failure

These are considered under the headings "Station Blackout" and "Power Recovery" in the PDS grouping logic.

F.1.22 Rate of Blowdown to Containment

The impact of vessel blowdown rate (e.g., break size) on Containment pressure just prior to vessel failure is considered in the DET for "Mode of Early Containment Failure."

F.1.23 Vessel Pressure Just Before Break

See discussion under APET event 15.

F.1.24 Is Core Damage Arrested-In-Vessel

The probability of terminating the accident progression in-vessel and preventing vessel breach is evaluated in the DET for CET event "Debris Cooled In-Vessel."

F.1.25 Early Sprays

Availability of the Recirculation Sprays prior to, and during, core damage is evaluated from plant damage state headings "Containment Recirculation Sprays," "Power Recovery," and "Station Blackout."

F.1.26 Early Fan Coolers

See discussion under APET event 7.

F.1.27 Early Containment Heat Removal

Considered under plant damage state heading "Containment Heat Removal."

F.1.28 Baseline Containment Pressure Just Before Vessel Breach

This parameter is evaluated in the DET for CET event "Mode of Early Containment Failure."

F.1.29 Time of Accumulator Discharge

Not considered explicitly in North Anna IPE Containment evaluation.

F.1.30 Fraction of Zr Oxidized In-Vessel During Core Degradation

This parameter is evaluated in the DET for CET event "Mode of Early Containment Failure."

F.1.31 Amount of Zr Oxidized In-Vessel During Core Degradation

See discussion under APET event 30.

F.1.32 Amount of Water in Reactor Cavity at Vessel Breach

Not explicitly evaluated in North Anna IPE Containment evaluation.

F.1.33 Fraction of Core Released from Vessel at Breach

Mass of core debris which participates in DCH event is explicitly evaluated in the DET for "Mode of Early Containment Failure."

F.1.34 Amount of Core Released from the Vessel at Breach

See discussion under APET event 33.

F.1.35 Does an Alpha Mode Event Fail Both the Vessel and the Containment

Alpha mode Containment failures are evaluated in the DET for CET event "No Alpha Mode Containment Failure."

F.1.36 Type of Vessel Breach

This event is not explicitly included in the North Anna IPE Containment evaluation. High Pressure Melt Ejection is considered in the DETs for "Mode of Early Containment Failure" and "Debris Cooled Ex-Vessel."

F.1.37 Does the Vessel Become a Rocket and Fail the Containment

This event was not considered in the North Anna IPE. It is clear from the treatment of this event in NUREG/CR-4551 that it was considered of negligible significance - the assigned probabilities were about an order of magnitude less than for alpha mode Containment failures. In addition, research has shown that, although the vessel may levitate, it is unlikely to fail the containment.

F.1.38 Size of the Hole in the Vessel (After Ablation)

The size of the vessel breach was not explicitly treated in the North Anna IPE. However, the impact of variations in the magnitude of HPME were considered in the DETs for "Mode of Early Containment Failure" and "Debris Cooled Ex-Vessel."

F.1.39 Pressure Rise at Vessel Breach (Large Hole Cases)

The pressure rise at vessel breach from DCH, hydrogen combustion and steam generation are considered in the DET for CET event "Mode of Early Containment Failure."

F.1.40 Pressure Rise at Vessel Breach (Small Hole Cases)

See discussion in 39 above.

F.1.41 Does a Significant Ex-Vessel Steam Explosion Occur

An energetic ex-vessel steam explosion capable of directly failing Containment was not considered credible in the NUREG/CR-4551 analysis. This event was not explicitly considered in the North Anna IPE.

F.1.42 Containment Failure Pressure

The probability of Containment failure at a given pressure and the size of the failure are evaluated in the DETs for "Mode of Early Containment Failure" and "Mode of Late Containment Failure."

F.1.43 Containment Failure and Type of Containment Failure

See discussion in 42 above.

F.1.44 Sprays After Vessel Breach

Failure of the Quench or Recirculation sprays at or near the time of vessel breach is considered in the DET for CET event "No Early Recirculation Spray Failure."

F.1.45 Is AC Power Available Late

Power recovery in the time period subsequent to vessel failure and prior to the anticipated time when Containment would first be threatened by long term overpressurization is considered under PDS grouping heading "Power Recovery..."

F.1.46 Late Sprays

Operation of sprays following vessel failure is determined in the North Anna IPE by the plant damage state conditions under headings "Power Recovery" and "Containment Recirculation Sprays" and by the

branch taken under CET event "No Early Recirculation Spray Failure."

F.1.47 Late Fan Coolers

See discussion under item 7.

F.1.48 Late Containment Heat Removal

Operation of Containment heat removal is defined by the same conditions as for the Recirculation Sprays (see 46 above) and by the status of Containment heat removal as defined by PDS conditions for this parameter.

F.1.49 How Much Hydrogen Burns Vessel Breach

If a HPME event occurred at vessel breach, it was assumed sufficient hydrogen was burned at that time to preclude a late hydrogen burn which could threaten Containment integrity.

F.1.50 Does Late Ignition Occur

Whether late Containment failure occurs and the mode of Containment failure from late hydrogen combustion is considered in the DET for CET event "Mode of Late Containment Failure."

F.1.51 Late Burn - Resulting Pressure in Containment

See discussion under APET heading 50.

F.1.52 Containment Failure and Type of Containment Failure

See discussion under APET heading 50.

F.1.53 Amount of Core Available for CCI

The spread of the debris, location of the debris, and the debris depth is considered in the DET for CET event "Debris Cooled Ex-Vessel."

F.1.54 Is the Debris Bed in a Coolable Configuration

The coolability of the debris pool is considered in the DET for CET event "Debris Cooled Ex-Vessel."

F.1.55 Does Prompt CCI Occur

CET event "Debris Cooled Ex-Vessel" defines whether or not the debris is cooled. If it is not cooled then CCI is assumed to occur.

F.1.56 Is AC Power Recovered Very Late

Plant damage state heading "Power Recovery" distinguishes sequences with power recovery late (i.e., many hours after reactor vessel failure).

F.1.57 Very Late Sprays

See discussion for APET heading APET 46. No explicit distinction in the North Anna IPE between late and very late spray operation.

F.1.58 Very Late Fan Coolers

See discussion APET Event 7.

F.1.59 Very Late CHR

See discussion under APET headings 46, 48 and 57.

F.1.60 Does Delayed CCI Occur

Very late CCI leading to Containment basemat melt-through is considered in CET event "Containment Failure Long Term."

F.1.61 How Much H_2 Is Produced

See discussion under APET heading 50. Note that no distinction is made between late and very late hydrogen combustion.

F.1.62 Does Very Late Ignition Occur

See discussion under APET headings 50 and 61.

F.1.63 Very Late Burn

See discussion under APET headings 50 and 61.

F.1.64 Containment Failure and Type of Failure

See discussion under APET headings 50 and 61.

F.1.65 Sprays After Very Late Containment Failure

Spray failure as a result of late Containment failure or due to the general accident environmental conditions is evaluated in the DET for CET event "No Late Recirculation Spray Failure." Also see discussion under APET headings 46, 48, and 57.

F.1.66 Fan Coolers After Very Late Containment Failure

See discussion for APET heading 7.

F.1.67 Containment Heat Removal After Very Late Containment Failure

See discussions under APET headings 46, 48, 57, and 65.

F.1.68 Eventual Basemat Melt-Through

Basemat melt-through is treated under CET event "Containment Failure Long Term." Melt-through failure is ignored if Containment failure has occurred via another failure mode.

F.1.69 Eventual Over-Pressure Failure of Containment

Eventual over-pressure failure of Containment is assumed to occur if Containment heat removal is not available. Over-pressure failure is considered in the DET for CET event "Mode of Late Containment Failure."

F.1.70 Basemat Melt-Through Before Over-Pressure Failure

In the North Anna IPE, if Containment over-pressure failure is predicted to occur (i.e., CHR not available), then the defined Containment failure mode will be above ground Containment failure. Only if over-pressure failure is precluded is melt-through failure considered. Hence the "competition" between above ground over-pressure and melt-through is not considered.

F.1.71 Final Containment Conditions

The CET event "Containment Failure Long Term" defines the long term condition of Containments that have not been set by prior CET events such as "Mode of Late Containment Failure."

F.2 PLANT DAMAGE STATE GROUPING CRITERIA

F.2.1 Plant Damage State Definition

The entry points to the Containment Event Trees are plant damage states. The plant damage states are groupings of the (extended) core melt (Level 1 sequences) into similarity bins or states. The goal of the grouping process is to reduce the number of required Containment analyses to a tractable number while continuing to distinguish the more important differences among the sequences which are likely to influence the Containment accident progression. The plant damage state characteristics are defined by selecting a set of key systems operation related parameters which are considered to be important to: accident progression in the Containment; the time, mode and location of Containment failure; and the radionuclide source term. The parameters that are used to define the plant damage states include the functional status of important systems, state variables which are determined by systems operation (e.g., Reactor Coolant System pressure), accident initiator type and timing of key events (e.g., power recovery).

Nine criteria were selected for use in defining the NAPS plant damage states. A description of these criteria and the bases for their selection are discussed in detail below. Generally, these criteria were selected because they have a controlling influence on determining key accident progression characteristics; the time, mode and location of containment failure and the radionuclide source term to the environment.

The plant damage state logic diagram is a tool used to perform the classification by combining the various grouping parameters into unique plant damage states. An initial logic diagram was constructed with the selected nine criteria as decision branches to aid in the assembly of specific plant damage state characteristics from the matrix of all possible combinations allowed by these nine grouping parameters.

Using nine parameters in a grouping logic structure with (only) binary choices at each decision point would result in 2^9 (512) groups which is clearly intractable. However, by arranging the logic diagram in such a way that the most important parameters are considered before parameters of lesser importance, and eliminating decision points by allowing only one decision branch results in the collapse of the number of plant damage states to a reasonable

number while still preserving the most important differences among the various sequences. The reasons for suppressing branching on a decision branch are somewhat judgmental and involve the following considerations: (1) Is this branch necessary to distinguish an important difference among the sequences? (2) Is the frequency of sequences following this pathway likely to be sufficiently large to warrant additional plant damage states?, and (3) Can a conservative choice be made which allows for branch suppression which is not likely to significantly impact the overall results. For example, on the North Anna PDS Logic Diagram shown on Figure F.2-2 branching is suppressed under the Station Blackout heading for large LOCA type sequences based on the relative frequency of these LOCAs with and without AC power.

The initial logic diagram for the NAPS plant damage state groups is shown in Figure F.2-1. The basis for the frequencies shown is described in the next section. The associated rules for assigning the Level 1 sequences to Plant Damage States are given in Table F.2-1. These rules are shown in NUCAP+ (Fulford, 1991) format and the diagram is drawn with the assistance of NUCAP+. The basis for the assignment rules for each criterion is given in detail below. The endpoints of the logic diagram represent individual plant damage states and the pathway through the diagram (i.e., the set of decision paths taken at each decision branch) define the attributes for each plant damage state. Fifty eight (58) individual plant damage states were defined for the NAPS. As described in the next section, the diagram was then simplified, on frequency grounds, to twenty five (25) states, using the same nine criteria and deleting zero frequency of occurrence states and transferring states with a frequency of less than 1.0E-8 to a similar but higher frequency state.

The rationale for selection of each of the PDS grouping criteria (or parameters) is discussed below. In scanning the rules, the following brief list of NUCAP+ rule syntax and semantics may be useful:

"==" denotes an equality test. If the item in front is equal to the item after, then the result is TRUE otherwise it is FALSE.

"!=" denotes an inequality test and returns the opposite results from the equality test.

":" The first item in the test for Level 1 classifications is denoted as "A:ccccc" where 'A:' means a sequence front line function success or failure as recorded in the .SEQ data file of the extended Level 1 core melt sequences and 'ccccc' is the name of the function. The second in the test is either SUCCESS or FAILURE.

"*" denotes a Boolean AND conjunction of the tests before and after it. Both tests have to return TRUE for the ANDed tests to be TRUE.

"IF .." A statement line beginning with 'IF' is evaluated to see if the tests on the line '..' are TRUE. An IF statement line may have more than one AND in it. Subsequent statement rule lines without an intervening THEN line are de facto OR statements.

"THEN aaa" When a complete statement (line) is evaluated as TRUE then the first subsequent THEN gives the assigned attribute 'aaa' for this RULE. A DEFAULT statement is always TRUE and the attribute is given on the same line. After an attribute is assigned no further processing of the rule is performed, so that the ordering of rule statements is important.

F.2.2 Containment Bypass (CONBYPASS)

This parameter is used to divide the Level 1 sequences into bypass and non-bypass groups. Furthermore, the containment bypass sequences are subdivided into interfacing system LOCAs ("EVENT V") and steam generator tube ruptures ("SGTR") with a direct pathway from the RCS to the environment - e.g., failed open secondary SRVs. The containment bypass sequences are distinctly different from non-bypass sequences in that there exists an open pathway from the primary system to the ambient environment which bypasses the main containment region. Hence, radionuclides (released from the core/primary system) are not attenuated by the natural processes and engineered safety systems in containment. Consequently, bypass sequences can result in relatively large source term releases early in time. The interfacing system LOCA and SGTR bypass sequences are separated into different groups because the radionuclide release pathways for these two groups of sequences are distinctly different.

For the SGTR sequences the pathway includes the reactor coolant system (RCS), steam generator (SG) secondary side, secondary steam line and safety/relief valves. For the interfacing system LOCA sequences the pathway is RCS, low pressure injection (LPI) system piping and the safeguards building (where the break location may be submerged). Strictly speaking a containment event tree is not required for these sequences since containment phenomena are largely irrelevant or unimportant. For the interfacing system LOCA sequence however, a "CET" which considers important safeguards building phenomena (such as whether or not the break location is submerged) is necessary to assess the effectiveness of the safeguards building in attenuating radionuclides.

PDS Sequence Classification Rule for CONBYPASS

```
IF A:VX == FAILURE;
THEN EVENT V;
IF A:T7 == FAILURE * A:P   == FAILURE;
IF A:T7 == FAILURE * A:SGI== FAILURE;
IF A:T7 == FAILURE * A:O   == FAILURE;
IF A:T7 == FAILURE * A:D1 == FAILURE * A:L == FAILURE;
THEN SGTR;
DEFAULT NO BYPASS;
```

Core damage sequences initiated by a SGTR (PDS tree initiating event T7) and with failure to isolate the ruptured steam generator (failure in heading SGI or O), with failure of auxiliary feedwater (event L) and concurrent loss of injection (D1), and with failure of feed and bleed (event P) will follow the PDS "CONTAINMENT BYPASS" heading "SGTR" branch. All core damage sequences initiated by an interfacing systems LOCA (initiating event V) will follow the PDS containment bypass "EVENT V" branch. All other core damage sequences will follow the "NO BYPASS" branch. Note that only one PDS group exists for the SGTR sequences and one group for the event V sequences. This implies that all SGTR and V sequences in these groups will be treated identically using a representative sequence without differentiating other PDS grouping attributes (e.g., high or low RCS pressure). The discussions below on the remaining eight criteria are thus only applicable to the non-bypass sequences.

F.2.3 Containment Status Before Core Melt (CONISOLAT)

This parameter segregates the Level 1 sequences into groups based on the status of the containment leak boundary at the time of core damage. The "not isolated" branch includes sequences with containment failure prior to core damage (the so-called "core vulnerable" sequences referred to above) as well as the sequences with an un-isolated containment. With the containment not isolated, early and relatively large releases of radionuclides from the plant are possible. If the containment is not isolated the most important additional system consideration from the standpoint of the radionuclide source term is whether the Quench or Recirculation sprays function. Consequently, for sequences which are not isolated this is the only other grouping parameter which is considered. Hence, all sequences with containment isolation failure are grouped into one of two PDS groups.

PDS Sequence Classification Rules for CONISOLAT

```
IF A:H1 == FAILURE;
IF A:H2 == FAILURE;
THEN ISOLATED;
IF A:IS == FAILURE;
IF A:D3 == SUCCESS * A:Rs == FAILURE;
```

```
IF A:D3 == SUCCESS * A:Ch == FAILURE;
IF A:H2 == SUCCESS * A:Rs == FAILURE;
IF A:H2 == SUCCESS * A:Ch == FAILURE;
IF A:H1 == SUCCESS * A:Rs == FAILURE;
IF A:H1 == SUCCESS * A:Ch == FAILURE;
THEN NOT ISOLATED;
IF A:IS != FAILURE;
THEN ISOLATED;
```

Since containment isolation failure is not strongly dependent on other systems considered in the PDS event trees it was determined by the Level 1 analysts that containment isolation failure could be evaluated independently from the PDS trees. Furthermore, since the NAPS containment is subatmospheric the probability that the containment is not isolated is very low. The probability of containment isolation failure has been assigned a constant value for all sequences. Two pseudo-sequences (initiator IS) were added to the Level 1 core melt sequence data file (.SEQ). One sequence accounts for the non-isolated sequences with sprays operational, and the other for the non-isolated sequences with spray failure (Rs). In particular all sequences with initiator IS are classified as NOT ISOLATED.

The sequences with containment failure before core melt require that injection/recirculation be successful and that containment heat removal be failed. All sequences with low or high head pressure recirculation failure (H1, H2) are classified into the ISOLATED (intact) state. All sequences with injection/recirculation success (D3,H1,H2 success) and containment heat removal failure either because of spray (Rs) failure or heat removal function (Ch) failure are classified into the NOT ISOLATED group.

All other sequences are classed as ISOLATED.

F.2.4 Transient or LOCA Type (TRANLOCA)

This parameter is used to separate transient sequences from LOCA type sequences and to further subdivide large LOCA sequences from the small/intermediate LOCAs. The major reasons for the use of this parameter for grouping are: 1) to aid in the subsequent classification of sequences by RCS pressure, 2) to distinguish sequences with distinctly different key event timing, and 3) for radionuclide release and transport behavior differences. Small and intermediate LOCAs have been combined since their containment accident progression is expected to be similar.

<u>PDS Sequence Classification Rules for TRANLOCA</u>

```
IF A:A  == FAILURE;
IF A:RX == FAILURE;
```

```
THEN LARGE LOCA;
IF A:S1  == FAILURE;
IF A:S2  == FAILURE;
IF A:T7 == FAILURE;
IF A:Q == FAILURE;
IF A:P == SUCCESS;
IF A:S1c == FAILURE;
IF A:T4 == FAILURE * A:O == FAILURE;
IF A:T6 == FAILURE * A:O == FAILURE;
IF A:T8 == FAILURE * A:O == FAILURE;
IF A:T1Tr == FAILURE * A:O == FAILURE;
IF A:T2Tr == FAILURE * A:O == FAILURE;
IF A:T2ATr == FAILURE * A:O == FAILURE;
IF A:T3Tr == FAILURE * A:O == FAILURE;
IF A:T9ATr == FAILURE * A:O == FAILURE;
IF A:T9BTr == FAILURE * A:O == FAILURE;
THEN SMALL/MED LOCA;
DEFAULT TRANSIENT;
```

All core damage sequences initiated by a large break LOCA (PDS tree initiating event A) or a vessel rupture (RX) will follow the PDS diagram "LARGE LOCA" branch. All core damage sequences initiated by a small LOCA (initiating event S2), or by a medium LOCA (initiating event S1) will follow the "SMALL/MED LOCA" branch. All core damage sequences that develop a permanent RCS pressure boundary failure will also follow the "SMALL/MED LOCA" branch. These include those with RCS boundary not intact (Q failure), seal LOCAs (S1c failure), and all SGTRs (initiator T7) that result in successful steam generator isolation but result in core damage (these are all the T7 sequences not already classed as SGTR by the rule for bypass sequences given above). Core melt sequences with feed and bleed success (P success) imply that the primary relief valves are open and the system can stay at low pressures and hence are SMALL/MED LOCA type. Reactor coolant pump seal failures (failure of function O) for the transients with loss of seal cooling (T4), loss of service water (T6), and loss of emergency switchgear room cooling (T8) are classified into the SMALL/MED LOCA type also.

All remaining sequences are classified as TRANSIENT type.

F.2.5 Station Blackout Type (SBO)

This parameter is used to distinguish sequences with effective total loss of AC power from other sequences. It is selected as a grouping parameter for several reasons. First, total loss of AC power results in a sequence without any containment safeguards (sprays or containment heat removal). Second, past studies at the similar Surry plant (NRC, 1989) and other plants indicate that station blackout sequences will be important contributors to core damage and offsite risks. Third, power recovery subsequent to core

damage allows for: 1) the possible restoration of in-vessel injection which may terminate the accident and prevent vessel failure or 2) restoration of Quench or Recirculation sprays and containment heat removal in sufficient time to prevent containment failure or mitigate the source term.

<u>PDS Sequence Classification Rules for SBO</u>

```
IF A:T1A   == FAILURE;
IF A:T8    == FAILURE * A:RC1 != SUCCESS;
IF A:T6    == FAILURE * A:RC1 != SUCCESS;
IF A:T1Tr   == FAILURE * A:RC1 != SUCCESS;
IF A:T2Tr   == FAILURE * A:RC1 != SUCCESS;
IF A:T2ATr   == FAILURE * A:RC1 != SUCCESS;
IF A:T3Tr   == FAILURE * A:RC1 != SUCCESS;
IF A:T9ATr   == FAILURE * A:RC1 != SUCCESS;
IF A:T9BTr   == FAILURE * A:RC1 != SUCCESS;
THEN YES;
DEFAULT NO;
```

All transient core damage sequences initiated by station blackout (initiator T1A) follow the PDS diagram "STATION BLACKOUT" heading "YES" branch. Transients with loss of switchgear room cooling (T8) and transients with loss of service water (T6), both without power recovery before core damage (RC1 is not success) will also follow the "YES" branch. All other transient core damage sequences will follow the "NO" branch for this heading. Loss of switchgear room cooling leads to loss of all AC power and hence T8 sequences are grouped with station blackout sequences.

F.2.6 Power Recover (POWRECOV)

This parameter is used to identify station blackout type sequences with recovery of offsite AC power (subsequent to core damage) within a time period judged to be prior to either vessel failure and/or containment failure. Note that recovery of the diesel generators is not considered in the PDS event trees and that power recovery is defined solely as offsite power recovery. Three possible branch pathways are evaluated: 1) "PRIOR RV FAILURE", 2) "PRIOR CONTAINMENT FAILURE" and 3) "NO POWER RECOVERY". Power recovery subsequent to core damage allows for: 1) the possible restoration of in-vessel injection which may terminate the accident and prevent vessel failure or 2) restoration of Quench or Recirculation sprays and containment heat removal in sufficient time to prevent containment failure or mitigate the source term. This parameter is also used to identify loss of switchgear room cooling transients with recovery of room cooling.

MAAP calculations indicate that there will be many hours between core damage and the time when the containment integrity is first threatened from long term steam/non-condensible gas pressurization.

We have conservatively chosen to use the 5% failure pressure to assess time available for power recovery prior to containment failure. For the purpose of estimating recovery probabilities in the Level 1 PDS event tree analysis 1 hour and 18 hours were used as the representative time periods for power recovery prior to vessel failure and prior to containment failure.

PDS Sequence Classification Rules for POWRECOV

```
IF A:B    == SUCCESS;
IF A:B1   == SUCCESS;
IF A:RC2  == SUCCESS;
THEN PRIOR RV FAIL;
IF A:B2   == SUCCESS;
IF A:RC3  == SUCCESS;
THEN PRIOR CONT FAIL;
DEFAULT NO POWER REC;
```

All station blackout type sequences with AC power recovery prior to core damage (event B success) or with power recovery prior to vessel failure (event B1 success or RC2 success) follow the branch "PRIOR RV FAIL". SBO sequences with power recovery prior to containment failure (event B2 success or RC3 success) all follow the "PRIOR CONT FAIL" branch. All other SBO type sequences are classified into the "NO POWER REC" state.

F.2.7 Containment Recirculation Sprays (RECSPRAYS)

Operation of the quench/recirculation sprays provide several important functions which impact containment accident progression, containment loading and the radionuclide source term. First, operation of the recirculation sprays is necessary for long term containment heat removal. Second, with or without the containment heat removal function available, operation of the sprays will attenuate fission products released to the containment atmosphere and greatly reduce the source term. The sprays also provide a source of cooling water to debris in the reactor cavity or on the lower containment floor enhancing the possibility of cooling the debris and preventing debris concrete attack and the release of radionuclides and non-condensible and combustible gases. To be considered successful for the purpose of this grouping the sprays must operate during periods of time when fission product release is occurring and when containment heat removal is required. This implies that long term operation of at least one train of the inside or outside recirculation spray systems is required. Successful operation of (only) the Quench (injection) Spray system does not meet the above requirements for successful spray operation. Sequences with only Quench Spray injection system operation will be grouped into PDS groups with sequences with no sprays.

PDS Sequence Classification Rules for RECSPRAYS

```
IF A:Rs    == SUCCESS;
IF A:SPRAY == SUCCESS;
THEN YES;
DEFAULT NO;
```

All core damage sequences with success for PDS event tree function "RECIRCULATION SPRAY AVAILABLE" (event Rs) will follow the "YES" branch for the PDS grouping diagram CONTAINMENT RECIRCULATION SPRAYS heading. All other core damage sequences will follow the "NO" branch.

Longer term failure of the Recirculation Spray system due to specific energetic containment events (e.g., hydrogen burns) or due to the general containment environment is evaluated in the containment event tree.

F.2.8 Containment Heat Removal (CNHEATREM)

Operation of containment heat removal (i.e., operation of at least one train of recirculation sprays with a functional heat exchanger) is necessary to prevent long term containment overpressure failure from steam generation and high containment temperature. Successful operation of containment heat removal requires that heat removal be established prior to the containment reaching a pressure where containment integrity is threatened (taken to be 93 psig). This particular timing requirement generally affects SBO type sequences where success of offsite power recovery (prior to containment failure) is based on the time period from onset of core damage to the time when the containment integrity is initially threatened.

PDS Sequence Classification Rules for CNHEATREM

```
IF A:Ch    == SUCCESS;
THEN YES;
DEFAULT NO;
```

All core damage sequences with success for PDS event tree function "CONTAINMENT HEAT REMOVAL AVAILABLE" (event Ch) will follow the "YES" branch for the PDS grouping diagram heading "CONTAINMENT HEAT REMOVAL." All other core damage sequences will follow the "NO" branch. Since recirculation spray operation is required for containment heat removal to be successful this heading is not branched for sequences without recirculation sprays and is set to "NO."

F.2.9 RCS Pressure During Core Damage/At Vessel Failure (RCSPRESS)

The reactor coolant system pressure during core damage and at the time of vessel failure can have a major impact on several potentially important containment events. High RCS pressures during core heatup and core damage facilitate natural circulation heat transfer from the core to the hot leg which increases the potential for temperature induced hot leg, surge line or steam generator tube failure. Elevated pressures at the time of vessel rupture may result in entrainment of the core debris out of the reactor cavity and increase the potential for debris fragmentation and dispersal into the main containment gas volume thus increasing the potential for direct containment heating (DCH). RCS pressure during core degradation can also impact the timing and magnitude of fission product release from the primary system. Four pressure regimes have been identified as being significant. These are:

Pressure Regime	Pressure Range (psig)
LO	< 200
LO HI	200 - 2000
HIGH	2000 - 2335
HI HI	> 2335

The reasons for this selection of pressure regimes for use as PDS grouping characteristics is discussed below. Energetic dispersal of the debris out of the reactor cavity following vessel failure is not expected for RCS pressures below about 200 psi, whereas for RCS pressures above 200 psi debris entrainment and dispersal out of the cavity and DCH are potentially important processes. The threshold pressure for these phenomena in NUREG/CR-4551 was 200 psi. A pressure of 2000 psi was judged by the NUREG-1150 In-Vessel Expert Panel as the lowest pressure where induced hot leg or surge line creep rupture failure was credible (though unlikely). At very high RCS pressures in the range of the pressurizer relief/safety valve setpoints (> 2335 psia) the NUREG-1150 experts panel judged that induced hot leg or surge line failure was likely and that induced steam generator rupture was possible (though highly unlikely).

<u>PDS Sequence Classification Rules for RCSPRESS</u>

(no rule necessary)

All LARGE LOCA type sequences are classified as LO LO type. All SMALL/MED LOCA type sequences are classified as LO HI type. This stems from the definition of the small LOCA primarily as being insufficient in size to remove decay heat. Various MAAP runs indicate that for the SMALL/MED LOCA type the pressure regime is generally below 2000 psi. The pressure can be expected however to be above 200 psi after core slump because of steam generation in the lower head plenum. That is, SMALL/MED LOCA (LO HI) sequences may result in a DCH event but will not induce a hot leg or surge line failure. The major effect of such a failure, which might

occur if the pressure were HIGH, would be to lower the pressure into the LO HI or LO LO range prior to vessel breach. So, even if certain of the SMALL/MED LOCA type sequences in fact were to result in a HIGH pressure regime, the end result is essentially the same. Because of the classification of transients with an RCS boundary failure into the LOCA class, the remaining transients must be of the HI HI type, that is, steam must be escaping from the RCS only through a properly cycling primary relief or safety valve.

As discussed in the preceding paragraph, all sequences are assigned into pressure regimes based only on whether they are LARGE LOCA type, SMALL/MED LOCA type, or TRANSIENT type. Therefore there is no further classification needed and no PDS selection rule is needed for this criterion. It is also worthwhile noting that no sequences are classified into the HIGH regime, for the reasons noted above.

F.2.10 Status of In-Vessel Injection (INVESSINJ)

The status of in-vessel injection at the time of core damage is important for several reasons. If in-vessel injection is available during the period of core uncovery, core damage may be limited and vessel failure prevented. This situation would be the case for a large break LOCA sequence with operable LHSI but with all accumulators failed. For this sequence the Level 1 success criteria indicate core damage occurs. MAAP calculations confirm that core damage is likely, however, these calculations also indicate that the amount of fuel damage would be limited (peak fuel temperature of approximately 2700°F) and termination of the accident progression in-vessel would be highly likely (Matras, 1992). If the RCS pressure is elevated above the LHSI injection threshold pressure (approximately 175 psig) but the system is available (deadheaded) it could provide in-vessel injection if the RCS is depressurized prior to RV failure (such as by an induced hot-leg rupture). In addition, with the LPI operating an additional source of cooling water is available to the cavity debris following vessel failure. (This additional source of water to the cavity was not considered in the containment analysis since it is expected that the number of core damage sequences with operational LHSI after vessel failure and failed recirculation sprays will be small.) The in-vessel injection systems may also be available following off-site power recovery for station blackout sequences. The four possible branches for this heading are thus:

ON	(available and operating)
LPI DEADHEAD	(available but cannot inject because of high RCS pressure)

RECOVERED (injection recovered subsequent to core damage but prior to the anticipated time of RV failure)

FAILED (never available)

PDS Sequence Classification Rules for INVESSINJ

```
IF A:H1 == FAILURE;
IF A:H2 == FAILURE;
THEN FAILED;
IF A:A == FAILURE * A:H1 == SUCCESS * A:Dh == SUCCESS;
IF A:A == FAILURE * A:D3 == SUCCESS * A:Rs == SUCCESS;
IF A:RX== FAILURE * A:D3 == SUCCESS * A:Rs == SUCCESS;
IF A:RX== FAILURE * A:Qs == SUCCESS * A:Rs == SUCCESS;
IF A:S1 == FAILURE * A:H1 == SUCCESS;
IF A:S1 == FAILURE * A:H2 == SUCCESS;
IF A:S2 == FAILURE * A:H2 == SUCCESS;
THEN ON;
IF A:A == FAILURE * A:H1 == SUCCESS * A:Dh == FAILURE;
IF P:SBO==NO *P:RCSPRESS!=LO LO * A:H1==SUCCESS;
IF A:S2 == FAILURE * A:H1 == SUCCESS;
THEN LPI DEADHEAD;
IF P:POWRECOV==PRIOR RV FAIL*P:RCSPRESS != LO LO*A:H1==S;
THEN RECOVERED;
DEFAULT FAILED;
```

This criteria is based on the status of the SI systems in recirculation. If there is a failure in recirculation mode (events H1 or H2 as failures) then the systems are considered FAILED. LARGE LOCA type core damage sequences with success for PDS event tree function "LOW HEAD SAFETY INJECTION AVAILABLE LATE" (event D3) or "LOW HEAD RECIRCULATION AVAILABLE LATE" (event H1) are considered "ON" except that the LARGE LOCA sequences with failure to switch to hot leg recirculation (event Dh is a failure) is assigned to LPI DEADHEAD, as the reason for core melt is plugging in the upper head. Other LOCA-initiated sequences (S1,S2) are considered ON if H1 or H2 (high head recirculation) is a success. For non-station blackout types (SBO is NO) with non LO LO pressures and with low head recirculation success (H1 success), and particularly for S1 sequences with H1 success, the systems are considered LPI DEADHEADed. For station blackout type sequences with power recovery prior to reactor vessel failure (PDS state PRIOR RV FAIL for the power recovery criterion), the LPI system available (H1 success), and pressure higher than LO LO, the systems are considered RECOVERED. All other sequences are considered to have invessel injection FAILED.

F.2.11 PDS Logic Diagram and PDS Characteristics

The quantified Plant Damage State Logic diagram for NAPS is shown in Figure F.2-2. The endpoints of the logic diagram represent the significant individual plant damage states and the pathway through the diagram (i.e., the set of decision paths taken at each decision branch) define the attributes for each plant damage state. Twenty five individual plant damage states are defined. This diagram is a simplified derivative of the initial diagram. All Level 1 sequences are represented in this diagram, the difference being that some very low frequency states have been rebinned and zero frequency states deleted. The frequencies shown at intermediate branch nodes on this diagram are merely the sum of the frequency of the branches stemming from this node. They are developed by simply combining branches starting from the "end" or rightmost end of the diagram and working back to the starting point recording the intermediate sums.

The PDS diagram was constructed as follows:

- The Plant Damage State Logic Diagram shown in Figure F.2-1 was quantified. The PDS assignment rules shown in Table F.2-1 were used to assign the sequences to the PDS of this diagram.

- The frequencies of all the sequences for each of the states were summed. These are shown in the rightmost column of the diagram for each sequence. These frequencies were then used to guide the simplification of the PDS diagram.

- All states with zero frequency were deleted. The 26 states so eliminated are designated with a "D" as the state attribute under the last diagram heading DISPOSTN.

- All states with a frequency of occurrence of less than 1.E-8 were binned with another state of higher frequency that was judged sufficiently similar. The binning target state of each of these very low frequency states is shown as T:## under DISPOSTN, where ## is the receiving state. Then these seven very low frequency states were eliminated as distinct states.

- The Level 1 sequences were then reassigned to the remaining twenty five states of the reduced diagram and the PDS frequencies summed. The PDS state numbers shown on the Plant Damage Event Trees (Chapter 3) are the ones assigned in this step.

Plant Damage States 1 and 2 contain sequences with the Containment not intact at core melt ("core vulnerable" sequences) and sequences with failure of Containment isolation. PDS 3 through 7 represent station blackout (SBO) type sequences without a significant breach of the primary system pressure boundary prior to core damage. PDS 3 represents all SBO type sequences with power recovery prior to RV

failure. PDS 4 through 6 represent SBO sequences with power recovery after vessel failure but prior to the time when the Containment failure would be expected from long term overpressurization. PDS 7 represents SBO type sequences with no power recovery. PDS 8 through 11 contain all transient initiated sequences other than those of the station blackout type. PDS 12 and 13 represent large break LOCAs including vessel ruptures. PDS 14 through 23 represent small and intermediate break LOCA type sequences, which includes the small and medium LOCA initiated sequences, the seal LOCAs including induced seal failures, and stuck open valve sequences. PDSs 14 through 19 represent the SBO subset of this type, with the subdivisions based on power recovery as for the non-LOCA SBO states. PDS 20 through 23 represent the small/medium LOCA types with AC power available. PDS 24 contains the Containment bypass interfacing system LOCA (Event V) sequences and PDS 25 contains the SGTR sequences.

F.3 DECOMPOSITION EVENT TREE BRANCH PROBABILITIES AND BRANCHING RULES

The following discussion summarizes the events included in the general NAPS CET.

F.3.1 Mode of Induced Primary System Failure

This question asks whether the elevated temperatures and pressures within the Reactor Coolant System following core uncovery can result in failure of the RCS pressure boundary outside of the vessel prior to reactor vessel lower head failure. Three branch possibilities are considered:

1. no induced RCS failure
2. rupture of a hot leg (or the pressurizer surge line)
3. Steam Generator tube rupture(s)

Induced RCS pressure boundary failure is only likely to be important for sequences where the RCS pressure remains elevated during core uncovery and core heatup, since the high pressure conditions enhance natural convection heat redistribution from the core to the hot leg and Steam Generators (NRC, 1988) and the high pressure conditions may lead to failure of these components at elevated temperatures. Each of the possible branch pathways for this event has an important impact on accident progression. Hot leg failures are likely to be of sufficient size (large break LOCA) to cause depressurization of the RCS prior to vessel failure and consequently to greatly reduce the probability that energetic events at vessel failure (e.g., DCH or H_2 burning) will cause Containment failure. Failure of one or more Steam Generator tubes can result in a bypass of Containment if a secondary relief/safety valve opens or if there is significant leakage past the MSIVs.

However, unless the number of induced Steam Generator tube failures is large (> 10), the primary system would not be expected to depressurize prior to reactor vessel failure.

F.3.2 Debris Cooled In-Vessel

Given that core uncovery and some core damage has occurred, this question considers whether the damaged core can be cooled in-vessel and gross damage and vessel failure prevented. For there to be any possibility that the core is being cooled in-vessel, a supply of water to the vessel in excess of that required to remove decay heat must be supplied. This requires an absolute minimum of several hundred gpm injection flow. At this minimum flow level the probability of successfully cooling the damaged core in-vessel will be low, even given a core debris configuration favorable to cooling. At substantially higher injection flow rates (several thousand gpm) the probability of cooling the debris under less favorable debris configurations (e.g., at later times with greater amounts of core damage, core slumping and/or core melting) is enhanced.

The plant damage state entry conditions define whether low pressure or high pressure injection flow is (or can be) provided. The types of core damage sequences with coolant injection to the vessel following core damage initiation can be divided in two major classes. The first class of sequences are those where the injection flows are insufficient to prevent core damage as defined by the Level 1 analysis success criteria of limiting peak fuel cladding temperatures to less than 2200°F (1200°C). An example of this type of sequence is a large break LOCA with successful low pressure injection but with failure of the Accumulators to inject. The second class of sequences are those where there is no coolant injection prior to core uncovery and incipient core damage but where some form of injection is recovered prior to vessel failure. This second class of sequences would include station blackout with late recovery of power and high pressure sequences with failure of high pressure injection followed by late depressurization (either by operator action or as a result of induced hot leg or surge line rupture) followed by successful LPI. The possible branch pathways for this event are:

1) debris cooled in-vessel (no vessel failure), and
2) debris not cooled in-vessel.

If the debris is cooled in-vessel Containment failure is extremely unlikely since only limited hydrogen production would be expected, steam generation will be limited, and DCH is not a possible threat. Furthermore, radionuclide release from the debris will be limited and longer-term revaporization of radionuclides deposited on RCS surfaces will be largely avoided. Hence, because the Containment does not fail and because of the limited radionuclide release, the

environmental source terms for core damage sequences successfully terminated in-vessel are expected to be very small. The sequences of this type are very similar to the TMI-2 accident.

F.3.3 No Alpha-Mode Containment Failure

Postulated alpha mode Containment failures result from large coherent in-vessel steam explosions which fail the reactor vessel and generate a missile (from part of the reactor vessel upper head) with sufficient mass and energy to fail Containment. There is a substantial body of evidence to suggest that in-vessel steam explosions do not represent a credible threat to early Containment failure (i.e., the probability of early Containment failure resulting from in-vessel steam explosions is negligibly small). This opinion appears to be shared by the authors of Appendix 1 to Generic Letter 88-20 (NRC, 1988). However, since in-vessel steam explosions were considered in the NUREG-1150 Containment analysis for Surry (Breeding, 1990) and because this event, if it should occur, can result in large and early environmental releases, this event has been included in the North Anna IPE CET.

Experimental evidence and calculations have shown that steam explosions are much less likely at elevated pressures than at low pressure, consequently the probability of an alpha mode Containment failure should be significantly less for high pressure sequences than for low pressure sequences.

The branches for this event are:

1. No alpha-mode Containment failure
2. Alpha mode Containment failure occurs.

F.3.4 Mode of Early Containment Failure

This question determines whether the Containment fails early in time, and if Containment fails, the mode of Containment failure. Early Containment failure is defined as shortly before, at, or soon after reactor vessel failure. Early Containment failure can potentially result from a combination of energetic processes and events which may occur at reactor vessel breach. These processes and events include blowdown of the primary system, direct Containment heating (DCH), hydrogen combustion and rapid steam generation in the cavity.

The ultimate Containment strength and the likely failure modes for the North Anna Containment were evaluated by comparing the North Anna Containment characteristics to those for Surry. It was concluded that the characteristics are sufficiently similar that the Surry Containment fragility curve can be used for the North Anna study (VEPCO, 1992). Therefore, a median failure pressure of

128 psig can be approximated for NAPS. Three failure modes corresponding to the following rupture sizes were considered possible:

1) a catastrophic rupture (nominal leak size approximately 7.0 ft^2)
2) a rupture (leak size approximately 1 ft^2 or larger
3) a leak (typical leak size 0.1 ft^2)

The major difference between a rupture and a leak is that a rupture is capable of arresting a gradual pressure rise in Containment and in depressurizing the Containment in less than 2 hours. A leak, would also arrest a gradual pressure buildup but would not result in Containment depressurization within 2 hours. The catastrophic rupture considers a sufficiently energetic event that piping systems which are attached to, or penetrate the Containment wall may be disrupted. The Containment fragility curve 5th to 95th percentile range of potential failure pressures extends from approximately 93 psig to 149 psig. For Surry, the NUREG-1150 (NRC, 1990) Structural Expert Panel estimated that if Containment failure occurred below 135 psig that leakage was the most likely failure mode. Ruptures were the most likely failure mode for failure pressures in the range 135-150 psig. For failure pressures in excess of 150 psig, catastrophic rupture was estimated to be the likely failure mode. These failure ranges are also assumed to be applicable for North Anna.

It should be noted that a fast pressure rise such as from DCH or a hydrogen burn will not be arrested by a small leak. Hence, for these loading conditions, a small leak, if it occurs, may progress to a rupture.

The branches for this event are:

1. No Early Containment Failure
2. Leak
3. Rupture
4. Catastrophic Rupture

F.3.5 No Early Recirculation Spray Failure

The failure of the Recirculation Spray System is included on the Containment event tree because this system provides the heat removal function for the Containment. Hence, without the Recirculation Sprays the pressurization of the Containment will continue unabated once the heat sinks absorb all the energy possible. In addition, operation of the Spray System provides an effective mechanism for fission product mitigation. Early is defined, as in previous event headings, to be before, at, or just after vessel failure.

Initial "failure" of the Recirculation Sprays (as defined by the plant damage state conditions) is most likely to be from station blackout. Since there are four Recirculation Spray pumps and only one is required for successful operation, random system failures are not likely to defeat this function. Other potential failure modes that may lead to failure of the Recirculation Sprays include spray failure as a result energetic Containment failure, a massive blockage of the Containment Sump screens by the core debris or environmental conditions inside the Containment or in the Safeguards Building that result in failure of the Recirculation Spray pumps or pump motors.

The effect of local hydrogen combustion on equipment is accounted for in the quantification of the effect of the containment environment on the spray pumps. Because of the diversity and redundancy of these systems, local hydrogen burn is not expected to have a significant impact on the failure probability. In addition, since only the catastrophic rupture failure mode of the containment is judged capable of failing the spray nozzle headers, header failure due to hydrogen combustion effects is considered bounded by the spray motor failures.

The two branches for this heading are simply failure or no failure. Failure includes both the spray function and the heat removal function.

F.3.6 Debris Cooled Ex-Vessel

This question concerns long term Containment loadings resulting from core debris concrete attack. Debris concrete attack results in concrete degradation and ablation, production of non-condensible and combustible gases, additional heat generation from chemical reactions, changes in the corium mass chemical composition and releases of radionuclides and aerosols.

If the debris is cooled then its only subsequent challenge to the Containment is the continued addition of the decay heat to the cooling water and hence to Containment.

Physically, the debris is not cooled if the debris surfaces that are exposed to the heat-removing medium are not large enough with respect to the heat generating volume to prevent high temperatures being attained. High surface-to-volume ratios imply debris being spread thinly over a large surface area. Additionally, sufficient cooling water must be present. (However, if spread thinly enough, water may not be necessary).

For the North Anna Station it has been determined that the Containment concrete aggregate is basaltic which, unlike limestone aggregate concrete, will not produce much combustible carbon monoxide or non-combustible carbon dioxide upon decomposition. The

concrete does contain the normal amounts of bound and unbound water so that sparging/aerosolization of the debris, metal oxidation, and hydrogen and steam production will occur.

Another important factor is the geometry of the cavity and instrument tube tunnel. Water will enter the cavity only if the Containment injection and/or Recirculation Sprays are operating (or if low pressure injection is operating after vessel failure). For high pressure vessel breach sequences a considerable fraction of the debris may be transported out of the cavity, relocating to the RHR cubicle floor and beyond.

The branches for this event are:

1. Debris Cooled Ex-vessel
2. Debris Not Cooled Ex-vessel

F.3.7 Mode of Late Containment Failure

The CET heading, mode of late Containment failure, is similar to the heading for early Containment failure. The obvious difference is that the accident has been in progress for a significant amount of time. The time frame for late Containment failure begins many hours after the vessel has failed and continues indefinitely.

The structural analysis discussed in the section entitled mode of early Containment failure is also applicable in this section. The primary cause for failure of the Containment late in time would be from steam overpressurization, resulting from loss of the Recirculation Sprays or Containment heat removal. The possibility of late failure due to a late hydrogen burn is also considered. The branches for this event are:

1. No Late Containment Failure
2. Leak
3. Rupture
4. Catastrophic Rupture

F.3.8 No Late Recirculation Spray Failure

The Recirculation Sprays are the only source of Containment heat removal. Additionally, these sprays provide the source of cooling for the sump water necessary to protect the Low Head Safety Injection pumps from overtemperature failure. The Recirculation Spray System, including the Service Water supply to the Recirculation Spray heat exchangers, is therefore vitally important for preventing both core damage and Containment overpressurization in the late phases of an accident.

The late failure of the Recirculation Sprays may be caused by a catastrophic failure of the Containment or by environmental conditions inside Containment and the Safeguards Building. Harsh environmental conditions can result from high radiation, high humidity, high temperatures, or from effects of local hydrogen burns.

The two branches for this heading are simply failure or no failure. Failure includes both the spray function and the heat removal function.

F.3.9 Containment Long Term Failure

The long term failure of the Containment can result from one of several scenarios. If the Recirculation Sprays fail late in the accident then the Containment will fail from overpressurization at some point in time. If Containment heat removal functions the Containment will not fail due to gradual steam overpressurization. The Containment can also fail due to basemat melt-through (even if the sprays function) if the molten debris is not coolable. Note that if the Containment heat removal function is not available we assume that over-pressure failure will occur and neglect basemat melt-through since the offsite consequences of basemat melt-through would be small compared to over-pressure failure. The two branches for this heading are No Late Late Containment Failure and Basemat Melt-through.

F.3.10 NAPS Containment Event Trees and the Supporting Decomposition Event Trees

Figure F.3-1 shows the general NAPS Containment event tree which can be used for plant damage states 3 thru 23. Figures F.3-2 and F.3-3 show the CETs which are used for loss of Containment isolation sequence PDSs 1 and 2. For these sequences the most important question is whether or not the accident progression is terminated in-vessel. Figure F.3-4 shows the CET used for interfacing system LOCA (event V) sequences (PDS 24). For these sequences the most important question is whether the break location is submerged in the safeguards building. Figure F.3-5 shows the CET for unisolated SGTR sequences (PDS 25). For these sequences it is assumed that there exists a release pathway from the secondary system directly to the environment and that the tube break location is uncovered. Hence, the most important factors which impact radionuclide release have been determined and no events are evaluated on the CET.

The Decomposition Event Trees (DET) which were used for the quantification of the CETs are discussed in the remainder of this section.

F.3.10.1 Mode of Induced Primary System Failure Decomposition Event Tree (RCSFAIL.DET - Figure F.3-6)

Event 1: Entry from Prior CET Event (Entry CET)

One Branch

Event 2: RCS Pressure at Core Melt (RCSPRESS)

Four Branches

- Lo Lo Pressure (< 200 psig)
- Lo Hi Pressure (200 - 2000 psig)
- High Pressure (2000 - 2335 psig)
- Hi Hi Pressure (> 2335 psig)

Branch Probability Type: One/Zero

Quantified Using: PDS Parameter: RCSPRESS

Event 3: Mode of Induced Primary System Failure (RCSFAIL)

Three Branches

- No RCS Failure
- SGTR (Steam Generator Tube Rupture)
- Hot Leg Failure (Surge Line Failure)

Branch Probability Type: Split Fraction

Quantified Using: NUREG 1150-NUREG/CR-4551

Case A: Lo Lo and Lo Hi Pressure Sequences (< 2000 psig)

NUREG-1150 In-vessel Expert's Panel did not consider temperature induced SGTR or hot-leg failure to be credible events for sequences with pressures below about 2000 psi (Breeding, 1990-Appendix A, Page A.1.1-24 and 25).

	Point Est.
No RCS Failure	1.0
Hot Leg Failure	0.
SGTR	0.

Note: Only "No RCS Failure" Branch Shown on Tree for LO LO and LO HI sequences

Case B: Hi Hi Pressure Sequences (> 2335 psig)

For very high RCS pressures (equal to or greater than the pressurizer PORV setpoint pressure - 2335 psig) the NUREG-1150 In-vessel Expert's Panel estimated that temperature induced SGTR would be highly unlikely if there were no defective tubes in the SGs. Since there are likely to be a number of defective tubes, however the probability of temperature induced SGTR would be increased. The expert panel estimated that under these conditions induced SGTRs would still be very unlikely [P(SGTR) = .018]. However, they also estimated that hot leg or surge line failure would be likely [P(HL) = .72]. Making the simplifying assumption that induced SGTR and hot leg failure are mutually exclusive results in the branch probabilities shown below (Breeding, 1990-Appendix A, Page A.1.1-24 and 25).

	Point Est.
No RCS Failure	.262
Hot Leg Failure	.72
SGTR	.018

Case C: High Pressure Sequences (< 2335 and > 2000 psig)

For high pressure sequences (RCS pressure less than pressurizer PORV setpoint pressure - 2335 psig and above 2000 psig) the NUREG-1150 In-vessel Expert's Panel estimated that temperature induced hot leg or surge line failure would be unlikely [P(HL) = .034]. The In-vessel Expert's Panel estimated that temperature induced SGTRs were not credible at pressures below the pressurizer PORV setpoint pressure [P(SGTR) = 0.] (Breeding, 1990-Appendix A, Page A.1.1-24 and 25).

	Point Est.
No RCS Failure	.966
Hot Leg Failure	.034
SGTR	.0

F.3.10.2 Debris Cooled In-Vessel Decomposition Event Tree (INVCOOL.DET - Figure F.3-7)

Event 1: Entry from Prior CET Event (Mode of Induced Primary System Failure)

One Branch

Event 2: Status of In-Vessel Injection (INVESSINJ)

Four Branches

On
LPI Deadhead
Recovered
Failed

Branch Probability Type: One/Zero

Quantified Using: PDS Parameter: INVESSINJ

Event 3: Mode of Induced Primary System Failure (RCSFAIL)

Three Branches

Hot Leg Failure
No RCS Failure
STGR

Branch Probability Type: One/Zero

Quantified Using: CET Event: RCSFAIL

For cases where low pressure (LPI) injection is available but the primary system pressure is elevated above the shutoff head of the LPI system (LPI Deadheaded) initiation of low pressure injection can occur if the RCS pressure is reduced to below the shutoff head of the LPI. Induced hot leg or surge line failure will result in a large break in the RCS which will rapidly reduce the RCS pressure allowing for LPI injection. Rupture of one or two Steam Generator tubes late in time would not be expected to depressurize the RCS to below the LPI shutoff pressure.

Event 4: Debris Cooled In-vessel (INVCOOL)

Two Branches

Not Cooled
Cooled

Branch Probability Type: Split Fraction

Quantified Using: NUREG-1150,NUREG/CR-4551

Case A: In-vessel Injection On

The success criteria for large break sequences (A) require LPIS and the Accumulators to operate to avoid core damage. Similarly for intermediate LOCAs (S1) both HPSI and LPIS must operate to prevent core damage. With only LPIS available core damage is assumed but the potential for cooling the core and preventing gross core damage and vessel failure is significant. Breeding, 1990 estimated that for these cases successful in-vessel cooling is likely [P(IVCool) = .95] (Breeding, 1990-Appendix A, Page A.1.1-32 and A1.1-33).

	Point Est.
Cooled	.95
Not Cooled	.05

Case B: In-vessel Injection Available (but RCS pressure above LPI shutoff)

If the RCS pressure remains above the shutoff head of the LPIS during the transient, the LPIS may be available but not able to inject. Later in the transient an induced hot leg (or surge line) failure may cause the pressure to decrease low enough to allow injection. Successful initiation of injection may provide enough core cooling to prevent vessel failure. Breeding, 1990 estimated that successful in-vessel cooling is less probable for this case than for cases where LPIS is available early. [P(IVCOOL) = .9] (Breeding, 1990-Appendix A, Page A.1.1-33).

	Point Est.
Cooled	.9
Not Cooled	.1

Case C: AC Power Recovery After Core Damage

For loss of AC power sequences the potential exists for recovery of AC power prior to reactor vessel failure. If power is restored in sufficient time then recovery of vessel injection, and in-vessel debris cooling and prevention of reactor vessel failure is possible. Since the Level 1 PDS event tree analysis considered power recovery in the time period prior to core uncovery, the recovery period considered here is from the end of the power recovery period considered in the Level 1 analysis up to vessel failure. For the recovery cases considered (Breeding, 1990) the mean values for the probability of successful in-vessel cooling ranged from indeterminant to likely [$.5 < P(IVCool) \leq .9$]. This range accounts for the different initiators and the different entry conditions. A value midway between these two values has been selected for our point estimate value. [P(IVCool) = .7] (Breeding, 1990 - Appendix A, Pages A.1.1-32 - A.1.1-34).

	Point Est.
Cooled	.7
Not Cooled	.3

Case D: In-vessel Injection Failed

For the case where coolant injection to the vessel is lost and not recovered prior to vessel failure then vessel failure is certain (Breeding, 1990 - Appendix A, Pages A.1.1-32 - A.1.1-34).

	Point Est.
Cooled	0.
Not Cooled	1.

F.3.10.3 No Alpha Mode Containment Failure Decomposition Event Tree (ALPHA.DET - Figure F.3-8)

Event 1: Entry from Prior CET Event (Debris Cooled In-vessel)

One Branch

Event 2: RCS Pressure at Core Melt (RCSPRESS)

Two Branches

Not Lo Lo Pressure (> 200 psig)
Lo Lo Pressure (≤ 200 psig)

Note: Not Lo Lo includes PDS RCSPRESS attributes Lo Hi, High and Hi Hi

Branch Probability Type: One/Zero

Quantified Using: PDS Parameter: RCSPRESS and CET Event: RCSFAIL

Event 3: No-Alpha Mode Containment Failure (ALPHA)

Two Branches

No Alpha CF
Alpha CF

Branch Probability Type: Split Fraction

Quantified Using: NUREG 1150-NUREG/CR-4551

Case A: Low Pressure Sequences

Steam explosions have been observed to occur much more readily at low pressures than at elevated pressures. The mean value of the aggregate distribution developed from the distributions in the Steam Explosion Review Group (SERG) (NUREG-1116) and reported in NUREG-4551 (Breeding, 1990) for Alpha mode Containment failure is 0.008 (Breeding, 1990-Appendix A, Page A.1.1-43).

	Point Est.
No Alpha CF	.992
Alpha CF	.008

Case B: High Pressure Sequences

For sequences where RCS pressure is greater than 200 psig, the SERG distributions were decreased by one order of magnitude in NUREG-4551. This results in a mean value for the Alpha mode Containment failure distribution of 0.0008 (Breeding, 1990 - Appendix A, Page A.1.1-43).

	Point Est.
No Alpha CF	.9992
Alpha CF	.0008

F.3.10.4 Mode Of Early Containment Failure Decomposition Event Tree (CF-EARLY.DET - Figure F.3-9)

Event 1: Entry from Prior CET Event (No Alpha Mode Containment Failure)

One Branch

Event 2: Containment Pressure at Reactor Vessel Failure (CONPRESRV)

Three Branches

- Low (nominal value 13 psia - range 10 - 20)
- Inter (nominal value 30 psia - range 21 - 32)
- High (nominal value 39 psia - range 33 - 42)

The three pressure ranges listed above cover the expected pressure regimes for the spectrum of North Anna accident sequences. The low pressure regime represents all sequences with successful operation of the Containment Recirculation Sprays and Containment heat removal. The high pressure regime represents large break LOCA

sequences and sequences where the RCS is depressurized at the time of vessel failure by an induced primary system failure and that are without Recirculation Sprays and Containment heat removal. The intermediate regime is typical of all other sequence types where the RCS is not depressurized prior to vessel failure and where Containment heat removal is not available. The following sequences have been analyzed with the MAAP code to determine the Containment pressure just prior to vessel failure. NUREG/CR-4551 estimates for the Surry plant are also presented in this table for comparison purposes.

Sequence	MAAP Value (psia)	NUREG/CR-4551 Estimate (psia)
Large Break LOCA No SI, No Sprays, No CHR	39	37
3" LOCA, 1 of 2 SI, 1 of 2 IRS and 1 of 2 ORS	14	
3" LOCA, No SI, Normal sprays	12	
Short-Term SBO	25	26
2" LOCA ,No SI, No Sprays, No CHR	23	
Loss of FW, No AFW, No SI, No sprays, No CHR	15	

Branch Probability Type: One/Zero

Quantified Using: PDS Parameters: TRANLOCA, CNHEATREM
CET Events: RCSFAIL

Event 3: Containment Pressure Rise Due to RCS Blowdown at RV Failure (BLOWDOWNP)

Two Branches

Low
High

The low pressure rise branch represents all sequences with low RCS pressures (below 200 psig) at vessel failure (including sequences

with induced primary system failure). The high pressure branch represents all other sequences (≥ 200 psig).

The following sequences have been analyzed with the MAAP code to determine the Containment pressure rise at vessel failure due to blowdown of the RCS.

	MAAP Calculated Values	
	Containment Pressure Rise (psi)	RCS Pressure At Vessel Failure (psia)
Large Break LOCA No Recirc. Sprays No Cont Heat Rem.	0	<< 200
6" LOCA No Recirc. Sprays No Cont Heat Rem.	3	< 200
Short-Term SBO	20	2400
Long-Term SBO	21	580
2" LOCA No Recirc. Sprays No Cont Heat Rem.	13	760

Hence we will assume that all sequences with low RCS pressure (< 200 psig) at RV failure have a low pressure rise (2 psi) and all other sequences have a high pressure rise (14 psi) due to blowdown of the RCS.

Branch Probability Type: One/Zero

Quantified Using: PDS Parameters: RCSPRESS

Event 4: Amount Hydrogen Produced In-Vessel (INVESSH2)

Two Branches

≥ 40% Zirc (core inventory Zircaloy reacted)
< 40% Zirc

Two discrete regimes have been selected to represent the uncertainty in the magnitude of in-vessel hydrogen production. This breakdown is the same as that chosen for this event in the NUREG/CR-4551 Surry analysis. For the Surry IPE, a number of sequences were analyzed with the MAAP code to assess the extent of

in-vessel hydrogen production. The MAAP code was run with the in-vessel core node blockage model both turned on and turned off. The results of these runs indicate that use of the MAAP blockage model will generally result in predicted in-vessel Zr oxidation fractions of less than 40%. Turning off the MAAP blockage model results in Zr oxidation fractions greater than 40%. The only exceptions to this trend is for large LOCAs where the amount of in-vessel oxidation was predicted to be less than 40% for all cases (with or without the MAAP blockage model on). There remains substantial disagreement within the technical community regarding the impact of blockage on the magnitude of in-vessel Zr oxidation. Consequently, we have chosen to assign a value of .5 for the probability of each branch (for all sequence types) indicating that the "correct" path is indeterminate. It is interesting to note that for the 7 cases considered by the NUREG-1150 (NRC, 1989) expert panel the mean values of the aggregate distribution for fraction of Zr oxidized in-vessel ranged from .32 to .52 (Breeding, 1990). It is also interesting to note that the peak Containment pressure at vessel failure (when DCH mechanisms are considered) is relatively insensitive to the amount of in-vessel Zr oxidation as discussed in the following two events.

Branch Probability Type: Split Fraction

	Point Est.
≥ 40% Zirc	.5
< 40% Zirc	.5

Event 5: Fraction of Core Mass Involved in DCH (DCH-MFCI)

Three Branches

Very High	(nominal value 75%	- range 65 -	100%)
High	(nominal value 50%	- range 35 -	65%)
Nominal	(nominal value 25%	- range 0 -	35%)

This event and the following event address two of the more important parameters impacting the peak Containment pressure associated with vessel failure (DCH and hydrogen combustion). Three discretized levels have been selected to represent the uncertainty in the amount of core debris which fully participates in a DCH event at vessel failure. This breakdown is based on sensitivity studies performed with the CONTAIN code investigating DCH events at the Surry plant (Williams, 1987, NUREG/CR-4896). The results of this study are summarized in Table F.3-1. In this study a five "cell" CONTAIN model of the Surry Containment was utilized to assess the peak pressure following reactor vessel failure for a matrix of variations in parameters considered to be important to the calculated DCH pressure. The parameters which were varied in this study included:

a. Extent of hydrogen burning
b. Rate of debris removal from the Containment atmosphere (trapping rate)
c. Debris particle size
d. Amount of In-vessel Zr oxidation
e. Rate of blowdown from the RCS
f. Effect of water
g. Amount of debris participating in the DCH event
h. Debris chemical reaction rate
i. Gas - structure heat transfer rate

The results from this study indicated that peak Containment pressure was not greatly sensitive to debris particle size, chemical reaction rate in the debris particle, extent of in-vessel Zr oxidation, or gas-structure heat transfer rates. The peak DCH pressure was found to be sensitive to the fraction of debris participating in the DCH event, the extent of hydrogen combustion associated with the event, the extent and timing of co-entrained water and the blowdown rate from the RCS. The fraction of debris participating in the DCH event has been explicitly included in the DET as has been the extent of hydrogen combustion (see Event 6). The extent and timing of co-entrained water has not been considered in the tree for the following reasons. Because of the North Anna cavity design one of two distinctly different situations will generally occur for a severe accident sequence. For sequences with the Quench Sprays and Recirculation Sprays operating the cavity will fill with water (>300,000 kg) of water. For all other sequences the cavity will remain essentially dry prior to reactor vessel failure. The CONTAIN sensitivity study shows minimum values for the peak Containment pressure for a dry cavity and for cases with a large mass of water co-dispersed with the debris (see Figure F.3-10 of SPS IPE). Consequently, we have not explicitly included mass of co-dispersed water as an uncertainty event in the tree. The rate of blowdown of the primary system was also shown to have a significant impact on the peak Containment pressure. This parameter was not explicitly included in the tree since a very rapid blowdown (approximately 10 seconds or less) was required to significantly increase the predicted peak Containment pressure. This rapid of a blowdown was judged to be very unlikely with the expected mode of vessel failure (i.e., limited area failure of a lower head penetration).

Results of RELAP/SCDAP calculations performed by INEL were presented at an ACRS Severe Accident Subcommittee meeting (Eltiwilia, 1990). These calculations were performed to address the question (posed by ACRS member Shewman) as to what was the expected mass of debris from the vessel likely to be available to participate in a DCH event. The RELAP/SCDAP analysis indicated that 17% would be a conservative estimate of the amount of the core debris which would be present as liquid in the lower head of the vessel and available to participate in DCH event at vessel failure. This analysis also suggested that 30% would be an upper limit on

this parameter. The median value of the aggregate distribution for fraction of core inventory released at vessel failure from the NUREG-1150 (NRC, 1989) In-Vessel Experts Panel is .28 (Breeding, 1990). In addition, the North Anna cavity design does not include an inclined tunnel (such as Zion) for the instrument tubes and hence debris entrainment out of the reactor cavity is likely to be somewhat restricted leading to less than 100% entrainment from the cavity. Given the above results it appears likely that the fraction of core inventory of debris participating in a DCH event will be in the 25% range, and that it is unlikely that the value would be in the 50% range and very unlikely to be greatly above 50%.

Branch Probability Type: Split Fraction

	Point Est.
Very High (75%)	.01
High (50%)	.09
Nominal (25%)	.90

Event 6: Extent of Hydrogen Burn at Reactor Vessel Failure (EARLYH2)

Three Branches

- UCHB (UnConditional Hydrogen Burn)
- FLAMECRIT (Standard Hydrogen Burn)
- NONE (No Hydrogen Burn)

This event and the previous event address the two most important parameters impacting the peak Containment pressure associated with vessel failure (DCH and hydrogen combustion). Given that a DCH event has occurred it is probable that some hydrogen combustion will occur since the DCH event can act as an ignition source or may even cause catalytic recombination. For DCH events two possible outcomes are considered - a hydrogen burn limited by the local flammability conditions of the Containment (Standard Hydrogen Burn) or hydrogen combustion limited only by the availability of hydrogen or oxygen in a region without regard to the region flammability conditions (UCHB). These two cases were selected since they were the parametric variations evaluated in the CONTAIN DCH sensitivity study (Williams, 1987). The UCHB is considered to be a very conservative assumption since it allows hydrogen combustion under conditions where the hydrogen is clearly non-flammable (NUREG/CR-5282). For sequences without a DCH event the two possible outcomes are No Hydrogen Burn or the Standard Hydrogen Burn. For these sequences the important uncertainty is whether an effective ignition source is present at the time of vessel failure

Branch Probability Type: Split Fraction

Case 1 - Very Large DCH

This case involves DCH events with participation of approximately 75% of the core debris. For this case substantial recombination of hydrogen in regions throughout the Containment may be possible. A probability of .5 is conservatively assigned to the UCHB case to account for the possibility of enhanced hydrogen recombination.

	Point Est.
UCHB	.5
FLAMECRIT	.5
NONE	0.

Case 2 - Nominal DCH

This case involves DCH events with participation of approximately 25% of the core debris. For this case substantial recombination of hydrogen in regions throughout the Containment is judged to be unlikely. A probability of .1 is assigned to the UCHB case to account for the slight possibility of enhanced hydrogen recombination.

	Point Est.
UCHB	.1
FLAMECRIT	.9
NONE	0.

Case 3 - Large DCH

This case involves DCH events with participation of approximately 50% of the core debris. A UCHB probability of .3 which is intermediate between that of Case 1 and 2 is assigned for this case.

	Point Est.
UCHB	.3
FLAMECRIT	.7
NONE	0.

Case 4 - No DCH

This case involves low pressure sequences without entrainment from the reactor cavity and without DCH. A UCHB probability of 0. is appropriate for these cases. The probability of No H_2 Burn and of a Standard H_2 Burn are assigned a value of .5 indicating an indeterminate event. (Note: Without DCH, a Standard Hydrogen Burn has zero probability of causing early Containment failure, hence both branches lead to No Containment Failure DET endpoints.)

	Point Est.
UCHB	0.
FLAMECRIT	.5
NONE	.

Event 7: Summary Event - Total Containment Pressure for DET Path (TOTPRESS)

One Branch

Total Containment Pressure

Branch Probability Type: Summary Event - No Branching

This event is used to summarize the expected Containment pressure for each DET event sequence. The pressure evaluated for each pathway is then used to evaluate the probability of Containment failure and the mode of Containment failure in the next event. The peak Containment pressures for each pathway are summarized on Table F.3-2 and are based largely on the CONTAIN 5 cell Surry model calculations summarized on Table F.3-1. The pressures in Table F.3-1 are multiplied by a factor of 1.17 to account for the increase in the ratio of rated power to containment volume in NAPS (2893 MWt over 1,825,000 ft^3) to the ratio at Surry (2441 MWt over 1,801,000 ft^3). Other correction factors are also used. These are discussed at the bottom of Table F.3-2. In addition, sequences with sprays on are estimated to have a peak Containment pressure 25 psi lower than an equivalent sequence without Quench or Recirculation sprays at vessel failure. This assumption is based on analysis performed in NUREG/CR-2228 (Pratt and Bari, 1981). MARCH code calculations for a ZION small break (S2B) sequence show peak Containment pressure at vessel failure reduced from 95 to 72 psi (23 psi reduction) based on operation of one spray pump and pressure reductions from 100 to 71 (29 psi reduction) and from 97 to 63 psi (34 psi reduction) for two TMLB sequences as a result of spray operation. Note also that with spray operation the Containment pressure will be at approximately 12 psi prior to vessel failure versus 28 to 37 psi for sequences without spray operation - a difference in base Containment pressure of from 16 to 25 psi even before the transient pressurization at vessel failure. Sequence pathways not involving a DCH event (DET endpoints 21 - 24, 57 - 64) and with or without a hydrogen burn at vessel failure were all well below the expected Containment failure pressure range (all peak pressures for these pathways were below the pressure - 85 psia - corresponding to the .001 probability of Containment failure on the North Anna Containment fragility curve). MAAP calculations indicate that the pressure rise associated with a hydrogen burn at vessel failure will be approximately 36 psi for sequences with > 40% in-vessel Zr reaction and approximately 20 psi for sequences with < 40% in-vessel Zr reaction.

Event 8: Mode of Early Containment Failure (CF-EARLY)

Four Branches

- No Early CF
- Leak
- Rupture
- Cat Rupture (Catastrophic Rupture)

The characteristics of each of these failure modes is discussed in Section 4.4 of this report. A study of the North Anna Containment strength shows that this Containment is comparable to the Surry Containment (Virginia Power, 1992). Therefore the Surry Containment fragility curve, the failure modes, and the corresponding failure pressures are assumed applicable for North Anna. Discretized representation for the composite aggregate Containment fragility curve developed by the NUREG-1150 (NRC, 1989) experts' panel showing failure probabilities vs Containment pressure is summarized in Table F.3-3. This table was used to evaluate the probability of Containment failure for each DET pathway. The mode of Containment failure was assessed as follows. The NUREG-1150 experts panel judged that 1) a Leak type failure was most likely for failure pressures less than 135 psig (150 psia), 2) a Rupture type failure was most likely for failure pressures between 135 and 150 psig (150 - 165 psia) and 3) a Catastrophic Rupture was most likely for failure pressures greater than 150 psig (165 psia). Note that in the analysis of early Containment failure that we assume that the peak calculated Containment pressure represents the Containment failure pressure. We assume that Containment failures which may occur at pressures lower than the calculated peak pressure do not limit the peak pressure. Furthermore we assume that the Containment failure mode is solely determined by the peak pressure regardless of which pressure Containment failure first occurs at. This implies, for example, that if a Leak type failure were to occur at a lower pressure it could evolve into a Rupture if the Containment pressure rises sufficiently to enter the Rupture pressure regime. The conditional probabilities for each mode of Containment failure as a function of pressure were also estimated for Surry in NUREG-1150 and these are again assumed applicable to North Anna. These conditional probabilities are also included in Table F.3-3.

The probability of failure by each failure mode for each calculated peak Containment pressure in the DET is evaluated by first assessing the probability of Containment failure from the Containment fragility curve and then multiplying by the conditional probability of failure for each mode (Table F.3-3).

Branch Probability Type: Split Fraction

F.3.10.5 Early Recirculation Spray Failure Decomposition Event Tree (RS-EARLY.DET - Figure F.3-10)

Event 1: Entry from Prior CET Event (Mode of Early Containment Failure)

One Branch

Event 2: Containment Recirculation Sprays Available Initially (RECSPRAYS)

Two Branches

Yes
No

This event assesses whether or not Recirculation Sprays were available (not failed mechanically and AC power is available) prior to reactor vessel failure.

Branch Probability Type: One/Zero

Quantified Using: PDS Parameters: RECSPRAYS, SBO and POWRECOV

Event 3: No Alpha Mode Containment Failure (ALPHA)

Two Branches

NO ALPHA CF (No Alpha Mode Containment Failure)
ALPHA CF (Alpha Mode Failure)

Branch Probability Type: One/Zero

Quantified Using: CET Event: ALPHA

Note: We assume that steam explosions sufficiently energetic to fail both the reactor vessel and Containment will also fail the outside and inside Recirculation Sprays.

Event 4: Mode of Early Containment Failure (CF-EARLY)

Four Branches

No CF (No Containment Failure)
Leak
Rupture
Cat Rupture (Catastrophic Rupture)

Branch Probability Type: One/Zero

Quantified Using: CET Event: CF-EARLY

Event 5: Containment Failure Causes Spray Failure (RS-CF)

Two Branches

No Failure
Spray Failure

Branch Probability Type: Split Fraction

Quantified Using: NUREG 1150-NUREG/CR-4551

The Sandia structural engineers who were consulted by the NUREG/CR-4551 authors indicated that the probability of spray failure as a result of Containment failure was "incredible" for all Containment failure modes except catastrophic rupture. For the case of catastrophic rupture they indicated that spray failure was unlikely. We interpret "incredible" to mean impossible (probability = 0) for No Containment Failure, and Leak and Rupture type failures. For Catastrophic Rupture, failure of both trains of inside and outside Recirculation Sprays was considered unlikely (probability = 0.1). NUREG/CR-4551 estimated that in-vessel steam explosions which fail the reactor vessel and the Containment (Alpha mode Containment failure) would also fail the sprays (Breeding, 1990-Appendix A, Page A.1.1-56).

Case A: NO CF

	Point Est.
No Failure	1.0
Spray Failure	0.

Case B: Leak Type Failures

	Point Est.
No Failure	1.0
Spray Failure	0.

Case C: Rupture Type Failures

	Point Est.
No Failure	1.0
Spray Failure	0.

Case D: Catastrophic Rupture Type Failures

	Point Est.
No Failure	0.9
Spray Failure	0.1

Case E: Alpha Mode Containment Failures

	Point Est.
No Failure	0.0
Spray Failure	1.0

Event 6: RCS Pressure at Vessel Breach (RCSPRESS)

Two Branches

Lo Lo Pressure (≤ 200 psig)
Not Lo Lo Pressure (> 200 psig)

Note: Not Lo Lo includes PDS RCSPRESS attributes: Lo Hi, High and Hi Hi. Lo Lo RCS pressure also results from an induced hot leg rupture CET event RCSFAIL = HOT LEG FAILURE.

Branch Probability Type: One/Zero

Quantified Using: PDS Parameter: RCSPRESS and
CET Event: RCSFAIL

Event 7: Excessive Debris in Sump Causes Spray Failure (RS-DEBRIS)

Two Branches

No Failure
Spray Failure

Branch Probability Type: Split Fraction

Quantified Using: Engineering Analysis/Judgement

Two failure mechanisms are postulated which could result in Recirculation Spray pump failure - (1) large core debris particles collecting on the fine mesh screens and blocking flow to the pumps and (2) passage of smaller debris particles through the fine mesh screens and into the pump suction which could damage the pumps. The fine mesh screens surrounding the sump and individual spray pumps are sized such that particles larger than the smallest Recirculation Spray nozzle opening would not pass through the screens. The total surface area of the outer set of screens is 168 square feet. A uniform debris layer thickness of 1/2 inch would require approximately 1950 kg of core debris which represents about 2% of the core debris expelled from the vessel at vessel failure. The sump at the North Anna units are directly opposite Containment from the incore instrument tunnel cavity exit in the RHR "cubicle" which is the most likely pathway of debris being entrained from the cavity. Hence debris that is expelled from the cavity will need to be transported a substantial distance across the lower Containment floor to reach the sump. In addition to the instrument tunnel, other debris paths out of the cavity include paths to the operating floor at elevation 291 ft. 10 in. or through the annulus grating at elevation 241 ft. and over to the containment sumps. In these cases, the debris would have to migrate a very tortuous and complex path through grating and other containment structures before it could reach the containment sump.

Based on the above discussion the authors believe that it is very unlikely that sufficient amounts of core debris will be entrained from the cavity and transported across Containment to either block the sump or damage both trains of inside and outside Recirculation Spray pumps.

Case A: Lo Lo RCS Pressure at Vessel Failure

For sequences with RCS pressure < 200 psig at vessel failure little debris would be expected to be entrained out of the reactor cavity.

	Point Est.
No Failure	1.0
Spray Failure	0.

Case B: Not Lo Lo RCS Pressure at Vessel Failure

For sequences with RCS pressure > 200 psig at vessel failure extensive debris entrainment out of the reactor cavity would be expected and their exists the possibility for sufficient amounts of core debris to be transported to the Containment Sump to potentially cause spray pump failure. However, failure of all spray pumps in the IRS and ORS is judged to be very unlikely.

	Point Est.
No Failure	.99
Spray Failure	.01

Event 8: Containment Fails into Safeguards Building (CF-SG)

Two Branches

- No
- Yes

Branch Probability Type: Split Fraction

Quantified Using: Engineering Analysis/Judgement

The safeguards building houses the outside Recirculation Spray pumps and the LPI pumps. Containment failure into this relatively small building may result in environmental conditions which could fail the ORS pumps. The safeguards building is adjacent to the Containment wall. Its contact with the Containment wall extends from the 256 ft. 3 in. elevation to elevation 279 ft. 6 in. It also covers an arc of the Containment wall of 47 degrees (57.1 '). Hence, the safeguards building covers an area of:

$$A\text{-}sg = 57.1 \times (279.5 + 256.25) = 1328 \text{ ft}^2$$

Containment geometric data:

cylinder outside radius = 67.5'
cylinder height = 127.5'
dome outside radius = 65.5'

The Containment cylindrical wall has an outside surface area of:

$$A\text{-}cyl = 127.5 \times 2 \times \pi \times 67.5 = 5.4\times10^4 \text{ ft}^2$$

The Containment dome has an outside surface area of:

$$A\text{-}dome = 2 \times \pi \times (65.5)^2 = 2.7\times10^4 \text{ ft}^2$$

The total Containment outside surface area is then:

$$A\text{-cont} = 5.4\times10^4 + 2.7\times10^4 = 8.1\times10^4 \ ft^2$$

Assuming that the probability that the Containment will fail in any given area of the Containment wall is uniform within the cylindrical wall and dome, then:

$$P(CF\text{-}SG) = \frac{1328}{8.1\times10^4} = .02$$

Note: The above calculation assumes that the probability of failure is uniform across the entire Containment surface. However, if failure location is dominated by failure at a particular region (for example, the dome-cylinder interface), then the probability of Containment failure into the region of the safeguards building would be dependent on the probable failure location. Since there is no reason to believe that the interface between the safeguards building and the Containment would be the vulnerable point in the Containment, the above calculation is conservative.

(North Anna drawings 11715-FM-1B and 11715-FM-1F)

	Point Est.
No	.98
Yes	.02

Event 9: Environmental Conditions in Safeguards Building Fails Outside Recirculation Spray (ORS) Pump Motors (ORS-ENVIR)

Two Branches

- Yes (ORS Fails)
- No (No ORS Failure)

Branch Probability Type: Split Fraction

Quantified Using: Engineering Analysis/Judgement

Given that the Containment has failed into the safeguards building this question assesses whether the environmental conditions (temperature, pressure, humidity, radiation) in the safeguards building will cause failure of the outside Recirculation Spray pump motors. The outside spray pump motors appear to be similar in design to the inside Recirculation Spray pump motors, however they are qualified for less severe environmental conditions. The table below indicates the environmental conditions for which the inside and outside recirculation pump motors are qualified.

	Ambient Temperature (°F)	Humidity	Radiation (rads)
IRS	280 for 30 min* 150 for 7 days	100% RH* at 150°F for 7 days	1.0E8
ORS	246	100% RH	1.0E7

* from test results

Case A: No Containment Failure

	Point Est.
Yes (ORS Fails)	0.
No (No ORS Failure)	1.

Case B: Leak Type Containment Failure

A leak type failure is characterized by a failure size of approximately 0.1 ft^2 (4 inch diameter hole). This is the failure mode considered most likely for Containment failure at pressures below 135 psig. Because of the limited leak rate from Containment and the isolated location of the ORS pump motors it is judged to be unlikely that both ORS pump motors will fail.

	Point Est.
Yes (ORS Fails)	.1
No (No ORS Failure)	.9

Case C: Rupture and Catastrophic Rupture Type Containment Failure

A rupture type failure is characterized by a failure size of approximately 1.0 ft^2 (14 inch diameter hole). A catastrophic rupture is characterized by a failure size of many square feet(>> 7). Because of the much larger leak rates from the Containment and uncertainties as to the actual peak temperatures the ORS pump motors can withstand it is judged that failure of both ORS pump motors is indeterminant.

	Point Est.
Yes (ORS Fails)	.5
No (No ORS Failure)	.5

Event 10: Environmental Conditions in Containment Fails Inside Recirculation Spray (IRS) Pump Motors (IRS-ENVIR)

Two Branches

Yes (IRS Fails)
No (No IRS Failure)

Branch Probability Type: Split Fraction

Quantified Using: Engineering Analysis/Judgement

Given that the ORS have failed we are now interested in determining whether the inside Recirculation Sprays will fail do to environmental conditions in the Containment. This question assesses whether the environmental conditions (temperature, pressure, humidity, radiation) in the Containment early in the accident sequence will cause failure of the inside Recirculation Spray pumps. The inside spray pumps are qualified for the severe accident environment shown under the Event 9 discussion above. Over-pressure failure of Containment implies that the temperature of the Containment atmosphere was elevated to a minimum of 350°F and possibly much higher if the Containment atmosphere was superheated (for example by a DCH event or hydrogen combustion event). These early pressure transients arising from vessel blowdown, DCH, hydrogen burns, etc., are likely to be short lived as Containment heat sinks and the spray systems act to cool the Containment atmosphere. Consequently, it is reasonable to assume that the sealed IRS pump motors can withstand transient ambient temperatures well in excess of their peak qualification temperature for a short period of time. For example, the Inside Recirculation Spray pump motors are qualified for ambient temperatures of 430°F for 2 minutes (following a Main Steam line break into Containment). Consequently, it is believed that the failure of both IRS pumps will be very unlikely due to environmental conditions for pressure transients which do not result in Containment failure and unlikely for transients which do result in Containment failure.

Because of the diversity and redundancy in the spray systems, local hydrogen burns is not expected to fail the spray or containment heat removal functions. Therefore, hydrogen combustion effects are considered bounded by the other environmental conditions discussed above and will not be treated explicitly.

Only sequences with Containment failure are considered since the outside recirculation pumps will not be failed by environmental conditions without Containment leakage into the safeguards building.

	Point Est.
Yes (IRS Fails)	.1
No (No IRS Failure)	.9

Event 11: No Early Recirculation Spray Failure (RS-EARLY)

Two Branches

Failure
No Failure

Branch Probability Type: Summary Event

This event has no branching. It is used solely to summarize the outcomes of each pathway in the appropriate form to transmit information back to the CET.

F.3.10.6 Debris Cooled Ex-Vessel Decomposition Event Tree (EXVCOOL.DET - Figure F.3-11)

Debris is considered cooled ex-vessel if the debris temperature is reduced to and maintained below the concrete melting temperature.

Event 1: Entry from Prior CET Event (No Early Recirculation Spray Failure)

One Branch

Event 2: RCS Pressure at Reactor Vessel Failure (RCSPRESS)

Two Branches

Not Lo Lo (> 200 psig)
Lo Lo (≤ 200 psig)

Note: Not Lo Lo includes PDS RCSPRESS attributes Lo Hi, High and Hi Hi. Additionally, Lo Lo RCS pressures will result from induced hot leg failures. (CET Event RCSFAIL = HOT LEG FAILURE)

Branch Probability Type: One/Zero

Quantified Using: PDS Parameter: RCSPRESS and
CET Event: RCSFAIL

Event 3: Debris Dispersed Out of Cavity (DEBDISP)

Two Branches

Yes (Debris dispersed out of cavity)
No (Debris not dispersed out of cavity)

Branch Probability Type: Split Fraction

Quantified Using: Engineering Judgement

Case A: Lo Lo RCS Pressure Sequences

For sequences where the RCS pressure is below 200 psig at the time of vessel failure it is very likely that a majority of the debris will not be entrained out of the reactor cavity. Since it is conservative in this case we will assume that the debris is never entrained out of the cavity for low pressure sequences.

	Point Est.
Yes (Debris Dispersed)	0.
No (Debris Not Disp.)	1.

Case B: High Pressure Sequences

For sequences with high RCS pressures at the time of vessel failure it is likely that a majority of the debris released from the vessel at vessel failure will be entrained out of the reactor cavity.

	Point Est.
Yes (Debris Dispersed)	.9
No (Debris Not Disp.)	.1

Event 4: Depth of Debris Pool (DEBDEPTH)

Three Branches

Deep	(> 25 cm)
Shallow	(10 < depth < 25 cm)
Very Shallow	(< 10 cm)

The debris depths listed above are based on debris with 100% theoretical density (no porosity).

For pools with depths greater than 25 cm it is problematic whether the debris pools are coolable given a supply of coolant water. For debris pools less than 25 cm deep the debris will be coolable if cooling water is available (Generic letter 88-20, Page 1-8, Section 4, "General Guidance on Containment Performance"). For pools with depths less than 10 cm it is likely that the debris will be able to transfer sufficient energy by radiation and convection to cool the debris to below the concrete melting temperature without cooling water flow to the debris.

Branch Probability Type: Split Fraction

Quantified Using: Engineering Judgement

Case A: Lo Lo RCS pressure

When the vessel fails at low RCS pressure the depth of the debris is assumed to be indeterminant. The depth can be either shallow or deep depending on the spread of the debris within the cavity which is a function of the failure mode of the vessel. A shallow debris pool will occur if the debris covers the entire cavity floor. The total surface area of the cavity floor is 57.6 m^2. The maximum debris depth for this case is:

$$h = V / A = 0.24 \text{ m}$$

where

V = The total debris volume (13.8 m^3)

A = The floor area of the cylindrical and keyway portions of the cavity (57.6 m^2)

The volume of debris is calculated as follows:

Component	Mass, kg*	Density kg/m^3	Volume m^3
Zircaloy	18700	6500	2.9
UO2	82200	10100	8.1
Steel	20000	8000	2.5
	120900		13.8

* The Zircaloy and UO_2 masses are obtained from the NAPS MAAP input calculations. The mass of steel which was not readily available and is estimated based on other studies.

A deep pool will result if the debris does not spread over the entire cavity but is restricted to a limited portion of the cavity. For example, the debris may be restricted to the area just below the vessel if the ejection is like a pour. The depth in this scenario is defined based on the above equation using the same mass but a floor area equivalent to that of the cylindrical portion of the cavity.

$$h = V / A = .39 \text{ m}$$

where

A = cavity floor area (35.3 m^2).

As can be seen from the above calculations, the debris depth in the cavity can be defined either as shallow or deep depending on the degree of spread over the cavity floor. It should be noted that

approximately only 30% of the debris will be ejected at the time of vessel breach. The other 70% of the debris will be ejected after vessel breach and will particulate, thus enhancing spread. For this case, a probability of 0.5 is assigned to a shallow pool and the other 0.5 assigned to deep pools.

	Point Est.
Very Shallow	0.
Shallow	.5
Deep	.5

Case B: High RCS Pressure and Debris Not Entrained Out of Cavity

If the RCS pressure at the time of vessel failure is high and the debris is not dispersed out of the cavity the pool depth can again be shallow or deep. Since the pressure is high it is more likely that the debris will be evenly distributed throughout the cavity so the probabilities are defined as follows:

	Point Est.
Very Shallow	0.
Shallow	.9
Deep	.1

Case C: High RCS Pressure and Debris Entrained Out of Cavity

If the RCS pressure is sufficiently high to entrain the debris out of the cavity then the most likely pathway for this debris is to follow the in-core instrument tubes through the keyway and up to the RHR flat. The RHR flat is located at the 231 ft. 6 in. elevation which is approximately 15 feet above the floor of the Containment. The RHR flat is open to the Containment atmosphere and is therefore coolable via Recirculation Sprays. Since there are no barriers to retain the core debris at the 231 ft. level, it is likely that the debris will be dispersed onto the Containment floor. In this event the pool depth is defined to be very shallow ($h < 10$ cm). A probability of 0.1 is assigned to a pool depth above 10 cm to account for possible accumulation of debris in corners and around equipment.

	Point Est.
Very Shallow	.9
Shallow	.1
Deep	0.

Event 5: Cooling Water To Debris Exvessel (COOLWATER)

Two Branches

Yes (Cooling Water To Debris Exvessel)
No (No Cooling Water To Debris Exvessel)

Branch Probability Type: One/Zero

Quantified Using: CET Event: RS-EARLY

Note: We are neglecting water supply to the cavity from in-vessel injection sources (LPSI) since there is not many core damage sequences with all Recirculation Sprays failed and with LPSI available.

Event 6: Debris Cooled Ex-vessel (EXVCOOL)

Two Branches

Cooled
Not Cooled

For sequences where long term heat removal is available and where with water is being supplied to the debris the following conditions are considered. For deep pools (depths greater than 25 cm) it is problematic (0.5 probability of success) whether the debris pools are coolable given a supply of cool water. For debris pools less than 25 cm deep the debris is coolable if cooling water is available (GL 88-20, page 1-8). For very shallow pools (pool depth less than 10 cm) it is likely that the debris will be able to transfer sufficient energy by radiation and convection to cool the debris to below the concrete melting temperature without cooling water flow to the debris (Breeding, 1990, Appendix A, Pages A1.1-66 -A1.1-68). Therefore very shallow pools are assumed to be coolable (probability of success = 0.9) even without the presence of water. Debris pools with depths greater than 10 cm are assumed non-coolable without water and long term containment heat removal. [Note: Without containment heat removal, temperature and pressure rise will continue and can, over a long period of time, fail the containment even for the very shallow debris pool scenario. However, this heatup is gradual and the long time frame available (in excess of 24 hours) will allow for operator, power, or equipment recovery.]

Case A: Deep Pool With Cooling Water

	Point Est.
Cooled	.5
Not Cooled	.5

Case B: Deep Pool With No Cooling Water

	Point Est.
Cooled	0.
Not Cooled	1.

Case C: Shallow Pool With Cooling Water

	Point Est.
Cooled	1.
Not Cooled	0.

Case D: Shallow Pool With No Cooling Water

	Point Est.
Cooled	0.
Not Cooled	1.

Case E: Very Shallow Pool With Cooling Water

	Point Est.
Cooled	1.
Not Cooled	0.

Case F: Very Shallow Pool With No Cooling Water

	Point Est.
Cooled	.9
Not Cooled	.1

F.3.10.7 Mode of Late Containment Failure Decomposition Event Tree (CF-LATE.DET - Figure F.3-12)

Event 1: Entry from Prior CET Event (Debris Cooled Ex-Vessel)
One Branch

Event 2: Power Available Prior to Reactor Vessel Failure (POWRECRV)

Two Branches

Yes
No

This event assess whether there is AC power available to operate the sprays at the time of reactor vessel failure.

Branch Probability Type: One/Zero

Quantified Using: PDS Parameters: SBO and POWEREC

Event 3: Power Recovery Late (POWRECLAT)

Two Branches

Yes
No

This event assess whether AC power is recovered late in the accident sequence (after RV failure but before Containment integrity is threatened by long term steam overpressurization) given that AC power was initially lost and not recovered prior to RV failure.

Branch Probability Type: One/Zero

Quantified Using: PDS Parameters: POWRECOV

Event 4: Recirculation Sprays Operate (RS-REC)

Two Branches

Yes
No

This event assesses whether Recirculation Sprays are available prior to Containment being threatened by steam overpressurization.

This requires that AC power is available (either always available or recovered) and that the sprays have not failed earlier.

Branch Probability Type: One/Zero

Quantified Using: PDS Parameters: RECSPRAYS, and POWRECOV, and
CET Event: RS-EARLY

Event 5: RCS Pressure at Vessel Failure (RCSPRESS)

Four Branches

Lo Lo Pressure (< 200 psig)
Not Lo Lo (> 200 psig)

Note: Not Lo Lo includes pressure ranges Lo Hi, High and Hi Hi Pressure.

Branch Probability Type: One/Zero

Quantified Using: PDS Parameter: RCSPRESS and
CET Event: RCSFAIL

Event 6: Debris Cooled Ex-vessel (EXVCOOL)

Two Branches

Cooled
Not Cooled

Branch Probability Type: One/Zero

Quantified Using: CET Event: EXVCOOL

Event 7: "Late" Hydrogen Burn Fails Containment (LATEH2)

Two Branches

Yes
No

In NUREG/CR-4551 it was judged that the only time that a hydrogen burn of sufficient magnitude to challenge the integrity of the Surry Containment might occur would be during rapid deinerting. Since the North Anna Containment is similar to the Containment at Surry, the previous statement is assumed to also apply to North Anna. The North Anna Containment is sufficiently robust that a hydrogen burn at relatively low hydrogen concentrations will not challenge the Containment. Furthermore, it is very unlikely that a large hydrogen concentration could accumulate in a deinerted Containment because of the plethora of ignition sources that would be expected to be available. For example, for the Containment to remain deinerted for long periods of time following core damage the Recirculation Sprays and Containment heat removal must be available or else steam generation would soon cause the Containment to reach an inert condition. The availability of AC power and the operation of electrical equipment inside Containment would almost certainly assure that ignition sources would be available to prevent accumulation of very high hydrogen concentrations. Consequently, it is judged that the only time that a high hydrogen concentration could occur in conjunction with a deinerted Containment would be late in accident sequences without sprays/Containment heat removal where sprays/CHR are recovered. This situation might occur, for example, for a SBO accident with later power recovery.

Bounding Calculation

A hydrogen burn which occurs when the steam concentration is 50% and which consumes all the available oxygen in Containment is calculated to result in a maximum pressure of 128 psia (adiabatic heatup). Spray operation (which is assumed for the rapid deinerting event) will reduce the peak pressure by approximately 25 psi (see discussion under Mode of Early Containment Failure Decomposition Tree) resulting in a peak pressure of approximately 103 psia. Given this pressure the Containment failure probability would be .03. This is a conservative calculation. Consumption of all oxygen requires an amount of hydrogen equivalent to greater than 130% reaction of the core inventory of Zirconium. Furthermore, it is assumed that all oxygen is consumed and it is assumed that the burn occurs when the Containment is at its highest pressure where a hydrogen burn could occur (i.e., Containment atmosphere has just deinerted). Three cases are considered below.

Branch Probability Type: Split Fraction

Quantified Using: PDS Parameter: RCSPRESS
CET Event: EXVCOOL

Case 1: Early Hydrogen Burn Occurs

If an early hydrogen burn at vessel failure has occurred then insufficient oxygen is available to react with hydrogen to threaten Containment. We assume that all sequences with high pressure melt ejection will result in sufficient hydrogen combustion at vessel failure to render the late hydrogen burn threat negligible.

	Point Est.
Yes-Late H_2 Burn Fails Cont	0.
No	1.

Case 2: Debris Cooled Ex-vessel

For sequences with no debris concrete attack then insufficient additional hydrogen will be produced over that generated in-vessel to establish a potential concentration that could threaten Containment integrity.

	Point Est.
Yes-Late H_2 Burn Fails Cont	0.
No	1.

Case 3: No Early Hydrogen Burn has Occurred and Debris is Not cooled Ex-vessel

For this case we will use the results from the conservative bounding calculation discussed above.

	Point Est.
Yes-Late H_2 Burn Fails Cont	.03
No	.97

Event 8: Containment Heat Removal Available (CNHEATREM)

Two Branches

Yes
No

For sequences without Recirculation Sprays and Containment heat removal eventual over-pressure Containment failure will occur. With sprays and CHR Containment steam over-pressure failure is prohibited. Non-condensible gas generation alone will not result in over-pressure failure of the Containment.

Branch Probability Type: Zero/One

Quantified Using: PDS Parameter: CNHEATRM

Event 9: Mode of Late Containment Failure (CF-LATE)

Four Branches

No Late CF
Leak
Rupture
Catastrophic Rupture

The characteristics of each of these failure modes is discussed in Analysis file 320MAF.N.16. The discretized Containment fragility curve shown as failure probabilities vs Containment pressure is shown in Table F.3-3. This table was used to evaluate the probability of Containment failure for each DET pathway. The mode of Containment failure for each DET pathway was assessed as follows. A Leak type failure was judged to be most likely for failure pressures less than 135 psig (150 psia); a Rupture type failure was most likely for failure pressures between 135 and 150 psig (150 -165 psia); and a Catastrophic Rupture was most likely for failure pressures greater than 150 psig (165 psia). [See also the discussion on he DET for mode of early Containment failure.] The conditional probabilities for each mode of failure is also presented in Table F.3-3. Note that unlike the early Containment

failure analysis where Containment loading were due to fairly rapid transient events (e.g., DCH, vessel blowdown, H_2 combustion) for late over-pressure failure the loading rate is relatively slow and we assume that any Containment failure mode results in a hole size which is sufficiently large to at least terminate the pressure rise in Containment.

The probabilities for each mode of Containment failure were evaluated by numerically integrating the following equations:

$$P_i = \frac{\int_{70psig}^{180psig} P_f(P) \times P_{c-i}(P)\, dp}{\int_{70psig}^{180psig} P_f(P)\, dp}$$

Where

P_i = the probability of Containment failure by mode i

$_i$ = leak, rupture, catastrophic rupture

P = Containment pressure (psig)

$P_f(P)$ = probability density function for Containment failure as a function of pressure

$P_{c-i}(P)$ = the conditional probability of Containment failure by mode i at pressure P

Solution of this equation with the data from Table F.3-3 yields

P_{leak} = .617

$P_{rupture}$ = .306

$P_{cat.\ rupture}$ = .078

These values give the probabilities of Containment failure for each failure mode for gradual pressurization where Containment pressurization is unmitigated (i.e., pressure continues to increase until failure occurs).

F.3.10.8 No Late Recirculation Spray Failure Decomposition Event Tree (RS-LATE.DET - Figure F.3-13)

Event 1: Entry from Prior CET Event (Mode of Late Containment Failure CET)

One Branch

Event 2: Recirculation Sprays Failed Earlier or Power Not Available Late (RSFAIL-L)

Two Branches

- Failed
- Not Failed

Branch Probability Type: One/Zero

Quantified Using: PDS Parameters: SBO,RECSPRAYS
CET Event: RS-EARLY

Event 3: Mode of Late Containment Failure (CF-LATE)

Four Branches

- No late CF
- Leak
- Rupture
- Cat Rupture

Branch Probability Type: One/Zero

Quantified Using: CET Event: CF-LATE

Event 4: Late Containment Failure Causes Spray Failure (RS-CF)

Two Branches

- No Failure
- Spray Failure

Branch Probability Type: Split Fraction

Quantified Using: NUREG 1150-NUREG/CR-4551

The quantification of this event is the same as that discussed for event RS-CF in the RS-EARLY DET.

Case A: No CF

	Point Est.
No Failure	1.
Spray Failure	0.

Case B: Leak Type Failures

	Point Est.
No Failure	1.
Spray Failure	0.

Case C: Rupture Type Failures

	Point Est.
No Failure	1.
Spray Failure	0.

Case D: Catastrophic Rupture Type Failures

	Point Est.
No Failure	0.9
Spray Failure	0.1

Event 5: Containment Heat Removal Available (CNHEATREM)

Two Branches

Yes
No

Branch Probability Type: Zero/One

Quantified Using: PDS Parameters: CNHEATREM,SBO and POWRECOV and CET Event: RS-EARLY

Event 6: Containment Fails into Safeguards Building (CF-SG)

Two Branches

No
Yes

Branch Probability Type: Split Fraction

Quantified Using: Engineering Analysis/Judgement

The quantification of this event is the same as that for CF-SG in the DET for RS-EARLY.

	Point Est.
No	.98
Yes	.02

Event 7: Environmental Conditions in Safeguards Building Fails Outside Recirculation Spray (ORS) Pump Motors (ORS-ENVIR)

Two Branches

Yes (ORS Fails)
No (No ORS Failure)

Branch Probability Type: Split Fraction

Quantified Using: Engineering Analysis/Judgement

Given that the Containment has failed into the safeguards building this question assesses whether the environmental conditions (temperature, pressure, humidity, radiation) in the safeguards building will cause failure of the outside Recirculation Spray pump motors. The outside spray pump motors appear to be similar in design to the inside Recirculation Spray pump motors, however they are qualified for less severe environmental conditions. The table below indicates the environmental conditions for which the inside and outside recirculation pump motors are qualified.

	Ambient Temperature (°F)	Humidity	Radiation (rads)
IRS	280 for 30 min* 150 for 7 days	100% RH* at 150°F for 7 days	1.0E8
ORS	246	100% RH	1.0E7

* from test results

Case A: No Containment Failure

	Point Est.
Yes - ORS Fails	0.
No - No ORS Failure	1.

Case B: Leak Type Containment Failure

A leak type failure is characterized by a failure size of approximately 0.1 ft^2 (4 in diameter hole). This is the failure mode considered most likely for Containment failure at pressures below 135 psig. Because of the limited leak rate from Containment and the isolated location of the ORS pump motors it is judged to be unlikely that both ORS pump motors will fail.

	Point Est.
Yes - ORS Fails	.1
No - No ORS Failure	.9

Case C: Rupture and Catastrophic Rupture Type Containment Failure

A rupture type failure is characterized by a failure size of approximately 1.0 ft^2 (14 in diameter hole). A catastrophic rupture is characterized by a failure size of many square feet (>> 7). Because of the much larger leak rates from the Containment and uncertainties as to the actual peak temperatures the ORS pump motors can withstand it is judged that failure of both ORS pump motors is indeterminant

	Point Est.
Yes - ORS Fails	.5
No - No ORS Failure	.5

Event 8: Environmental Conditions in Containment Fails Outside Recirculation Spray (ORS) (ORS-ENCON)

Two Branches

Yes - ORS Fails
No - No ORS Failure

Branch Probability Type: Split Fraction

Quantified Using: Engineering Analysis/Judgement

If the outside Recirculation Spray pumps do not fail as a result of the failure of the Containment into the safeguard building, they may fail due to the environmental conditions (temperature, pressure, humidity, radiation) in the Containment late in the accident sequence. The only significant failure mechanism is for the pump seals to fail as a result of the temperature of the water passing through the pumps.

The outside spray pumps are qualified for the severe accident environment shown under the Event 7 discussion above. At the

median Containment failure pressure, the temperature of the Containment Sump water will be approximately 350°F. Long term Containment overpressurization will expose equipment in Containment to elevated temperatures for many hours or days. The ORS pump seals may be exposed to temperatures well in excess of their peak qualification temperature for a long period of time since Containment heat removal is not available.

It is considered unlikely that the outside recirculation pumps will fail within the 24 hour mission time being used for this project.

	Point Est.
Yes - ORS Fails	.1
No - No ORS Failure	.9

Event 9: Environmental Conditions in Containment Fails Inside Recirculation Spray (IRS) Pump Motors (IRS-ENVIR)

Two Branches

Yes (IRS Fails)
No (No IRS Failure)

Branch Probability Type: Split Fraction

Quantified Using: Engineering Analysis/Judgement

We are now interested in determining whether the inside Recirculation Sprays will fail due to environmental conditions in the Containment. This question assesses whether the environmental conditions (temperature, pressure, humidity, radiation) in the Containment late in the accident sequence will cause failure of the inside Recirculation Spray pumps. The inside spray pumps are qualified for the severe accident environment shown above under the Event 7 discussion.

At the median Containment failure pressure, the temperature of the Containment atmosphere will be approximately 350°F and possibly much higher if the Containment atmosphere is superheated. Unlike the early pressure transients arising from vessel blowdown, DCH, hydrogen burns, etc., which are likely to be short lived, long term Containment overpressurization will expose equipment in Containment to elevated temperatures for a long periods of time. Thus, the IRS pump seals and motors may be exposed to temperatures and pressures well in excess of their peak qualification temperature for a long period of time. It is believed that the failure of both IRS pumps is more likely than the failure of both ORS pumps even considering the sealed nature of the IRS pumps and the more severe environmental qualification pedigree since the IRS pump motors will be exposed to Containment ambient temperatures.

	Point Est.
Yes - IRS Fails	.9
No - No IRS Failure	.1

Event 10: No Late Recirculation Spray Failure (RS-LATE)

Two Branches

No Failure
Failure

Branch Probability Type: Summary Event (No Branching)

F.3.10.9 Containment Failure Long Term Decomposition Event Tree (CF-LONG.DET - Figure F.3-14)

This tree is entered only for sequences with operable Recirculation Sprays and Containment heat removal and with the debris **NOT** cooled ex-vessel. CHR operation assures that Containment over-pressure failure from gradual steam generation will not occur. Hence, only basemat melt-through is possible as a long term Containment failure mechanism. In addition, operation of the Recirculation Sprays indicates that water is being supplied to the debris. However, the debris is not in a coolable configuration for these sequences.

Event 1: Entry from Prior CET Event (No Late Recirculation Spray Failure)

One Branch

Event 2: RCS Pressure at During Core Damage/At Vessel Failure (RCSPRESS)

Two Branches

Not Lo Lo Pressure (> 200 psig)
Lo Lo Pressure (≤ 200 psig)

Note: Not Lo Lo includes PDS RCSPRESS attributes Lo Hi, High and Hi Hi

Branch Probability Type: One/Zero

Quantified Using: PDS Parameter: RCSPRESS and CET Event RCSFAIL

Event 3: Containment Failure Long Term (CF-LONG)

Two Branches

No Late Late CF
Melt-through (Basemat Melt-through)

Branch Probability Type: Split Fraction

Quantified Using: NUREG 1150-NUREG/CR-4551

Case A: Low Pressure Sequences

For non-coolable debris pools with an overlying water layer NUREG/CR-4551 provides the following estimates for the probability of basemat melt-through:

P(BMT) = .25	for core concrete interactions (CCI) involving a large fraction of the core debris
P(BMT) = .05	for intermediate CCI

The assumption is made that "deep pools" used in this analysis(see DET for Debris Cooled Exvessel) can be equated with the NUREG/CR-4551 large CCI category and "shallow pools" with the intermediate CCI category.

For low pressure sequences there is a high probability of the core debris remaining in the cavity in relatively deep pools. Evaluating the DET for CET Event Debris Cooled Ex-Vessel for low pressure sequences (LO LO branch) with in-vessel cooling available indicates that uncooled shallow pools have a conditional probability of .05 and uncooled deep pools a conditional probability of .25. Combining these results with the NUREG/CR-4551 probabilities shown above results in a probability of basemat melt-through of .2 for low pressure sequences with a cooling water supply to the debris which are uncoolable.

Example calculations:

$$P(BMT) = \frac{P(deep)}{P(deep\ or\ shallow)} * P(BMT|deep) + \frac{P(shallow)}{P(deep\ or\ shallow)} * P(BMT|shallow)$$

where

P(BMT)	=	probability of basemat melt-through for low pressure non-coolable sequences with cooling water supplied to the debris
P(deep)	=	prob. of a non-coolable deep pool with a cooling water supply = .25
P(shallow)	=	prob. of a non-coolable shallow pool with a cooling water supply = .05
P(BMT¦deep)	=	the cond. prob. of basemat melt-through for an uncoolable deep pool with an overlying water pool = .25
P(BMT¦shallow)	=	the cond. prob. of basemat melt-through for an uncoolable shallow pool with an overlying water pool = .05
P(shall or deep)	=	prob. that the debris is not coolable whether it is deep or shallow = P(deep) + P(shallow) = .3

$$P(BMT) = \frac{.25}{.25 + .05} * .25 + \frac{.05}{.25 + .05} * .05$$

$$= .217$$

(Breeding, 1990-Appendix A, Page A.1.1-83)
(see also DET for Debris Cooled Ex-vessel)

	Point Est.
No Late Late CF	.8
Melt-through	.2

Case B: High Pressure Sequences

For high pressure sequences there is a high probability of the core debris entraining out of the cavity and spreading over large areas of the Containment floor resulting in relatively shallow pools. A calculation similar to the one described above results in a probability of basemat melt-through for high pressure sequences of .1 .

	Point Est.
No Late Late CF	.9
Melt-through	.1

F.3.10.10 Event V Safeguards Building FP Retention Effectiveness Decomposition Event Tree - Used for CET Associated with Interfacing Systems LOCAs (AUXSGSEC.DET - Figure F.3-15)

Event 1: Entry from Prior CET Event (CET Entry)

One Branch

Event 2: Event V LOCA Break Covered by Water Pool in Safeguards Building (BREAKCOV)

Two Branches

YES - (Break covered)
NO - (Break Uncovered)

Branch Probability Type: Split Fraction

Quantified Using: NUREG 1150-NUREG/CR-4551 (Breeding, 1990- Appendix A, Pages A.1.1-17 and 18)

The NUREG-1150 experts thought that the probability that the break location in the Safeguards building would be submerged was reasonably high for the Surry plant. Plant walkdowns of both the Surry and North Anna Safeguards Building show that the piping arrangement and room geometry in both plants is similar. Accordingly, the Surry mean probability of 0.85 was also assumed applicable to North Anna.

	Point Est.
YES - (Break Covered)	.85
NO - (Break Uncovered)	.15

F.3.10.11 Debris Cooled In-Vessel Decomposition Event Tree - Used for CETs Associated with PDS 1 and 2 - Loss of Containment Isolation Sequences (ISO1COOL.DET and ISO2COOL.DET - Figures F.3-16 & 17)

Event 1: Entry from Prior CET Event (CET Entry)

One Branch

Event 2: Debris Cooled In-Vessel

Two Branches

Cooled
Not Cooled

Branch Probability Type: Split Fraction

Quantified Using: Coolability Results for Isolated Sequences

It is assumed that failure to isolate the Containment will have no impact on whether or not the core debris is coolable in-vessel. Hence the probability that sequences with loss of isolation are coolable in-vessel should be the same as for successfully isolated sequences. The probabilities shown below are the frequency weighted average for all isolated sequences (PDSs 3 through 23).

	Point Est.
Cooled	.25
Not Cooled	.75

For loss of isolation sequences without recirculation sprays, the debris is assumed not to be cooled in-vessel

F.4 QUANTIFIED CONTAINMENT EVENT TREES

This section contains the North Anna quantified Containment event trees. A different tree is used to represent each of the plant damage states. These trees are shown in Figures F.4-1 through F.4-25.

F.5 MAAP PARAMETER FILE

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************************************************************************
************************************************************************
************************************************************************
**     NAPARM3
**
**     NORTH ANNA PARAMETER FILE GENERATED BY M. G. MATRAS (VP)
**     TO BE COMPATIBLE WITH MAAP 3.0B REVISION 18.0 INPUTS.
**     VP SPECIFIC ESF INPUTS HAVE BEEN DELETED AND
**     STANDARD ESF AND GENERALIZED ESF PARAMETERS REPLACE
**     THE VP SPECIFIC ESF PARAMETERS. MGM 5-22-92
**
**
**
**      MGM 5-22-92
**      THIS PARAMATER FILE HAS BEEN MODIFIED TO BE COMPATIBLE WITH MAAP
**      3.0B REVISION 18.0, WHICH USES THE GENERALIZED ESF PARAMETERS.
**      THE VP SPECIFIC ESF PARAMETERS ARE NOT NEEDED AND ARE DELETED.
**      SOME OF THESE INPUTS WERE TAKEN FROM THE SURRY PARAMATER FILE
**      FOR PARAMETERS WHICH WERE JUDGED TO BE SIMILAR IN MAGNITUDE,
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**     HOWEVER BEST ESTIMATE VALUES WERE USED FOR THOSE SYSTEMS WHERE
**     PLANT SPECIFIC VALUES WERE NECESSARY.
**
**
**     MGM 5-22-92
**
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*************************************************************************
*************************************************************************
**
**
**
** NORTH ANNA PLANT: PARAMETER FILE FOR MAAP 3.0B  REV 18   5-22-92
**
**
**
** REVISION HISTORY IN SEQUENCE FROM MOST TO LEAST RECENT:
**
** PARAMETERS WHICH HAVE BEEN ADDED, DELETED, OR REDEFINED FOR
** REVISION 17 ARE MARKED BY @@@REV 17
**
** PARAMETERS WHICH HAVE BEEN ADDED, DELETED, OR REDEFINED FOR
** REVISION 16 ARE MARKED BY @@@REV 16
**                              L/GROUP #22/
**
** PARAMETERS WHICH HAVE BEEN ADDED, DELETED, OR REDEFINED FOR
** REVISION 15 ARE MARKED BY @@@REV 15
** (SINCE MAAP 3.0B ZION_3B_REV2.PAR)
**
** PARAMETERS WHICH HAVE BEEN ADDED OR REDEFINED SINCE THE ISSUANCE OF
** MAAP 3.0 ARE MARKED WITH @@@3B
**
**@@@REV 17, GENERAL CHANGES
** THIS PARAMETER FILE WAS REVISE TO INCLUDE VARIABLE PARAMETER NAMES
** AND PARAMETER SECTION SORTED BY GROUP NUMBER SHOWN IN TABLE 3-1
** OF THE MAAP USER'S MANUAL, VOL I.  OTHER SPECIFIC CHANGES ARE
** IDENTIFIED BY THE USUAL @@@REV 17 LABELING SCHEME.  FOR THOSE OF
** YOU WHO WOULD LIKE VARIABLE NAMES INSERTED IN YOUR PARAMETER FILE,
** WE HAVE A SMALL PROGRAM WHICH WOULD AUTOMATICALLY INSERT IN THE
** NAMES IN, AS WE HAVE DONE FOR THIS FILE.  JUST ASK FOR IT.
**
**@@@REV 17, BECAUSE THE EASE OF PLTMAP IN SELECTING ANY MAAP COMMON
** VARIABLE NAME FOR PLOTTING, BOTH THE HARDWIRED PLOT FILES (ROUTINE
** PLTFIL) AND PARAMETER SECTION *APLOT (& ROUTINE PLOTRB) ARE OBSOLETE.
** BE SURE TO DELETE *APLOT PARAMETER SECTION IF YOU STILL HAVE IT.
** ALSO, PARAMETERS #7 AND #10 IN *CONTROL WAS CHANGED AS A RESULT.
**
**@@@REV 17, THE RANGE OF EVENT CODES IS NOW, FOR BOTH CODES:
**   1 THRU 199 INTERNAL EVENT CODES SET BY MAAP - NOT SETTABLE BY THE USER
** 200 THRU 399 EXTERNAL EVENT CODES DEFINED BY MAAP FOR A SPECIFIC
**              OPERATION, IE., MANUALLY TURN A PUMP ON, ETC.
** 400 THRU 699 EXTERNAL EVENT CODES NOT DEFINED BY MAAP, AVAILABLE
**              AS USER DEFINED EVENT CODES.
**
** THERFORE, EVENT CODES 200 THRU 699 ARE USER DEFINABLE.  FOR EXAMPLE
** WE COULD MODEL A SEQUENCE IN WHICH THE LOST OF AC AND DC POWER OCCURS
** 30 MINUTES INTO THE SEQUENCE, AND RE-GAIN THE POWER AT 1.5 HOURS.
** THIS CAN BE MODELED AS
**
**      205 TIM > .5 HR AND TIM < 1.5 HR
**
** NOTE THAT 205 IS MAAP DEFINED EVENT CODE FOR LOSS OF AC AND DC POWER,
```

```
** AND HERE, WE MERELY HAD DEFINED A 205 EVENT CODE CONDITION TO CONTROL
** THE MAAP'S EVENT CODE 205 STATE.  WHEN THE CONDITION IS TRUE, IE.,
** TIME IS GREATER THAN .5 HR BUT IS LESS THAN 1.5 HR
**
** ALSO, YOU MAY NEED TO RENUMBER SOME OF YOUR PREVIOUS USER-DEFINED
** CODES TO AVOID COLLISIONS WITH NEW EXTERNAL CODES.
**
**
**THIS FILE CONTAINS THE BEST AVAILABLE DESCRIPTION OF PARAMETER DEFINITIONS
**AND SHOULD BE USED AS THE REFERENCE FOR WRITING A PARAMETER FILE FOR
**A NEW PLANT--FOR GUIDANCE ON TYPICAL VALUES FOR PARAMETERS IN OTHER PLANT
**TYPES (CE,B AND W, AND WESTINGHOUSE ICE CONDENSER) SEE SAMPLE PARAMETER
**FILES IN MAAP USER'S MANUAL VOL 1.
**
**THE GENERAL INFORMATION SECTION BELOW GIVES HINTS ON PARAMETER FILE
**PREPARATION AND SHOULD BE SCANNED WHENEVER NEW REVISIONS ARE ISSUED.
**
************************************************************************
**
**GENERAL INFORMATION:
**
**
**1. FOR THE GEOMETRICAL RELATIONSHIP BETWEEN VARIOUS CONTAINMENT AND PRIMARY
**   SYSTEM NODES, SEE THE REGION SUBROUTINE WRITE-UPS IN VOL 2 OF USER'S
**   MANUAL
**   FOR LARGE, DRY CONTAINMENTS, SPECIFY ZERO VOLUME FOR ICE-CONDENSER AND
**   UPPER PLENUM-THIS CAUSES ALL OTHER UPPER PLENUM AND ICE CONDENSER
**   PARAMETERS TO BE IGNORED
**
**2. NOTE OUTER WALLS IN COMPARTMENTS A AND D SEPARATE THE CONTAINMENT FROM
**   THE ENVIRONMENT; THE OUTER WALL IN COMPT B SEPARATES COMPTS B AND D;
**   THE OUTER WALLS IN COMPTS I AND U (ICE CONDENSERS ONLY) ARE NOT MODELED
**   SINCE THESE WALLS ARE INSULATED; THE OUTER WALL IN COMPT C IS ASSUMED
**   TO BE ADIABATIC ON ITS FAR SIDE (IE NO HEAT LOST FROM THE SIDE OPPOSITE
**   THE INNER FACE)
**   TO REPRESENT A FREE STANDING STEEL CONTAINMENT WITH A SHIELD BUILDING,
**   TREAT THE SHIELD BUILDING AS THE WALL AND THE CONTMT PRESSURE BOUNDARY
**   AS A "LINER"; ENTER THE "GAP" DISTANCE BETWEEN THE TWO WHERE CALLED FOR
**
**3. INTERNAL OR INTERIOR WALLS ARE WALLS TOTALLY CONTAINED IN A COMPT
**   PROPERTIES (THERMAL CONDUC ETC.) OF INTERIOR WALLS IN A AND B ARE
**   ASSUMED THE SAME AND ARE ENTERED IN THE LOWER COMPT SECTION
**   IF (AS IS USUALLY THE CASE) YOU MUST LUMP WALLS OF SEVERAL THICKNESSES
**   TOGETHER, YOU SHOULD LUMP ONLY RELATIVELY THICK WALLS (EG GREATER THAN
**   ABOUT 1 FOOT OR .3 METER IN THICKNESS) AND ENTER THE THICKNESS
**   OF THE THINNEST WALL CREDITED
**
**4. DECK REFERS TO THE FLOOR (AND VERTICAL WALLS IN ICE CONDENSER PLANTS)
**   THAT SEPARATES THE UPPER COMPARTMENT FROM THE COMPARTMENTS LOWER IN
**   THE CONTAINMENT
**
**5. TWO WAYS TO HANDLE CONTAINMENT FAILURE:
**  A. MECHANISITIC MODEL:
**     ENTER 0 FOR THE FAILURE PRESSURE (ACOMPT NO. 36) ALSO SUPPLY:
**     (1) CONCRETE: SUPPLY ALL THE MATERIAL DATA: CONCRETE PARAMS 13-22, ETC.
**     (2) FREE STANDING STEEL SHELL: ENTER THE WALL THICKNESS IN THE UPPER
**         AND ANNULAR COMPARTMENTS IN THE "LINER" THICKNESS ENTRIES
**         AND SUPPLY ONLY THE LINER MATERIAL PROPERTIES; THE NUMBER OF
**         TENDONS,AND AMOUNT OF REBAR SHOULD BE SET TO ZERO IN THIS CASE
**  B. SIMPLE MODEL:
**     SUPPLY ACOMPT NO. 36 AND 37; FAILURE AREA ENTERED AS MODEL PARAMATER
**     NO.2;NEED NOT SUPPLY THE OTHER PARAMETERS
```

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**
**6. SEDIMENTATION AREA" IS THE TOTAL UPWARD-FACING AREA IN A
**   GIVEN COMPARTMENT UPON WHICH FISSION PRODUCT AEROSOLS CAN SETTLE; THIS
**   SHOULD INCLUDE (WHERE APPROPRIATE), FLOORS, CABLE TRAYS, EQUIPMENT ETC
**
**7. AS DESCRIBED IN THE *CONTROL SECTION, THE AUXILIARY BUILDING MODELS ARE
**   ACTIVATED BY SUPPLYING A NONZERO NO. OF AUX. NODES TO BE MODELLED.
**   THE MODEL CAN BE RUN SIMULTANEOUS WITH A RUN OF THE CONTMT AND PRIMARY
**   SYSTEM MODELS, OR, BY SUPPLYING A NONZERO INPUT FILE NO., THE
**   AUX MODELS ONLY CAN BE RUN USING AN INPUT FILE OF T/H DATA FROM AN
**   EARLIER MAAP RUN.
**
**8. FISSION PRODUCT REMOVAL BY INERTIAL IMPACTION IS MODELLED ONLY IN
**   ONE CONTAINMENT COMPARTMENT. IN LARGE, DRY'S SUCH PARAMETERS
**   SHOULD CHARACTERIZE GRATES WHICH ARE ASSUMED TO BE IN THE ANNULAR
**   COMPARTMENT. IF MORE THAN ONE LEVEL OF GRATES EXISTS, SUPPLY THE TOTAL
**   IMPACTION AREA OF ALL THE GRATES, AND THE MAXIMUM FLOW AREA AT ANY
**   OF THE GRATE ELEVATIONS
**
**   IN ICE CONDENSER PLANTS, THESE PARAMETERS (EVEN THOUGH LOCATED
**   IN THE *ANNULAR COMPARTMENT DATA SECTION) SHOULD REFLECT IMPACTION AND
**   FLOW AREAS AND STRAP WIDTHS IN THE ICE BOX--SEE EG POSTMA'S REPORT
**
**9. THE UNITS FOR PARAMETER INPUTS ARE SPECIFIED BY EITHER A *SI (METRIC)
**   OR *BR (BRITISH) UNITS CARD.  ALL PARAMETERS FOLLOWING SUCH A CARD
**   ARE ASSUMED TO HAVE THESE UNITS UNTIL THE NEXT UNITS CARD IS INCLUDED.
**   THUS A PARAMETER FILE CAN HAVE SECTIONS WITH DIFFERENT UNITS, IF
**   DESIRED.  THE LAST UNITS CARD IN A PARAMETER FILE CONTROLS THE UNITS
**   OF OTHER PROGRAM INPUTS IN TAPE 5 (EG START AND FINAL TIMES ETC.) AND
**   THE UNITS TO BE OUTPUT IN THE OUTPUT FILE AND PLOT FILES.
**   METRIC UNITS ARE M-KG-SEC-DEGREE KELVIN-PASCALS-M**3/SEC,ETC.
**   BRITISH UNITS ARE FEET-LBM-HOURS-DEGREE F-PSI-GPM
**   EXAMPLES:
**
**   IN METRIC UNITS, FLOWRATES SPECIFIED TO BE VOLUMETRIC SHOULD BE
**   M**3/SEC; OTHER FLOWRATES IE ALL THOSE NOT EXPLICITLY STATED TO BE
**   VOLUMETRIC SHOULD BE KG/SEC; HEADS SHOULD BE IN M; PRESSURES IN PA;
**   IN ENGLISH THE UNITS ARE RESPECTIVELY GPM,LBM/HR,FT, PSIA--
**   NOTE TO MAAP/BWR USERS--GPM IS USED IN MAAP/PWR INSTEAD OF FT**3/HR
**   THE ONLY EXCEPTION TO THIS PROCEDURE IS THAT THE TIME STEPS ARE ENTERED
**   IN THE *TIMING SECTION ALWAYS IN SECONDS
**
**@@@REV 17, CLARIFICATION
**   THERE ARE OTHER EXPECTIONS.  SPECIFICALLY, THE RESTRICTION THAT
**   YOU CANNOT PLACE *SI OR *BR IN *TOPOLOGY OR *PLTMAP PARAMETER
**   SECTION HAS BEEN REMOVED FOR REV 17.  HOWEVER, THE RESTRICTION
**   THE YOU CANNOT USE *SI OR *BR IN *INTEGRATION, *USEREVT AND *EVTMES
**   PARAMETER SECTION STILL APPLIES.  THIS IS BECAUSE BOTH INTEGRATION
**   AND USEREVT PARAMETER SECTION EXPECTS ALL THE UNITS TO BE IN SI
**   UNITS, AND EVTMES PARAMETER SECTION IS USED ONLY TO DEFINE MAAP
**   EVENT CODE MESSAGES.  ALSO SEE ADDITIONAL COMMENTS AT THE END OF
**   THE PARAMETER FILE.
**
**10.IN LARGE, DRY CONTAINMENTS "FANS" REFERS TO FAN COOLERS WHICH TAKE
**   SUCTION FROM THE UPPER COMPT AND DISCHARGE TO EITHER THE LOWER OR
**   ANNULAR COMPT. AS SPECIFIED BELOW.  THE SAME INPUTS IN ICE CONDENSER
**   PLANTS ARE USED TO CHARACTERIZE THE AIR RETURN FANS.
**
**11.IN THE PAST, USERS HAVE OFTEN NEGLECTED TO ADJUST "MODEL" PARAMETERS,
**   PROBABLY BECAUSE THEY ASSUMED THAT NONE OF THEM WERE RELATED TO
**   PLANT-SPECIFIC FEATURES.  UNFORTUNATELY, A FEW OF THEM ARE SINCE
**   SOME OF THE PHYSICS DEPENDS ON PLANT GEOMETRY BUT NOT YET IN
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**    A WAY THAT CAN ALWAYS BE RELATED PRECISELY TO NUMERICAL INPUTS.
**    FOR THIS REASON, YOU SHOULD AT LEAST REVIEW THE MODEL PARAMETERS.
**    ESPECIALLY TAKE NOTE OF THE FOLLOWING:
**       A. PLANTS WITH NO BOTTOM PENENTRATIONS FOR IN-CORE INSTRUMENTS
**          SHOULD LOOK AT NO. 3
**       B. PLANTS WITH TIGHT CAVITIES (SEE PWR IPE METHODOLOGY DOCUMENT
**          FOR A DISCUSSION OF THIS POINT) FOR WHICH DEBRIS ENTRAINMENT
**          IS LIKELY TO BE TO THE UPPER COMPARTMENT SHOULD PAY HEED TO
**          NO. 13
**       C. IN ALL PLANTS, DIRECT CONTAINMENT HEATING MAGNITUDE DEPENDS
**          ON 14 AND THE POTENTIAL FOR DEBRIS DISPERSAL DEPENDS ON 31.
**       D. B AND W PLANTS AND OTHERS WITH LOTS OF HOLES IN THE CORE
**          BAFFLE SHOULD LOOK AT 54.
**       E. PARAMETER 59 IS USED TO MAKE UP FOR SIMPLIFICATIONS IN THE
**          PRIMARY SYSTEM 2 PHASE NATURAL CIRCULATION (NC) MODEL
**          (SEE DISCUSSION IN THE SUBROUTINE PRISYS WRITE-UP IN
**          VOL 2 OF THE USERS' MANUAL).  THE VALUE SHOWN,
**          0.6, IS TYPICAL OF THAT SEEN IN LOW PRESSURE SEQUENCES
**          IN SCALE MODELS OF TYPICAL WESTINGHOUSE PLANTS.  IF
**          YOU HAVE DETAILED RELAP ETC. CALCS, YOU MAY WISH TO ADJUST
**          THIS NO. (EG TO 0.4 IN HIGHER PRESSURE SEQUENCES).  A HIGH
**          NO. SHOULD NORMALLY BE CONSERVATIVE BY MAXIMIZING THE RATE
**          OF WATER LOSS FROM THE PRIMARY SYSTEM BY MAINTAINING NC AS
**          LONG AS POSSIBLE.  ON THE OTHER HAND, A HIGH NO. MAY CAUSE
**          PROBLEMS IN RECOVERY SEQUENCES DUE TO ENGAGING NC EARLY AND
**          CAUSING VIOLENT STEAM CONDENSATION AND RAPID REDUCTION IN
**          PRESSURE.
**       F. THE AMOUNT OF CORE MATERIAL THAT HANGS UP IN THE VESSEL AFTER
**          VESSEL FAILURE VARIES A LOT IN ESSENTIALLY UNPREDICTABLE WAYS.
**          WHAT IS CLEAR IS THAT THIS IS VERY UNCERTAIN.  HOLDING MATERIAL
**          UP ALSO MEANS THE CORE MODELS ARE USED FOREVER, WHICH SLOWS
**          THE CODE.  FOR ALL THESE REASONS, YOU MAY FIND IT USEFUL TO
**          VARY PARAMETER 65.
**
**12.       A DISCHARGE COEFFICIENT OF 0.82 (IE 1.5 VELOCITY HEADS) IS
**          ASSOCIATED WITH ALL CONTMT FLOW JUNCTIONS IN MAAP.  THIS
**          CORRESPONDS TO ASSUMING THAT EVERY JUNCTION CORRESPONDS TO
**          AN ACCELERATION FROM INFINITY INTO THE JUNCTION AND A
**          DECELERATION TO INFINITY ON THE OTHER SIDE OF THE JUNCTION
**          THIS IS A PRETTY GOOD ASSUMPTION, BUT YOU CAN ALWAYS ADJUST
**          THE FLOW AREA TO CORRESPOND TO DIFFERENT DISCHARGE COEFFICIENTS
**          IF YOU WANT (NOTE TO ICE CONDENSER MODELLERS: THIS REPRESENTS
**          A CHANGE FROM EARLIER VERSIONS OF MAAP)
**
**13.       IN ICE CONDENSER PLANTS, THE DEFINITION OF THE NO. OF IGNITERS,
**          THEIR DISTANCE FROM THE CEILING, ETC. IS SIMPLE.
**          IN OTHER PLANTS, YOU HAVE TWO OPTIONS.  MOST USERS ENTER 0, WHICH
**          IMPLIES THAT ONLY GLOBAL (COMPARTMENT-WIDE) BURNS WILL
**          BE MODELLED (ONE EXCEPTION: JET BURNING IN SUBROUTINE CBURN).
**          OR, YOU CAN MODEL SOME DISCRETE IGNITION SOURCES (EG EQUIPTMENT)
**          WHERE YOU ASSUME BURNS WILL INITIATE.
**          IN EITHER CASE, THERE IS ONE ADDTIONAL INPUT
**          YOU MUST CONSIDER.  IF A GLOBAL BURN HAPPENS IN A COMPARTMENT,
**          BURNS CAN PROPAGATE INTO OTHER COMPARTMENTS.  THIS CAN OCCUR
**          IN A STRAIGHTFORWARD WAY IF THE OTHER COMPARTMENTS ARE HEATED
**          ABOVE THEIR GLOBAL BURN CRITERION.  YOU CAN ALSO MODEL BURNS
**          THAT PROPAGATE VERTICALLY INTO HIGHER COMPARTMENTS AT LOWER
**          CONCENTRATIONS/TEMPERATURES THAN IS REQUIRED FOR GLOBAL
**          COMBUSTION BY ENTERING THAT A NONZERO NUMBER
**          OF IGNITION SOURCES CAN BE SEEN IN THE LOWER COMPARTMENT WHEN
**          VIEWED FROM THE HIGHER (EVEN IF DISCRETE SOURCES ARE NOT
**          BEING MODELLED IN THE FORMER). AN EXAMPLE OF SUCH A PARAMETER
```

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**         IS UPPER COMPARTMENT NO. 32).
**
**              JKB 3-6-91
**
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**
**THIS DECK IS IN BRITISH (FT-LB-HR-DEGF) AND SI UNITS (M-KG-SEC-DEGK).
**THE UNITS ARE PREDOMINANTLY IN BRITISH HOWEVER SOME INPUT VARIABLES
**ARE INPUT IN SI UNITS WHERE CONVENIENT, BUT PRECEDED BY THE PROPER
**UNITS DESIGNATOR I.E., *SI OR *BR.
*BR
**
***********************************************************************
**
*************************************************************************
*CONCRETE AND CONTAINMENT SHELL   (PARAMETER GROUP #1)
*************************************************************************
**UNLESS OTHERWISE STATED, CONCRETE PROPERTIES ARE FOR "PURE"
**(UNREINFORCED) CONCRETE
**  NOTE: ALL THE CONCRETE MASS FRACS SHOULD ADD UP TO ROUGHLY 1.0
**@@@REV 17 VALUES 1-17 CHANGED FOR CONSISTENT USE OF
**          LIMESTONE/COMMON SAND WITH THE BWR CODE AND CORCON
01   0.21     AVERAGE SPECIFIC HEAT OF CONCRETE
02  2240.     MELTING TEMPERATURE OF CONCRETE
03   494.     ENERGY ABSORBED IN ENDOTHERMIC CHEMICAL REACTIONS
**            DURING CONCRETE DECOMPOSITION
04   241.     LATENT HEAT OF MELTING
**      JKB     3-6-91
**@@@@@@@@NEW: DEFINITIONS OF FOLLOWING HAVE CHANGED@@@@@@@@@@@@@
**ALL THE CONCRETE MASS FRACS SHOULD ADD UP TO ROUGHLY 1.;
**      JKB     3-6-91
05   .5484         MASS FRACTION OF CONCRETE THAT IS SIO2
06   .0882         MASS FRACTION OF CONCRETE THAT IS CAO
07    .0832        MASS FRACTION OF CONCRETE THAT IS AL2O3
08    .0539        MASS FRACTION OF CONCRETE THAT IS K2O
09    .0180        MASS FRACTION OF CONCRETE THAT IS NA2O
10    .0721        MASS FRACTION OF CONCRETE THAT IS MGO,MNO,OR TIO2
11    .0626        MASS FRACTION OF CONCRETE THAT IS FE2O3
12    0.           MASS FRACTION OF CONCRETE THAT IS FE
13    0.           MASS FRACTION OF CONCRETE THAT IS CR2O3
14    .0586        MASS FRACTION OF CONCRETE THAT IS H2O
**@@@@@@REV 18 - NOTE: DO NOT SET CO2 MASS FRACTION TO ZERO EVEN IF IT
**                is very small.
15    0.015          MFCN(11) MASS FRACTION OF CONCRETE THAT IS CO2
16     0.0           MASS FRACTION OF CONCRETE THAT IS  O2
17     7.66     REBAR DENSITY (MASS OF REBAR PER UNIT VOLUME OF
**              REINFORCED CONCRETE)
**REMAINDER OF THE QUANTITIES ARE USED IN THE CONTAINMENT FAILURE MODEL
**AND NEED NOT BE SUPPLIED IF THE "SIMPLE" MODEL IS USED (SEE ACOMPT SECTION)
**NOTE: FOR FREE-STANDING STEEL CONTAINMENTS, YOU NEED SUPPLY ONLY
**REBAR PROPERTIES AND THE STEEL THICKNESS (STEEL THICKNESS IS INPUT AS
**"LINER" THICKNESS AS DESCRIBED BELOW)
**18              ELASTIC YOUNGS MODULUS FOR TENDONS
**19              ELASTIC YOUNGS MODULUS FOR REBAR
**20              PLASTIC YOUNGS MODULUS FOR TENDONS
**21              PLASTIC YOUNGS MODULUS FOR REBAR
**22              PRESTRESS ON HOOP TENDONS
**23              PRESTRESS ON AXIAL TENDONS
**24              TENDON YIELD STRESS
**25              REBAR YIELD STRESS
**26              TENDON ULTIMATE STRESS
**27              REBAR ULTIMATE STRESS
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**28                ELASTIC YOUNGS MODULUS FOR LINER
**29                PLASTIC YOUNGS MODULUS FOR LINER
**30                LINER YIELD STRESS
**31                LINER FAILURE STRESS
**
**
****************CONCRETE AND CONT END********************
**
**********************************************************************
**********************************************************************
*PRIMARY SYSTEM     (PARAMETER GROUP #2)
**********************************************************************
**********************************************************************
**
**UNLESS OTHERWISE NOTED, ALL ELEVATIONS IN THIS SECTION SHOULD BE
**REFERENCED TO THE LOWEST POINT OF THE INSIDE OF THE RV HEAD
**WHEN A PARAMETER SUCH AS THE VOLUME OF THE DOWNCOMER IS CALLED FOR,
**THE ACTUAL DOWNCOMER VOLUME SHOULD, OF COURSE, BE USED EVEN THOUGH THE
**MAAP NODALIZATION LUMPS OTHER VOLUMES WITH THE DOWNCOMER VOLUME (THE
**LUMPING IS DONE INTERNALLY IN THE CODE)
01    3           NUMBER OF COLD LEGS
02    2.42        INNER DIAMETER OF A HOT LEG PIPE
03    6.54        INSIDE RADIUS OF THE CYLINDRICAL PART OF THE REACTOR VESSEL
04    283.2       VOLUME WHICH IS INSIDE THE CORE BARREL AND LIES BETWEEN
**                THE BOTTOM OF THE CORE AND THE LINE WHICH DENOTES THE TOP
**                OF THE RV LOWER HEAD (THE LAST IS THE SAME AS THE BOTTOM
**                OF THE RV CYLINDRICAL SECTION)
05    41.71       FLOW AREA OF CORE PLUS CORE BYPASS AREA
06   122.9        VOLUME OF HORIZONTAL RUN OF PIPE IN ONE COLD LEG FROM
**                THE REACTOR VESSEL OUT TO THE MAIN COOLANT PUMP
07    .125        RADIUS OF VESSEL PENETRATION--IF NO VESSEL PENETRATION
**                (EG SOME CE PLANTS) USE THE ASSUMED INITIAL RADIUS OF
**                FAILURE WHEN THE RV LOWR HEAD FAILS DUE TO CORIUM ATTACK
**                AND SUPPLY 1 FOR THE NO. OF FAILED PENETRATIONS IN *MODEL
08    13.65E6     ENERGY INPUT FROM ONE PRIMARY SYSTEM PUMP (WHEN RUNNING)
09    0.          TOTAL MAKEUP FLOW TO THE PRIMARY SYSTEM--UNDER NORMAL
**                OPERATION SHOULD EQUAL LETDOWN FLOW BELOW;THIS IS USED
**                MAINLY IN THE TMI SCENARIO AND MOST USERS WILL INPUT ZERO;
**                THIS WATER IS NOT SUBTRACTED FROM THE RWST AND CONTINUES
**                (IF POWER IS AVAILABLE) UNTIL MANUALLY SHUT OFF
10    126.8       TEMPERATURE OF MAKEUP WATER, IF ANY, GIVEN IN 09
11    2.29        INNER DIAMETER OF A COLD LEG PIPE
12    26.6        ELEVATION OF THE NOZZLE WHICH ATTACHES THE SURGE LINE
**                TO THE HOT LEG--THIS MUST BE GREATER THAN ITEM 47
**NOTE: IT IS HELPFUL IN LOCAS (ESP SMALL BREAKS) TO AVOID
**PUTTING THE BREAK ELEVATION IN THE VICINITY OF THE SURGE LINE;
**ARTIFICIALLY INCREASING THE
**ELEVATION OF THE SURGE LINE 0.5-1 METER OR SO ABOVE THE BREAK IS SUGGESTED
**FURTHER, IT IS HELPFUL TO AVOID PUTTING BREAKS NEAR THE ELEVATION OF THE
**TUBESHEET IN U-TUBE TYPE S/G PRIMARY SYSTEMS--BOTH OF THESE MEASURES
**HELP AVOID WATER SLOSHING INTO AND OUT OF NODES (WHICH CRANKS THE TIME STEP
**DOWN) AND WILL GREATLY DECREASE RUNNING TIME AT NEGLIGIBLE LOSS OF ACCURACY
13     3          ENTER BROKEN LOOP BREAK LOCATION KEY (NODE NO.):
**                3--BROKEN HOT LEG NODE
**                4--BROKEN HOT LEG "TUBE" NODE (B AND W ONLY)
**                6--BROKEN INTERMEDIATE LEG NODE (BETWEEN PUMP AND COLD SIDE OF
**                   S/G)
**                7--BROKEN COLD LEG NODE (HORIZ PART OF COLD LEG)
**                8--DOWNCOMER NODE (IE DOWNCOMER PLUS LOWER HEAD)
14    0.          BROKEN LOOP BREAK AREA (FT**2)
15    26.6        BROKEN LOOP BREAK ELEVATION--SEE NOTES ABOVE
**
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**              JKB 3-6-91
**@@@REV 17, NOTE: YOU CAN ONLY SPECIFY FBB AND ZBB EITHER IN THE
** PARAMAETER FILE OR IN INITIAL LOCAL PARAMETER CHANGE, BUT NOT IN
** SUBSEQUENT LOCAL PARAMETER CHANGES.  THIS WAS DISCOVERED IN FINAL
** TESTING OF THE CODE, AND WILL BE CHANGED IN THE FUTURE TO AUTOMATE
** LOCA ACTION BLOCKS.
**              JKB 3-6-91
**@@@@@@@@@DEFINITION CHANGE
16   137100.    MASS OF S/G HEAD AND TUBESHEET (BOTH HEADS AND TUBESHEETS FOR
**              OTSGS)
17    46.2      MAX VOLUME OF WATER IN ONE COLD LEG WHICH WILL STILL ALLOW
**              GAS TRANSFER TO OCCUR PAST THE LOWEST PART OF THE COLD LEG
18   330.8      TOTAL VOLUME OF ONE COLD LEG
19   109.7      TOTAL VOLUME OF ONE HOT LEG
20   3382.8     TOTAL FLUID VOLUME OF THE RX VESSEL, IE THE VOLUME NOT
**              INCLUDING THE CORE ITSELF OR INTERNAL STRUCTURES
21     0.       GAS FLOWRATE OF REACTOR HIGH POINT VENT(S),IF ANY, AT
**              NOMINAL SYSTEM PRESSURE
**DOWNCOMER IS MODELLED AS ENDING AT THE POINT WHERE THE LOWER HEAD
**OF THE RV MEETS THE CYLINDRICAL SECTION--NOTE THE CORE BARREL IS
**ALSO ASSUMED TO STOP AT THIS POINT
22   702.7      TOTAL VOLUME OF DOWNCOMER
23   434.3      PORTION OF DOWNCOMER VOLUME WHICH IS BELOW THE
**              ELEVATION OF THE BOTTOM OF THE COLD LEG NOZZLES
24     3        ENTER A 3 FOR PZR TO BE IN BRKN LOOP; 9 FOR UNBROKEN
**              LOOP FOR U-TUBE GEOMETRIES; USE 4 AND 10 RESPECTIVELY FOR
**              B AND W PLANTS (NODE NO. OF PRIMARY SYSTEM SURGE LINE NOZ)
25     3        NUMBER OF HOT LEGS
26    0.50      VOID FRACTION AT WHICH REACTOR COOLANT PUMPS TRIP OR FAIL
**SCRAM SETPOINTS: IF A GIVEN TRIP DOES NOT EXIST, INPUT A VALUE WHICH THE
**CODE WILL NEVER CROSS
27    1884.7    LOW PRESSURIZER PRESSURE TRIP POINT
28    2399.7    HIGH PRESSURIZER PRESSURE TRIP POINT
29     64.8     HIGH LOOP DELTA-T SCRAM SETPOINT
30   -100.0     LOW PRESSURIZER LEVEL TRIP
**@@@@@@REV 18 NOTE: THE REFERENCE POINT FOR ZWPZH IS THE BOTTOM OF
**              THE PRESSURIZER  BJS
31   35.1       ZWPZH   HIGH PRESSURIZER LEVEL TRIP
32   6.667E-4   REACTOR TRIP DELAY TIME
**@@@@@@ REV 18 NOTE: THE REFERENCE POINT FOR ZWSGL IS THE STEAM
**              GENERATOR TUBE SHEET
33   30.2       ZWSGL    LOW S/G WATER LEVEL SCRAM SETPOINT
34   5          NUMBER OF POINTS IN MAIN COOLANT PUMP COAST-DOWN CURVE
**              (5 MAX)
35   35.53E6    FIRST MASS FLOWRATE IN MCP COAST-DOWN CURVE(MUST BE THE
**              ONE PUMP FLOW UNDER NOMINAL CONDITIONS)
36   18.48E6    SECOND FLOWRATE
37   10.30E6    NEXT FLOWRATE
38   3.55E6     NEXT FLOWRATE
39   1.78E6
40   0.         FIRST TIME IN COAST-DOWN CURVE--MUST BE 0
41   0.00278    NEXT TIME
42   0.00556    NEXT TIME
43   0.01111    NEXT TIME
44   0.01667    NEXT TIME
**@@@@@@@FOLLOWING NO LONGER IGNORED IN B AND W PLANTS; DEFTN CHANGED
45   35.2       ELEVATION OF TOP OF S/G TUBESHEET ABOVE BOTTOM OF RV
46   .392       THICKNESS OF RV LOWER HEAD
47   25.4       ELEVATION OF THE BASE OF THE COOLANT LOOP NOZZLES (DIST.
**              FROM BOTTOM OF NOZZLES TO BOTTOM OF RV LOWER HEAD)
48   10.47      VERTICAL DISTANCE FROM LOWEST POINT OF A COLD LEG TO THE
**              ELEVATION OF THE BASE OF THE COLD LEG NOZZLE ON THE RV
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49   118.6      VOLUME OF THE HORIZONTAL RUN OF A HOT LEG PIPE
50   0          TOTAL LETDOWN FLOW--SEE NOTE NEAR MAKEUP FLOW ENTRY ABOVE
**@@@ REV 18:   NEW DEFINITION OF PDCRO FOR 17.04
**
51   37.6       PDCRO  THE PRESSURE DROP ACROSS THE RCP'S DURING NORMAL
**              OPERATION. NOTE, HOWEVER, THAT THIS IS ONLY USED TO
**              COMPUTE A FRICTION COEFFICIENT THAT IS USED DURING
**              TWO-PHASE NATURAL CIRCULATION, ESPECIALLY IN B&W PLANTS.
**              AS SUCH, LIMITED BENCHMARKING STUDIES INDICATE THAT
**              WHEREAS A VALUE OF 120 PSID OR SO WOULD SEEM
**              APPLICABLE FROM THE DEFINITION, A VALUE FOR ABOUT
**              1000PSID RESULTS IN A MORE ACCURATE FRICTION
**              COEFFICIENT. WHILE NOT COMPLETELY UNDERSTOOD, PART
**              OF THIS DIFFERENCE IS THOUGHT TO BE DUE TO THE
**              ADDED RESISTANCE PROVIDED BY THE STOPPED RCP IMPELLERS.
**              IN ANY EVENT, CODE RESULTS SHOULD BE GENERALLY
**              INSESITIVE TO THE VALUE ENTERED, EXCEPT IN CRITICAL
**              APPLICATIONS IN B&W PLANTS INVOLVING A LONG PERIOD
**              OF TWO-PHASE NATURAL CIRCULATION WITH VFPS GREATER
**              THAN VFSEP.
**
**MOST USERS WILL USE THE "UNBROKEN" LOOP BREAK ONLY FOR PUMP SEAL LOCAS
**IN TMLB SEQUENCES; IT CAN ALSO BE USED FOR SPECIAL PURPOSES (EG LOFT FP/2
**SIMULATION)
**THIS BREAK, ALONG WITH THE BROKEN LOOP BREAK IS CONTROLLED BY EVENT CODE
**209; ONE CAN TURN THE BREAKS ON AND OFF SEPERATELY BY USING A PARAMETER
**CHANGE-TYPE INTERVENTION (CODE 1000---SEE VOL 1 OF USER'S MANUAL)
52   12.          LOCATION KEY FOR UNBROKEN LOOP BREAK, IF ANY
**              9 --UNBROKEN HOT LEG NODE
**              10--UNBROKEN HOT LEG "TUBE" NODE (B AND W ONLY)
**              12--UNBROKEN INTERMEDIATE LEG NODE--
**                  NOTE UNBROKEN LOOP BREAK IN UNBROKEN LOOP COLD LEG OR
**                  DOWNCOMER NODE NOT ALLOWED AT THE PRESENT--FOR BREAKS
**                  IN DOWNCOMER USE BROKEN LOOP BREAK KEY ABOVE
53    0.            AREA OF UNBROKEN LEG BREAK--PUT IN ZERO IF NONE
54   26.6         ELEVATION OF UNBROKEN LOOP BREAK (SEE NOTES PERTAINING
**                  TO BREAK ELEVATION ABOVE
**THE "DOME" REFERS TO THE REGION ABOVE THE UPPER PLENUM
**THE "DOME PLATE" IS THE PERFORATED PLATE THAT DIVIDES THE UPPER PLENUM
**FROM THE DOME (SOMETIMES REFERRED TO AS THE UPPER CORE SUPPORT PLATE)
**--SEE DRAWINGS IN THE PRISYS SECTION OF THE USER'S MANUAL
**                        JKB 3-6-91
**@@@REV 17, NOTE: YOU CAN ONLY SPECIFY FUB AND ZUB EITHER IN THE
** PARAMAETER FILE OR IN INITIAL LOCAL PARAMETER CHANGE, BUT NOT IN
** SUBSEQUENT LOCAL PARAMETER CHANGES.  THIS WAS DISCOVERED IN FINAL
** TESTING OF THE CODE, AND WILL BE CHANGED IN THE FUTURE TO AUTOMATE
** LOCA ACTION BLOCKS.
**                                  JKB 3-6-91
55     33.43      ELEVATION OF THE RV DOME PLATE
56     39.4       ELEVATION OF THE INSIDE OF THE TOP OF THE RV CLOSURE
**                  HEAD
57    33.43       ELEVATION OF THE RV FLANGE (CLOSURE STUDS)
**                  (NOTE THAT THIS ELEVATION IS
**                  TAKEN TO BE THE TOP OF THE CORE BARREL)
58    315.8      OUTSIDE AREA OF THE DOME EXTERIOR WALL
59    156237.    MASS OF THE CORE BARREL BELOW THE ELEVATION OF THE TOP OF
**               THE CORE ("LOWER CORE BARREL")--LUMP IN THE BAFFLE,
**               THERMAL SHIELDS, AND FORMER PLATES
60    32670.     MASS OF THE CORE BARREL ABOVE THE ELEV OF THE TOP OF THE CORE
**               ("UPPER CORE BARREL")
61    45520.     MASS OF UPPER PLENUM INTERNALS
62    22380.9    MASS OF THE RV DOME PLATE
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63    169516.   MASS OF THE WALL FORMING THE EXTERIOR OF THE DOME (IE
**              INCLUDES THE RV CLOSURE HEAD)
**@@@@@@@@@@@@@@@@DEFINITION CHANGED SLIGHTLY@@@@@@@@@@@@@@@@
64     16975.   TOTAL MASS OF ONE HOT LEG; SEE NOTE IN S/G SECTION AT
**              ITEM 37
65     71034.   TOTAL MASS OF ONE COLD LEG; SEE NOTE IN S/G SECTION AT
**              ITEM 37
66    551250.   MASS OF THE RV WALL (BELOW THE RV FLANGE; THE DOME WALL
**              MASS ENTERED ABOVE STARTS AT THE FLANGE)
67      90.4    WATER LINE FLOW AREA IN THE UPPER PLENUM (ABOVE THE
**              CORE AND BELOW THE DOME PLATE)--THE PRODUCT OF THIS AND
**              THE DIFFERENCE IN ELEVATIONS OF THE TOP OF THE CORE AND
**              THE DOME PLATE DEFINES THE UPPER PLENUM VOLUME
68     1.345     HYDRAULIC DIAMETER IN THE UPPER PLENUM
69     2347.    TOTAL HEAT TRANSFER AREA OF THE UPPER PLENUM INTERNALS
70     8.4E6    CONVECTIVE (NON-RADIATIVE) HEAT LOSSES UNDER NOM CONDITIONS
**                 FROM STEAM GENERATORS, PRESSURIZER, AND REST OF PRIM. SYS.
**                 NOTE: DETAILED CALCULATIONS INDICATE THAT UNDER NORMAL
**                 OPERATION, THE PRIMARY SYSTEM HEAT LOSS IS DUE VIRTUALLY
**                 ENTIRELY TO UNINSULATED PARTS OF THE SYSTEM (LOSS THROUGH
**                 INSULATION IS NEGLIGBLE); THUS THIS NUMBER
**                 SHOULD BE APPROXIMATELY THE TOTAL NOMINAL PRIMARY
**                 SYSTEM HEAT LOSS (SEE IDCOR REPORT 85-2 FOR DISCUSSION)
71        12       NO. OF PLATES IN PRIMARY SYSTEM REFLECTIVE INSULATION OR:
**                 ENTER 0 FOR CALCIUM SILICATE BULK INSULATION OR
**                 ENTER -1 FOR ROCK WOOL INSULATION--IF YOU HAVE A
**                 DIFFERENT TYPE OF INSULATION YOU SHOULD CONSIDER MODIFYING
**                 FUNCTION THCBUL WHICH SUPPLIES THE THERMAL CONDUCTIVITY
72      .1         TOTAL THICKNESS OF INSULATION--USED ONLY IF BULK
**                 INSULATION (NOT IF REFLECTIVE)
73      5.97       ELEVATION OF THE BASE OF THE CYLINDRICAL PART OF THE RV
74     438.6       VOLUME OF THE LOWER HEAD OF THE RV
75     3343.4      TOTAL HEAT TRANSFER AREA OF LOWER CORE BARREL/THERMAL
**                 SHIELDS/BAFFLE ETC
**                 (IE THAT PORTION BELOW THE TOP OF THE CORE)
76     739.5       TOTAL HEAT TRANSFER AREA OF UPPER CORE BARREL
77     0.0113      CLEARANCE BETWEEN FUEL RODS (ROD PITCH - OUTSIDE DIAMETER
**                 OF FUEL ROD)
**
**                JKB 3-6-91
**
**@@@REV17, #78 THRU #143 ARE NEW FOR A HALFLOOP OPERATION
78       0.       HALFLP     = 0, NORMAL OPERATION
**                           = 1, HALFLOOP OPERATION
79       0.       WRHRHI     RHR PUMP FLOW INJECTION INTO COLD LEG DURING
**                         HALFLOOP OPERATION.
80       0.       WRHRHO     RHR PUMP SUCTION FLOW FROM HOT LEG DURING
**                         HALFLOOP OPERATION.  IN STEADY-STATE, WRHRHI=WRHRHO
**              *** USER CAN ALSO USE NEW ESF MODEL TO ARRANGE DIFFERENT ****
**              *** SUCTION AND DISCHARGE LOCATIONS AND CALCULATE FLOW   ****
**              *** RATE BASED ON PUMP HEAD  CURVE.                      ****
**@@@REV 18     *** IN THIS CASE, WRHRHI SHOULD BE SET TO 0              ****
81      24.0      TIHALF     TIME ELAPSED FROM REACTOR SCRAM AT THE BEGINNING
**                         OF HALFLOOP RUNS.
82       0.       FQINHF     = 0, DECAY HEAT CALCULATED BY MAAP BASED ON TIHALF
**                           = 1, DECAY HEAT FROM INPUT
83       0        NFQHF      NUMBER OF ENTRIES IN DECAY HEAT (FRACTION OF FULL
**                         POWER) AS A FUNCTION OF TIME.  MAXIMUM NUMBER IS 30.
**84-113        TIFQHF(I), I=1,30 : TIME FROM THE REACTOR SCRAM
**114-143       FQHF(I), I=1,30  : DECAY HEAT (FRACTION OF FULL POWER)
**
**@@@ REV 18: 144,145 ARE NEW FOR T/H MODIFICATIONS AND B&W UPGRADES
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**   ZSINOZ
144  1.15        HEIGHT OF THE SI NOZZLE ABOVE THE ELEVATION (ZNOZ)
**               OF THE BOTTOM OF THE COLD LEG NOZZLE AT THE RPV.
**               SET TO ZOFFCL IF A B&W PLANT, XDCL/2 IF NOT
**               XDCL IS PARAMETER #11 ABOVE.
**
145  0.0    ZOFFCL   THE DIFFERENCE IN ELVATIONS OF THE BOTTOM OF THE
**                       COLD LEG MEASURED AT THE RCP DISCHARGE AND AT THE
**                       RPV NOZZLE
******    JKB 3-6-91 PRIMARY SYSTEM ENDS
**
**
*************************************************************************
*PRESSURIZER    (PARAMETER GROUP #3)
*************************************************************************
01  1400.        PRESSURIZER VOLUME
02  38.5         PRESSURIZER CROSS-SECTIONAL AREA
03  2250.        PRESSURIZER HEATER PRESSURE SETPOINT
04  2300.        PRESSURIZER SPRAY PRESSURE SETPOINT
05  10.0         WATER LEVEL BELOW WHICH PZR HEATERS TRIP
06  4.777E6      PRESSURIZER HEATER TOTAL OUTPUT--IN MAAP THE HEATERS
**               ARE EITHER ALL ON OR ALL OFF
07   2.32E5      SPRAY SYSTEM FLOW RATE
08  380000.      FLOW RATE OF SAFETY VALVE AT ITS SETPOINT
09   2500.       LOWEST SETPOINT OF A SAFETY VALVE (OPENING PRESSURE)
10   2525.       HIGHEST SETPOINT OF A SAFETY VALVE (OPENING PRESSURE)
11   0.958       DIAMETER OF THE SURGE LINE
12   37.7        ELEVATION OF SPRAY HEAD ABOVE BOTTOM OF PZR
13   54.5        LENGTH OF THE SURGE LINE
14   3           NUMBER OF SAFETY VALVES
15   3.28E-3     NOMINAL PZR SPRAY DROPLET
16   2350.       LOWEST SET POINT OF PORV (OPENING PRESSURE)
17   2350.       HIGHEST SET POINT OF PORV (OPENING PRESSURE)
18   2           NUMBER OF PORVS
19   210000.     NOMINAL FLOWRATE OF A PORV AT ITS SETPOINT
20   155272.     EMPTY MASS OF PZR STEEL
21   0           ENTER A 1 IF THE SURGE LINE HAS A LOOP SEAL (EG TMI);
**               THIS PREVENTS COUNTER-CURRENT DRAINING OF PRESSURIZER
**               THROUGH SURGE LINE WHEN THE PRIMARY COOLANT LOOP SIDE
**               IS VOIDED (SEE WRITEUP FOR SUBROUTINE DRAIN)
22   38.54       SEDIMENTATION AREA
**PRESSURIZER RELIEFS ARE ASSUMED TO CLOSE AT PRESSURE PSET-PDEAD WHERE
**PSET IS THE OPENING PRESSURE DEFINED ABOVE AND PDEAD IS GIVEN BELOW
23   100.        DEADBAND ON PRESSURIZER SAFETY VALVES
24   14.5        DEADBAND ON PRESSURIZER PORVS
25   7747.       SURGE LINE MASS (BE SURE IS CONSISTENT WITH LENGTH GIVEN
**               ABOVE)
26   .03125      DIAMETER OF HOLES IN THE SCREEN AT THE TOP OF SURGE LINE
27   161         NUMBER OF HOLES IN THE SCREEN AT THE TOP OF SURGE LINE
**
**@@@REV 18 - #28-30 ARE ADDITIONAL PRESSURIZER PARAMETERS; ONLY APPLY WHEN
**              GENERALIZED ESF MODEL IS USED (NESF=1)
28   2           NPZT       NPZCT=1: HPI SYSTEM USED TO CONTROL PZR LEVEL
**                          NPZCT=2: CHARGING PUMPS USED TO CONTROL PZR LEVEL
29   10.0        ZWPZCL     LEVEL CONTROL ACTIVATED WHEN PZR LEVEL FALLS BELOW
**                          THIS ELEVATION
30   35.1        ZWPZCH     LEVEL CONTROL TERMINATED WHEN PZR LEVEL REACHES
**END OF PRESSURIZER
**
*************************************************************************
*ICE CONDENSER("I" COMPARTMENT)
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01   0.EO       TOTAL VOLUME INCLUDING THE ICE
**02 EXIT GAS TEMPERATURE--THIS IS THE TEMPERATURE OF GAS LEAVING THE
**   ICE BOX (SEE WRITE-UP FOR SUBROUTINE HTICE IN VOL 2 OF USER'S MAN)
**03 INITIAL TEMPERATURE OF THE ICE
**04 SPECIFIC VOLUME OF ICE--NOTE THE TOTAL VOLUME MINUS THE ICE MASS
**   TIMES THE SPEC VOL SHOULD BE THE FREE VOLUME
**05 FLOOR AREA OF WATER SUMP IN BOTTOM OF ICE CONDENSER
**06 HEIGHT OF SUMP (IE CURB OVER WHICH WATER DRAINS INTO B)
**07 VERTICAL HEIGHT OF ICE BOX
**08 FLOW AREA BETWEEN LOWER COMPARTMENT AND THE ICE CONDENSER
**09 SEDIMENTATION AREA
**      JKB 3-6-91
**@@@REV 17, #10 IS NEW
**10   300.      AIGRAT    TOTAL UPWARD GAS FLOW AREA IN THE COMPT AT THE
**                         ELEVATION OF THE GRATING (USED TO CALCULATE THE
**                         GAS VELOCITY THROUGH THE GRATING GIVEN MASS FLOWS
**                        THROUGH THE COMPT)--IF DIFFERENT ELEVATIONS ON WHICH
**                         GRATING IS FOUND HAVE DIFFERENT TOTAL FLOW AREAS,
**                         USE THE LARGEST TO GIVE SLOWEST VELOCITY FOR
**                         CONSERVATISM
**
**       JKB 3-6-91
**END OF ICE COND
**
*************************************************************************
*CAVITY (CCOMPT)
*************************************************************************
**THE CAVITY INCLUDES ALL THE VOLUME BELOW THE REATOR NOZZLES INSIDE
**THE BIOLOGICAL SHIELD AND ALL THE VOL OUT TO WHERE THE TUNNEL SLOPES UP
**
**NOTE THAT THE CAVITY HAS TWO FLOWPATHS--"TUNNEL" REFERS TO A WATER
**AND PERHAPS CORIUM FLOW PATH THAT ENTERS NEAR THE BASE OF THE CAVITY;
**"BYPASS" REFERS TO A FLOWPATH HIGHER IN THE CAVITY; THIS COULD BE THE
**AREA AROUND THE RV NOZZLES, OR IN THE CASE OF SOME PLANTS, BLOWOUT PANELS
**HIGHER IN THE CAVITY--THE BYPASS AREA IS ASSUMED TO EMPTY INTO B
**
**IN SOME PLANTS WATER CAN FLOW DOWN FROM THE REFUELING POOL TO THE CAVITY
**AND IN SOME, CORIUM CAN BE ENTRAINED UP TO THE UPPER COMPARTMENT AROUND
**THE RV ANNULUS--AT PRESENT GAS IS NOT EXCHANGED BETWEEN C AND A HOWEVER
**
**IN MANY SEQUENCES, NAT. CIRC. IS SET UP WHEREBY COLD GAS ENTERS THE
**CAVITY THROUGH THE TUNNEL, IS HEATED BY PASSING OVER CORIUM, AND LEAVES
**THROUGH THE BYPASS AREA
01   32.3        BYPASS (NON-TUNNEL) FLOW AREA COUPLING CAVITY TO LOWER/UPPER
**               COMPARTMENTS; THIS SHOULD BE THE LIMITING FLOW AREA, EG
**               THE AREA AROUND THE NOZZLES AS THEY PENETRATE THE BIOLOGICAL
**               SHIELD OR THE ANNULAR FLOW AREA BETWEEN THE RV AND THE SHIELD
02  620.         AREA OF CAVITY POOL--THIS INCLUDES KEYWAY ETC WHERE APPLIC
**
**                JKB 3-6-91
**03   57.6       CHARAC. CROSS-SEC AREA OF COMPT FOR BURN TIME CALCULATION
**@@@REV 16, #3 REMOVED
**03  NOT USED
**
**                JKB 3-6-91
04   14.9        HEIGHT OF VESSEL ABOVE BOTTOM OF CAVITY
05   144.        TUNNEL CROSS-SECTNL AREA
06   144.        LARGEST CHARAC CROSS-SECTNL AREA THAT CORIUM MUST
**               TRAVERSED ON ITS WAY TO THE OPENING WHERE IT MAY BE
**               ENTRAINED OR FLOODED TO COMPTS A OR B--IN PLANTS WITH
**               BOTTOM HEAD PENETRATIONS, THIS WILL TYPICALLY BE THE
**               "KEYWAY" AREA (THIS IS USED TO CALCULATE THE MINIMUM
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**              VELOCITY WHICH CAN ENTRAIN THE CORIUM AND WATER)
07   8682.      CAVITY FREE VOLUME
08   14.0       HEIGHT OF TOP OF TUNNEL ABOVE CAVITY FLOOR (MEASURED AT
**              CAVITY END OF THE TUNNEL IF IT SLOPES)
**              WHEN THE WATER LEVEL IN C EXCEEDS THIS VALUE, GAS TRANSFER
**              BETWEEN B AND C THROUGH THE TUNNEL IS PREVENTED (EXCEPT
**              WHEN THE DELTA-P  EXCEEDS THE STATIC HEAD OF WATER IN THE
**              TUNNEL EG AT VESSEL FAILURE)--THIS PREVENTS NAT CIRC THRU THE
**              CAVITY SINCE ONLY THE BYPASS FLOWPATH IS THEN AVAILABLE
09    1639.6    AREA OF CAVITY OUTER WALLS
10    .0625     LINER THICKNESS
11   .0148      LINER GAP RESISTANCE
12   3.         THICKNESS OF WALL (OR DEPTH TO BE MODELLED FOR HEAT
**              TRANSFER IF IT IS VERY DEEP)
13    .8        THERMAL CONDUCTIVITY OF WALL
14    0.16      SPECIFIC HEAT OF WALL
15   145.       DENSITY OF WALL
16    0.        NUMBER OF IGNITION SOURCES IN C
**
**      JKB 3-6-91
**@@@REV 16, #17 CHANGED
**17    0.         AVG DISTANCE OF THESE FROM THE CEILING
17   0.0        XIGC      XIGC ELEVATION OF IGNITER FROM FLOOR OF C
**
**
**      JKB 3-6-91
18    620.      SEDIMENTATION AREA
19    60.0      MINIMUM FLOW AREA WHICH CONNECTS CAVITY TO LOWER COMPT
**              THROUGH TUNNEL--THIS IS USED TO DEFINE THE FLOW RESISTANCE
**      JKB 3-6-91
**
**@@@REV 16, #20 & #21 ADDED
20  11.0        XRBRC     CHARACTERISTIC RADIUS FOR BURN
21  14.1        XHBRC     CHARACTERISTIC HEIGHT FOR BURN
**                        THIS IS FLOOR TO CEILING (NOT IGNITER TO CEILING)
**
**
**      JKB 3-6-91
**END COMP C
*************************************************************************
************** STANDARD (OLD) ENGINEERED SAFEGUARDS  *****************
*************************************************************************
*ENGINEERED SAFEGUARDS   (PARAMETER GROUP #6)
*************************************************************************
*************************************************************************
**@@@REV 18  NOTE: IN THE CASE OF INJECTION WHEN THERE IS A BREAK, THE
**           INJECTED FLOW IS ASSUMED TO GO THE VESSEL VS. DIRECTLY OUT
**           THE BREAK.  THEN, IF THE WATER LEVEL IS HIGH ENOUGH, WATER
**           WILL FLOW OUT THE BREAK.  (I.E., THE CODE DOES NOT KNOW IF
**           INJECTION IS UPSTREAM OR DOWNSTREAM OF A BREAK).
**
**IN METRIC UNITS,
**FLOWRATES SPECIFIED TO BE VOLUMETRIC SHOULD BE M**3/SEC; OTHER FLOWRATES
**IE ALL THOSE NOT EXPLICITLY STATED TO BE VOLUMETRIC
**SHOULD BE KG/SEC; HEADS SHOULD BE IN M; PRESSURES IN PA; IN ENGLISH THE
**UNITS ARE RESPECTIVELY GPM,LBM/HR,FT, PSIA--
**NOTE TO MAAP/BWR USERS--GPM IS USED IN MAAP/PWR INSTEAD OF FT**3/HR
**
**IN THE FOLLOWING,"FANS"REFER TO FAN COOLERS--(AIR RETURN FANS IN
**CONDENSER PLANTS)
**
**FOR BETTER ACCURACY, YOU MAY ELECT TO INPUT "SYSTEM" PUMP HEAD CURVES WHICH
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**INCLUDE THE EFFECTS OF FRICTION IN THE INLET AND OUTLET PIPING (WHICH IS
**IGNORED IN MAAP); IF YOU DO SO, BE SURE THE ASSUMPTIONS ON STATIC HEAD
**WHICH ARE USED IN THEIR CALCULATION ARE CONSISTENT WITH THE PUMP ELEVATIONS
**ETC. WHICH ARE INPUT BELOW--THIS IS GENERALLY A FACTOR ONLY IN CRITICAL
**APPLICATIONS SUCH AS FEED AND BLEED WHERE THE CHARGING PUMP FLOW IS
**BARELY (OR NOT) ADEQUATE TO MATCH DECAY HEAT
**
01   0.875      ACCUMULATOR PIPE DIAMETER
02  1770.0      PRESSURE SETPOINT FOR LPI
03    1.0       PRESSURE SETPOINT FOR HPI
04  648.0       INITIAL PRESSURE OF ACCUMULATORS
05    50.0     TEMPERATURE OF REFUELING WATER STORAGE TANK (RWST)--IE
**              THE TANK FROM WHICH THE CHARGING, HPI, LPI, AND SPRAYS
**              DRAW THEIR WATER DURING THE INJECTION PHASE
06   125.0      TEMPERATURE OF ACCUMULATORS
07  3.889E6     INITIAL MASS IN RWST
08  62002.0     INITIAL MASS PER COLD LEG ACCUMULATOR
09  1134.0      AREA OF BASE OF RWST
10   122.7      LENGTH OF AN ACCUMULATOR PIPE
11   27.75      PRESSURE SETPOINT OF BLDG SPRAYS
**12            PRESSURE SETPOINT OF BLDG FANS
**13  0         NUMBER OF OPERATING FAN COOLERS OR FANS
**14            VOLUMETRIC FLOW THROUGH ONE FAN COOLER OR FAN
15   4.101E-3   NOMINAL DIAMETER OF CONTAINMENT SPRAY DROPLETS AS THEY
**              LEAVE THE SPRAY HEADER
16   1450.0     VOLUME OF ONE COLD LEG ACCUMULATOR
17   3.0        NUMBER OF OPERATIONAL COLD LEG ACCUMULATORS
18   0.0        NUMBER OF OPERATIONAL HPI PUMPS
19   2.0        NUMBER OF OPERATIONAL LPI PUMPS
20    0         NUMBER OF ENTRIES USED IN HPI PUMP-HD CURVE TABLE(5 MAX)
**21            HIGHEST HEAD IN TABLE (UNITS ARE METERS)
**22            NEXT HIGHEST HEAD IN HPI PUMP-HEAD CURVE TABLE
**23            NEXT HIGHEST HEAD IN HPI PUMP-HEAD CURVE TABLE
**24            NEXT HIGHEST HEAD IN HPI PUMP-HEAD CURVE TABLE
**25            LOWEST HEAD IN HPI PUMP-HEAD CURVE TABLE
**26            VOLUMETRIC FLOWRATE CORESPONDING TO FIRST ENTRY IN
**              THE PRESSURE TABLE
**27            NEXT VOL. FLOWRATE
**28            NEXT VOL. FLOWRATE
**29            NEXT VOL. FLOWRATE
**30            NEXT VOL. FLOWRATE
**
31     5        NUMBER OF ENTRIES USED IN LPI TABLE
32   395.0      HIGHEST HEAD IN LPI TABLE
33   255.0      NEXT HEAD
34   195.0      NEXT HEAD
35   180.0      NEXT HEAD
36     0.0      NEXT HEAD
37    0.0       FIRST VOLUMETRIC FLOWRATE IN TABLE
38  3000.0      NEXT VOL. FLOWRATE
39  4000.0      NEXT VOL. FLOWRATE
40  4400.0      NEXT VOL. FLOWRATE
41  4500.0      NEXT VOL. FLOWRATE
**
42  1780.0      CHARGING PUMP PRESSURE SETPOINT
43    2.0       NUMBER OF WORKING CHARGING PUMPS
44    5.0       NUMBER OF ENTRIES IN CHARGING PUMP HEAD CURVE TABLE
45   6000.0     FIRST HEAD
46   5800.0     NEXT HEAD
47   5500.0     NEXT HEAD
48   4900.0     NEXT HEAD
49    0.0       NEXT HEAD
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50    0.0       FIRST VOL. FLOWRATE
51   200.0      NEXT VOL. FLOWRATE
52   300.0      NEXT VOL. FLOWRATE
53   400.0      NEXT VOL. FLOWRATE
54   500.0      NEXT VOL. FLOWRATE
**
55    85.0      AREA OF BASE OF CONTMT SUMP
56    1.81      DEPTH OF CONTMT SUMP
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
57     5.0      NUMBER OF USED ENTRIES IN CS PUMP HEAD CURVES (5 MAX)
58    305.0     FIRST ENTRY IN CONT SPRAY PUMP HEAD TABLE
59    290.0     SECOND ENTRY IN CONT SPRAY PUMP HEAD TABLE
60    250.0     THIRD ENTRY IN CONT SPRAY PUMP HEAD TABLE
61    180.0     FOURTH ENTRY IN CONT SPRAY PUMP HEAD TABLE
62    0.0       FIFTH ENTRY IN CONT SPRAY PUMP HEAD TABLE
**
63     0.0      FIRST VOLUMETRIC FLOW ENTRY IN CS PUMP TABLE
64   1200.0     SECOND VOLUMETRIC FLOW ENTRY IN CS PUMP TABLE
65   2000.0     THIRD VOLUMETRIC FLOW ENTRY IN CS PUMP TABLE
66   2800.0     FOURTH VOLUMETRIC FLOW ENTRY IN CS PUMP TABLE
67   2900.0     FIFTH VOLUMETRIC FLOW ENTRY IN CS PUMP TABLE
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
68   10.0        NPSH (UNITS OF LENGTH) REQ'D FOR CHARGING PUMP
**               AT FIRST FLOW IN TABLE
69   12.0        NEXT NPSH ENTRY FOR CHARGING PUMPS
70   15.0        NEXT NPSH ENTRY FOR CHARGING PUMPS
71   18.0        NEXT NPSH ENTRY FOR CHARGING PUMPS
72   25.0        NEXT NPSH ENTRY FOR CHARGING PUMPS
**
73   15.0        FIRST NPSH ENTRY FOR LPI
74   16.0        NEXT ENTRY FOR LPI
75   20.0        NEXT ENTRY FOR LPI
76   23.0        NEXT ENTRY FOR LPI
77   23.0        NEXT ENTRY FOR LPI
**78             FIRST NPSH ENTRY FOR HPI
**79             NEXT ENTRY FOR HPI
**80             NEXT ENTRY FOR HPI
**81             NEXT ENTRY FOR HPI
**82             NEXT ENTRY FOR HPI
83    7.0        FIRST NPSH ENTRY FOR CONT SPRAY PUMPS
84    8.0        NEXT ENTRY FOR SPRAY PUMPS
85    13.0       NEXT ENTRY FOR SPRAY PUMPS
86    19.0       NEXT ENTRY FOR SPRAY PUMPS
87    19.0       NEXT ENTRY FOR SPRAY PUMPS
**VP-START
88     2.0      NUMBER OF OPERATING SPRAY PUMPS FOR UPPER COMPARTMENT
**VP-END
89     2.0      NUMBER OF OPERATING SPRAY PUMPS FOR LOWER COMPARTMENT
90     0.0      HEIGHT OF BOTTOM OF RWST ABOVE THE ENG SAFE PUMPS
91     0.0      HEIGHT OF BOTTOM OF CONTAIN SUMP ABOVE THE ENG SAFE PUMPS
92     0.0      ELEVATION OF THE RV INJECTION NOZZLES ABOVE THE SI PUMPS
93  1.E6        FLOW THROUGH ONE SPRAY PUMP WHEN ITEM 94 IS MEASURED
94  34.6        DIFFERENTIAL PRESSURE ACROSS THE SPRAY NOZZLES
95     0.0      MASS FLOWRATE OF EXTERNAL RWST REPLACEMENT WATER, IF ANY
96     0.0      TIME DELAY FOR HPI (IE TIME BETWEEN THE ACTUATION AND WHEN
**              ACTUAL OPERATION BEGINS)
97   .0075      TIME DELAY FOR LPI
98   .0075      TIME DELAY FOR CHARGING PUMPS
99   .0183      TIME DELAY FOR UPPER COMPARTMENT SPRAYS
```

```
100  .085        TIME DELAY FOR LOWER COMPARTMENT SPRAYS
**101            TIME DELAY FOR FAN COOLERS
**@@@REV 18  NOTE: NTFC IS THE TOTAL NUMBER OF TUBES IN A FAN COOLER
**102   1200.      NUMBER OF TUBES IN A FAN COOLER
**103            OUTSIDE AREA OF ALL TUBES IN A FAN COOLER
**104            AREA OF ALL FINS IN A FAN COOLER
**105            FAN COOLER FIN EFFICIENCY
**106            FAN COOLER INSIDE FOULING FACTOR
**107            FAN COOLER FIN DIAMETER
**108            FAN COOLER TUBE THICKNESS
**109            FAN COOLER TUBE THERMAL CONDUCTIVITY
**110            MINIMUM FLOW AREA THROUGH FAN COOLER
**111            FAN COOLER TUBE ID
**@@@REV 18  NOTE: THE FAN COOLER IS SEGMENTED LONGITUDINALLY INTO NODES
**               (SECTIONS) FOR THE HEAT TRANSFER CALCULATIONS.  THE NUMBER
**               OF NODES IS ONLY FOR CALCULATIONAL PURPOSES, AND DOES NOT
**               CORRESPOND TO ANY GROUPINGS OF TUBES, TUBE GEOMETRY, ETC.
**112   5    NREGFC   NUMBER OF NODES USED TO MODEL FAN COOLER (5 MAX)
113   67.5   INLET COOLING WATER TEMP TO FAN COOLER--NOTE THIS IS
**           ALSO USED AS THE COOLING WATER TEMP FOR ALL OTHER
**           SAFEGUARDS HEAT EXCHANGERS
**114            INLET COOLING WATER FLOW TO A FAN COOLER
115    0.0       NUMBER OF LPI PUMPS USED FOR RHR SPRAYS WHEN VALVE OPEN
**116  0.0       ENTER A 1 IF FANS/COOLERS DISCHARGE TO B;0 TO D
**@@@REV 18  NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                  LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**
**ESF HX'S
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**    -1   SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**     0   IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**     1   STRAIGHT TUBE HX
**     2   U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
117   1.0        TYPE OF HX FOR SPRAY
118  1500.0      NUMBER OF TUBES IN SPRAY HXS
119    27.0      NUMBER OF SHELL SIDE BAFFLES IN SPRAY HXS
120   .04625     SPRAY HX TUBE ID
121   .0029      SPRAY HX TUBE THICKNESS
**@@@REV 18  CORRECTED DEFINITION OF XTCSP (PITCH, NOT SEPARATION)
122   0.0729     XTCSP  TUBE TO TUBE PITCH IN SPRAY HX
123   41.7       SHELL LENGTH IN SPRAY HX
124   8.08       THERMAL CONDUCTIVITY OF SPRAY HX TUBES
125   .635       LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
126   .0521      SHELL TO TUBE CLEARANCE AT OUTSIDE OF SPRAY HX TUBE BDL
127  2.248E6     SPRAY HX COOLING WATER MASS FLOWRATE
**@@@@@@@@@@@@@@@@@NEW@@@@@@@@@@@@@@@@@@@@@@@
128   1.E6       PRESSURIZER LEVEL SETPOINT FOR MAKEUP CONTROL SYSTEM, OR
**               A LARGE NO. IF YOU DON'T WANT TO CONTROL MAKEUP AND/OR
**               CHARGING PUMP FLOW ON PRESSURIZER LEVEL
**@@@REV 18  NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**               LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**129  0         FHXRH    TYPE OF HX FOR RHR
**130  0.0       NUMBER OF TUBES IN RHR HXS
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**131  0.0      NUMBER OF BAFFLES IN RHR HXS
**132  0.0      TUBE ID IN RHR HXS
**133  0.0      TUBE THICKNESS IN RHR HXS
**@@@REV 18  CORRECTED DEFINITION OF XTCRH (PITCH, NOT SEPARATION)
**134    0.DO    XTRCRH    TUBE TO TUBE PITCH IN RHR HXS
**135  0.0      SHELL LENGTH IN RHR HXS
**136  0.0      TUBE THERMAL CONDUCTIVITY IN RHR HXS
**137  0.0      BAFFLE CUT DISTANCE IN RHR HXS (SEE 125)
**138  0.0      SHELL TO TUBE CLEARANCE AT OUTSIDE OF RHR HX TUBE BUNDLE
**139  0.0      RHR HX COOLING WATER MASS FLOWRATE
140   0.0       SPRAY HX NTU
**141  0.0      RHR HX NTU
142  3.17     SHELL ID OF SPRAY RECIRC HX
**143  0.0      SHELL ID OF RHR RECIRC HX
**ENTER ZERO VOLUME FOR ITEM 148 IF NO UHI SYSTEM
**@@@REV 18: IF MORE THAN ONE UHI ACCUMULATOR, SPECIFY THE TOTAL
**           AMOUNT OF MASS IN ALL ACCUMULATORS IN PARAMETER 144
**144           INITIAL MASS IN THE UHI WATER ACCUMULATOR
**145 LENGTH OF THE UHI PIPE TO THE RV
**146 DIAMETER OF THE UHI PIPE
**147 INTIAL PRESSURE OF THE UHI ACCUMULATOR
148   0.0       TOTAL (WATER + GAS) VOLUME IN THE UHI ACCUMULATORS
**149 FAILURE DIFFERENTIAL PRESSURE OF THE UHI PIPE RUPTURE DISK
**THE "CAVITY INJECTION SYSTEM" IS (RARELY) USED TO SIMULATE A
**PROPOSED DEDICATED ESF WHICH MERELY DUMPS WATER INTO THE CAVITY
150   0.0       TOTAL MASS IN THE CAVITY INJECTION SYSTEM TANK
151   0.0       MASS FLOWRATE OF THE CAV INJ SYSTEM WHEN ACTIVATED
**    USER HAS THE OPTION TO THROTTLE ESF SYSTEMS AT LESS THAN
**    THEIR FULL FLOW GIVEN THE CONDITIONS EXISTING--TO DO THIS,
**    ENTER FOR THE APPROPRIATE SYSTEM (AND FOR THE AFW IN THE STM
**    GENERATOR SECTION) A TOTAL FLOWRATE DESIRED; THE CODE WILL USE
**    THE MINIMUM OF THIS FLOW AND THAT CALCULATED FROM THE HEAD CURVES
**    AND THE NO. OF OPERATIONAL PUMPS;IF OPERATOR ISN'T THROTTLING,
**    ENTER A LARGE NO.;IF HE CHANGES THE DEGREE OF THROTTLING, ENTER
**    PARAMETER CHANGES USING INTERVENTION NO. 1000 IN CONTROL CARDS
152   1.E9       THROTTLED FLOW FOR LPI SYSTEM (TOTAL)
153   1.E9       SAME FOR HPI
154   1.E9       SAME FOR CHARGING PUMPS
155   1.E9       SAME FOR UPPER COMPT NORMAL SPRAYS
156   1.E9       SAME FOR UPPER COMPT RHR SPRAYS (WHEN ACTIVATED)
157   1.E9       SAME FOR LOWER COMPT SPRAYS
**@@@@@@@@@@@@@@@@@@@@@@@@@@@FOLLOWING ARE NEW@@@@@@@@@@@@@@@@@@@@@@
**
**        MOTOR DRIVEN AFW FLOW TABLE
**
158    5.0       NO. OF POINTS USED IN AFW PUMP-HEAD CURVE (5 MAX)
159    0.0       FIRST VOL FLOW IN PUMP-HEAD CURVE
160    200.0     SECOND VOL FLOW IN PUMP-HEAD CURVE
161    350.0     THIRD VOL FLOW IN PUMP-HEAD CURVE
162    360.0     FOURTH VOL FLOW IN PUMP-HEAD CURVE
163    360.0     FIFTH VOL FLOW IN PUMP-HEAD CURVE
**
164    3150.0    FIRST HEAD IN AFW PUMP-HEAD CURVE
165    3100.0    SECOND HEAD IN AFW PUMP-HEAD CURVE
166    2850.0    THIRD HEAD IN AFW PUMP-HEAD CURVE
167     0.0      FOURTH HEAD IN AFW PUMP-HEAD CURVE
168     0.0      FIFTH HEAD IN AFW PUMP-HEAD CURVE
**
169    615.7     AREA OF BASE OF CST
170     0.0      DISTANCE THAT CST IS ABOVE AFW PUMPS
171     56       DISTANCE THAT S/G IS ABOVE AFW PUMPS
**@@@REV 18:  PARAMETERS #172-175 ARE ONLY USED WITH GENERALIZED ESF
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**            MODEL.  THEY ARE INCLUDED IN THE "OLD" ESF SECTION BECAUSE
**            OF THE REPETITIVE FORMAT OF THE GENERALIZED ESF SECTION.
**            SIMILAR VALUES FOR OTHER PUMP TRAINS WERE ALREADY
**            INCLUDED IN THIS SECTION.  IF OLD ESF MODEL IS USED THEN
**            THEY ARE ONLY FOR TRAIN 1.
**172   5.0      TDLP2      TIME DELAY FOR LPI TRAIN 2
173   0.085    TDSPC      TIME DELAY FOR CONTAINMENT SPRAY PUMPS TRAIN C
174   1.E10    WSPCX      TOTAL CONT SPRAY TRAIN C THROTTLED FLOW
175   1.E10    WLP2X      TOTAL LPPI TRAIN 2 THROTTLED FLOW
**
**          END OF ESF
*************************************************************************
************************************************************************
*ANNULAR COMPARTMENT ("D" COMPARTMENT)
************************************************************************
**
**IN LARGE DRY CONTAINMENTS:
**THIS COMPARTMENT REPRESENTS THE VOLUME BETWEEN THE CRANE WALL (IF ANY)
**AND THE CONTMT WALL, AND BETWEEN THE DECK AND THE LOWER COMPT FLOOR--
**IF NO CLEAR DISTINCTION, ARBITRARILY DIVIDE THE SPACE BELOW THE UPPER
**COMPT AND USE LARGE FLOW AREAS TO KEEP THE GAS WELL MIXED--AT PRESENT,
**CORIUM IS ASSUMED NOT TO GET INTO THIS COMPARTMENT
**
**IN ICE CONDENSERS: THIS VOLUME REFLECTS THE "DEAD-END" COMPARTMENTS
01  2.66E5      FREE VOLUME
02  3644.0      AREA OF WATER POOL
03    0.0       DISTANCE THE FLOOR OF D IS ABOVE THE FLOOR OF B
**@@@REV 16, #4 REMOVED  JKB 3-6-91
**04 NOT USED
**04 339.       CHARAC. CROSS-SEC AREA OF COMPT FOR BURN TIME CALCULATION
**
** JKB 3-6-91
05  2.89E4      AREA OF EXTERIOR WALLS
06  0.03125     WALL LINER THICKNESS
07  0.0148      GAP RESISTANCE OF WALL LINER
08   4.5        THICKNESS OF WALL
09   0.8        THERMAL CONDUCTIVITY OF WALL
10   0.21       SPECIFIC HEAT OF WALL
11   145.0      DENSITY OF WALL
12     0.0      ENTER A 1 IF THE OUTER WALL (CONTMT OUTER BOUNDARY)
**              IS MADE OF STEEL
13     0.0      HEIGHT OF CURB SEPERATING D AND B MEASURED FROM B'S FLOOR
14    0.0       NUMBER OF IGNITERS OR IGNITION SOURCES IN D
**    JKB 3-6-91
**15    0.0       AVG DISTANCE OF THESE FROM THE CEILING
**@@@REV 16, #15 CHANGED
15   0.0         XIGD       AVERAGE ELEVATION OF IGNITERS WITH RESPECT TO D FLOOR
**   JKB 3-6-91
16  10932.0     SEDIMENTATION AREA
**THE NEXT THREE PARAMETERS ARE USED TO DEFINE THE EFFICIENCY OF
**INERTIAL IMPACTION
**IN LARGE, DRY'S THESE PARAMETERS SHOULD CHARACTERIZE
**GRATES WHICH ARE ASSUMED TO BE IN THE ANNULAR COMPARTMENT
**
**IN ICE CONDENSER PLANTS, THESE PARAMETERS (EVEN THOUGH LOCATED
**IN THE ANNULAR COMPARTMENT DATA SECTION) SHOULD REFLECT IMPACTION AND
**FLOW AREAS AND STRAP  WIDTHS IN THE ICE BOX--SEE EG POSTMA
17    1722.3    IMPACTION AREA (AREA OF BARS IN GRATES THAT INTERCEPT FLOW)
18   0.0156     WIDTH OF GRATE BARS
**
**@@@REV 17, DOUBLE USAGE OF AGRATE FOR "D" AND "I" COMPT CORRECTED.  AGRATE
**             RENAMED TO ADGRAT FOR "D" COMPT AND AIGRAT FOR "I" COMPT (NEW)
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19   2163.6     TOTAL UPWARD GAS FLOW AREA IN THE COMPT AT THE ELEVATION
**              OF THE GRATING (USED TO CALCULATE THE GAS VELOCITY THROUGH
**              THE GRATING GIVEN MASS FLOWS THROUGH THE COMPT)--IF DIFFERENT
**              ELEVATIONS ON WHICH GRATING IS FOUND HAVE DIFFERENT TOTAL
**              FLOW AREAS, USE THE LARGEST TO GIVE SLOWEST VELOCITY FOR
**              CONSERVATISM
**NOTE: IF MORE THAN ONE LEVEL OF GRATES EXISTS, USE THE TOTAL IMPACTION AREA
**OF ALL THE GRATES, AND THE MAXIMUM FLOW AREA AT ANY OF THE GRATE ELEVATIONS
**AS NOTED ABOVE
**DETAILED CONTAINMENT FAILURE MODEL INPUTS--IGNORE IF SIMPLE MODEL
**USED
**20            NUMBER OF TENDONS IN HOOP DIRECTION IN THE PART OF THE WALL
**              WHOSE AREA IS GIVEN IN ITEM 5 ABOVE
**21            NUMBER OF TENDONS WHICH RUN IN THE AXIAL (VERTICAL) DIRECTION
**22            VOLUME OF REBAR PER UNIT AREA OF OUTER WALL (EQUIV THICKNESS)
**              RUNNING IN THE HOOP DIRECTION
**23            DIAMETER OF HOOP TENDONS
**24            DIAMETER OF THE AXIAL TENDONS
**25            VOLUME OF REBAR PER UNIT AREA OF OUTER WALL (EQUIV THICKNESS)
**              RUNNING IN THE AXIAL DIRECTION
**26            DISPLACEMENT IN AXIAL DIRECTION WHICH IS SUFFICIENT TO TEAR
**              THE CONTMT WALL (EG AT A PENETRATION)
**27            SAME AS 26 FOR THE RADIAL DIRECTION
**
**      JKB 3-6-91
**@@@REV 16, #28 & #29 ADDED
28   10.0       XRBRD     CHARACTERISTIC RADIUS FOR BURN IN D
29   73.0       XHBRD     CHARACTERISTIC HEIGHT FOR BURN IN D
**                        THIS IS FLOOR TO CEILING (NOT IGNITER TO CEILING)
**                  JKB 3-6-91
**
***************************************************************************
*UPPER COMPARTMENT (OR "A" COMPT)  (PARAMETER GROUP #7)
***************************************************************************
***************************************************************************
01  11.24E5     FREE VOLUME
**@@@REV 18  CHANGED VALUE OF ARP
02  1351.0      AREA OF REFUELING POOL
03   101.       HEIGHT OF CONTAINMENT SPRAY HEAD ABOVE BOTTOM OF COMPARTMENT
**               JKB 3-6-91
04   2163.6     FLOW AREA FROM UPPER COMPARTMENT INTO ANNULAR COMPT
**         JKB 3-6-91 WAS 202 IN ENGINEERED SAFEGUARDS
**
**      JKB 3-6-91
**
**@@@REV 16, #5 REMOVED
**05   759.       CHARACTERISTIC CROSS-SEC AREA OF COMPT FOR BURN TIME
**              CALCS--EG THE BURN TIME IS THE SQUARE ROOT OF THIS
**               JKB 3-6-91
**              AREA DIVIDED BY THE BURN VELOCITY
06   0.722      CURB HEIGHT IN REFUELING POOL TO ALLOW OVERFLOW--NORMALLY
**              0 UNLESS YOU ASSUME REFUELING POOL DRAINS ARE BLOCKED (A
**              CLASSICAL ICE CONDENSER SEQUENCE), THEN MAKE IT LARGE
07  4.47E4      SURFACE AREA OF OUTER WALLS IN UPPER COMPARTMENT
08  0.037       LINER THICKNESS ON OUTER WALL
09   .0148      OUTER WALL LINER GAP RESISTANCE--SEE NOTE IN
**              LOWER COMPT
**              FOR HOW TO MODEL FREE STANDING STEEL CONTMTS WITH A SHIELD
**              WALL
10   3.35       OUTER WALL TOTAL THICKNESS
11   0.75       THERMAL CONDUCTIVITY OF OUTER WALL (FOR CONCRETE STRUCTURES
**              WITH A LINER, THIS REFERS TO THE CONCRETE PART)
```

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12    0.21        SPECIFIC HEAT OF OUTER WALL
13    143.0       DENSITY OF OUTER WALL
14    0.0         ENTER A 1 IF THE OUTER WALL IS SOLID STEEL (IE A STEEL CONTMT
**                WITH NO SHIELD BUILDING), 0 FOR CONCRETE WITH OR W/O LINER
15   22174.0      HALF AREA (WALLS MODELED AS 1-D SLABS) OF INTERNAL WALLS
16    0.0         LINER THICKNESS ON INTERIOR WALL, IF ANY
17    0.0         LINER GAP RESISTANCE IN INTERIOR WALL
18    2.0         THICKNESS OF INTERNAL WALLS
**@@@REV 18      CHANGED VALUE OF ADCK
19    4284.       ADCK    DECK AREA
20    0.0         LINER THICKNESS ON DECK
21    0.0         LINER GAP RESISTANCE ON DECK
22    2.0         DECK THICKNESS
23    0.751       THERMAL CONDUCTIVITY OF DECK
24    0.21        SPECIFIC HEAT OF DECK
25    143.6       DENSITY OF DECK
26    0.0         ENTER A 1 IF THE DECK IS SOLID STEEL, 0 FOR CONCRETE
27    5.95E5      METAL EQPT MASS
28    19.4E3      EQPT HEAT TRANSFER AREA
29     0.0        NUMBER OF IGNITION SOURCES IN UPPER COMPT (A COMPARTMENT)
**
**@@@REV 16, #30 IS CHANGED
30    0.0         XIGA       AVERAGE ELEVATION OF IGNITERS FROM FLOOR OF A
**FOLLOWING PARAMETERS ARE USED TO DETERMINE WHICH IGNITERS OR IGNITION
**
**SOURCES IN THE LOWER, ANNULAR, OR UPPER PLENUM CAN INITIATE BURNS IN
**THEIR RESPECTIVE COMPARTMENTS WHICH CAN THEN PROPAGATE INTO THE UPPER
**COMPARTMENT--IF NO IGNITERS IGNORE 31-33
31     0.0        NO. OF IGNITERS/IGN SOURCES IN B WHICH CAN BE SEEN FROM A
32     0.0        NO. OF IGNITERS/IGN SOURCES IN D WHICH CAN BE SEEN FROM A
**
*BR                                                                            ES
33    113.0       DISTANCE FROM THE TOP OF A TO THE DECK
**@@@REV 17 FOLLOWING PARAMETER CHANGED (NEED VALUE ALWAYS)
****33   60.          ZA          DISTANCE FROM THE TOP OF A TO THE DECK
34    0.16        FRACTION OF UPPER COMPT SPRAY WATER THAT RUNS INTO THE
**                REFUELING POOL (VS. CONTINUING ON DIRECTLY INTO LOWER COMPT)
35     0.0        FRACTION OF WATER DRAINING OUT OF REFUELING POOL THAT
**                GOES INTO LOWER COMPT (REMAINING FRACTION RUNS INTO THE
**                CAVITY)
**INPUTS FOR SIMPLE (FAILURE PRESSURE SUPPLIED) OR DETAILED (CONTMT STRAINS
**CALCULATED) MODELS FOR CONTAIMENT FAILURE--SEE GENERAL NOTES ABOVE
**@@@REV 18 NOTE:  IT IS RECOMMENDED IN THE EPRI SENSITIVITY ANALYSES
**                GUIDANCE DOCUMENT THAT THE SIMPLE MODEL BE USED INSTEAD OF THE
**                MECHANISTIC MODEL.
**@@@REV 18 NOTE:  THE FOLLOWING PARAMETERS MUST BE SPECIFIED
**IN ORDER TO USE THE SIMPLE MODEL:  PCF, FCFA, XRCONT, ZACYL, ZIWA
36     141.0      FAILURE PRESSURE OF CONTAINMENT OR 0 TO USE DETAILED MODEL
37     1.0        ENTER A 1 IF CONTMT FAILS IN UPPER COMPT;0 FOR
**                FAILURE IN THE ANNULAR COMPT (USED ONLY FOR THE SIMPLE MODEL)
38     63.        CONTAINMENT RADIUS FOR STRESS CALCULATIONS
39     0.0        EQUIVALENT AREA TO CALCULATE CONTAINMENT NORMAL LEAKAGE--
**                NORMAL LEAKAGE IS ASSUMED TO COME FROM THE ANNULAR COMPT;
**                GIVEN A DESIGN LEAKAGE, THE AREA SHOULD BE CALCULATED BY
**                USING CHOKED GAS FLOW FORMULA SHOWN IN SUBROUTINE GFLOW
**                WRITEUP
40     0.0        MASS OF WATER IN NEUTRON SHIELD BAGS--WHEN BAGS RUPTURE
**                THEY DROP THEIR CONTENTS INTO REFUELING POOL
41     1.25E4     SEDIMENTATION AREA FOR FISSION PRODUCT SETTLING
**THE REST OF THESE ARE NEW
**42              NUMBER OF TENDONS IN HOOP DIRECTION IN THE LENGTH OF WALL
**                GIVEN IN ITEM 43
```

```
**43           VOLUME OF REBAR PER UNIT AREA OF OUTER WALL (EQUIV THICKNESS)
**             RUNNING IN THE HOOP DIRECTION
**44           VOLUME OF REBAR PER UNIT AREA OF OUTER WALL (EQUIV THICKNESS)
**             RUNNING IN THE Z DIRECTION
**45           DIAMETER OF HOOP TENDONS
46    50.0     HEIGHT OF THE CYLINDRICAL PART OF THE CONTAINMENT WALL A BOVE
**             THAT PART OF THE WALL REPRESENTED IN DCOMPT ITEM NO. 5
**             (EG APPROX THAT ABOVE THE OPERATING DECK)
47    50.0     HEIGHT OF INTERNAL WALLS
**48           DISPLACEMENT IN AXIAL DIRECTION WHICH IS SUFFICIENT TO TEAR
**             THE CONTMT WALL (EG AT A PENETRATION)
**49           SAME AS 48 FOR THE RADIAL DIRECTION
**@@@@@@@@NEW@@@@@@@
*BR
50    8.53     AVG VERTICAL HEIGHT OF THE METAL EQPT IN ACOMPT THAT IS
**             REPRESENTED BY THE MASS ENTERED IN ITEM 27
**
****
**      JKB 3-6-91
**
**@@@REV 16, ADDED #51 & #52
51   63.0      XRBRA     CHARACTERISTIC RADIUS OF UPPER COMPT FOR H2 BURNS
52   113.0     XHBRA     CHARACTERISTIC HEIGHT OF UPPER COMPT FOR H2 BURNS
**                       THIS IS FLOOR TO CEILING (NOT IGNITER TO CEILING)
**@@@REV 17, ADDED #53
53   101.0     ZSPA2     ELEVATION OF UPPER COMPARTMENT SPRAY HEADER #2
**                       ABOVE BOTTOM OF COMPARTMENT
**
**      JKB     3-6-91
**
************************************************************************
*LOWER COMPARTMENT (OR "B" COMPT)
************************************************************************
01   72.0      DISTANCE FROM FLOOR TO TOP OF B COMPARTMENT
02   948.0     AREA OF CORIUM POOL; THIS MUST BE LESS THAN THE AREA OF
**             THE FLOOR (ENTERED BELOW)
03   14.58     HEIGHT OF CURB ON FLOOR (OVER WHICH WATER OVERFLOWS TO C)
**04             CHARAC. CROSS-SEC AREA OF LOWER COMPT FOR BURN TIME CALCS
**
**      JKB     3-6-91
**@@@REV 16, #4 REMOVED
**04   NOT USED
**
**      JKB 3-6-91
05    4.38E5   FREE VOLUME
06   39.4      VERTICAL DISTANCE FROM THE CAVITY BYPASS FLOW AREA
**             (EG AREA AROUND VESSEL NOZZLES BUT SEE DEFINITION
**             IN CAVITY SECTION BELOW) TO THE CENTER OF THE CAVITY END
**             OF THE TUNNEL FLOW AREA
07    61.8     DISTANCE FROM THE FLOOR OF A TO THE OPENING FROM B INTO D
08    0.0      FOR CASES WHERE THE OUTER BOUNDARY OF CONTMT IS A
**             STEEL SHELL SEPERATED FROM A CONCRETE SHIELD WALL,
**             ENTER DISTANCE BETWEEN THE TWO AND TREAT THE STEEL
**             SHELL AS A LINER (ACOMPT AND DCOMPT OUTER WALLS)--
**             ENTER 0 OTHERWISE
**
**      JKB      3-6-91
**@@@REV 16, #9 SHOULD BE CHECKED FOR ICE CONDENSERS DUE TO CONFUSING
**             COMMENTS IN EARLIER PARAMETER FILES
**OUTER WALL OF B DIVIDES IT FROM COMPT D
**
**    JKB       3-6-91
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```
09   2.38E4      AREA OF OUTER WALL
10   0.0        OUTER WALL LINER THICKNESS
11   0.0        GAP RESISTANCE OF OUTER WALL LINER
12   2.375      THICKNESS OF OUTER WALL
13   0.75       THERMAL CONDUCTIVITY OF OUTER WALL
14   0.21       SPECIFIC HEAT OF OUTER WALL
15   143.6      DENSITY OF OUTER WALL
16   0.0        ENTER 1 IF THE OUTER WALL IS SOLID STEEL, 0 FOR CONCRETE
**NOTE THAT CORIUM IN B IS ASSUMED TO SEE ONLY ONE FACE OF THE INTERIOR
**WALL FOR RADIATION CALCULATIONS
17   1.85E4     HALF SURFACE AREA OF INTERIOR WALL
18   0.0        INTERIOR WALL LINER THICKNESS
19   0.0        GAP RESISTANCE OF BUILDING INTERIOR WALL LINER
20   3.0        THICKNESS OF INTERIOR WALLS
21   0.75       THERMAL CONDUCTIVITY OF INTERIOR WALLS
22   0.21       SPECIFIC HEAT OF INTERIOR WALLS
23   143.6      DENSITY OF INTERIOR WALLS
24   6478.0     AREA OF FLOOR (USE WATER POOL AREA IF LESS)
25   0.0        FLOOR LINER THICKNESS
26  0.0148      GAP RESISTANCE OF FLOOR LINER
27   12.0       THICKNESS OF FLOOR
28   0.75       THERMAL CONDUCTIVITY OF FLOOR
29   0.21       SPECIFIC HEAT OF FLOOR
30   143.6      DENSITY OF FLOOR
31   11.68E5    MASS OF EQUIPMENT--THIS REFERS TO EQPT INTERNAL TO THIS
**              REGION;
**              THE PRIMARY SYSTEM MASS SHOULD NOT BE INCLUDED SINCE IT
**              HAS A SPECIFIC TREATMENT ELSEWHERE
32   15.07E4    HEAT TRANSFER AREA OF EQPT
**QUANTITY 33 IS USED FOR ALL EXTERNAL WALLS
33   8.8        HEAT TRANSFER COEFFICIENT TO BE USED ON THE OUTER SURFACE
**              OF THE CONTAINMENT OUTER WALLS (EG IN A AND D)
**34 NOT USED
35    0.0       FRACTIONAL AREA AVAILABLE FOR REVERSE FLOW ON B-I FLOWPATH
**              COMPARED TO THE FORWARD DIRECTION(EG DUE TO ICE
**              CONDENSER DOOR(S) SHUTTING)--THIS NO. MUST
**              BE NONZERO AND POSITIVE IN ICE CONDENSER PLANTS--IGNORED IN
**              LARGE, DRY CONTMTS
36     1.0      FRACTIONAL AREA AVAILABLE FOR REVERSE FLOW ON A-D FLOWPATH
**              (EG AIR RETURN FAN FLOW DAMPERS IN ICE CONDENSERS)
**              ENTER 1 IF NO DAMPER
37    4657.0    FLOW AREA FROM B INTO D
38    1776.0    FLOW AREA FROM B TO A
39    0.0       NUMBER OF IGNITERS/IGNITION SOURCES IN B
**
**               JKB 3-6-91
**
40    0.0       AVG DISTANCE OF THESE FROM THE CEILING OF B
**@@@REV 16, #40 CHANGED
40   0.0        XIGB       AVERAGE ELEVATION OF IGNITERS FROM FLOOR OF B
41   1.94       HEIGHT OF FLOOR OF B ABOVE FLOOR OF C
**
**               JKB 3-6-91
42   16200.0    SEDIMENTATION AREA
**@@@@@@@@NEW@@@@@@@
43    20.0      AVG VERTICAL HEIGHT OF THE METAL EQPT IN BCOMPT THAT IS
**              REPRESENTED BY THE MASS ENTERED IN ITEM 31
**
**
**               JKB 3-6-91
**@@@REV 16, #44 & #45 ADDED
44    45.0      XRBRB      CHARACTERISTIC RADIUS FOR H2 BURNS IN B
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45   72.0       XHBRB     CHARACTERISTIC HEIGHT FOR H2 BURNS IN B
**                        THIS IS FLOOR TO CEILING (NOT IGNITER TO CEILING)
**
**                         JKB 3-6-91
***********************************************************************
*INITIAL CONDITIONS
***********************************************************************
01   586.8      NOMINAL FULL POWER PRIMARY SYSTEM WATER TEMPERATURE
02   2250.0     NOMINAL FULL POWER PRIMARY SYSTEM PRESSURE
03   29.5       PRESSURIZER WATER LEVEL (ABOVE BOTTOM OF PZR HEAD)
04   10.5       CONTAINMENT BUILDING PRESSURE
05   103.0      LOWER CONTAINMENT BUILDING COMPARTMENTS (ALL BUT
**              UPPER COMPT AND ICE CONDENSER) TEMPERATURE
**06            ICE CONDENSER GAS TEMPERATURE, WHERE APPLICABLE
07   0.5        LOWER CONTAINMENT BUILDING COMPARTMENTS REL. HUMIDITY (0-
**08  0.0       INITIAL ICE MASS
09   97890.0    INITIAL MASS OF WATER ON SECONDARY SIDE OF EACH S/G
10   103.0      INITIAL TEMPERATURE OF CONTAINMENT CONCRETE AND
**              METAL STRUCTURES
11   850.0      INITIAL PRESSURE ON SEC SIDE OF S/G'S
**UPPER COMPT CONDITIONS COULD BE DIFFERENT IN ICE CONDENSERS
12   0.5        UPPER COMPARTMENT REL HUMIDITY (0-1)
13   103.0      UPPER COMPARTMENT TEMPERATURE
14   586.8      INITIAL PRIMARY SYSTEM WATER TEMPERATURE FOR THIS RUN
15  2250.0      INITIAL PRIMARY SYSTEM PRESSURE FOR THIS RUN
16   0.0        AMOUNT OF SUPERHEAT (DEG F OR K) AT EXIT NOZZLE
**              OF AN OTSG; IGNORED FOR U-TUBE STEAM GENERATORS
**
**                         JKB 3-6-91
**@@@REV 17, #17 THRU 21 ARE NEW FOR A HALFLOOP OPERATION
17   103.0        TSGOHL    INITIAL TEMPERATURE OD WATER AND GAS IN STEAM
**                        GENERATOR FOR HALFLOOP OPERATION.
18     109000.0  MWSGHL     INITIAL WATER MASS IN S/G FOR HALFLOOP OPERATION
19     14.7       PSGOHL    INITIAL PRESSURE IN S/G FOR HALFLOOP OPERATION
20     3.54       ZWPSHL    INITIAL WATER LEVEL ABOVE TOP OF CORE FOR HALFLOOP
**                        OPERATION
21   2.05E5     MWPSHL    INITIAL WATER MASS OF THE PRIMARY SYSTEM.  IF   THIS
**                        MASS IS LARGER THAN THE MASS REQUIRED TO COVER THE
**                        CORE, THIS MASS WILL BE USED INSTEAD OF THE ABOVE
**                        WATER LEVEL (ZWPSHL).  IF MWPSHL < MWMIN (THE MINIMUM
**                        WATER MASS REQUIRED TO COVER THE CORE), THEN THE
**                        WATER LEVEL (ZWPSHL) IS USED TO CALCULATE THE TOTAL
**                        PRIMARY SYSTEM WATER MASS.  THE MINIMUM WATER MASS IS
**                        DEFINED AS:
**
**              MWMIN=(VHD+VLOWCR+ADC*(ZCRU-ZRVCYL)+ACR*(ZCRU-ZCRL))/VWPS
**
**  SAMPLE ICE CONDENSER NUMBERS IN BRITISH UNITS:
**06  60.   ICE CONDENSER GAS TEMPERATURE
**08  2.E6  INITIAL ICE MASS
**
**       JKB 3-6-91
**
**
***********************************************************************
*CONTROL CARDS  (PARAMETER GROUP #11)
***********************************************************************
**
**USE OF THE FAST STEAM TABLES SAVES LITTLE TIME IN CONTMT BUT MAY BE
**USEFUL IN THE PRIMARY SYSTEM
01      1       ENTER A 0 TO USE FAST STEAM TABLES IN PRI SYS WHEN POSSIBLE
02      1       ENTER A 0 TO USE FAST STEAM TABLES IN CONTMT WHEN POSSIBLE
```

```
**              INTEGRATION METHOD: RUNGE-KUTTA ORDER (1 OR 2);
**              THIS IS CURRENTLY IGNORED SINCE 2ND ORDER RUNGE-KUTTA IS
**              NOT SUPPORTED
03    1          IRUNG    INTEGRATION METHOD: RUNGE-KUTTA ORDER (1 OR 2);
***@@@REV 18    SET IRUNG=1 TO USE 1ST ORDER INTEGRATION.  2ND IS ONLY
**              AVAILABLE DUE TO HISTORIC REASONS, AND IS RETAINED BECAUSE
**              IT WAS USED FOR NUMERICAL EVALUATION FOR DESIGN REVIEW.
**              THE CODE IS ONLY TEST WITH 1ST ORDER.
04      29      UNIT NUMBER ("TAPE" NO. IN CDC JARGON)
**              TO WRITE RESTART FILES FOR MAIN PROGRAM FROM THIS RUN
**05            NOT USED
06      30      UNIT NUMBER TO WRITE RESTART FILES FOR HEATUP FROM THIS RUN
**@@@REV 3, NEXT ITEM IS NEW
**               JKB     3-6-91
**07       1      IPLMAP =0, USE OLD ARCHIC HARDWIRD PLOT ROUTINES AND APLOT
**@@@REV 17, PARAMETER #07 OBSOLETE, PLTFIL, PLOTRB, *APLOT ARE NO
**             LONGER SUPPORTED.
**               JKB     3-6-91
**                     =1, USE NEW PLTMAP ROUTINES
**              SEE *PLTMAP PARAMETER SECTION FOR DESCRIPTIONS.
08      09      UNIT NUMBER TO PUT PRI SYSTEM OUTPUT ON
09      09      UNIT NUMBER TO PUT CONTAINMENT OUTPUT ON (MOST USERS PUT
**              IN THE SAME NO. WHICH APPENDS THE TWO FILES)
**VP10     31       UNIT NUMBER FOR THE FIRST PLOT FILE (OTHERS SEQUENTIAL)
**      JKB 3-6-91
**
**@@@REV 17, PARAMETER #10 REDEFINED
10    1         IPLT1  OPTION FOR PLTMAP VARIABLE LABEL LENGTH IN PLOT FILES
**                     =1, USE A8 FORMAT (AS HAS BEEN IN THE PAST)
**                     =2, USE A15 FORMAT - MAX LENGTH OF ANY MAAP
**                         COMMON BLOCK NAME.
**@@@REV 17, USE OF IPLT1=1 WILL WORK WITH EXISTING PLOTTING PACKAGES.
** USE OF IPLT1=2 WILL NECESSIATE AT LEAST CHANGE OF FORMATS IN EXISTING
** PLOTTING PACKAGES TO READ IN LONGER NAMES, AND FILES PRODUCED WITH
** IPLT1=2 WILL INITIALLY GIVE THE NEGATIVE TOTAL NUMBER OF PLOT VARIABLES
** (INSTEAD OF THE POSITIVE TOTAL NUMBER) IN PLOT FILES TO DISTINQUISH FROM
** FILES PRODUCED WITH IPLT1=1.  ALL OTHER FORMATS REMAIN THE SAME.
**
11      39      UNIT NUMBER FOR SCENARIO FILE
**NEXT 3 QUANTITIES CONTROL THE PLOT POINT STORAGE FREQUENCY (SEE VOL 1 OF
**USER'S MANUAL)
12      150     NON-SPIKE NUMBER OF POINTS (AVERAGE BEHAVIOR) STORED
13      10      NUMBER OF POINTS STORED DURING A SPIKE (TO RESOLVE FAST
**              TRANSIENTS)
14      500     MAXIMUM NUMBER OF PLOT POINTS ALLOWED PER PLOT FILE
**SEE ESF LINEUP MENU IN SUBROUTINE ENGSAF WRITE-UP IN
**VOL 2 OF USER'S MANUAL FOR NEXT TWO ENTRIES
15      2       ESF PUMP LINEUP IN RECIRC (1 FOR ZION, 2 FOR SEQUOYAH)--
**              SEE FIGURES FOR THE DIFFERENT LINEUPS IN THE DESCRIPTION
**              OF SUBROUTINE ENGSAF
**@@@REV 18     CORRECTION/EXPANSION OF IDISCH DESCRIPTION:
**              ACCUMS ALWAYS DISCHARGE TO DONCOMER  (BOTH FOR OLD AND
**              GENERALIZED ESF MODELS)
**              FOR OLD MODEL:
**              IDISCH=1 - ALL ESF SYSTEMS EXCEPT ACCUMS DISCHARGE TO COLD LEG
**              IDISCH=2 - ALL SEF SYSTEMS EXCEPT ACCUMS DISCHARGE TO HOT LET
**             IDISCH=3 - ALL ESF SYSTEMS DISCHARGE TO DOWNCOMER BEFORE FILLING
**                          UP COLD LEG
16      1       IDISCH     ESF PUMP DISCHARGE SETUP
17      0       ENTER A 1 FOR B AND W PLANTS, 0 OTHERWISE (NOTE THAT MAAP
**              WAS WRITTEN FOR B AND W PLANTS WHOSE OTSG LOWER TUBESHEETS
**              LIE BELOW THE LEVEL OF THE PRIMARY SYSTEM NOZZLES--THE
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**              OTHER CONFIGURATION IS NOT CURRENTLY ALLOWED)
18      0       FILE NUMBER TO WRITE AUX DATA ON FOR LATER STAND-ALONE
**              AUX RUNS (OR 0 NOT TO WRITE DATA)
19      0       FILE NO. TO READ AUX DATA FROM (IF THIS NUMBER IS NONZERO, ONLY
**              THE AUX BUILDING MODELS ARE RUN, THE INPUT T/H DATA FROM THE
**              CONTAINMENT HAVING BEEN RECORDED FROM A PREVIOUS RUN)
**@@@@@@@@@DETAILS OF AUX BLDG IMPLEMENTATION HAVE CHANGED@@@@@@@@@@@@@
20      0       NUMBER OF NODES IN THE AUX BUILDING (IF 0, THE AUX BLDNG
**              MODELS ARE NOT RUN, BUT A FILE MAY STILL BE CREATED FOR
**              SUBSEQUENT STAND-ALONE AUX BUILDING ANALYSES BY SUPPLYING
**              A NONZERO NO. FOR ITEM 18)--MAXIMUM OF 9 NODES
**              (SEE *AUX SECTION)
**21-26 NOT USED
**@@@@@@@@@@@@@@@@@@@@@@NEW@@@@@@@@@@@@@@@@@@@@@@@@
**
**      JKB             3-6-91
**@@@REV 16, MUST USE 12 FP GROUPS SINCE TE GOES TO GROUP 11
**
**      JKB             3-6-91
27     12       MAXIMUM NO. OF FISSION PRODUCT GROUP YOU WANT TO MODEL--
**              NORMALLY THE MAXIMUM NO. MODELLED (12) IS USED; USING
**              SMALLER NOS. SPEEDS EXECUTION AT THE EXPENSE OF NOT MODELLING
**              THE MORE OBSCURE FP GROUPS; NOS. LESS THAN 6 SHOULD BE USED
**              WITH CAUTION (SEE GROUPING SCHEME IN FISSION PRODUCT SECTION
**              BELOW); IN PRINCIPLE AS FEW AS 3 GROUPS COULD BE REPRESENTED
**
**@@@REV 3, NEW ADDITIONS FOR INTEGRATOR (#28 THRU #31)
**
28      1       JNTGRT = 1 : USE CONSISTENT TIMESTEPS BETWEEN
**                           DIFFUN (ICALL=3) AND INTGRT
**              JNTGRT = 0 : USE THE SMALLER OF THE DIFFUN (ICALL=3) TIMESTEP
**                           AND THE LIMITING ONE IN INTGRT AS IS NOW
**
29       0      ITDLIM = 1 : UTILIZE USER-INPUT CRITICAL PARAMETERS
**                           IN DETERMINING THE LIMITING TIMESTEP
**              ITDLIM = 0 : UTILIZE ORIGINAL HARDWIRED CRITICAL PARAMETERS
**
30       0      ISORT  = 1 : SORT OUT NEW FIGURES OF MERIT
**                     = 0 : NO SORTING
**
**@@REV 18:  31 AND 32 ARE NEW
31       0      IBALAN = 0 : DON'T WRITE MASS AND ENERGY BALANCES
**                           IF SPECIFY IBALAN GREATER THAN ZERO, MASS AND
**                           ENERGY BALANCES WILL BE WRITTEN TO UNIT IBALAN
**                           FOR EXAMPLE, IF IBALAN=55, INFO WILL BE
**                           WRITTEN TO UNIT 55
32       0      IRSBAD = 0 : DON'T WRITE RESTART FILES WHEN RATES GO BAD
**                       1 : WRITE RESTART FILES IF MORE THAN 3 OCCASIONS
**                           OF BAD RATES IN SAME ROUTINE & CONTINUE EXECUTION
**                       2 : WRITE RESTART FILES IF MORE THAN 3 OCCASIONS
**                           OF BAD RATES IN SAME ROUTINE & STOP EXECUTION.
**                                                                      N.
**@@@ REV 18, DBM, 11/26/91,  ADDED NEW CONTROL OVER OUTPUT
** PRIOR TO THIS REVISION, TABULAR OUTPUT WAS SENT TO THE TABULAR OUTPUT FILE
** AT USER-SPECIFIED TIME INTERVAL AND WHENEVER IEVNT(320) WAS SET TRUE.  WHILE
** THESE OPTIONS ARE STILL SUPPORTED, THE USER NOW HAS THE ABILITY TO CONTROL
** WHAT OUTPUT SHOULD BE INCLUDED AND TO WHICH UNIT EACH BLOCK OF OUTPUT SHOULD
** BE SENT.  A NEW ARRAY, IPSET1, ALLOWS THE USER THIS CONTROL.  DEFAULT VALUES
** WITHOUT THIS CHANGE TO THE PARAMETER FILE.  NEVERTHELESS, VALUES OF
** IPSET1(I), WHERE I IS THE BLOCK INDEX, CAN BE SET HERE.
**
** EXAMPLES:
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** IPSET1(6)=9  --  BLOCK #6 WILL BE SENT TO UNIT 9 (OUTPUT FILE)
** IPSET1(15)=40 --  BLOCK #15 WILL BE SENT TO UNIT 40
** IPSET1(12)=6  --  BLOCK #12 WILL BE SENT TO UNIT 6 (LOG FILE)
** IPSET1(8)=0   --  BLOCK #8 WILL NOT BE INCLUDED IN ANY OUTPUT
**
** THE STANNARD OUTPUT UNIT IS 9.  OUTPUT BLOCKS CAN BE SENT TO ANY LEGAL
** FORTRAN UNIT THAT IS EITHER SET ASIDE BY MAAP FOR OUTPUT (EG., UNIT 9) OR
** OTHERWISE UNASSIGNED (EG., UNIT 40 FOR PWR).  THE UNIT NUMBER SHOULD NEVER
** BE NEGATIVE.
** IPSET1(I) VALUES USED DURING STANDARD OUTPUT CALLS
**          IPSET1(I) = 0 : SUPPRESS BLOCK I OUTPUT
**          IPSET1(I) > 0 : UNIT NUMBER TO RECEIVE OUTPUT
**
**IPSET1(1)  =9   PRIMARY SYSTEM/PRESSURIZER CONDITIONS
**IPSET1(2)  =9   PRIMARY LOOP DETAILS
**IPSET1(3)  =9   CORE TEMPERATURES
**IPSET1(4)  =9   CORE NODE MASSES
**IPSET1(5)  =9   CLADDING STRAINS
**IPSET1(6)  =9   TOTAL FISSION PRODUCT MASS IN CORE
**IPSET1(7)  =9   TOTAL STRUCTURAL MATERIAL MASS IN CORE
**IPSET1(8)  =9   RELEASE RATE OF MATERIAL
**IPSET1(9)  =9   PRIMARY SYSTEM FISSION PRODUCT MASSES
**IPSET1(10) =9   STEAM GENERATORS
**IPSET1(11) =9   EVENT CODES
**IPSET1(12) =9   COMPARTMENT CONDITIONS
**IPSET1(13) =9   FISION PRODUCT MASSES
**IPSET1(14) =9   RESERVED FOR AUX. BUILDING
**IPSET1(15) =9   FIGURES OF MERIT
**IPSET1(16) =9   RESERVED
**IPSET1(17) =9   RESERVED
**IPSET1(18) =9   RESERVED
**IPSET1(19) =9   RESERVED
**IPSET1(20) =9   RESERVED
**
** IPSET2(I) -- ARRAY FOR DIRECTED OUTPUT CALLS, CONTROLLED INTERNALLY
**          IPSET2(I) = 0 : SUPPRESS BLOCK I OUTPUT
**          IPEST2(I) > 0 : UNIT NUMBER TO RECEIVE OUTPUT
**
** IPSET2(I) IS CONTROLLED BY THE "PRINT BLOCK" DIRECTIVE.  SETTING
**   INITIAL VALUES HERE HAS LITTLE EFFECT SINCE MAAP RESETS ALL VALUES
**   OF IPSET2 TO ZERO AFTER THE FIRST USE OF "PRINT BLOCK"
*************************************************************************
*TIMING DATA   (PARAMETER GROUP #12)
*************************************************************************
**01 NOT USED
**02 NOT USED
**@@@REV 18 - WARNING: TDMAX IS USED AT THE BEGINNING OF A RUN TO
**            NODALIZE CERTAIN COMPONENTS.  USERS CAN CHANGE TDMAX
**            DURING A RUN, BUT THEY SHOULD NOT CHANGE IT TO A VALUE
**            GREATER THAN THE VALUE USED AT THE BEGINNING (CHANGING IT
**            TO A HIGHER VALUE COULD RESULT IN NUMERICAL PROBLEMS.)
03     20.0     TDMAX    MAX TIME STEP (ALWAYS INPUT IN SECONDS)
04    0.005    MINIMUM TIME STEP (ALWAYS INPUT IN SECONDS)
**TIME SELECTION ALGORITHMS ARE EXPLAINED IN THE WRITE-UPS FOR SUBROUTINES
**INTGRT (T/H MODELS) AND INTGFP (FISSION PRODUCT MODELS)
**@@@REV 16, #05 MFCHMX REDUCED FOR BETTER NUMERICAL PERFORMANCE
**            BE SURE TO USE AT LEAST THIS VALUE
05  0.025      MFCHMX   RELATIVE MASS CHANGE USED TO SELECT TIME STEP
06   0.05      MINIMUM INTER-NODE FISSION PROD MASS EXCHANGE (UNITS OF
**             MASS) CONSIDERED WHEN PICKING TIME STEP IN FISSION
**             PRODUCT MODELS
07   0.02      RELATIVE GAS TEMPERATURE CHANGE USED TO SELECT TIME STEP
```

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**@@@REV 17, #08 REDUCED FOR BETTER NUMERICAL PERFORMANCE
08  0.025      MFCHFP   RELATIVE MASS CHANGE FOR FISSION PRODUCTS USED TO
**             STEP IN FISSION PRODUCT ROUTINES
** CARDS 09-17 NOT USED
**
**@@@REV 17, #18 ADDED FOR HALFLOOP
18  0.01       FPPSHL   RATE OF ALLOWED PRIMARY SYSTEM PRESSURE CHANGE
**                      CONTROLLING TIMESTEP
**
*************************************************************************
*STEAM GENERATOR, VALUES REFER TO ONE UNIT   (PARAMETER GROUP #13)
*************************************************************************
01    5701.1     TOTAL SECONDARY SIDE FREE VOLUME, EG OUT TO THE MSIV'S
02     6.1       DOWNCOMER CROSS-SECTIONAL FLOW AREA
03    55.9       TUBE BUNDLE (SECONDARY SIDE) FLOW AREA
04    0.0        B AND W ONLY--ELEVATION OF AUX FEED SPRAY HEAD ABOVE
**               THE TOP OF THE LOWER TUBESHEET
05    911647.0   INITIAL MASS IN CONDENSATE STORAGE TANK--OR A LARGE
**               NO. IF NO LIMIT ON AFW SUPPLY
06    42.2       2-PHASE WATER LEVEL IN TUBE BUNDLE AT THE SEC SIDE
**               INVENTORY SUPPLIED IN THE *INITIAL CONDITIONS SECTION;
**               THIS IS USED TO ADJUST THE VOID FRACTION DISTRIBUTION
**               IN THE TUBE BUNDLE SO AS TO APPROXIMATELY MAKE UP FOR
**               SIMPLIFICATIONS IN THE MAAP MODEL ; THE CORRECTION
**               SHOULD MOST IMPACT LOSS OF FEED SEQUENCES
07    440.0      MAIN FEEDWATER TEMPERATURE
08    1100.0     LOWEST SETPOINT OF SECONDARY SAFETY VALVES
09    1150.0     HIGHEST SETPOINT OF SEC SAFETY VALVES
10    5.0        NUMBER OF SAFETY VALVES PER S/G
11    855084.0   NOMINAL FLOWRATE OF A SAFETY VALVE AT THE SETPOINT
12    1040.0     SETPOINT OF SEC RELIEF VLV (ASSUMED SAME FOR ALL RELIEFS)
**IF NO "RELIEF VALVES"--SUPPLY A SET POINT PRESSURE HIGHER THAN THE
**SAFETIES AND USE THE RELIEFS AS MANUALLY CONTROLLED STEAM DUMPS
13    1.0        NUMBER OF RELIEF VALVES PER S/G
14    425244.0   NOMINAL FLOWRATE OF A RELIEF VALVE
15    6.992E6    MAX FEEDWATER FLOWRATE PER S/G
**INCLUDE THAT PORTION OF THE TUBE VOLUME WHICH IS NOT COOLED (IE IS INSIDE
**THE TUBESHEET(S)) IN ITEM 16
16    342.7      TOTAL (BOTH PLENA FOR OTSG'S) PRIMARY HEAD(S) VOLUME--
**MAIN STEAM ISOLATION VALVE (MSIV) CLOSURE, MAIN FEEDWATER SHUTOFF,
**AND AUX FEEDWATER ACTUATION ARE ASSUMED TO OCCUR AT REACTOR SCRAM
**UNLESS DEFEATED WITH APPROPRIATE EVENT CODES
17    .0167      TIME DELAY FOR ACTIVATION OF AUX FEED AFTER SCRAM
18    1.94E-3    TIME REQUIRED FOR MSIVS TO LINEARLY RAMP FROM OPEN
**               TO CLOSED
19    1112.92    TOTAL PRIMARY SIDE VOLUME OF ONE STEAM GENERATOR
**@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@NEW@@@@@@@@@@@@@@@@@@@@@@@@@
20    1.769      TUBESHEET THICKNESS
21    75.0       AUX FEED TEMPERATURE
22     3388.0    NUMBER OF TUBES IN A STEAM GENERATOR
23    0.0042     THICKNESS OF STEAM GENERATOR TUBES
24    0.065      ID OF STEAM GENERATOR TUBES
25     10.4      THERMAL CONDUCTIVITY OF STEAM GENERATOR TUBES
26     1.E6      THROTTLED AUX FEED FLOW PER S/G IN THE UNBROKEN
**               LOOP(S) OR LARGE NUMBER IF FLOW NOT THROTTLED (SEE
**               DISCUSSION AFTER ENGIN. SAFEGUARDS ITEM 151)
27     1.0       FRACTIONAL AREA USED FOR STEAM DUMPS IN BROKEN LOOP S/G
28     1.0       FRACTIONAL AREA USED FOR STEAM DUMPS IN UNBKN LOOPS S/GS
**STEAM GENERATOR WATER LEVEL CONTROL (SGWLC) SYSTEM PARAMETERS:
29    30.2       DOWNCOMER PROGRAM WTR LEVEL FOR STEAM GENERATOR WATER
**               LEVEL CONTROL SYSTEM IN BROKEN LOOP S/G
30    30.2      DOWNCMR PROG WTR LVL FOR SGWLC SYSTEM IN UNBKN LOOP S/GS
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31   10.78     STEAM GENERATOR TUBESHEET DIAMETER
**FOR TMI ACCIDENT SIMULATION IT WAS NECESSARY TO INCORPORATE A BANG-BANG
**MODE OF S/G WATER LEVEL CONTROL--IE OPERATOR CONTROLS THE WATER LEVEL
**IN AN OSCILLATORY WAY WITHIN A DEADBAND; MOST USERS WILL NOT WISH
**TO USE THIS MODE AND SHOULD LEAVE THE NEXT THREE ENTRIES EQUAL TO 0
32   0.0           B-LOOP SGWLC DEADBAND
33   0.0           A-LOOP SGWLC DEADBAND (NONZERO VALUE ACTUATES
**                 BATCH FEED MODE)
34   0.0           FOR BANG-BANG MODE, THE MINIMUM AFW FLOWRATE PER S/G TO
**                 BE USED ON THE DECREASING CYCLE
35   0             MAIN STEAM LINE BREAKS CAN BE SIMULATED:ENTER 0 FOR NO
**                 MAIN STEAM LINE BREAK; 1 DIRECTS STEAM FROM BROKEN
**                 LOOP S/G TO CONTMT; 2 DIRECTS STEAM FROM ALL S/GS TO
**                 CONTMT--SEE ALSO ITEM 44 BELOW
36    59.7         TOTAL HEIGHT OF S/G SHELL ABOVE TUBESHEET
**@@@@@@@@@@@@@@@@@@@@@@DEFINITION CHANGE@@@@@@@@@@@@@@@@@@@@@@@@@@
37   415500.0      MASS OF S/G SHELL
38    12           NUMBER OF PLATES IN REFLECTIVE INSULATION ON S/G SHELLS OR
**                 CODE INDICATING OTHER INSULATION TYPE (SEE PRIMARY SYSTEM
**                 INPUT NO. 71)
**@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@FOLLOWING ARE NEW@@@@@@@@@@@@@@@@@@@@@@@
39    4            ENTER A 4 FOR BREAK IN HOT SIDE OF S/G OR 5 FOR BREAK
**                 IN COLD SIDE--USE 5 FOR B AND W OTSGS
40    0.0          AREA OF PRIMARY SYTEM TO S/G BREAK
41    1.0          ELEVATION OF BREAK (IF ANY) ABOVE TUBESHEET
42    497.3        SEDIMENTATION AREA OF ONE S/G
43    1.E6         THROTTLED AUX FEED FLOW TO THE S/G IN THE BROKEN LOOP OR
**                 A LARGE NUMBER IF FLOW NOT THROTTLED (SEE DISCUSSION
**                 AFTER ENGIN. SAFEGUARDS ITEM 151)
44    0.0          FLOW AREA PER S/G USED TO COMPUTE GAS FLOWS TO CONTMT WHEN
**                 A MAIN STEAM LINE BREAK OCCURS
**
**@@@REV 18: 45-65 ARE NEW SG DOWNCOMER VOLUME VS HEIGHT
45    6.0          NZPTS       NUMBER OF POINTS IN HEIGHT VS VOLUME FOR SG
**                             DOWNCOMER (MAX = 10)
46    0.0          VOFZSG(1)   FIRST POINT, CORRESP TO ZOFSG(1)
47    1800.        VOFZSG(2)   SECOND POINT, CORRESP TO ZOFSG(2)
48    2400.        VOFZSG(3)   THIRD POINT, CORRESP TO ZOFSG(3)
49    3900.        VOFZSG(4)   FOURTH POINT, CORRESP TO ZOFSG(4)
50    5250.0       VOFZSG(5)   FIFTH  POINT, CORRESP TO ZOFSG(5)
51    5701.0       VOFZSG(6)   SIXTH  POINT, CORRESP TO ZOFSG(6)
**51    0.0          VOFZSG(6)  SIXTH  POINT, CORRESP TO ZOFSG(6)
**52    0.0          VOFZSG(7)  SEVENTH POINT, CORRESP TO ZOFSG(7)
**53    0.0          VOFZSG(8)  EIGHTH POINT, CORRESP TO ZOFSG(8)
**54    0.0          VOFZSG(9)  NINTH  POINT, CORRESP TO ZOFSG(9)
**55    0.0          VOFZSG(10) TENTH  POINT, CORRESP TO ZOFSG(10)
**
56     0.0           ZOFSG(1) FIRST POINT, REFERENCED TO BOTTOM OF TUBESHEET
**                             (LOWER TUBESHEET IN B&W PLANTS)
**                              CORRESPONDS TO VOFZSG(1)
57    30.0           ZOFSG(2)   SECOND POINT CORRESP TO VOFZSG(2)
58    36.7           ZOFSG(3)   THIRD POINT CORRESP TO VOFZSG(3)
59    45.8           ZOFSG(4)   FOURTH POINT, CORRESPONDS TO VOFZSG(4)
60    55.8           ZOFSG(5)   FIFTH POINT, CORRESPONDS TO VOFZSG(5)
61    60.0           ZOFSG(6)   SIXTH POINT, CORRESPONDS TO VOFZSG(6)
**62   0.0           ZOFSG(7)   SEVENTH POINT, CORRESPONDS TO VOFZSG(7)
**63   0.0           ZOFSG(8)   EIGHTH POINT, CORRESPONDS TO VOFZSG(8)
**64   0.0           ZOFSG(9)   NINTH POINT, CORRESPONDS TO VOFZSG(9)
**65   0.0           ZOFSG(10)  TENTH POINT, CORRESPONDS TO VOFZSG(10)
**
*************************************************************************
*CORE   (PARAMETER GROUP #14)
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************************************************************************
01   0.0312    FUEL PIN OUTER DIAMETER
02   41289.0   INTIAL ZIRCALLOY MASS
03   45373.0   NUMBER OF FUEL PINS
04   181128.0  TOTAL UO2 MASS
**ITEM 5 MUST BE ABOVE THE ELEVATION SUPPLIED FOR THE TOP OF THE RV HEAD
**IN THE PRIMARY SYSTEM SECTION
05   9.84      ELEVATION OF BOTTOM OF ACTIVE FUEL ABOVE BOTTOM OF VESSEL
06   21.84     ELEVATION OF TOP OF ACTIVE FUEL ABOVE BOTTOM OF VESSEL
07   1.028E4   TIME OF IRRADIATION
08   9870.9E6  FULL POWER
**THE CORE NODALIZATION ADMITS UP TO 70 NODES; IN ADDITION, NO MORE THAN
**20 ROWS MAY BE USED AND NO MORE THAN 7 RINGS OR COLUMNS
**WHATEVER NODALIZATION IS USED, INSERT PEAKING FACTORS INTO APPROPRIATE
**ENTRY NUMBERS (EG SECOND RING FROM INSIDE RADIAL PEAKING FACTOR IS
**ALWAYS ITEM 32 NO MATTER HOW MANY AXIAL NODES)
**TOP NODE IS UNFUELED (FISSION GAS PLENUM ETC) AND MUST HAVE ZERO PEAKING
**FACTOR
**              JKB 3-6-91
**@@@REV 16, USER GUIDANCE ON NODALIZATION:
**
**     FINER AXIAL NODALIZATION SEEMS MORE APPROPRIATE THAN FINE
**     RADIAL NODALIZATION, THOUGH BY NO MEANS IS THERE A CLEAR
**     "CORRECT" NODALIZATION SCHEME.  PERHAPS TEN NODES AT A MINIMUM
**     SHOULD BE USED AXIALLY.  AXIAL GRADIENTS STRONGLY INFLUENCE
**     ZIRC OXIDATION AND MELT PROGRESSION.  THERE ARE NOT STRONG
**     RADIAL GRADIENTS DUE TO FLUID MIXING AND RADIATION HEAT TRANSFER,
**     SO COARSER NODALIZATION FOR INNER RINGS IS OK.  THE OUTER RINGS
**     EXHIBIT GRADIENTS, DUE TO HEAT LOSSES TO THE SHROUD, AND
**     IN GENERAL TO LOW PEAKING FACTORS.  THEREFORE, 7 RINGS IS
**     PERHAPS AN OVERKILL IN RADIAL NODALIZATION.
**
**     IN GENERAL, SINCE REDUCING THE NUMBER OF NODES WILL REDUCE THE
**     RUN TIME, LESS THAN 70 NODES IS DESIRABLE.  FOR EXAMPLE, USING
**     15 AXIAL NODES AND 4 RADIAL RINGS GIVES 60 TOTAL NODES, LESS
**     THAN THE LIMIT BUT STILL A LARGE NUMBER, AND
**     PUTS EMPHASIS ON AXIAL VERSUS RADIAL NODALIZATION, SO
**     IT COULD BE A GOOD COMPROMISE.
**
**     SOME SENSITIVITY STUDY TO NODALIZATION IS APPROPRIATE FOR
**     CASES IN WHICH THE EXTENT OF DEBRIS ENTRAINMENT, DIRECT
**     CONTIANMENT HEATING, CORE-CONCRETE ATTACK, DEBRIS
**     COOLABILITY EX-VESSEL, AND TIMING OF FIRST CORE MELT ARE IMPORTANT.
**
**              JKB 3-6-91
09    7.0      NUMBER OF RINGS
10    10       NUMBER OF ROWS
11    0.66     AXIAL PEAKING FACTOR   BOTTOM
12    1.01     AXIAL PEAKING FACTOR
13    1.14     AXIAL PEAKING FACTOR
14    1.21     AXIAL PEAKING FACTOR
15    1.24     AXIAL PEAKING FACTOR
16    1.22     AXIAL PEAKING FACTOR
17    1.12     AXIAL PEAKING FACTOR
18    0.91     AXIAL PEAKING FACTOR
19    0.52     AXIAL PEAKING FACTOR
20    0.0      AXIAL PEAKING FACTOR   TOP
**ENTRIES 21-30 AXIAL PEAKING FACTORS NOT USED IN THIS NODALIZATION
31    1.187    RADIAL PEAKING FACTOR    INSIDE
32    1.350    RADIAL PEAKING FACTOR
33    1.121    RADIAL PEAKING FACTOR
34    1.156    RADIAL PEAKING FACTOR
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35    1.266    RADIAL PEAKING FACTOR
36    1.019    RADIAL PEAKING FACTOR
37    0.480    RADIAL PEAKING FACTOR    OUTSIDE
**                          JKB 3-6-91
**@@@REV 16, USER GUIDANCE NOTE ON AREA FRACTIONS:
**
**    THIS CORE NODALIZATION WAS RETAINED FOR CONSISTENCY WITH PREVIOUS
**    VERSIONS FOR NUMERICS EVALUATION,  BUT REALISTICALLY SHOULD BE
**    CHANGED.  AREA FRACTIONS SHOULD NOT DIFFER DRAMATICALLY FROM
**    THE AVERAGE NUMBER GIVEN BY 1/(NUMBER OF RINGS).
**    AREA FRACTIONS SHOULD NOT BE (MUCH) LOWER
**    THAN 8% OF A CORE (EVEN IF 7 RINGS ARE USED) AND SHOULD NOT
**    BE MUCH LARGER THAN THE AVERAGE (HERE 20% WOULD BE AN UPPER
**    BOUND FOR 7 RINGS).  FOR EXAMPLE, A NICE CHOICE OF AREA
**    FRACTIONS FOR THE 7 RING CORE MIGHT BE 0.1,0.1,0.1,
**    0.15,0.15,0.2,0.2 SINCE THE AVERAGE NUMBER IS 0.143.
**
**                          JKB 3-6-91
38    0.083    AREA OR VOLUME FRACTIONS    INSIDE
39    0.076    AREA OR VOLUME FRACTIONS
40    0.102    AREA OR VOLUME FRACTIONS
41    0.178    AREA OR VOLUME FRACTIONS
42    0.178    AREA OR VOLUME FRACTIONS
43    0.127    AREA OR VOLUME FRACTIONS
44    0.255    AREA OR VOLUME FRACTIONS    OUTSIDE
**FOLLOWING QUANTITIES CONTROL ANSI DECAY HEAT CALCULATION
**@@@REV 18  CHANGED VALUES OF #45 TO 51
**QUANTITIES 45 TO 51 CONTROL ANSI DECAY HEAT CALCULATION
** *************** OLD VALUES ****************
**45      33000    EXPO     FUEL EXPOSURE AT SCRAM (ALWAYS IN
**                 MEGAWATT-DAYS/METRIC TON NO MATTER WHAT UNITS SELECTED)
**46     .3          FALPHA  FUEL "ALPHA" AT SHUTDOWN (FISSILE ISOTOPE
**                 CAPTURES/FISSION)
**47      .032     ENRCH    INITIAL ENRICHMENT OF FUEL IN ATOM FRACTION
**48     .6D0      FCR      CONVERSION RATIO (PRODUCTION RATE OF U-239/ABSORPTION
**                          RATIO IN FISSILE ISOTOPES) AT SHUTDOWN
**49     .5D0      FQFISS(1) FRACTION OF FISSION POWER MADE DUE TO FISSIONS IN
**                          U-235 AND PU-241 AT SHUTDOWN
**50     .42       FQFISS(2) SAME AS 43 FOR PU-239
**51     .08       FQFISS(2) SAME AS 43 FOR U-238 (FAST FISSIONS)
** ****************NEW VALUES ****************
** NOTE:  THE TYPICAL RANGES FOR PARAMETERS FALPHA,FCR,FQFISS'S ARE COMPILED
**        FROM A DATA BASE WHICH IS OBTAINED BY RUNNING MIT BRICC CODE WITH
**        DIFFERENT BURNUPS AND CORE CONDITIONS (MIT-BRICC IS COMPARABLE TO
**        LEOPARD)
**        THE MAX DECAY POWER DIFFERENCE BETWEEN ANY TWO SETS
**        { (PMAX-PMIN)/PAVG } WITHIN THE RANGES IS LESS THAN 10% UPTO 36hrs
**        AFTER REACTOR SHUTDOWN
**        THE DATA SHOWN HERE CAN GENERATE THE POSSIBLE MAX DECAY POWER
**        NOTE:  THE NEW VALUES OF FCR AND FALPHA ARE VERY DIFFERENT FROM THE
**        OLD VALUES, HOWEVER, FCR*(1+FALPHA) REMAINS ABOUT THE SAME.  THIS
**        IS BECAUSE THE TOTAL ABSORPTION RATE INSTEAD OF FISSILE
**        ABSORPTION RATE IS USED.
**
45   21000.    EXPO       FUEL EXPOSURE AT SCRAM (ALWAYS IN MEGAWATT-DAYS/
**                        METRIC TON NO MATTER WHAT UNITS SELECTED
**                      FOR EQUILIBRIUM FUEL CYCLE PLANTS, PRACTICAL RANGES ARE
**                        10000 -- 21000 (3-BATCH PLANTS)
**                        12500 -- 25000 (4-BATCH PLANTS)
**
46   1.30      FALPHA     TOTAL CAPTURE RATE / TOTAL FISSION RATE
**                        NOTE:  THE CAPTURE (OR FISSION) RATE IS CALCULATED
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**                            BY INTEGRATING CROSS SECTION*NEUTRON FLUX OVER
**                            ENERGY AND SPACE
**                            THE TYPICAL RANGE IS
**                            3-BATCH (BOC)  0.92 -- 1.09
**                            3-BATCH (EOC)  1.11 -- 1.30
**                            4-BATCH (BOC)  1.01 -- 1.19
**                            4-BATCH (EOC)  1.18 -- 1.37
**
47   .04        ENRCH         INITIAL ENRICHMENT OF FUEL IN ATOM FRACTION
**
48   0.323      FALPHA        TOTAL CAPTURE RATE OF U-238/ TOTAL FISSION RATE
**                            NOTE:  THE CAPTURE (OR ABSORPTION) RATE IS CALCULATED
**                            BY INTEGRATING CROSS SECTION*NEUTRON FLUX OVER
**                            ENERGY AND SPACE
**                            THE TYPICAL RANGE IS
**                            3-BATCH (BOC)  0.296 -- 0.333
**                            3-BATCH (EOC)  0.296 -- 0.323
**                            4-BATCH (BOC)  0.297 -- 0.330
**                            4-BATCH (EOC)  0.299 -- 0.324
**
49   .510       FQFISS(1) FRACTION OF FISSION POWER MADE DUE TO FISSION IN
**                            U-235 AND PU 241 AT SHUTDOWN
50   .405       FQFISS(2) SAME AS 43 FOR PU-239
51   .085       FQFISS(3) SAME AS 43 FOR U-238 (FAST FISSIONS)
**
**             FQFISS(1)=(XFU235+XFPU241)/XFFUEL
**             FQFISS(2)=XFPU239/XFFUEL
**             FQFISS(3)=XFU238/XFFUEL
**            WHERE,
**             XFFUEL=SFU235+XFPU241+XFPU239
**             XFU235=INTEGRATION OF "FLUX*U-235 FISSION X-SECTION"
**                     OVER SPACE AND ENERGY
**             XFPU241=INTEGRATION OF "FLUX*PU-241 FISSION X-SECTION"
**                     OVER SPACE AND ENERGY
**             XFPU239=INTEGRATION OF "FLUX*PU-239 FISSION X-SECTION"
**                     OVER SPACE AND ENERGY
**             XFU238=INTEGRATION OF "FLUX*U-238 FISSION X-SECTION"
**                     OVER SPACE AND ENERGY
**
**   THE TYPICAL RANGES FOR FQFISS(1) AND CORRESPONDING FQFISS(2) AND (3) ARE
**
**                             FQFISS(1)    FQFISS(2)    FQFISS(3)
**        3-BATCH (BOC)  0.630-0.673  0.266-0.249  0.104-0.078
**        3-BATCH (EOC)  0.466-0.510  0.426-0.405  0.108-0.085
**        4-BATCH (BOC)  0.568-0.608  0.327-0.311  0.105-0.081
**        4-BATCH (EOC)  0.436-0.476  0.454-0.437  0.110-0.087
**
52    1.0E-4   FRACTIONAL ZRO2 MASS (COMPARED TO ZR MASS) AT TIME 0
**@@@REV 18  CHANGED VALUE OF XRPEL
53    .01344   XRPEL     FUEL PELLET RADIUS
54    16.4     CORE FLOW AREA IN THE BYPASS AREA BETWEEN THE CORE BAFFLE
**             AND THE CORE BARREL (ENSURE THIS IS CONSISTENT WITH PRI
**             SYSTEM CORE FLOW AREA PARAMETER NO. 5)
**PARAMETERS 55-60 ARE USED FOR CALCULATING BALLOONING (DATA SHOWN IS
**MOSTLY FROM TMI REPORTS)
55  0.001875   CLAD THICKNESS
56   5.4537E-4 GAS VOLUME PER FUEL PIN
57    290.0    AS-BUILT ROOM TEMP FUEL PIN FILL GAS PRESSURE
58    7118.6   CORE SUPPORT PLATE MASS--THIS PLATE IS MELTED BY THE DEBRIS
**             AS IT LEAVES THE ORIGINAL CORE BOUNDARY
59     0.0     FRACTION OF THE TOTAL FUEL PIN GAS VOLUME WHICH IS
**             CONTAINED IN THE LOWER GAS PLENUM OF THE PIN
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60     .457     SAME IN THE UPPER GAS PLENUM
61     6.705    RADIUS OF CORE BAFFLE (2*PI*THIS ENTRY SHOULD BE THE
**              CIRCUMFERENCE OF THE BAFFLE)
62     0.0      "FLOW AREA PER ROW" IN CORE BAFFLE (IMPORTANT ONLY IF
**              IN-VESSEL NATURAL CIRCULATION RETURN LEG IS IN BAFFLE-CORE
**              BARREL ANNULUS--SEE *MODEL)--THIS REPRESENTS THE APPROXIMATE
**              FLOW AREA AVAILABLE AS THE FLOW TURNS SIDEWAYS AND PENETRATES
**              THE CORE
63     0.0      FOR TMI-TYPE GEOMETRIES THE FLOW AREA THROUGH EACH CORE
**              FORMER PLATE IN AXIAL DIRECTION
64     0.0      FOR TMI-TYPE CORES,NUMBER OF CORE FORMER PLATES IN THE
**              BAFFLE-CORE ANNULUS
**@@@REV 18
**  #65-67 ARE STAINLESS STEEL MASS FRACTIONS
**  THE CORE SUPPORT PLATE CONSISTS OF STAINLESS STEEL
**  THIS CONTAINS CHROMIUM WHICH OXIDIZES DIFFERENTLY THAN IRON,
**  AND IS TAKEN INTO ACCOUNT FOR DIRECT CONTAINMENT HEATING
**  AND CORE-CONCRETE INTERACTIONS.
**  USE THE CORE PLATE MASS #58 ABOVE TO REPRESENT ANY STAINLESS
**  STEEL THAT COULD BE ADDED TO DEGRIS, AND USE THESE INPUTS
**  TO SPECIFY THE CHROMIUM CONTENT
**
65  0.78     NFFESS     MASS FRACTION OF FE IN STAINLESS STEEL
66  0.16     MFCRSS     MASS FRACTION OF CR IN STAINLESS STEEL
67  0.06     MFNISS     MASS FRACTION OF NI IN STAINLESS STEEL
**
**
**
**************************************************************************
*QUENCH TANK ("QT" COMPT) OR PZR RELIEF TANK  (PARAMETER GROUP #15)
**************************************************************************
01   1300.0    TOTAL VOLUME, INCLUDING THAT OF THE INITIAL WATER MASS
02   55539.0   INITIAL WATER MASS
03   100.0     FAILURE DIFFERENTIAL PRESSURE OF RUPTURE DISK
04   35.4      HEIGHT OF RUPTURE DISK ABOVE BCOMPT FLOOR
05   190.0     SEDIMENTATION AREA
**           NOTE AS SOON AS RUPTURE DISK FAILS, HOLD-UP
**           IN THE GAS SPACE OF THE QUENCH TANK IS NOT MODELLED
**                                JKB 3-6-91
**@@@REV 17, #06 ADDED
**@@@REV 18, #06 NAME CHANGED FROM QTNODE TO NQT
06   0.0          NQT      LOCATION OF QUENCH TANK
**                          =0, LOCATED IN LOWER COMPARTMENT (BCOMPT)
**                          =1, LOCATED IN ANNULAR COMPARTMENT (DCOMPT)
**
**                                   JKB 3-6-91
**************************************************************************
*UPLENUM (UPPER PLENUM OF ICE CONDENSER--"U" COMPARTMENT)
**************************NOT MODELED FOR NAPS*************************
**************************************************************************
01   0.        VOLUME--ENTER 0 VOLUME FOR LARGE, DRY CONTAINMENTS
**02  CHARACTERISTIC CROSS-SEC AREA OF THE COMPT FOR BURNS
**@@@REV 16, #6 CHANGED   JKB 3-6-91
**03  HEIGHT OF UPPER PLENUM
**04  LIMITING FLOW AREA WHICH COUPLES THE ICE CONDENSER TO THE UPPER
**    COMPARTMENT--IE USE THE LESSER OF THE UPPER PLEN TO UPPER COMPT
**    FLOW AREA OR THAT COUPLING THE UPPER PLEN TO THE ICE COND.
**05  NUMBER OF IGNITERS IN U
**06  AVERAGE DISTANCE OF IGNITERS BELOW THE CEILING OF U
**@@@REV 16, #6 CHANGED              JKB 3-1-91
**07  AVG DISTANCE FROM THE TOP OF UP PLEN TO THE PORTION OF THE
**    CEILING OF THE UPPER COMPT WHICH IS JUST OVER THE EXIT OUT OF U;
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**    THIS IS USED TO CALCULATE LOCAL BURNING IN THE UPPER COMPT
**    INTIATED BY FLAME PROPAGATION OUT OF U
**08  SEDIMENTATION AREA IN U
**
**@@@REV 16, #9 & #10 ADDED   JKB 3-6-91
**09    4.0      XRBRU CHARACTERISTIC RADIUS FOR BURN IN U
**10   10.0      XHBRU CHARACTERISTIC HEIGHT FOR BURN IN U
**                     THIS IS FLOOR TO CEILING (NOT IGNITER TO CEILING)
**
**                                                 JKB 3-6-91
***************************************************************************
*FISSION PRODUCTS  (PARAMETER GROUP #17)
***************************************************************************
**
**FISSION PRODUCTS ARE ENTERED AS ELEMENTS BELOW, ARE TREATED SEPERATELY
**WHEN IN THE CORE AND DEBRIS, AND THEN LUMPED TO THE FOLLOWING
**12 GROUP SCHEME WHEN RELEASED
**GROUP 1 GAS: NOBLES
**GROUP 1 AEROSOL: ALL INERT AEROSOLS
**GROUP 2: CSI
**GROUP 3: TEO2
**GROUP 4: SRO
**GROUP 5: MOO2
**GROUP 6: CSOH
**GROUP 7: BAO
**GROUP 8: LA2O3+PR2O3+ND2O3+SM2O3+Y2O3
**GROUP 9: CEO2
**GROUP 10: SB
**GROUP 11: TE2
**GROUP 12: UO2+NPO2+PUO2
**STRUCTURAL MATERIAL GROUPING SCHEME
**USED IN CORE NODES (TRACKED IN CONTAINMENT AS LUMPED GROUP 1 AEROSOLS)
**GROUP 1:  CD
**GROUP 2:  IN
**GROUP 3:  AG
**GROUP 4:  SN
**GROUP 5:  MN
**
**@@@@@@@@@@DEFINITIONS OF THE FOLLOWING HAVE BEEN CHANGED@@@@@@@@@@@@
**IN THE FOLLOWING, THE DESCRIPTIONS INDICATE THE ASSUMED MOLECULAR WEIGHT
**OF THE ELEMENT; THE TOTAL MASS OF THE ELEMENT (IE INCLUDING ALL OF THE
**ISOTOPES) SHOULD BE ENTERED IN EACH CASE
01   656.3      INITIAL MASS OF XE AS XE-131
02    33.5      INITIAL MASS OF KR AS KR-84
03    31.28     INITIAL MASS OF I  AS I-131
04    36.8      INITIAL MASS OF RB AS RB-86
05   328.0      INITIAL MASS OF CS AS CS-133
06   119.3      INITIAL MASS OF SR AS SR-88
07   153.2      INITIAL MASS OF BA AS BA-138
08    57.3      INITIAL MASS OF Y  AS Y-89
09   171.5      INITIAL MASS OF LA AS LA-139
10   448.2      INITIAL MASS OF ZR AS ZR-91
11     7.05     INITIAL MASS OF NB AS NB-109
12   388.0      INITIAL MASS OF MO AS MO-96
13    92.6      INITIAL MASS OF TC AS TC-99
14   260.4      INITIAL MASS OF RU AS RU-101
15     2.03     INITIAL MASS OF SB AS SB-122
16    63.7      INITIAL MASS OF TE AS TE-128
17   328.0      INITIAL MASS OF CE AS CE-140
18   126.9      INITIAL MASS OF PR AS PR-141
19   428.4      INITIAL MASS OF ND AS ND-144
20    85.1      INITIAL MASS OF SM AS SM-150
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21    64.8      INITIAL MASS OF NP AS NP-237
22  1174.6      INITIAL MASS OF PU AS PU-239
**23 RESERVED FOR FUTURE USE
**24 RESERVED FOR FUTURE USE
**25 RESERVED FOR FUTURE USE
26     345.7    INITIAL MASS OF CD IN CORE (STRUC MATERIAL GROUP 1)
27    1034.4    INITIAL MASS OF IN IN CORE
28    5514.8    INITIAL MASS OF AG IN CORE
29     656.1    INITIAL MASS OF SN IN CORE
30     375.7    INITIAL MASS OF MN IN CORE (STRUC MATERIAL GROUP 5)
*BR
**@@@@@@@@@@@@@@@@@@@@@@@@@@@@MANY OF THE FOLLOWING HAVE BEEN CHANGED@@@@@@@@
**
**@@@REV 18 7/8/91
** INCLUDE DECAY FEACTIONS (FQP(1-12)): COPIED FROM DEFAULT VALUES
**@@@REV 18 11/20/91 BJS   FQP'S ARE THE FRACTIONS OF THE TOTAL
**          DECAY POWER CARRIED BY THE VOLATILE FISSION PRODUCTS.
**          THEIR SUM IS LESS THAN 1- REMAINING FRACTION IS
**          CARRIED BY THE NON-VOLATILE FISSION PRODUCTS.
**
**
31   0.028    FQP(1)    FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 1  (NOBLES)
32   0.151    FQP(2)    FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 2  (CSI)
33   0.0194   FQP(3)    FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 3  (TEO2)
34   0.062    FQP(4)    FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 4  (SRO)
35   0.05     FQP(5)    FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 5  (MOO2)
36   0.1      FQP(6)    FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 6  (CSOH)
37   0.0      FQP(7)    FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 7  (BAO)
38   0.0      FQP(8)    FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 8  (LA2O3)
39   0.0      FQP(9)    FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 9  (CEO2)
40   0.0      FQP(10)   FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 10 (SB)
41   0.0194   FQP(11) FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 11 (TE2)
42   0.0      FQP(12)   FRACTION OF TOTAL DECAY POWER CARRIED BY
**                      SPECIES 12 (UO2)
**
************************************************************************
*MODEL PARAMETERS    (PARAMETER GROUP #18)
************************************************************************
**SEE DISCUSSION IN VOL 1 OF USER'S MANUAL FOR ALLOWABLE LIMITS ON
**MODEL PARAMETER VALUES AND THE DIFFERENT SENSITIVITY ANALYSIS MODES
**
**"SCALE FACTORS" MULTIPLY MODEL PREDICTIONS OF FLOWRATES ETC.--
**THE BEST-ESTIMATE VALUE IS USUALLY 1
*SI
01  0.005       CORIUM FRICTION COEFFICIENT FOR VESSEL ABLATION HEAT
**              TRANSFER (REYNOLD'S ANALOGY) CALCS
**VP02   .002       LEAK-BEFORE-BREAK CONTMT LEAKAGE AREA (IF THE CONTMT STRAIN
**VP**              MODEL IS NOT USED, THIS IS THE AREA USED WHEN THE CONTMT PRESS
**VP**                EXCEEDS THE USER-SUPPLIED FAILURE STRESS)
**@@@REV 3, DEFINITION CHANGE
02  0.002       LEAK-BEFORE-BREAK CONTMT LEAKAGE AREA.  IF THE CONTMT STRAIN
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**              MODEL IS USED, THIS IS THE AREA USED TO CALCULATE THE BREAK
**              FLOW FROM THE CONTAINMENT TO THE ENVIRONMENT.
03   500.0      TIME TO FAIL VESSEL PEN. WELDS AFTER CONTACT WITH CM
**VP04   .093      THE CONTMT FAILURE AREA USED IF THE CONTMT FAILS DUE TO OVER-
**VP**              PRESSURIZATION IN A GROSS MANNER (IE BEFORE THE STRAIN
**VP**             CRITERION IS REACHED AT PENETRATIONS); USED ONLY IF DETAILED
**VP**              CONTAINMENT FAILURE MODEL ACTIVATED
**@@@REV 3, DEFINITION CHANGE
04   9.3E-2     THE CONTMT FAILURE AREA IF THE CONTMT FAILS DUE TO
**              CONTAINMENT PRESSURE EXCEEDING USER SUPPLIED FAILURE
**              PRESSURE; USED ONLY IF SIMPLE CONTAINMENT FAILURE MODEL
**              ACTIVATED
05    1.0       MULTIPLIER OF NORMAL CLAD SURFACE AREA USED IN OXIDATION
**              CALCS TO ACCOUNT FOR STEAM INGRESS AFTER
**              CLAD RUPTURE (MUST BE BETWEEN 1 AND 2)
**JKB 3-6-91
**06    983.D0   CRITICAL FLAME TEMP AT ZERO STEAM MOLE FRACTION
**@@@REV 17, #6 CHANGE NAME AND DEFINITION BY CDW 10/15/90
06   0.1        TDSTX      TIME DELAY AFTER CORIUM CONTACTS FLOOR TO TRIGGER
**JKB 3-6-91
**                         STEAM EXPLOSION, IT'S USED IN EXVIN. NOMINAL VALUE=0.1
**              USED IF NO IGNITION SOURCES; THIS IS MULTIPLIED BY THE
**              WESTINGHOUSE FLAME TEMPERATURE MULTIPLIER CORRELATION
**              FOR NONZERO STEAM MOLE FRACTIONS
07    1.0       SCALE FACTOR FOR FISSION PRODUCT AND INERT AERO RELEASE RATES
**              FROM CORE (SHOULD USE A NO. LESS THAN OR EQUAL TO 1)
08    300.0     NON-RADIATIVE FILM BOIL. HT. TRANS COEFF FROM CM TO POOL
09    850.0     NAT. CIRC. (MCP'S OFF) S/G PRIMARY SIDE FILM RESISTANCE
**              WHEN 2- OR 1- PHASE NATURAL CIRCULATION IS OCCURING
**              IN THE COOLANT LOOPS--NOTE THAT COOLANT VELOCITY AND
**              VOID FRACTION DISTRIBUTION ARE NOT COMPUTED UNDER THESE COND.
**
**@@@REV 17 FAOUT CHANGED FROM 0.2 TO 0.3 BASED ON BENCHMARKING FOR DRG
10   .3         FAOUT      FRACTION OF S/G TUBES CARRYING "OUT" FLOWS IN THE
**                         HOT LEG NATURAL CIRC MODEL (SEE SUBROUTINE HLNC
**                         WRITE-UP); IF YOU WISH TO FORCE THE FLOW OFF, USE
**                         0 (THIS REQUIRES BYPASSING PARAMATER CHECKING BY
**                         USING THE SENSITIVITY ANALYSIS OPTION IBATCH=2);
**                         PARAMETER DOES NOT AFFECT B AND W GEOMETRY UNLESS
**                         0 IS INPUT SINCE OTSG TUBES DON'T PARTICIPATE IN FLOW
**
11     0.1      FRACTION OF S/G TUBES STRUCK BY AFW
12     1.0E3    HT. TRANSFER COEFF BETWEEN MOLTEN CORIUM AND A FROZEN CRUST;
**              USED IN DECOMP AND IN CALCULATIONS WITHIN A MOLTEN POOL IN
**              THE CORE
13     0.0      ENTER A 0 FOR ENTRAINMENT FROM C TO B; 1 FOR C TO A--LATTER
**              GENERALLY USED ONLY IF CAVITY HAS NO INSTRUMENT TUNNEL
**@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@NEW@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
**SCOPING DIRECT CONTMT HEATING MODEL (SUBROUTINE DCH)
14     0.0      FRACTION OF THE ENTRAINED CORIUM MASS WHICH IS ASSUMED TO
**              BE FINELY FRAGMENTED AND TO INTERACT COMPLETELY (SENSIBLE
**              HEAT AND OXIDATION) WITH THE GAS OF THE COMPT TO WHICH IT
**              IS ENTRAINED--CALCS IN IDCOR 85/2 AND IN THE PWR IPE SOURCE
**              TERM REPORT SHOW THAT THIS NO. SHOULD BE LESS THAN ABT .1
**              TYPICALLY
**@@@REV 18, #15 THROUGH 18 NEW DEFINITION:  SS CLAD MODS (ALSO#55)
15   0.0        FSSCL      FSSCL=0 MEANS YOU ARE USING ZIRCALLOY CLAD
**                         FSSCL=1 MEANS YOU ARE USING STAINLESS STEEL CLAD
16  1800.0      TSSMP      MELTING POINT FOR STAINLESS STEEL AND OXIDE
17   1.15       FFEOX      MOLES OF OXYGEN PER MOLE OF IRON IN IRON OXIDE
18  0.6667      FGCSSR     MOLE FRACTION OF HYDROGEN FOR IRON/IRON-OXIDE
**                         EQUILIBRIUM
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**
**JKB 3-6-91
20      1.53    CHURN-TURBULENT CRITICAL VELOCITY COEFFICIENT
21      3.7     DROPLET FLOW CRITICAL VELOCITY COEFFICIENT
22       1.35   SPARGED POOL VOID FRACTION COEFFICIENT
**JKB 3-6-91
**@@@REV 18, SEEMS LIKE FVOL=2 IS BEST VALUE
23   2.0        FVOL       VOLUMETRIC STEAM GENERATION VOID FRACTION COEFFICIENT
**@@@REV 17, #23 DEFAULT VALUE CHANGED FROM 2. TO 1.3, BUT NEEDS FURTHER
**           STUDY TO DETERMINE THE BEST VALUE, THUS KEEP THE 2.0 UNTIL
**           BETTER # COMES UP.
**23   2.0        FVOL      VOLUMETRIC STEAM GENERATION VOID FRACTION COEFFICIENT
**JKB 3-6-91
24      0.5     DEBRIS ENTRAINMENT TIME CONSTANT (UNITS OF TIME)
25      0.9     EMISSIVITY OF WATER
26      0.85    EMISSIVITY OF WALLS
27      0.85    EMISSIVITY OF EQUIPMENT
28      0.85    EMISSIVITY OF CORIUM SURFACE
29      0.6     EMISSIVITY OF GAS
30      0.3     CORE HYDRODYNAMIC LIMIT KUTATELADZE NO. FOR REFLOODING HT
**              AND OXIDATION CALCULATIONS
31     1.0      NUMBER TO MULTIPLY KUTATELADZE CRITERION BY TO REPRESENT
**              DIFFICULTY (GT 1.D0) OR EASE (LT 1.D0) FOR DEBRIS TO GET
**              OUT OF CAVITY
32      3.0     FLOODING CRITICAL VELOCITY COEFFICIENT
**@@@REV 18, #33 FCHF CHANGED TO .1 FROM .14
33      .1      FCHF      FLAT PLATE CHF CRITICAL VELOCITY COEFFICIENT
34      1.0     NUMBER OF VESSEL PENETRATIONS THAT FAIL
**
**              MAAP FLASH ISSUE NO 3 SUGGESTS USE 0.7 FOR PIPE BREAK
**              DISCHARGE LOSS COEFFICIENT
**@@@REV 18, FAI RECOMMENDS USING .75 UNTIL FURTHER NOTICE, AS .7
**           CHANGES RESULTS TO A LARGE DEGREE
35     0.75     FCDBRK   DISCHARGE COEFFICIENT FOR PRIMARY SYSTEM BREAK(S)
**
**"SCALE FACTORS" MULTIPLY MODEL PREDICTIONS--THE BEST-ESTIMATE VALUE
**IS USUALLY 1
36     1.0      SCALE FACTOR FOR BURN VELOCITY CORRELATION
37     1.0      SCALE FACTOR FOR HEAT TRANSFER COEFFICIENTS TO PASSIVE
**              HEAT SINKS
38      2.5     GAMMA SHAPE FACTOR (TO ACCOUNT FOR NON-SPHERICAL SHAPES IN
**              THE COAGULATION EQUATION) USED FOR AEROSOLS
39      1.0     CHI SHAPE FACTOR (TO ACCOUNT FOR NON-SPHERICAL SHAPES IN
**              STOKES LAW) USED FOR AEROSOLS
**@@@REV 17, #40 DEFAULT VALUE WAS CHANGED FROM 3 TO 8.  NO CHANGE IS MADE
** FOR SAMPLE RUNS - FURTHER TESTING IS REQUIRED TO EVALUATE AFFECT OF THE
** CHANGE
40   3.0        FAERDC    RATIO OF AIRBORNE AEROSOL MASS TO THE MASS WHICH
**                        WOULD LEAVE YOU IN STEADY-STATE WITH THE CURRENT
**                        SOURCE STRENGTH;THIS IS USED TO CONTROL SELECTION
**                       OF DECAY VS STEADY-STATE AEROSOL SETTLING CORRELATIONS
**
41      10.0    DECONTAMINATION FACTOR ASSOCIATED WITH THE PASSAGE THROUGH 1
**              METER (REFERENCE LENGTH USED FOR EITHER SET OF UNITS) OF WATER;
**              ASSUME DF IS LINEAR FUNCTION OF DEPTH FOR OTHER DEPTHS
42     0.02     CAPTURE EFFICIENCY OF CONTMT SPRAY FOR AEROSOLS--THIS IS
**              THE FRACTION OF THE TOTAL VOLUME SWEPT BY FALLING DROPS WHICH
**              IS CLEANSED OF AEROSOLS
43     1.0      ABSOLUTE VALUE OF THE DESIRED MULTIPLIER OF CSI AND
**              CSOH VAPOR PRESSURE--ENTER A NEGATIVE NUMBER TO SELECT
**              JANAF CSOH FUNCTION; POS FOR SANDIA CORELLATION (BEST-EST)
44   0.1        FRACTION OF CLAD OXIDIZED WHICH CAUSES CORE TO COLLAPSE ON
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**              REFLOOD (GIVES SMALLER KU FOR HEAT TRANSFER THAN INTACT
**              MODEL) AND  CAUSES CORE GEOMETRY TO CHANGE
**@@@REV 18, #45 FCDDC CHANGED TO .75 FROM 0
45    0.0       FCDDC     FOR B AND W UNITS ONLY, FCDDC CAN BE USED TO LIMIT
**                        THE AMOUNT OF CONDENSATION THAT OCCURS ON A FREE
**                        SURFACE IN THE HORIZONTAL PORTION OF THE COLD LEG
**                        IF 0 IS ENTERED, NO CONDENSATION IS MODELED; THIS
**                        IS WHAT WAS ASSUMED IN EARLIER REVISIONS ON MAAP
**                        AND APPEARS TO BE AT ODDS WITH RELAP RESULTS.  IF 1
**                        IS ENTERED (THE BEST ESTIMATE VALUE), THE AMOUNT
**                        OF CONDENSATION WILL BE THE SMALLER OF THAT COMPUTED
**                        BY A SIMPLE REYNOLD;S ANALOGY MODEL (FOR A DESCRIPTION
**                        SEE EPRI NP-4292, APPENDIX D) AND THAT WHICH WOULD
**                       SATURATE THE FILM OF WATER FLOWING THROUGH THIS PORTION
**                       OF THE COLD LEG.  VALUES X INTERMEDIATE BETWEEN 0 AND 1
**                       WILL LIMIT THE CONDENSATION TO THAT WHICH WILL INCREASE
**                        THE ENTHALPY BY A FRACTION X OF THE TOTAL SUBCOOLING.
**                        VALUES GREATER THAN 1 SHOULD NOT BE ENTERED.
**@@@REV 18, #46 TCLMAX CHANGED TO 1200 FROM 2100
46    1200.0    TCLMAX    TEMPERATURE AT WHICH CLAD FAILS IF IT HASN'T ALREADY
**                        RUPTURED; THIS HALTS FURTHER BALLOONING AND ALLOWS
**                        FISSION PRODUCT RELEASE
47    2.5E5     LATENT HEAT OF U-ZR-ZRO2 EUTECTIC
48    0.25      VOID FRACTION OF A COLLAPSED CORE
49    0.3E-6    SEED RADIUS ASSUMED FOR HYGROSCOPIC AEROSOL GROWTH CALC
**
**@@@REV 17 EXPLANATION FOR #50 FPRAT IS CHANGED, PLEASE READ!
50     -1.0       FPRAT     FISSION PRODUCT RELEASE CORRELATION & CONTROL
**                        ENTER A VALUE TO SELECT CORRELATIONS:
**                          +1 OR -1  NUREG-0772 MODEL
**                          +2 OR -2  IDCOR/EPRI STEAM OXIDATION MODEL
**                        ENTER A SIGN TO SELECT RELEASE LIMITATIONS:
**                          + SIGN: RELEASE RATES DEFINED BY CORRELATIONS
**                          - SIGN: RELEASES FURTHER LIMITED BY SATURATION
**                             VAPOR PRESSURE FOR NONVOLATILES AND STRUCTURE
**                        THE + SIGN IS USEFUL WHEN THE IDCOR BLOCKAGE MODEL
**                        IS SELECTED, SINCE FLOW IN CORE NODES CAN GO TO
**                        ZERO DURING BLOCKAGE, THUS STOPPING RELEASES.
**                        THE - SIGN IS USEFUL WHEN NO BLOCKAGE IS
**                          ALLOWED AND THERE IS ALWAYS BULK FLOW.
**                        THE + SIGN ALSO IS USEFUL FOR SENSITIVITY.
**                        THE - SIGN ALLOWS THE PHYSICAL MECHANISM OF
**                          SATURATION TO BE CONSIDERED FOR RELEASE.
**                        HOWEVER, DIFFUSION COEFFICIENTS, VAPOR
**                          PRESSURES AND GEOMETRY ARE QUITE UNCERTAIN .
**
51   0.0        FTEREL     ENTER A 1 IF TELLURIUM IS RELEASED IN-VESSEL;   0 IF
**                         IS ASSUMED TO BE TOTALLY BOUND UP WITH ZIRCALLOY
**                         (0 IS BEST-EST)
**                         THIS APPLIES TO CUBICOITTI FISSION PRODUCT
**                         RELEASES CALC'S ONLY.  (SEE MODEL PARAMETER
**                         FPRAT #50 ABOVE)  EXPERIMENTAL EVIDENCE HAS
**                         SHOWN THAT SIGNIFICANT AMOUNT RELEASED TE TENDS
**                         TO BIND WITH UNOXIDIZED ZR.  THIS PARAMETER IS
**                         NOT TO BE CONFUSED WITH MODEL PARAMETER FTENUR
**                         (#77) BELOW.
52    2500.0    ASSUMED EUTECTIC MELTING TEMP
**@@@REV 18  OPTION OF SETTING FFRICR GREATER THAN 100 SHOULD NOT BE USED
53    .1        FFRICR     FRICTION COEF FOR AXIAL FLOW USED FOR UPPER PLENUM-
**                         CORE FLOW CALCS;THIS CAN BE ESTIMATED BY
**                         F=2.*DP*RHO/G**2 WHERE (ALL VALUES ARE FOR NORMAL
**                         OPERATION WITH MCP'S ON) DP=CORE PRESSURE DROP.
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**                        RHO=DENSITY OF PRIMARY SYSTEM COOLANT, G=CORE
**                        AVERAGE MASS FLOW PER UNIT AREA (IN BRIT UNITS,
**                      . INCLUDE G0 AND OTHER NECESSARY CONVERSIONS TO MAKE F
**                        DIMENSIONLESS)--USE GT 100 TO ARTIFICIALLY STOP FLOW
**                        (REQUIRES USING THE SENSTIVITY OPTION IBATCH=2)
54    0.0        INSERT 0 IF IN-VESSEL NATURAL CIRCULATION FLOW RETURN LEG
**               IS IN OUTER FUEL ASSEMBLIES (USUAL CASE);INSERT 1 IF RETURN
**               IS DOWN "BYPASS" (IE BAFFLE-CORE BARREL ANNULUS)--THIS WOULD
**               BE EXPECTED ONLY IF THERE WAS A LOT OF FLOW AREA IN THE
**               BYPASS (EG PERHAPS B AND W PLANTS)
**JKB 3-6-91
**@@@REV 18, #55 REINTRODUCED FOR SS CLAD MODS (ALSO SEE #15-#18)
**              BE SURE TO COMMENT THIS OUT IF THE DEFAULT CORE SUPPORT PLATE
**              MODEL IS TO BE USED.
**55    2501.0   TCPFAL    TEMPERATURE OF LOWEST NODE THAT DEFINES
**                         CORE PLATE FAILURE
**@@@REV 17 #55 VFCRBL IS NO LONGER USED DUE TO CHANGE IN SUBRROUTINE GNODE.
**55  NOT USED
**JKB 3-6-91
56     10.0      NO. OF SAMPLES AVERAGED OVER IN NC MODEL (SEE USER'S MANUAL)
**@@@REV 18, #57 CHANGED FROM -.25 TO +.25
**         EPRI SENSITIVITY ANALYSIS (BUT MAKES NO DIFFERENCE, SINCE USED ONLY
**         ONCE IN CODE AND WITH ABSOLUTE VALUE
57     .25       FFRICX    CROSS-FLOW FRICTION COEF IN CORE NATURAL CIRCULATION
**               MODELS (LITERATURE SAYS .25-.45).
58    0.05       FRACTION OF XENON INVENTORY IN THE PELLET-CLAD GAP DUE TO
**               LONG-TERM OPERATION (OFTEN CALLED THE "GAP RELEASE", THIS
**               IS USED IN CALCULATING THE PRESSURE INSIDE THE FUEL PIN FOR
**               BALLOONING CALCS--NUREG 0772 SAYS OBSERVED VALUES ARE 0-0.25)
59    0.59       VOID FRACTION IN PRIMARY SYSTEM ABOVE WHICH THE PHASES
**               SEPARATE AND TWO-PHASE NATURAL CIRCULATION STOPS--VALUE
**               SHOWN IS TYPICAL OF FLECHT-SEASET TESTS; AT HIGHER PRESSURES
**               A SMALLER VALUE IS APPROPRIATE; RANGE SEEN IS MAYBE .4 - .6
60     1060.0    TEMPERATURE OF H2 JET ENTERING NON-INERTED COMPARTMENT WHICH
**               IS SUFFICIENT TO CAUSE A LOCAL BURN--FROM HEDL-TME 78-80
**@@@@@@@@@@@@@@@@@@@FOLLOWING ARE NEW@@@@@@@@@@@@@@@@@@@@@@@@
**
**REV1 (START)
**REV1 CHANGES---PARAMETERS #61-63 HAVE CHANGED VALUE
**61      1.       ACTIVITY COEFFICIENT FOR SIO2 IN METOXA EQUILIBRIUM
61     0.01      ACTIVITY COEFFICIENT FOR SIO2 IN METOXA EQUILIBRIUM
**               CHEMISTRY MODEL
62     0.05      ACTIVITY COEFFICIENT FOR SRO
63     0.05      ACTIVITY COEFFICIENT FOR BAO
**REV1 (END)
**
**JKB 3-6-91  COMMENTED OUT THE V15 VALUES
64    1.0E-8     ACTIVITY COEFFICIENT FOR K2O
65   0.1         FCRDR      FRACTION OF ORIGINAL CORE MASS BELOW WHICH THE
**                          REMAINING CORE IS JUST DUMPED INTO REACTOR CAVITY
**                          (ASSUMING VESSEL FAILURE AND DEPRESSURIZATION HAVE
**                          OCCURED) THE MAAP CORE MELT PROGRESSION MODELLING
**                          TENDS TO RESULT IN A SMALL FRACTION OF THE CORE
**                        BEING HELD INDEFINITELY IN THE ORIGINAL CORE BOUNDARIES
**                        WITH HEAT BEING REMOVED CONVECTIVELY AND RADIATIVELY TO
**                         THE REST OF THE PRIMARY SYSTEM; THIS IS NOT CONSIDERED
**                          UNREASONABLE; HOWEVER THE ABILITY OF THE MODEL TO
**                          CORRECTLY COMPUTE HEAT AND GAS FLOW AREAS IS CLEARLY
**                          LIMITED UNDER THESE CONDITIONS AND MANY USERS WILL
**                          FIND IT DESIRABLE TO DUMP THE CORE OUT AT THIS POINT,
**                          IF FOR NO OTHER REASON THAN TO SAVE ON CPU TIME.
**@@@REV 16                 HOWEVER, AFTER THE FULLY MIXED FLOW IMPLEMENTED IN
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**                          "REMIX" FOR REVISION 16, THE CODE MAY NOT DUMP THE
**                          CORE MATERIAL TO THE CAVITY WITH FCRDR=0.5 IN TMLB
**                        . CASES, BECAUSE:
**                          1. THE FULLY MIXED FLOW ENHANCES THE CONVECTIVE HEAT
**                         TRANSFER AFTER RV FAILED WITH THE SAME AMOUNT OF INFLOW
**                          2. AN ASSUMPTION IN CRUST RADIATION FOR OUTER RINGS
**                          THAT PREVENTS THE HOT NODES FROM RADIATING MORE HEAT
**                          THAN IT CAN GENERATE ONCE THE HOT NODES TEMP = 2500K,
**                          BECAUSE THAT SOME NODES REMAINS SOLID WITH MELT TEMP.
**                          FOR TMLB CASES, THE PREVIOUS CODE MELTED JUST ABOVE
**                          50%, THIS REVISION MELTS JUST BELOW 50%. THEREFORE,
**                          FOR TMLB CASES, A 0.6 IS RECOMMENDED IN THE INPUT
**                          DECK TO ASSURE THE CODE DUMPS THE CORE MATERIAL SOME
**                          TIME AFTER RV FAILED AND RESULT IN A CONTNT FAILURE
**                          TIME COMPARABLE TO THAT FROM REVISION 14. AT THE SAME
**                          TIME THESE TWO ASSUMPTIONS WILL BE JUSTIFIED
**
**
**@@@REV 16, #66 CHANGED AFTER RESEARCH FOR DESIGN REVIEW GROUP
66  0.4         FROUPZ      FROUDE NO. USED FOR COUNTER-CURRENT DRAINING OF
**                          PRESSURIZERS THROUGH SURGE-LINE WHEN NO LOOP SEAL
**                          EXISTS
67      0.0     ENTER A 1 TO ACTIVATE THE IDCOR BLOCKAGE MODEL IN THE CORE.
**              AT PRESENT, THIS STOPS OXIDATION AND GAS FLOW THROUGH A CORE
**              NODE AT THE ONSET OF MELTING IN THE NODE. THIS IS MEANT TO
**              REPRESENT THE EFFECTS OF PHENOMENA SUCH AS SURF. AREA TO VOLUME
**              REDUCTIONS AFTER MELTING; FLOW CHANNEL BLOCKAGES, HYDRAULIC
**              DIAMETER REDUCTIONS, AND INCREASES IN SURFACE ROUGHNESS; AND
**              MOVEMENT OF UNREACTED ZIRCALLOY TO LOWER PARTS OF THE CORE.
**              CONSIDERABLE CONTROVERSY SURROUNDS THE USE OF THIS MODEL
**              SINCE IT TENDS TO GREATLY REDUCE THE HYDROGEN SOURCE TERM
**              COMPARED TO NRC (SOURCE TERM CODE PACKAGE) RESULTS.
**              AT PRESENT A CONSENSUS ON THE HYDROGEN SOURCE TERM SEEMS
**              FAR OFF.  TO SEE IF A GIVEN ANALYSIS IS SENSITIVE TO THE
**              SOURCE TERM, ENTERING A 0 (WHICH REQUIRES ACTIVATING THE
**              SENSITIVITY OPTION WITH IBATCH=2) WILL OVER-ESTIMATE THE
**              SOURCE TERM (PROBABLY EVEN WHEN COMPARED TO CODES WHICH
**              ATTEMPT A DETAILED MELT PROGRESSION CALCULATION) SINCE THIS
**              STOPS GAS FLOW THROUGH A NODE AND THUS OXIDATION
**              ONLY IF THE NODE IS COMPLETELY FULL OF MOLTEN MATERIAL.
**
**
**@@@REV 17, SUGGESTED VALUE CHANGE FOR FCRBLK IS 0 (NO BLOCKAGE)
**
**JKB 3-6-91
68  0.33        PRUPACHER-KLETT COLLISION EFFICIENCY (USE .33 FOR P-K MODEL;
**              1 FOR FUCHS)
69     18.0     NUSSELT NO. WHICH GOVERNS HEAT CONDUCTION INTO A SMALL
**              DROPLET (EG FROM CONTAINMENT SPRAYS); AVAILABLE DATA
**              SUGGESTS THAT A CONSTANT VALUE IS FAIRLY ACCURATE
**
**           JKB 3-6-91
**@@@REV 16, # 71 THROUGH #74 ADDED FOR H2 BURNS
71   983.0      TAUTO       AUTOIGNITION TEMPERATURE FOR H2 BURNS
**                          A BURN WILL OCCUR IF THE GAS T EXCEEDS THIS VALUE
**                          NO MATTER WHAT THE H2 CONCENTRATION IS
72   0.75       XSTIA       STEAM MOLE FRACTION TO INERT A H2-AIR-H2O MIXTURE
**                          AT INCIPIENT AUTOIGNITION -- AT TEMPERATURES JUST
**                          BELOW AUTOIGNITION, THIS STEAM MOLE FRACTION WILL
**                          PREVENT A BURN.
73   0.00       DXHIG       OFFSET H2 MOLE FRACTION FOR DEFINITION OF IGNITION
**                         DURING A BLACKOUT SEQUENCE: THIS IS ADDED TO (OR TAKEN
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**                          FROM, IF NEGATIVE) THE DOWNWARD FLAMMABILITY LIMIT
**                          IGNITION (GLOBAL BURNS) WILL OCCUR IF THE H2
**                          MOLE FRACTION EXCEEDS THE LIMIT PLUS THE OFFSET
74   2.0        FLPHI       FLAME FLUX MULTIPLIER (BETWEEN 1.0 AND 10.0)
**                          BEST-ESTIMATE USED FOR CONTAINMENTS IS 2
**                          USE HIGHER VALUES FOR FANS ON
**@@@REV 16, #75  ADDED AS A RESULT OF DESIGN REVIEW GROUP WORK
75   0.115      FWHL        COEFFICIENT IN EQUATION TO CALCULATE THE HOT LEG
**                          NATURAL CIRCULATION FLOW RATE.  IT HAS BEEN CHANGED
**                          FROM 0.09 TO 0.115 AS A RESULT OF BENCHMARKING
**                          EXERCISE.
**@@@REV 17, #76 ADDED FOR A HALFLOOP OPERATION
76   1.0        FHTPRI      MULTIPLIER FOR A PRIMARY SIDE CONDENSATION HEAT
**                          TRANSFER COEFFICIENT DURING REFLUX COOLING.
**@@@REV 17, #77 NEW
77   .90        FTENUR    OXIDIZED ZR MASS FRACTION LIMIT.
**                        THIS APPLIES TO NUREG-0772/KELLY FISSION PRODUCT
**                        RELEASES CALC'S ONLY.  (SEE MODEL PARAMETER FPRAT
**                        #50 ABOVE)  IF CALC'D OXIDIZED ZR NODAL MASS FRAC IS
**                        LESS THAN THIS LIMIT, THEN THE TE RELEASE RATE IS
**                        LIMITED, OTHERWISE THE TE RELEASE RATE
**                        IS NOT, AS RECOMMENDED IN NUREG-0956.  EXPERIMENTAL
**                        EVIDENCE HAS SHOWN THAT SIGNIFICANT AMOUNT OF RELEASED
**                        TE TENDS TO BIND WITH UNOXIDIZED ZR. THIS PARAMETER
**                        IS NOT TO BE CONFUSED WITH MODEL PARAMETER FTEREL
**                        #51 ABOVE.
*BR
*************************************************************************
*************************************************************************
*AUXILIARY BUILDING   (PARAMETER GROUP #19)
********************* NOT MODELED FOR NORTH ANNA **********************
*************************************************************************
**@@@REV 18,  NOTE:  IF YOU ARE RUNNING THE AUX BLDG IN STAND-ALONE MODE
**            AND YOU WANT THE OUTPUT IN BRITISH UNITS, INCLUDE A *BR IN
**            THE *PLTMAP SECTION
**A MAXIMUM OF 9 NODES CAN BE REPRESENTED--THE NO. OF NODES INODRB IS GIVEN
**IN THE *CONTROL SECTION--NOTE THAT NODE INODRB+1 IS THE ENVIRONMENT BUT
**NO INFORMATION NEED BE ENTERED FOR IT
**THE FOLLOWING ARE MODELLED AT PRESENT:
**     1. WATER OVERFLOWS--THE SAME JUNCTIONS ARE USED AS IN THE GAS TRANSFERS
**        AND ARE SPECIFIED IN THE *TOPOLOGY SECTION BELOW; NOTE THAT ENTERING
**        A ONE IN THE APPROPRIATE SPOT MODELS FLOOR DRAINS WHICH INSTANTLY
**        DRAIN ALL ACCUMULATED WATER AWAY
**     2. H2 BURNS
**     3. CO2 FIRE SUPPRESSION SYSTEMS
**     4. SPRAYS
**     5. NATURAL CIRCULATION, BOTH UNIDIRECTIONAL AND COUNTER-CURRENT
**     6. TWO HEAT SINKS/NODE--ONE HEAT SINK REPRESENTS AN "OUTER" WALL WHICH
**        HAS THE NODE IN QUESTION ON ONE SIDE AND A USER-SPECIFIED NODE ON
**        THE OTHER SIDE; THE OTHER HEAT SINK REPRESENTS AN "INNER" WALL WHICH
**        HAS THE NODAL GAS TEMPERATURE ON BOTH SIDES
**
**THE NOS. SHOWN REPRESENT A CRUDE REPRESENTATION OF A MARK II REACTOR BLDG
**
*********************************************************************
** !!!!!!NOTE: INPUTS USED BELOW ARE NOT NORTH ANNA SPECIFIC!!!!!!!
*********************************************************************
**
01   31500       VOLRB(I) FREE VOLUME OF NODE 1
02   7261.0      NODE 2
**NODES 3 AND 4 REPRESENT TWO HALVES OF THE UPPER-MOST VOLUME IN THE RX BLDG
03   11089       NODE 3
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04   10000.     NODE 4
**
**04    AS IN ALL THE ENTRY LOCATIONS ENTER THE VALUES FOR SUBSEQUENT NODES
**      AS NEEDED IN LOCATIONS 04-09 INCLUSIVE--SINCE NODE 10 IS USED, IF
**      AT ALL, ONLY FOR THE ENVIRONMENT, NO ENTRY NEED BE PLACED IN ENTRY 10
**
11   700.0      AREA OF FLOOR IN NODE 1--USED BOTH FOR WATER DEPTH AND TO
**              REPRESENT CHARACTERISTIC DIMENSION OF COMPT FOR BURN TIMES
12   900.0      NODE 2
13   650.0      NODE 3
14   650.0      NODE 4
**EITHER A STEEL OR CONCRETE WALL CAN BE MODELED BY INPUTTING THE
**APPROPRIATE MATERIAL PROPERTIES
21   5274.8    AHSRB(I) ONE-SIDED OUTER WALL AREA FOR NODE 1
22   928.7     NODE 2
23   450.9     NODE 3
24   450.9     NODE 4
31   .6096      XHSRB(I) THICKNESS FOR NODE 1 OUTER WALL
32   .6096      NODE 2
33   .01267     NODE 3
34   .01267     NODE 4
41   1.3       KHSRB(I) THERMAL CONDUCTIVITY OF OUTER WALL IN NODE 1
42   1.3       NODE 2
43   35.0      NODE 3
44   35.0      NODE 4
51  880.       CPHSRB(I) SPECIFIC HEAT OF OUTER WALL IN NODE 1
52  880.       NODE 2
53  472.0      NODE 3
54  472.0      NODE 4
61  43.3       ZHSRB(I) HEIGHT OF OUTER WALL FOR NODE 1
62  7.58       NODE 2
63  15.        NODE 3
64  15.        NODE 4
71  2300.      DHSRB(I) DENSITY OF OUTER WALL IN NODE 1
72  2300.      NODE 2
73  8000.      NODE 3
74  8000.      NODE 4
**THE VENTILATION (OR "SGTS") SYSTEM IS MODELED BY SUPPLYING
**A FORCED OUT FLOW AND/OR A FORCED IN FLOW--IF AC POWER IS AVAILABLE,
**THIS FLOW IS ON UNTIL THE FIRE DAMPER SETPOINT(SEE BELOW) IS
**REACHED IN A COMPARTMENT--THIS SHUTS FLOW DOWN IN THAT COMPT
**FOR RECIRCULATING FLOWS, ENTER THE APPROPRIATE NODE ON THE SUCTION
**SIDE IN FIELDS 161-169
81  0.0        WVORB(I) FORCED VOLUMETRIC
**             (REMEMBER, IN PWR CODE THIS MUST BE M**3/SEC OR GPM)
**             VENTILATION FLOW OUT OF NODE 1
82  0.0        NODE 2
83  0.0        NODE 3
84  0.0        NODE 4
91  0.0        WVIRB(I) FORCED VOLUMETRIC VENTILATION FLOW INTO NODE 1
**             (REMEMBER, IN PWR CODE THIS MUST BE M**3/SEC OR GPM)
92  0.0        NODE 2
93  0.0        NODE 3
94  0.0        NODE 4
101  24949.5   ASEDRB(I) AEROSOL SETTLING AREA FOR NODE 1
102  2381.8    NODE 2
103  680.7     NODE 3
104  680.7     NODE 4
**AEROSOL IMPACTION DATA
**SEE DISCUSSION OF IMPACTION PARAMETERS IN *ANNULAR SECTION ABOVE
**IF IMPACTION IS MODELED IN A NODE, THE IMPACTION AREA, DIAMETER (EG GRATE
**THICKNESS), AND FLOW AREA MUST ALL BE GIVEN
```

```
111  50.        AIMPRB(I) IMPACTION AREA FOR NODE 1
112  50.        NODE 2
113  50.        NODE 3.  .
114  50.        NODE 4
121  0.005      XDIMRB(I) IMPACTION DIAMETER FOR NODE 1
122  0.005      NODE 2
123  0.005      NODE 3
124  0.005      NODE 4
131  700.       AGRARB(I) TOTAL FLOW AREA THROUGH NODE 1 AT THE ELEVATION
**              OF THE GRATING (USED TO CALCULATE THE GAS VELOCITY THROUGH
**              THE GRATING GIVEN MASS FLOWS THROUGH THE NODE)--IF DIFFERENT
**              ELEVATIONS ON WHICH GRATING IS FOUND HAVE DIFFERENT TOTAL
**              FLOW AREAS, USE THE LARGEST TO GIVE SLOWEST VELOCITY FOR
**              CONSERVATISM
132  700        NODE 2
133  650        NODE 3
134  650        NODE 4
**SPRAYS (EG FIRE SPRAYS)--THESE ARE TURNED ON AND OFF MANUALLY USING EVENT
**CODE 240
**THEY WILL ALSO COME ON IF THE NODAL TEMPERATURE EXCEEDS THE SETPOINT
**VALUE INPUT BELOW
141  100        WSPRB(I)  SPRAY MASS FLOW RATE FOR NODE 1
142  100        NODE 2
143  100.       NODE 3
144  100.       NODE 4
151  10.0       XHSPRB(I) SPRAY FALL HEIGHT FOR NODE 1
152  10.0       NODE 2
153  10.0       NODE 3
154  10.0       NODE 4
161   5         NODE NO. THAT THE VOL IN NODE 1 RECEIVES ITS INLET VENT.
**              FLOW FROM; USE INODRB+1 FOR ENVIRONMENT WHERE INODRB IS
**              NO. OF NODES IN THE MODEL; USE SMALLER NOS. IF A
**              RECIRCULATING SYSTEM EXISTS (IE TAKES FROM NODE 1 AND PUTS
**              INTO NODE 4)
162   5         NODE 2
163   5         NODE 3
164   5         NODE 4
171   1         ENTER A ONE TO INSTANTLY DRAIN ALL WATER FROM NODE 1; THIS
**              IS CONVENIENT IF THE BLDG HAS AN EFFICIENT DRAIN SYSTEM THAT
**              PUTS ALL THE WATER INTO A LARGE SUMP (EG SEQUOYAH)--IF 0 IS
**              ENTERED, THE WATER DRAINS THROUGH THE SAME JUNCTIONS USED FOR
**              GAS TRANSFER
172   1         NODE 2
173   1         NODE 3
174   1         NODE 4
181   -3.7      ELEVATION OF FLOOR OF NODE 1 WITH RESPECT TO GROUND LEVEL
182   40.       NODE 2
183   48        NODE 3
184   48        NODE 4
191    .0.      CO2 MASS FLOWRATE FROM FIRE SUPPRESSION SYSTEM, IF ANY
**              THIS SYSTEM IS ACTIVATED IF THE NODAL GAS TEMP EXCEEDS
**              THE SETPOINT SPECIFIED BELOW
192    0.       NODE 2
193    0.       NODE 3
194    0.       NODE 4
201    5000.       AREA OF INTERNAL WALL(S) IN NODE 1
202    5000.       NODE 2
203    5000.       NODE 3
204   0.        NODE 4
211    1.       THICKNESS OF INTERNAL WALL(S) IN NODE 1
212    1.       NODE 2
213    1.       NODE 3
```

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214     0.        NODE 4
221     1.3        THERMAL CONDUCTIVITY OF INTERNAL WALL(S) IN NODE 1
222     1.3        NODE 2 .
223     1.3        NODE 3
224     0.        NODE 4
231     880.        SPECIFIC HEAT OF INTERNAL WALL(S) IN NODE 1
232     880.        NODE 2
233     880.        NODE 3
234     0.        NODE 4
241     10.        HEIGHT OF INTERNAL WALL(S) IN NODE 1
242     10.        NODE 2
243     10.        NODE 3
244     0.        NODE 4
251     2300.        DENSITY OF INTERNAL WALL(S) IN NODE 1
252    2300.        NODE 2
253    2300.        NODE 3
254     0.        NODE 4
261     5         NODE NO. ON THE OTHER SIDE OF THE WALL DESIGNATED
**                AS THE OUTER WALL OF NODE 1;
**                USE INODRB+1 FOR ENVIRONMENT WHERE INODRB IS
**                NO. OF NODES IN THE MODEL; USE SMALLER NOS. IF AN
**                OUTER WALL IN NODE 1 HAS A DIFFERENT NODE ON THE OTHER SIDE;
**
**                FOR DIFFICULT SITUATIONS, IE WHEN A GIVEN NODE'S OUTER WALLS
**                HAVE DIFFERENT NODES ON THEIR OTHER SIDE CONSIDER THE
**                FOLLOWING:
**                FOR CONCRETE WALLS THICKER THAN ROUGHLY 1-2 FEET, THE THERMAL
**                BOUNDARY LAYER DOESN'T PENETRATE THE WALL OVER THE TIME
**                OF TYPICAL TRANSIENTS
**                THUS, ONE CAN TAKE CONCRETE WALL SURFACE AREA
**                (OR FLOORS AND CEILINGS) NOT ACCOUNTED FOR IN THE OUTER WALL
**                ASSIGNMENTS AND LUMP WITH THE TRUE
**                INTERIOR WALLS AS INTERIOR WALLS--THE OTHER SIDE OF SUCH WALLS
**                WOULD THEN BE LUMPED WITH THE INTERIOR WALLS IN THE ADJACENT
**                NODE
262     5         NODE 2
263     4         NODE 3
264     5         NODE 4
**
**INITAL CONDITION DATA AND OTHER DATA WHICH APPLIES TO ALL NODES
271     1.E10     TOTAL INITIAL MASS OF WATER AVAILABLE FOR FIRE SPRAYS
272     500.      TOTAL INITIAL MASS OF CO2 IN FIRE SUPPRESSION SYSTEM
273    305.       INITIAL TEMPERATURE OF AUX BUILDING
274    305.       AUX BLDG SPRAY WATER TEMPERATURE
275    1.D-3      AUX BLDG SPRAY DROP DIAMETER
276    .5         INITIAL REL HUMIDITY OF AUX BUILDING COMPTS
277     300.      ENVIRONMENT TEMP
278    1.D5       ENVIRONMENT/AUX BLDG PRESSURE
279    355.       FIRE DAMPER ACTIVATION TEMP; PUT IN A VERY HIGH NO.
**                IF NO FIRE DAMPERS)
280    800.       FIRE SPRAY ACTIVATION TEMP
281    800.       CO2 INJECTION ACTIVATION TEMP
282    0.EO       MASS OF AEROSOL WHICH CAUSES SGTS FILTERS TO FAIL
283    1.EO       DF USED FOR SGTS FILTERS WHEN THEY ARE INTACT
**
**@@@REV 18,  304-313 ADDED FOR HYDROGEN COMBUSTION
** ITEM 3B16-58
**304   0.DO     XIGRB( 1) NODE 1 AVERAGE ELEVATION OF IGNITERS ABOVE FLOOR
**305     0.DO     XIGRB( 2) NODE 2
**306     0.DO     XIGRB( 3) NODE 3
**307     0.DO     XIGRB( 4) NODE 4
**308     0.DO     XIGRB( 5) NODE 5
```

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**309    0.D0    XIGRB( 6) NODE 6
**310    0.D0    XIGRB( 7) NODE 7
**311    0.D0    XIGRB( 8) NODE 8
**312    0.D0    XIGRB( 9) NODE 9
**313    0.D0    XIGRB(10) NODE 10
**
*********************************************************************
*TOPOLOGY
*********************************************************************
**THIS SECTION DEFINES THE WAYS THAT THE VARIOUS AUX NODES ARE CONNECTED
**TOGETHER--THERE ARE THREE FORMATS FOR ENTERING DATA THAT ARE DESCRIBED
**BELOW; THE LAST CARD IN THIS SECTION MUST BE "END"
**    1. "JUNCTION" CARDS--THIS IS DEFINED BY A CARD WITH A "J" IN COLUMN
**        1 FOLLOWED BY A CARD WITH THE FOLLOWING INFORMATION:
**        A. NODE NO. OF THE VOLUME ON THE UPSTREAM SIDE OF JUNCTION;
**        B. NODE NO. OF DOWNSTREAM VOLUME;
**        C. 1 IF JUNCTION IS IN A HORIZONTAL WALL (IE FLOW IS VERTICAL,
**           USE 0 IF JUNCTION IS IN A VERTICAL WALL);
**        D. ELEVATION OF THE BOTTTOM OF THE JUNCTION ABOVE THE FLOOR
**           OF THE UPSTREAM NODE;
**        E. FACING THE HOLE, THE WIDTH OF JUNCION;
**        F. FACING THE HOLE, THE HEIGHT OF JUNCTION;
**        G. LENGTH OF JUNCTION;
**        H. AREA OF JUNCTION
**
**        NOTE: IF WIDTH=HEIGHT, THE JUNCTION IS ASSUMED CIRCULAR, OTHERWISE
**        RECTANGULAR (USE WIDTH SLIGHTLY DIFFERENT THAN HEIGHT FOR SQUARE)
**        EVEN IF THE JUNCTION IS RECTANGULAR, THE AREA CAN BE DIFFERENT
**        THAN THE PRODUCT OF LENGTH AND WIDTH IF THE JUNCTION REPRESENTS THE
**        SUM OF SEVERAL HOLES WHICH HAVE THE SAME ELEVATION, ETC.
**    2. "FAILURE" CARDS--THIS IS DEFINED BY A CARD WITH AN "F" IN COLUMN
**        1 FOLLWED BY A CARD WITH THE FOLLOWING INFORMATION:
**        A. NODE NO. OF NODE WHICH CAN FAIL (UPSTREAM NODE);
**        B. NODE NO. THAT THE FAILED VOLUME  BLOWS DOWN INTO;
**        C. 1 IF THE JUNCTION IS HORIZ (0 IF VERTICAL);
**        D. ELEVATION OF THE BOTTOM OF THE OPENING ABOVE THE FLOOR OF
**           THE FAILED NODE;
**        E. FACING THE HOLE, THE WIDTH OF JUNCTION;
**        F. FACING THE HOLE, THE HEIGHT OF JUNCTION;
**        G. LENGTH OF JUNCTION;
**        H. AREA OF JUNCTION;
**        I. DIFFERENTIAL PRESSURE REQUIRED TO FAIL THE NODE IF THE UPSTREAM
**           NODE HAS THE HIGHEST PRESSURE
**        J. DIFFERENTIAL PRESSURE REQUIRED TO FAIL THE NODE IF THE DOWNSTRM
**           NODE HAS THE HIGHEST PRESSURE
**
**
**        NOTE: IF WIDTH=HEIGHT, THE JUNCTION IS ASSUMED CIRCULAR, OTHERWISE
**        RECTANGULAR (USE WIDTH SLIGHTLY DIFFERENT THAN HEIGHT FOR SQUARE)
**        EVEN IF THE JUNCTION IS RECTANGULAR, THE AREA CAN BE DIFFERENT
**        THAN THE PRODUCT OF LENGTH AND WIDTH IF THE JUNCTION REPRESENTS THE
**        SUM OF SEVERAL HOLES WHICH HAVE THE SAME ELEVATION, ETC.
**     3. "CONTAINMENT INTERFACE" CARD--ONE SUCH SET OF TWO CARDS SHOULD BE
**        PROVIDED
**        THE FIRST CARD SHOULD HAVE A "C" IN COLUMN ONE;
**        THE SECOND CARD GIVES:
**        A. THE NODE NO. WHICH RECEIVES FLUID FROM THE CONTAINMENT (OR
**           PRIMARY SYSTEM FOR V SEQUENCES) AND
**        B. ELEVATION ABOVE THE FLOOR OF THIS NODE OF THE TOP OF THE
**           JUNCTION THROUGH WHICH THE PRI SYS OR CONTMT EFFLUENT IS ISSUING
**
**        ONLY ONE SET OF THESE SHOULD BE INCLUDED
```

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**
**TO MAKE TEMPORARY CHANGES TO THESE QUANTITIES IN THE CONTROL CARDS USE
**THE FOLLOWING FORMAT; ENTER THE CARD BELOW AND THEN A CARD WITH THE REQ'D
**INFORMATION AS SHOWN BELOW)
**
**JUNCTION CARD:   ENTER  20,1,J (WHERE J IS THE JUNCTION NO. YOU WANT TO
**                               ADD OR CHANGE--NOTE THAT THE JUNCTION NOS.
**                               ARE ASSIGNED CONSECUTIVELY)
**FAILURE CARD:    ENTER  20,2,J (WHERE J IS THE JUNCTION NO.)
**CONTMT INTERFACE CARD: ENTER 20,3,0
**
JUNCTION NODES 1-2
1 2 1  44 8.52   8.53   1.0 72.71
FAILURE OF NODE 3--BOTTOM OF BLOW OUT PANELS
3 5  0   8.0     8   .025    .01267    3.     3080.25    3080.25
FAILURE OF NODE 4--TOP OF BLOW OUT PANELS
4 5  0   16.0    8   .025    .01267    3.     3080.25    3080.25
JUNCTION NODES 2-3
2 3 1 8.0 8.52   8.53  .67  72.71
JUNCTION NODES 3-4 (THESE ARE ON THE SAME LEVEL)
3 4 0  20  8.52   8.53   0.  1300.
CONTAINMENT INTERFACE
2   1.
END
**@@@REV 17, PARAMETER SECTION *APLOT IS OBSOLETE & DELETED
**           IT HAS BEEN REPLACED WITH PARAMETER SECTION *PLTMAP
**
**@@@REV 17, PARAMETER SECTION GENERALIZED ENGINEERED SAFEGUARDS IS NEW
**
************************************************************************
************************************************************************
*GENERALIZED ENGINEERED SAFEGUARDS  (PARAMETER GROUP #21)
************************************************************************
************************************************************************
**@@@REV 18  NOTE:  IN THE CASE OF INJECTION WHEN THERE IS A BREAK, THE
**           INJECTED FLOW IS ASSUMED TO GO THE VESSEL VS. DIRECTLY OUT
**           THE BREAK.  THEN, IF THE WATER LEVEL IS HIGH ENOUGH, WATER
**           FLOW FLOW OUT THE BREAK.  (I.E., THE CODE DOES NOT KNOW IF
**           INJECTION IS UPSTREAM OR DOWNSTREAM OF A BREAK)
**
**IN METRIC UNITS,
**FLOWRATES SPECIFIED TO BE VOLUMETRIC SHOULD BE M**3/SEC; OTHER FLOWRATES
**IE ALL THOSE NOT EXPLICITLY STATED TO BE VOLUMETRIC
**SHOULD BE KG/SEC; HEADS SHOULD BE IN M; PRESSURES IN PA; IN ENGLISH THE
**UNITS ARE RESPECTIVELY GPM,LBM/HR,FT, PSIA--
**NOTE TO MAAP/BWR USERS--GPM IS USED IN MAAP/PWR INSTEAD OF FT**3/HR
**
**IN THE FOLLOWING,"FANS"REFER TO FAN COOLERS--(AIR RETURN FANS IN
**CONDENSER PLANTS)
**
**FOR BETTER ACCURACY, YOU MAY ELECT TO INPUT "SYSTEM" PUMP HEAD CURVES WHICH
**INCLUDE THE EFFECTS OF FRICTION IN THE INLET AND OUTLET PIPING (WHICH IS
**IGNORED IN MAAP); IF YOU DO SO, BE SURE THE ASSUMPTIONS ON STATIC HEAD
**WHICH ARE USED IN THEIR CALCULATION ARE CONSISTENT WITH THE PUMP ELEVATIONS
**ETC. WHICH ARE INPUT BELOW--THIS IS GENERALLY A FACTOR ONLY IN CRITICAL
**APPLICATIONS SUCH AS FEED AND BLEED WHERE THE CHARGING PUMP FLOW IS
**BARELY (OR NOT) ADEQUATE TO MATCH DECAY HEAT
**
**THIS PARAMETER FILE SECTION IS REQUIRED ONLY IF NEW ESF MODELS ARE DESIRED
**
01  1          NESF: ESF MODEL SELECTION
**                   = 0 FOR OLD ESF MODEL ONLY
```

```
**                        = 1 FOR GENERALIZED ESF MODEL ONLY
**
*************************  PUMP 1  **********************************
***            UPPER COMPARTMENT CONTAINMENT SPRAY SYSTEM        ***
***            (QUENCH SPRAY SYSTEM)                             ***
********************************************************************
**
02   2         NSPAG:  NUMBER OF OPERATIONAL UPPER COMPT SPRAY PUMPS
**                     REPRESENTED BY THIS SYSTEM
**
03   1         NORSPA: UPPER COMPT CONTAINMENT SPRAY PUMP
**                     CHARACTERISTICS SELECTION FOR NORMAL LINEUP;
**                     THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                     CHARACTERISTICS SETS DEFINED IN *PUMP #1-40
**
04   3         NSSPA:  WATER SOURCE UNDER NORMAL PUMP LINEUP FOR UPPER
**                     COMPT SPRAY PUMPS
**                     = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                     = 1: HOT LEG
**                     = 2: COLD LEG
**                     = 3: RWST
**                     = 4: LOWER COMPARTMENT SUMP
**                     = 5: ANNULAR COMPARTMENT SUMP
**
05   4         NDSPA:  DISCHARGE LOCATION UNDER NORMAL PUMP LINEUP FOR UPPER
**                     COMPT SPRAY PUMPS
**                     = 1: HOT LEG
**                     = 2: COLD LEG
**                     = 3: DOWNCOMER
**                     = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                     = 5: LOWER COMPARTMENT SPRAY HEADER
**                     = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
06   1         RECSPA: UPPER COMPT CONTAINMENT SPRAY PUMP
**                     CHARACTERISTICS SELECTION FOR RECIRC LINEUP;
**                     THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                     CHARACTERISTICS SETS DEFINED IN *PUMP #1-40
**
07   3         RSSPA:  WATER SOURCE UNDER RECIRC PUMP LINEUP FOR UPPER
**                     COMPT SPRAY PUMPS
**                     = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                     = 1: HOT LEG
**                     = 2: COLD LEG
**                     = 3: RWST
**                     = 4: LOWER COMPARTMENT SUMP
**                     = 5: ANNULAR COMPARTMENT SUMP
**
08   4         RDSPA:  DISCHARGE LOCATION UNDER RECIRC PUMP LINEUP FOR UPPER
**                     COMPT SPRAY PUMPS
**                     = 1: HOT LEG
**                     = 2: COLD LEG
**                     = 3: DOWNCOMER
**                     = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                     = 5: LOWER COMPARTMENT SPRAY HEADER
**                     = 6: INLET OF HPI PUMP
**                     = 7: INLET OF CHARGING PUMP
**                     = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                     = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
09   0        SNPSPA:  NPSH ENHANCEMENT FLOW SOURCE FOR SPA
**                     = 0: NO ENHANCEMENT FLOW
**                     = 1: NPSH ENHANCEMENT RECIRCULATION FLOW;
```

```
**                                  NPSH ENHCANCEMENT RECIRCULATION FLOW IS DRAWN FROM
**                                  DISCHARGE SIDE PUMP DOWNSTREAM OF HX OUTLET (IF HX
**                             .    EXISTS), AND RECIRCULATED TO INLET SIDE OF PUMP
**                             = 2: NPSH ENHANCEMENT FLOW FROM SPA OUTLET
**                             = 3: NPSH ENHANCEMENT FLOW FROM EXTERNAL WATER STORAGE
**                                  TANK
**
**@@@REV 18 CORRECTED DEFINITION OF WESPA: IT IS FOR ANY ENHANC. FLOW SOURCE,
**              NOT JUST RECIRC. ENHANC.  (BJS, 12/27/91)
10    0.E0      WESPA:   NPSH ENHANCEMENT FLOW RATE;
**                       SET = 0 IF NO NPSH ENHANCEMENT IN LINEUP
**                            NPSH ENHANCEMENT RECIRCULATION FLOW IS DRAWN FROM
**                            DISCHARGE SIDE PUMP DOWNSTREAM OF HX OUTLET (IF HX
**                            EXISTS), AND RECIRCULATED TO INLET SIDE OF PUMP
**@@@REV 18 CORRECTED DESCRIPTION OF TDNSPA (TYPOS)
11    0.E0      TDNSPA: TIME TO UPPER COMPARTMENT SPRAY PUMP FAILURE
**                      ONCE HAVE INSUFFICIENT NPSH.  PUMPS WILL CONTINUE TO
**                      OPERATE WITH DEGRADED PERFORMANCE (SEE *GENERALIZED #12)
**                      UNTIL TIME ELAPSED SINCE LOSS OF SUFFICIENT NPSH EXCEEDS
**                      TDNSPA. IF TDNSPA EXCEEDED BEFORE RE-ACQUIRING SUFFICIENT
**                      NPSH, THEN PUMP WILL BE LOST FOR DURATION OF SEQUENCE.
**                      IF RE-ACQUIRE SUFFICIENT NPSH THEN TIME COUNTER RESET.
**
12    1         DEGSPA: UPPER COMPT CONTAINMENT SPRAY PUMP
**                      CHARACTERISTICS SELECTION FOR DEGRADED PERFORMANCE;
**                      THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                      CHARACTERISTICS SETS DEFINED IN *PUMP #1-40.
**                      THIS SET OF PUMP CHARACTERISTICS IS AUTOMATICALLY
**                      SELECTED WHEN HAVE INSUFFICIENT NPSH.
**                      THIS CHARACTERISTIC SET CAN BE THE
**                      SAME AS THAT SPECIFIED FOR NORMAL LINEUP (SEE
**                      *GENERALIZED 04) IF NO DEGRADED PERFORMANCE WILL BE
**                      CONSIDERED.  ALSO, CAN SPECIFY AN "ALTERNATIVE" PUMP
**                      RATHER THEN A "DEGRADED" PUMP.
**
13     0.0      ZSPARW: HEIGHT OF BOTTOM OF RWST ABOVE THE SPA PUMPS
**
14     0.0      ZSPACS: HEIGHT OF BOTTOM OF CONTAINMENT SUMP ABOVE THE
**                      SPAPUMPS.
**
**@@@REV 18 MPT"  THE ELEVATION OF THE RV NOZZLES ABOVE THE DIFFERENT
**                PUMPS IS ONLY RELEVANT IF THE PUMPS ARE USED FOR
**                INJECTION TO THE VESSEL.  OTHERWISE, THESE TERMS
**                CAN BE IGNORED.          BJS
**15    9.8     ZSPASI: ELEVATION OF THE RV INJECTION NOZZLES ABOVE THE
**                      SPA PUMPS.
**
***************************  PUMP 2  ********************************
***           LOWER COMPARTMENT CONTAINMENT SPRAY SYSTEM          ***
***           (INSIDE RECIRCULATION SPRAY SYSTEM)                 ***
*********************************************************************
16    2         NSPBG:  NUMBER OF OPERATIONAL LOWER COMPT SPRAY PUMPS
**                      REPRESENTED BY THIS SYSTEM
17    12        NORSPB: LOWER COMPT CONTAINMENT SPRAY PUMP
**                      CHARACTERISTICS SELECTION FOR NORMAL LINEUP;
**                      THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                      CHARACTERISTICS SETS DEFINED IN *PUMP #441-480
**                      = 2: 1 PUMP OPERATION
**                      =12: 2 PUMP OPERATION
**
18    5         NSSPB:  WATER SOURCE UNDER NORMAL PUMP LINEUP FOR LOWER
**                      COMPT SPRAY PUMPS
```

```
**                        = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: RWST
**                        = 4: LOWER COMPARTMENT SUMP
**                        = 5: ANNULAR COMPARTMENT SUMP
**
19   9         NDSPB:     DISCHARGE LOCATION UNDER NORMAL PUMP LINEUP FOR LOWER
**                        COMPT SPRAY PUMPS
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: DOWNCOMER
**                        = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                        = 5: LOWER COMPARTMENT SPRAY HEADER
**                        = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
20   12        RECSPB:    LOWER COMPT CONTAINMENT SPRAY PUMP
**                        CHARACTERISTICS SELECTION FOR RECIRC LINEUP;
**                        THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                        CHARACTERISTICS SETS DEFINED IN *PUMP #441-480
**                        = 2: 1 PUMP OPERATION
**                        =12: 2 PUMP OPERATION
**
21   5         RSSPB:     WATER SOURCE UNDER RECIRC PUMP LINEUP FOR LOWER
**                        COMPT SPRAY PUMPS
**                        = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: RWST
**                        = 4: LOWER COMPARTMENT SUMP
**                        = 5: ANNULAR COMPARTMENT SUMP
**
22   9         RDSPB:     DISCHARGE LOCATION UNDER RECIRC PUMP LINEUP FOR LOWER
**                        COMPT SPRAY PUMPS
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: DOWNCOMER
**                        = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                        = 5: LOWER COMPARTMENT SPRAY HEADER
**                        = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
23   2         SNPSPB:    NPSH ENHANCEMENT FLOW SOURCE FOR SPB
**                        = 0: NO ENHANCEMENT FLOW
**                        = 1: NPSH ENHANCEMENT RECIRCULATION FLOW;
**                             NPSH ENHCANCEMENT RECIRCULATION FLOW IS DRAWN FROM
**                             DISCHARGE SIDE PUMP DOWNSTREAM OF HX OUTLET (IF HX
**                             EXISTS), AND RECIRCULATED TO INLET SIDE OF PUMP
**                        = 2: NPSH ENHANCEMENT FLOW FROM SPA OUTLET
**                        = 3: NPSH ENHANCEMENT FLOW FROM EXTERNAL WATER STORAGE
**                             TANK
**
**@@@REV 18  CORRECTED DEFINITION OF WESPB:  IT IS FOR ANY ENHANC. FLOW SOURCE,
**             NOT JUST RECIRC. ENHANC.  (BJS, 12/27/91)
24   75087.    WESPB:     NPSH ENHANCEMENT FLOW RATE;
**                        SET = 0 IF NO NPSH ENHANCEMENT IN LINEUP
**
**                        NPSH ENHCANCEMENT RECIRCULATION FLOW IS DRAWN FROM
**                        DISCHARGE SIDE PUMP DOWNSTREAM OF HX OUTLET (IF HX
**                        EXISTS), AND RECIRCULATED TO INLET SIDE OF PUMP
**
**@@@REV 18  CORRECTED DESCRIPTION OF TDNSPB (TYPOS)
25   0.E0      TDNSPB:    TIME TO LOWER COMPARTMENT SPRAY PUMP FAILURE
```

```
**                     ONCE HAVE INSUFFICIENT NPSH.  PUMPS WILL CONTINUE TO
**                     OPERATE WITH DEGRADED PERFORMANCE (SEE *GENERALIZED #26)
**                     UNTIL TIME ELAPSED SINCE LOSS OF SUFFICIENT NPSH EXCEEDS
**                     TDNSPB. IF TDNSPB EXCEEDED BEFORE RE-ACQUIRING SUFFICIENT
**                     NPSH, THEN PUMP WILL BE LOST FOR DURATION OF SEQUENCE.
**                     IF RE-ACQUIRE SUFFICIENT NPSH THEN TIME COUNTER RESET.
**
26   2          DEGSPB: LOWER COMPT CONTAINMENT SPRAY PUMP
**                      CHARACTERISTICS SELECTION FOR DEGRADED PERFORMANCE;
**                      THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                      CHARACTERISTICS SETS DEFINED IN GENESF #241-280.
**                      THIS SET OF PUMP CHARACTERISTICS IS AUTOMATICALLY
**                      SELECTED WHEN HAVE INSUFFICIENT NPSH.
**                      THIS CHARACTERISTIC SET CAN BE THE
**                      SAME AS THAT SPECIFIED FOR NORMAL LINEUP (SEE
**                      *GENERALIZED 17) IF NO DEGRADED PERFORMANCE WILL BE
**                      CONSIDERED.  ALSO, CAN SPECIFY AN "ALTERNATIVE" PUMP
**                      RATHER THEN A "DEGRADED" PUMP
**
27    54.5      ZSPBRW: HEIGHT OF BOTTOM OF RWST ABOVE THE SPB PUMPS.
**
28    5.3       ZSPBCS: HEIGHT OF BOTTOM OF CONTAINMENT SUMP ABOVE THE
**                      SPB PUMPS.
**
**29  39.3      ZSPBSI: ELEVATION OF THE RV INJECTION NOZZLES ABOVE THE
**                      SPB PUMPS.
**
****************************  PUMP 3  ******************************
***             LOW PRESSURE INJECTION (TRAIN 1) SYSTEM            ***
************** (LOW HEAD SAFETY INJECTION PUMP) *******************
*******************************************************************
30   2          NLP1G:  NUMBER OF OPERATIONAL LPI1 PUMPS
**                      REPRESENTED BY THIS SYSTEM
31   4          NORLP1: LPI1 PUMP
**                      CHARACTERISTICS SELECTION FOR NORMAL LINEUP;
**                      THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                      CHARACTERISTICS SETS DEFINED IN *PUMP #41-80
**
32   3          NSLP1:  WATER SOURCE UNDER NORMAL PUMP LINEUP FOR LPI1 PUMPS
**                      = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                      = 1: HOT LEG
**                      = 2: COLD LEG
**                      = 3: RWST
**                      = 4: LOWER COMPARTMENT SUMP
**                      = 5: ANNULAR COMPARTMENT SUMP
**                      = 6: LPI 1
**                      = 7: LPI 2
**
33   2          NDLP1:  DISCHARGE LOCATION UNDER NORMAL PUMP LINEUP FOR LPI1
**                      PUMPS
**                      = 1: HOT LEG
**                      = 2: COLD LEG
**                      = 3: DOWNCOMER
**                      = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                      = 5: LOWER COMPARTMENT SPRAY HEADER
**                      = 6: INLET OF HPI PUMP
**                      = 7: INLET OF CHARGING PUMP
**                      = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                      = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
34   9          RECLP1: LPI1 PUMP
**                      CHARACTERISTICS SELECTION FOR RECIRC LINEUP;
```

```
**                           THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                           CHARACTERISTICS SETS DEFINED IN *PUMP #321-360
**                           .
35   5          RSLP1:       WATER SOURCE UNDER RECIRC PUMP LINEUP FOR LPI1 PUMP
**                           = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                           = 1: HOT LEG
**                           = 2: COLD LEG
**                           = 3: RWST
**                           = 4: LOWER COMPARTMENT SUMP
**                           = 5: ANNULAR COMPARTMENT SUMP
**                           = 6: LPI 1
**                           = 7: LPI 2
**
36   13         RDLP1:       DISCHARGE LOCATION UNDER RECIRC PUMP LINEUP FOR
**                           LPI1 PUMP
**                           = 1: HOT LEG
**                           = 2: COLD LEG
**                           = 3: DOWNCOMER
**                           = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                           = 5: LOWER COMPARTMENT SPRAY HEADER
**                           = 6: INLET OF HPI PUMP
**                           = 7: INLET OF CHARGING PUMP
**                           = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                           = 9: UPPER COMPARTMENT SPRAY HEADER #2
**                         =10: DISCHARGE TO UPPER SPRAY HEADER #1 AND HPI INLET
**                         =11: DISCHARGE TO COLD LEG AND HPI INLET
**                         =12: DISCHARGE TO UPPER SPRAY HEADER #1 AND CHP INLET
**                         =13: DISCHARGE TO COLD LEG AND CHP INLET
**
37   0        SNPLP1:        NPSH ENHANCEMENT FLOW SOURCE FOR LP1
**                           = 0: NO ENHANCEMENT FLOW
**                           = 1: NPSH ENHANCEMENT RECIRCULATION FLOW;
**                                NPSH ENHCANCEMENT RECIRCULATION FLOW IS DRAWN FROM
**                                DISCHARGE SIDE PUMP DOWNSTREAM OF HX OUTLET (IF HX
**                                EXISTS), AND RECIRCULATED TO INLET SIDE OF PUMP
**                           = 2: NPSH ENHANCEMENT FLOW FROM SPA OUTLET
**                           = 3: NPSH ENHANCEMENT FLOW FROM EXTERNAL WATER STORAGE
**                                TANK
**
**@@@REV 18      CORRECTED DEFINITION OF WELP1: IT IS FOR ANY ENHANC. FLOW SOURCE
**                NOT JUST RECIRC. ENHANC.  (BJS, 12/27/91)
38   0.E0       WELP1:       NPSH ENHANCEMENT FLOW RATE;
**                           SET = 0 IF NO NPSH ENHANCEMENT IN LINEUP
**
39   0.E0       TDNLP1:      TIME TO LPI1 PUMP FAILURE
**                           ONCE HAVE INSUFFICIENT NPSH.  PUMPS WILL CONTINUE TO
**                          OPERATE WITH DEGRADED PERFORMANCE (SEE *GENERALIZED #40)
**                          UNTIL TIME ELAPSED SINCE LOSS OF SUFFICIENT NPSH EXCEEDS
**                         TINLP1. IF TINLP1 EXCEEDED BEFORE RE-ACQUIRING SUFFICIENT
**                           NPSH, THEN PUMP WILL BE LOST FOR DURATION OF SEQUENCE.
**                           IF RE-ACQUIRE SUFFICIENT NPSH THEN TIME COUNTER RESET.
**
40   4          DEGLP1:      LPI1 PUMP
**                           CHARACTERISTICS SELECTION FOR DEGRADED PERFORMANCE;
**                           THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                           CHARACTERISTICS SETS DEFINED IN GENESF #201-240.
**                           THIS SET OF PUMP CHARACTERISTICS IS AUTOMATICALLY
**                           SELECTED WHEN HAVE INSUFFICIENT NPSH.
**                           THIS CHARACTERISTIC SET CAN BE THE
**                           SAME AS THAT SPECIFIED FOR NORMAL LINEUP (SEE
**                           *GENERALIZED 31) IF NO DEGRADED PERFORMANCE WILL BE
**                           CONSIDERED.  ALSO, CAN SPECIFY AN "ALTERNATIVE" PUMP
```

```
**                          RATHER THEN A "DEGRADED" PUMP
**
41    60.5        ZLP1RW: HEIGHT OF BOTTOM OF RWST ABOVE THE LP1 PUMPS.
**
42    3.6         ZLP1CS: HEIGHT OF BOTTOM OF CONTAINMENT SUMP ABOVE THE
**                        LP1 PUMPS.
**
43    45.3        ZLP1SI: ELEVATION OF THE RV INJECTION NOZZLES ABOVE THE
**                        LP1 PUMPS.
**
**************************** PUMP 4 ******************************
***               LOW PRESSURE INJECTION (TRAIN 2) SYSTEM          ***
***               NOT USED FOR NORTH ANNA MODEL                    ***
******************************************************************
44    0           NLP2G:  NUMBER OF OPERATIONAL LPI2 PUMPS
**                        REPRESENTED BY THIS SYSTEM
45    2           NORLP2: LPI2 PUMP
**                        CHARACTERISTICS SELECTION FOR NORMAL LINEUP;
**                        THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                        CHARACTERISTICS SETS DEFINED IN *PUMP #41-80
**
46    3           NSLP2:  WATER SOURCE UNDER NORMAL PUMP LINEUP FOR LPI2 PUMPS
**                        = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: RWST
**                        = 4: LOWER COMPARTMENT SUMP
**                        = 5: ANNULAR COMPARTMENT SUMP
**                        = 6: LPI 1
**                        = 7: LPI 2
**
47    2           NDLP2:  DISCHARGE LOCATION UNDER NORMAL PUMP LINEUP FOR LPI2
**                        PUMPS
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: DOWNCOMER
**                        = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                        = 5: LOWER COMPARTMENT SPRAY HEADER
**                        = 6: INLET OF HPI PUMP
**                        = 7: INLET OF CHARGING PUMP
**                        = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                        = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
48    2           RECLP2: LPI2 PUMP
**                        CHARACTERISTICS SELECTION FOR RECIRC LINEUP;
**                        THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                        CHARACTERISTICS SETS DEFINED IN *PUMP #41-80
**
49    4           RSLP2:  WATER SOURCE UNDER RECIRC PUMP LINEUP FOR LPI2 PUMP
**                        = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: RWST
**                        = 4: LOWER COMPARTMENT SUMP
**                        = 5: ANNULAR COMPARTMENT SUMP
**                        = 6: LPI 1
**                        = 7: LPI 2
**
50    4           RDLP2:  DISCHARGE LOCATION UNDER RECIRC PUMP LINEUP FOR
**                        LPI2 PUMP
**                        = 1: HOT LEG
**                        = 2: COLD LEG
```

```
**                        = 3: DOWNCOMER
**                        = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                        = 5: LOWER COMPARTMENT SPRAY HEADER
**                        = 6: INLET OF HPI PUMP
**                        = 7: INLET OF CHARGING PUMP
**                        = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                        = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
51    0        SNPLP2:    NPSH ENHANCEMENT FLOW SOURCE FOR LP2
**                        = 0: NO ENHANCEMENT FLOW
**                        = 1: NPSH ENHANCEMENT RECIRCULATION FLOW;
**                             NPSH ENHCANCEMENT RECIRCULATION FLOW IS DRAWN FROM
**                             DISCHARGE SIDE PUMP DOWNSTREAM OF HX OUTLET (IF HX
**                             EXISTS), AND RECIRCULATED TO INLET SIDE OF PUMP
**                        = 2: NPSH ENHANCEMENT FLOW FROM SPA OUTLET
**                        = 3: NPSH ENHANCEMENT FLOW FROM EXTERNAL WATER STORAGE
**                             TANK
**
**@@@REV 18   CORRECTED DEFINITION OF WELP2: IT IS FOR ANY ENHANC. FLOW SOURCE
**              NOT JUST RECIRC. ENHANC.  (BJS, 12/27/91)
52    0.E0      WELP2:   NPSH ENHANCEMENT FLOW RATE;
**                       SET = 0 IF NO NPSH ENHANCEMENT IN LINEUP
**
53    0.E0      TDNLP2:  TIME TO LPI2 PUMP FAILURE
**                       ONCE HAVE INSUFFICIENT NPSH.  PUMPS WILL CONTINUE TO
**                      OPERATE WITH DEGRADED PERFORMANCE (SEE *GENERALIZED #54)
**                      UNTIL TIME ELAPSED SINCE LOSS OF SUFFICIENT NPSH EXCEEDS
**                     TINLP2. IF TINLP2 EXCEEDED BEFORE RE-ACQUIRING SUFFICIENT
**                       NPSH, THEN PUMP WILL BE LOST FOR DURATION OF SEQUENCE.
**                       IF RE-ACQUIRE SUFFICIENT NPSH THEN TIME COUNTER RESET.
**
54    2         DEGLP2:  LPI2 PUMP
**                       CHARACTERISTICS SELECTION FOR DEGRADED PERFORMANCE;
**                       THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                       CHARACTERISTICS SETS DEFINED IN GENESF #41-80.
**                       THIS SET OF PUMP CHARACTERISTICS IS AUTOMATICALLY
**                       SELECTED WHEN HAVE INSUFFICIENT NPSH.
**                       THIS CHARACTERISTIC SET CAN BE THE
**                       SAME AS THAT SPECIFIED FOR NORMAL LINEUP (SEE
**                       *GENERALIZED 45) IF NO DEGRADED PERFORMANCE WILL BE
**                       CONSIDERED.  ALSO, CAN SPECIFY AN "ALTERNATIVE" PUMP
**                       RATHER THEN A "DEGRADED" PUMP
**
55    15.0      ZLP2RW:  HEIGHT OF BOTTOM OF RWST ABOVE THE LP2 PUMPS.
**
56     7.5      ZLP2CS:  HEIGHT OF BOTTOM OF CONTAINMENT SUMP ABOVE THE
**                       LP2 PUMPS.
**
57     9.8      ZLP2SI:  ELEVATION OF THE RV INJECTION NOZZLES ABOVE THE
**                       LP2 PUMPS.
**
****************************   PUMP 5   *****************************
***                 HIGH PRESSURE INJECTION SYSTEM                ***
***                 NOT USED FOR NORTH ANNA MODEL                 ***
*********************************************************************
58    0         NHPIG:   NUMBER OF OPERATIONAL HPI PUMPS
**                       REPRESENTED BY THIS SYSTEM
59    3         NORHPI:  HPI PUMP
**                       CHARACTERISTICS SELECTION FOR NORMAL LINEUP;
**                       THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                       CHARACTERISTICS SETS DEFINED IN *PUMP #81-120
**
```

```
60    3           NSHPI:  WATER SOURCE UNDER NORMAL PUMP LINEUP FOR HPI PUMPS
**                        = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: RWST
**                        = 4: LOWER COMPARTMENT SUMP
**                        = 5: ANNULAR COMPARTMENT SUMP
**                        = 6: LPI 1
**                        = 7: LPI 2
**
61    2           NDHPI:  DISCHARGE LOCATION UNDER NORMAL PUMP LINEUP FOR HPI
**                        PUMPS
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: DOWNCOMER
**                        = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                        = 5: LOWER COMPARTMENT SPRAY HEADER
**                        = 6: INLET OF HPI PUMP
**                        = 7: INLET OF CHARGING PUMP
**                        = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                        = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
62    3           RECHPI: HPI PUMP
**                        CHARACTERISTICS SELECTION FOR RECIRC LINEUP;
**                        THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                        CHARACTERISTICS SETS DEFINED IN *PUMP #81-120
**
63    6           RSHPI:  WATER SOURCE UNDER RECIRC PUMP LINEUP FOR HPI PUMP
**                        = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: RWST
**                        = 4: LOWER COMPARTMENT SUMP
**                        = 5: ANNULAR COMPARTMENT SUMP
**                        = 6: LPI 1
**                        = 7: LPI 2
**
64    2           RDHPI:  DISCHARGE LOCATION UNDER RECIRC PUMP LINEUP FOR
**                        HPI PUMP
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: DOWNCOMER
**                        = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                        = 5: LOWER COMPARTMENT SPRAY HEADER
**                        = 6: INLET OF HPI PUMP
**                        = 7: INLET OF CHARGING PUMP
**                        = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                        = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
65    0           SNPHPI: NPSH ENHANCEMENT FLOW SOURCE FOR HPI
**                        = 0: NO ENHANCEMENT FLOW
**                        = 1: NPSH ENHANCEMENT RECIRCULATION FLOW;
**                             NPSH ENHCANCEMENT RECIRCULATION FLOW IS DRAWN FROM
**                             DISCHARGE SIDE PUMP DOWNSTREAM OF HX OUTLET (IF HX
**                             EXISTS), AND RECIRCULATED TO INLET SIDE OF PUMP
**                        = 2: NPSH ENHANCEMENT FLOW FROM SPA OUTLET
**                        = 3: NPSH ENHANCEMENT FLOW FROM EXTERNAL WATER STORAGE
**                             TANK
**
**@@@REV 18      CORRECTED DEFINITION OF WEHPI: IT IS FOR ANY ENHANC. FLOW SOURCE
**                  NOT JUST RECIRC. ENHANC.  (BJS, 12/27/91)
66    0.E0         WEHPI:  NPSH ENHANCEMENT FLOW RATE;
```

```
**                      SET = 0 IF NO NPSH ENHANCEMENT IN LINEUP
**
67   0.E0      TDNHPI: TIME TO HPI PUMP FAILURE
**                      ONCE HAVE INSUFFICIENT NPSH.  PUMPS WILL CONTINUE TO
**                     OPERATE WITH DEGRADED PERFORMANCE (SEE *GENERALIZED #68)
**                     UNTIL TIME ELAPSED SINCE LOSS OF SUFFICIENT NPSH EXCEEDS
**                    TINHPI. IF TINHPI EXCEEDED BEFORE RE-ACQUIRING SUFFICIENT
**                      NPSH, THEN PUMP WILL BE LOST FOR DURATION OF SEQUENCE.
**                      IF RE-ACQUIRE SUFFICIENT NPSH THEN TIME COUNTER RESET.
**
68   3         DEGHPI: HPI PUMP
**                      CHARACTERISTICS SELECTION FOR DEGRADED PERFORMANCE;
**                      THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                      CHARACTERISTICS SETS DEFINED IN *PUMP #81-120.
**                      THIS SET OF PUMP CHARACTERISTICS IS AUTOMATICALLY
**                      SELECTED WHEN HAVE INSUFFICIENT NPSH.
**                      THIS CHARACTERISTIC SET CAN BE THE
**                      SAME AS THAT SPECIFIED FOR NORMAL LINEUP (SEE
**                      *GENERALIZED 58) IF NO DEGRADED PERFORMANCE WILL BE
**                      CONSIDERED.  ALSO, CAN SPECIFY AN "ALTERNATIVE" PUMP
**                      RATHER THEN A "DEGRADED" PUMP
**
69   15.0      ZHPIRW: HEIGHT OF BOTTOM OF RWST ABOVE THE HPI PUMPS.
**
70    7.5      ZHPICS: HEIGHT OF BOTTOM OF CONTAINMENT SUMP ABOVE THE
**                      HPI PUMPS.
**
71    9.8      ZHPISI: ELEVATION OF THE RV INJECTION NOZZLES ABOVE THE
**                      HPI PUMPS.
**
*************************  PUMP 6  ********************************
*******************************************************************
***                     CHARGING PUMP SYSTEM                   ***
***            (HIGH HEAD SAFETY INJECTION PUMP)               ***
*******************************************************************
72   2         NCHPG:   NUMBER OF OPERATIONAL CHARGING PUMPS
**                      REPRESENTED BY THIS SYSTEM
73   6         NORCHP:  CHARGING PUMP
**                      CHARACTERISTICS SELECTION FOR NORMAL LINEUP;
**                      THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                      CHARACTERISTICS SETS DEFINED IN *PUMP #121-160
**
74   3         NSCHP:  WATER SOURCE UNDER NORMAL PUMP LINEUP FOR CHARGING PUMPS
**                      = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                      = 1: HOT LEG
**                      = 2: COLD LEG
**                      = 3: RWST
**                      = 4: LOWER COMPARTMENT SUMP
**                      = 5: ANNULAR COMPARTMENT SUMP
**                      = 6: LPI 1
**                      = 7: LPI 2
**
75   2         NDCHP:  DISCHARGE LOCATION UNDER NORMAL PUMP LINEUP FOR CHARGING
**                      PUMPS
**                      = 1: HOT LEG
**                      = 2: COLD LEG
**                      = 3: DOWNCOMER
**                      = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                      = 5: LOWER COMPARTMENT SPRAY HEADER
**                      = 6: INLET OF HPI PUMP
**                      = 7: INLET OF CHARGING PUMP
**                      = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
```

```
**                            = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
76   11           RECCHP: CHARGING PUMP
**                        CHARACTERISTICS SELECTION FOR RECIRC LINEUP;
**                        THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                        CHARACTERISTICS SETS DEFINED IN *PUMP #401-440
**
77   6            RSCHP:  WATER SOURCE UNDER RECIRC PUMP LINEUP FOR CHARGING PUMP
**                        = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: RWST
**                        = 4: LOWER COMPARTMENT SUMP
**                        = 5: ANNULAR COMPARTMENT SUMP
**                        = 6: LPI 1
**                        = 7: LPI 2
**
78   2            RDCHP:  DISCHARGE LOCATION UNDER RECIRC PUMP LINEUP FOR
**                        CHARGING PUMP
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: DOWNCOMER
**                        = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                        = 5: LOWER COMPARTMENT SPRAY HEADER
**                        = 6: INLET OF HPI PUMP
**                        = 7: INLET OF CHARGING PUMP
**                        = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                        = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
79   0            SNPCHP: NPSH ENHANCEMENT FLOW SOURCE FOR CHP
**                        = 0: NO ENHANCEMENT FLOW
**                        = 1: NPSH ENHANCEMENT RECIRCULATION FLOW;
**                             NPSH ENHCANCEMENT RECIRCULATION FLOW IS DRAWN FROM
**                             DISCHARGE SIDE PUMP DOWNSTREAM OF HX OUTLET (IF HX
**                             EXISTS), AND RECIRCULATED TO INLET SIDE OF PUMP
**                        = 2: NPSH ENHANCEMENT FLOW FROM SPA OUTLET
**                        = 3: NPSH ENHANCEMENT FLOW FROM EXTERNAL WATER STORAGE
**                             TANK
**
**@@@REV 18       CORRECTED DEFINITION OF WECHP: IT IS FOR ANY ENHANC. FLOW SOURCE
**                 NOT JUST RECIRC. ENHANC.  (BJS, 12/27/91)
80   0.E0         WECHP:  NPSH ENHANCEMENT FLOW RATE;
**                        SET = 0 IF NO NPSH ENHANCEMENT IN LINEUP
**
81   0.E0         TDNCHP: TIME TO CHARGING PUMP FAILURE
**                        ONCE HAVE INSUFFICIENT NPSH.  PUMPS WILL CONTINUE TO
**                       OPERATE WITH DEGRADED PERFORMANCE (SEE *GENERALIZED #82)
**                       UNTIL TIME ELAPSED SINCE LOSS OF SUFFICIENT NPSH EXCEEDS
**                      TINCHP. IF TINCHP EXCEEDED BEFORE RE-ACQUIRING SUFFICIENT
**                        NPSH, THEN PUMP WILL BE LOST FOR DURATION OF SEQUENCE.
**                        IF RE-ACQUIRE SUFFICIENT NPSH THEN TIME COUNTER RESET.
**
82   6            DEGCHP: CHARGING PUMP
**                        CHARACTERISTICS SELECTION FOR DEGRADED PERFORMANCE;
**                        THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                        CHARACTERISTICS SETS DEFINED IN *PUMP #121-160.
**                        THIS SET OF PUMP CHARACTERISTICS IS AUTOMATICALLY
**                        SELECTED WHEN HAVE INSUFFICIENT NPSH.
**                        THIS CHARACTERISTIC SET CAN BE THE
**                        SAME AS THAT SPECIFIED FOR NORMAL LINEUP (SEE
**                        *GENERALIZED 73) IF NO DEGRADED PERFORMANCE WILL BE
**                        CONSIDERED.  ALSO, CAN SPECIFY AN "ALTERNATIVE" PUMP
```

```
**                         RATHER THEN A "DEGRADED" PUMP
**
83    27.        ZCHPRW: HEIGHT OF BOTTOM OF RWST ABOVE THE CHARGING PUMPS.
**
84  -29.9        ZCHPCS: HEIGHT OF BOTTOM OF CONTAINMENT SUMP ABOVE THE
**                       CHARGING PUMPS.
**
85   11.8        ZCHPSI: ELEVATION OF THE RV INJECTION NOZZLES ABOVE THE
**                       CHARGING PUMPS.
**
************************  PUMP 7  **********************************
***            (OUTSIDE RECIRCULATION SPRAY PUMP)                ***
********************************************************************
**
86   2           NSPCG:  NUMBER OF OPERATIONAL TRAIN C SPRAY PUMPS
**                       REPRESENTED BY THIS SYSTEM
**
87   13          NORSPC: TRAIN C CONTAINMENT SPRAY PUMP
**                       CHARACTERISTICS SELECTION FOR NORMAL LINEUP;
**                       THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                       CHARACTERISTICS SETS DEFINED IN *PUMP #481-520
**                       = 7: 1 PUMP OPERATION
**                       =13: 2 PUMP OPERATION
**
88   5           NSSPC:  WATER SOURCE UNDER NORMAL PUMP LINEUP FOR TRAIN C
**                       SPRAY PUMPS
**                       = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                       = 1: HOT LEG
**                       = 2: COLD LEG
**                       = 3: RWST
**                       = 4: LOWER COMPARTMENT SUMP
**                       = 5: ANNULAR COMPARTMENT SUMP
**                       = 6: LPI 1
**                       = 7: LPI 2
**
89   9           NDSPC:  DISCHARGE LOCATION UNDER NORMAL PUMP LINEUP FOR TRAIN C
**                       SPRAY PUMPS
**                       = 1: HOT LEG
**                       = 2: COLD LEG
**                       = 3: DOWNCOMER
**                       = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                       = 5: LOWER COMPARTMENT SPRAY HEADER
**                       = 6: INLET OF HPI PUMP
**                       = 7: INLET OF CHARGING PUMP
**                       = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                       = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
90   13          RECSPC: TRAIN C CONTAINMENT SPRAY PUMP
**                       CHARACTERISTICS SELECTION FOR RECIRC LINEUP;
**                       THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                       CHARACTERISTICS SETS DEFINED IN *PUMP #481-520
**                       = 7: 1 PUMP OPERATION
**                       =13: 2 PUMP OPERATION
**
91   5           RSSPC:  WATER SOURCE UNDER RECIRC PUMP LINEUP FOR TRAIN C
**                       SPRAY PUMPS
**                       = 0: NO SOURCE (I.E., SYSTEM NOT FUNCTIONAL)
**                       = 1: HOT LEG
**                       = 2: COLD LEG
**                       = 3: RWST
**                       = 4: LOWER COMPARTMENT SUMP
**                       = 5: ANNULAR COMPARTMENT SUMP
```

```
**                        = 6: LPI 1
**                        = 7: LPI 2
**                        .
92   9          RDSPC:   DISCHARGE LOCATION UNDER RECIRC PUMP LINEUP FOR TRAIN C
**                        SPRAY PUMPS
**                        = 1: HOT LEG
**                        = 2: COLD LEG
**                        = 3: DOWNCOMER
**                        = 4: UPPER COMPARTMENT SPRAY HEADER #1
**                        = 5: LOWER COMPARTMENT SPRAY HEADER
**                        = 6: INLET OF HPI PUMP
**                        = 7: INLET OF CHARGING PUMP
**                        = 8: DISCHARGE TO BOTH HPI AND CHARGING PUMP INLET
**                        = 9: UPPER COMPARTMENT SPRAY HEADER #2
**
93   3          SNPSPC:  NPSH ENHANCEMENT FLOW SOURCE FOR SPC
**                        = 0: NO ENHANCEMENT FLOW
**                        = 1: NPSH ENHANCEMENT RECIRCULATION FLOW;
**                             NPSH ENHCANCEMENT RECIRCULATION FLOW IS DRAWN FROM
**                             DISCHARGE SIDE PUMP DOWNSTREAM OF HX OUTLET (IF HX
**                             EXISTS), AND RECIRCULATED TO INLET SIDE OF PUMP
**                        = 2: NPSH ENHANCEMENT FLOW FROM SPA OUTLET
**                        = 3: NPSH ENHANCEMENT FLOW FROM EXTERNAL WATER STORAGE
**                             TANK
**
**@@@REV 18   CORRECTED DEFINITION OF WESPC: IT IS FOR ANY ENHANC. FLOW SOURCE
**              NOT JUST RECIRC. ENHANC.  ()BJS, 12/27/91)
94   4.E5       WESPC:   NPSH ENHANCEMENT FLOW RATE;
**                        SET = 0 IF NO NPSH ENHANCEMENT IN LINEUP
**
**@@@REV 18   CORRECTED DESCRIPTION OF TDNSPC (TYPOS)
95   0.E0       TDNSPC: TIME TO TRAIN C CONTAINMENT SPRAY PUMP FAILURE
**                        ONCE HAVE INSUFFICIENT NPSH.  PUMPS WILL CONTINUE TO
**                       OPERATE WITH DEGRADED PERFORMANCE (SEE *GENERALIZED #96)
**                       UNTIL TIME ELAPSED SINCE LOSS OF SUFFICIENT NPSH EXCEEDS
**                      TDNSPC. IF TINSPC EXCEEDED BEFORE RE-ACQUIRING SUFFICIENT
**                        NPSH, THEN PUMP WILL BE LOST FOR DURATION OF SEQUENCE.
**                        IF RE-ACQUIRE SUFFICIENT NPSH THEN TIME COUNTER RESET.
**
96   7          DEGSPC: TRAIN C CONTAINMENT SPRAY PUMP
**                        CHARACTERISTICS SELECTION FOR DEGRADED PERFORMANCE;
**                        THIS CORRESPONDS TO ID NUMBER OF VARIOUS PUMP
**                        CHARACTERISTICS SETS DEFINED IN *PUMP #1-40.
**                        THIS SET OF PUMP CHARACTERISTICS IS AUTOMATICALLY
**                        SELECTED WHEN HAVE INSUFFICIENT NPSH.
**                        THIS CHARACTERISTIC SET CAN BE THE
**                        SAME AS THAT SPECIFIED FOR NORMAL LINEUP (SEE
**                        *GENERALIZED 87) IF NO DEGRADED PERFORMANCE WILL BE
**                        CONSIDERED.  ALSO, CAN SPECIFY AN "ALTERNATIVE" PUMP
**                        RATHER THEN A "DEGRADED" PUMP.
**
97  54.5        ZSPCRW: HEIGHT OF BOTTOM OF RWST ABOVE THE SPC PUMPS.
**
98    5.3       ZSPCCS: HEIGHT OF BOTTOM OF CONTAINMENT SUMP ABOVE THE
**                        SPC PUMPS.
**
**99 39.3       ZSPCSI: ELEVATION OF THE RV INJECTION NOZZLES ABOVE THE
**                        SPC PUMPS.
**
*******************************************************************
***                  ANNULAR COMPARTMENT SUMP                      ***
*******************************************************************
```

```
**
100   85.0      ACSD:   AREA OF BASE OF ANNULAR COMPARTMENT SUMP
**                      = 0 IF NO SUMP AVAILABLE
101  1.81       ZCSD:   DEPTH OF ANNULAR COMPARTMENT SUMP
**
*******************************************************************
***        EXTERNAL NPSH ENHANCEMENT WATER STORAGE TANK        ***
*******************************************************************
102  50.0        TWEXT: WATER TEMPERATURE IN EXTERNAL STORAGE TANK
**
103  1.0262E6  MWEXTO: INITIAL WATER MASS IN EXTERNAL STORAGE TANK
**
*******************************************************************
***                    FAN COOLER LINEUP                       ***
*******************************************************************
**
**104 1            NSFAN: CONTAINMENT FANCOOLER SUCTION LOCATION
**                      =1: UPPER COMPARTMENT
**                      =2: LOWER COMPARTMENT
**                      =3: ANNULAR COMPARTMENT
**
**105  2          NDFAN:  CONTAINMENT FANCOOLER DISCHARGE LOCATION
**                      =1: UPPER COMPARTMENT
**                      =2: LOWER COMPARTMENT
**                      =3: ANNULAR COMPARTMENT
**
**106  3          NDFNCD: FAN COOLER CONDENSATE DISCHARGE LOCATION
**                      =1: UPPER COMPARTMENT
**                      =2: LOWER COMPARTMENT
**                      =3: ANNULAR COMPARTMENT
**                      =4: CAVITY
**
*******************************************************************
***                  CONTAINMENT CHILLERS                      ***
*******************************************************************
**107    0        NCHILL: NUMBER OF OPERATING CONTAINMENT CHILLERS
**108   20.0      WVCHO:  VOLUMETRIC FLOW THROUGH ONE CHILLER
**109   1200      NTCH:   NUMBER OF TUBES IN A CHILLER
**110   180.      ATCH:   OUTSIDE AREA OF ALL TUBES IN A CHILLER
**111   1500.     AFINCH: AREA OF ALL FINS IN A CHILLER
**112    .50      FFINCH: CHILLER FIN EFFICIENCY
**113   .001      RGFLCH: CHILLER INSIDE FOULING FACTOR
**114   .05       XDFNCH: CHILLER FIN DIAMETER
**115  .001       XTTCH:  CHILLER TUBE THICKNESS
**116   240.      KTCH:   CHILLER TUBE THERMAL CONDUCTIVITY
**117   10.       AFMNCH: MINIMUM FLOW AREA THROUGH CHILLER
**118   .013      XIDTCH: CHILLER TUBE ID
**119    5        NREGCH: NUMBER OF NODES USED TO MODEL CHILLER (5 MAX)
**120    310.     TCWCH:  INLET COOLING WATER TEMP TO CHILLER--NOTE THIS IS
**              ALSO USED AS THE COOLING WATER TEMP FOR ALL OTHER
**              SAFEGUARDS HEAT EXCHANGERS
**121   110.      WCWCH:  INLET COOLING WATER FLOW TO A CHILLER
**
**122   1         NSCHIL: CHILLER SUCTION LOCATION
**                      =1: LOWER COMPARTMENT
**                      =2: ANNULAR COMPARTMENT
**                      =3: CAVITY
**
**123   2         NDCHIL: CHILLER DISCHARGE LOCATION
**                      =1: LOWER COMPARTMENT
**                      =2: ANNULAR COMPARTMENT
**                      =3: UPPER COMPARTMENT
```

```
**
**124    3         NDCHCD: CHILLER CONDENSATE DISCHARGE LOCATION
**                         =1: LOWER COMPARTMENT
**                         =2: ANNULAR COMPARTMENT
**                         =3: CAVITY
**
*******************************************************************
***            STEAM DRIVEN AUXILIARY FEEDWATER SYSTEM          ***
*******************************************************************
**@@@REV 18
125  5          NIPTS: NUMBER OF POINTS IN TURBINE DRIVEN AUX FEED SYSTEM
**                      FLOW CURVE
**
**      PSIA
**    --------
126     1100.     PSG(1): 1ST PRESSURE (PSIA)
127      615.     PSG(2): 2ND PRESSURE (PSIA)
128      600.     PSG(3): 3RD PRESSURE (PSIA)
129      300.     PSG(4): 4TH PRESSURE (PSIA)
130      200.     PSG(5): 5TH PRESSURE (PSIA)
**
**   LB/HR
**  --------
131  28755.    WSTSGT(1): STEAM FLOW RATE THROUGH TURBINE CORRESPONDING
**                          TO THE FIRST STEAM GENERATOR PRESSURE (LBM/HR,KG/S)
132  28755.    WSTSGT(2): STEAM FLOW RATE THROUGH TURBINE CORRESPONDING
**                          TO THE SECOND STEAM GENERATOR PRESSURE
133  0.0       WSTSGT(3): STEAM FLOW RATE THROUGH TURBINE CORRESPONDING
**                          TO THE THIRD STEAM GENERATOR PRESSURE
134  0.0       WSTSGT(4): STEAM FLOW RATE THROUGH TURBINE CORRESPONDING
**                          TO THE FOURTH STEAM GENERATOR PRESSURE
135  0.0       WSTSGT(5): STEAM FLOW RATE THROUGH TURBINE CORRESPONDING
**                          TO THE FIFTH STEAM GENERATOR PRESSURE
136  2.233E5   WWTDFW(1): WATER FLOW RATE THROUGH TURBINE DRIVEN AUX
**                           FEEDWATER PUMP CORRRESPONDING TO THE FIRST
**                           STEAM FLOW RATE (LBM/HR)
137  2.233E5   WWTDFW(2): WATER FLOW RATE THROUGH TURBINE DRIVEN AUX
**                           FEEDWATER PUMP CORRRESPONDING TO THE FIRST
**                           STEAM FLOW RATE (LB/HR)
138  0.0       WWTDFW(3): WATER FLOW RATE THROUGH TURBINE DRIVEN AUX
**                           FEEDWATER PUMP CORRRESPONDING TO THE FIRST
**                           STEAM FLOW RATE
139  0.0       WWTDFW(4): WATER FLOW RATE THROUGH TURBINE DRIVEN AUX
**                           FEEDWATER PUMP CORRRESPONDING TO THE FIRST
**                           STEAM FLOW RATE
140  0.0       WWTDFW(5): WATER FLOW RATE THROUGH TURBINE DRIVEN AUX
**                           FEEDWATER PUMP CORRRESPONDING TO THE FIRST
**                           STEAM FLOW RATE
**
**@@@REV 17, PARAMETER SECTION PUMP CHARACTERISITCS IS NEW
*******************************************************************
*******************************************************************
*PUMP CHARACTERISITCS: (PARAMETER GROUP #22)
*******************************************************************
*******************************************************************
***
***  THIS SECTION ONLY APPLIES IF GENERALIZED ESF SECTION IS USED
***
***  PUMP CHARACTERISTICS REFER TO:
***
***  1)  THE PUMPING CAPACITY OF A PUMP IN A PARTICULAR
***      LINE-UP (FLOW VS HEAD); THIS CAN BE OBTAINED FROM
```

```
***      SYSTEM CURVES
***
***  2)  NPSH REQUIREMENTS
***
***  3)  HEAT EXCHANGER ATTRIBUTES IF A HEAT EXCHANGER EXITS
***      DOWNSTREAM OF THE PUMP
***
***  NOTE THAT PUMP DATA ARE ENTERED IN GROUPS OF FORTY, IE.,
***
***   1-40  DEFINES PUMP CHARACTERISTIC 1,
***  41-80  DEFINES PUMP CHARACTERISTIC 2,
***  81-120 DEFINES PUMP CHARACTERISTIC 3, ETC..
***
***  THE GROUP OF FORTY PARAMETERS NEEDED TO DEFINE THE
***  PUMP CHARACTERISTICS (DEFINED BELOW) ARE:
***
***  NPOINT, ZHDPMP(5), WVPMP(5), ZHDREQ(5),
***  FHXPMP, NTPMP, NBPMP, XIDT, XTT, XTC, XS, RGFLHX, KT, XBC, XIDS, XSTR,
***  NWCW, TIWCW(5), WCWPMP(5), NTU
***
***  THE CURRENT SCHEME HAS SEVEN SETS OF PUMP CHARACTERISTICS DEFINED AS:
***
***  PUMP 1, NORMAL SPA FLOW
***  PUMP 2, NORMAL LPI1 FLOW
***  PUMP 3, NORMAL HPI FLOW
***  PUMP 4, NORMAL CHP FLOW
***  PUMP 5, NORMAL SPRAY RECIRC SYSTEM
***  PUMP 6, NORMAL DEGRADED LPI1 FLOW
***  PUMP 7, NORMAL SPB FLOW
***
***  MAXIMUM OF 21 PUMP CHARACTERISTICS CAN BE DEFINED
***
***
***  NOTE - TO CHANGE ANY OF THESE PARAMETERS VIA A LOCAL
***    PARAMETER CHANGE IN THE INPUT DECK USE THE VARIABLE
***    NUMBER (OLD WAY) VS. VARIABLE NAME (NEW WAY).  THIS
***    IS BECAUSE THE VARIABLES NAMES LISTED HERE ARE JUST FOR
***    CLARITY AND ARE NOT THE ACTUAL NAMES OF THE VARIABLES
***    IN THE CODE.  (THE VARIABLES IN THE CODE ARE CONTAINED
***    IN ONE VERY LARGE ARRAY.)  THIS ONLY APPLIES WHEN THE
***    NEW GENERALIZED ESF SECTION IS USED.
***
*************************      PUMP 1     ************************
********************* CONTAINMENT INJECTION SPRAY ***************
********************* QUENCH SPRAY PUMP **************************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
01     5.0     NPOINT: NUMBER OF ENTRIES IN PUMP1 HEAD CURVES (5 MAX)
**
**
** ===============  HEADS  (M) ===============
**
02   305.0     ZHDPMP(1): FIRST ENTRY IN  PUMP1 HEAD TABLE
03   290.0     ZHDPMP(2): NEXT HEAD
04   250.0     ZHDPMP(3): NEXT HEAD
05   180.0     ZHDPMP(4): NEXT HEAD
06     0.0     ZHDPMP(5): NEXT HEAD
**
```

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**
** ===============  VOLUMETRIC FLOWS  (GPM) ===============
**
07   0.0       WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP1 TABLE
08   1200.0    WVPMP(2): NEXT VOL. FLOWRATE
09   2000.0    WVPMP(3): NEXT VOL. FLOWRATE
10   2800.0    WVPMP(4): NEXT VOL. FLOWRATE
11   2900.0    WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ===============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
12    7.0       ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP1
13    8.0       ZHDREQ(2): NEXT ENTRY FOR PUMP1
14    13.0      ZHDREQ(3): NEXT ENTRY FOR PUMP1
15    19.0      ZHDREQ(4): NEXT ENTRY FOR PUMP1
16    19.0      ZHDREQ(5): NEXT ENTRY FOR PUMP1 ** ** ===============
**
**************************************************************************
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**     -1    SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**      0    IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**      1    STRAIGHT TUBE HX
**      2    U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
17   -1         FHXPMP:  TYPE OF HX FOR PUMP1
**18   0.DO       NTPMP:   NUMBER OF TUBES IN PUMP1 HXS
**19   0.DO       NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP1 HXS
**20   0.DO       XIDT: PUMP1 HX TUBE ID
**21   0.DO       XTT:  PUMP1 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
**22   0.DO       XTC:  TUBE TO TUBE PITCH IN PUMP1 HX
**23   0.DO       XS:   SHELL LENGTH IN PUMP1 HX
**24              RGFLHX:  INSIDE FOULING FACTOR
**25   0.DO       KT:   THERMAL CONDUCTIVITY OF PUMP1 HX TUBES
**26  0.DO      XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
**27              XIDS:  SHELL INSIDE DIAMETER
**28  0.DO      XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP1 HX TUBE BDL
**29   1          NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
**30  0.DO      TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                        FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                        CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                        RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                        = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
```

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**                    FLOW
**31   0.D0        TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
**32   0.D0        TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
**33   0.D0        TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
**34   0.D0        TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**35   311.9       WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**36   0.D0        WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**37   0.D0        WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**38   0.D0        WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**39   0.D0        WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**40   0.989       NTU:  PUMP1 HX NTU
**
*****************************************************************
*********************          PUMP 2        *********************
**************** INSIDE RECIRCULATION SPRAY PUMP ****************
********************     1 PUMP OPERATION    *********************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
41     5.0      NPOINT: NUMBER OF ENTRIES IN PUMP2 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===============
**
42     400.0    ZHDPMP(1): FIRST ENTRY IN  PUMP2 HEAD TABLE
43     330.0    ZHDPMP(2): NEXT HEAD
44     290.0    ZHDPMP(3): NEXT HEAD
45     269.0    ZHDPMP(4): NEXT HEAD
46       0.0    ZHDPMP(5): NEXT HEAD
**
**
** ===============  VOLUMETRIC FLOWS  (GPM) ===============
**
47       0.0    WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP2 TABLE
48    2000.0    WVPMP(2): NEXT VOL. FLOWRATE
49    3000.0   WVPMP(3): NEXT VOL. FLOWRATE
50    3300.0   WVPMP(4): NEXT VOL. FLOWRATE
51    3310.0   WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ===============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
52    15.0      ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP2
53    15.0      ZHDREQ(2): NEXT ENTRY FOR PUMP2
54    14.0      ZHDREQ(3): NEXT ENTRY FOR PUMP2
55    14.5      ZHDREQ(4): NEXT ENTRY FOR PUMP2
56    14.5      ZHDREQ(5): NEXT ENTRY FOR PUMP2
**
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**    -1    SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**     0    IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**     1    STRAIGHT TUBE HX
**     2    U-TUBE HX
**
```

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**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                 LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
57   1.0         FHXPMP:  TYPE OF HX FOR PUMP2
58   1500.0      NTPMP:   NUMBER OF TUBES IN PUMP2 HXS
59    27.0       NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP2 HXS
60   0.04625     XIDT: PUMP2 HX TUBE ID
61   0.0029      XTT:  PUMP2 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
62   0.0729      XTC:  TUBE TO TUBE PITCH IN PUMPS HX
63   41.7        XS:   SHELL LENGTH IN PUMP2 HX
64   0.0005        RGFLHX: INSIDE FOULING FACTOR
65    8.08       KT:   THERMAL CONDUCTIVITY OF PUMP2 HX TUBES
66   0.635       XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
67   3.23          XIDS:  SHELL INSIDE DIAMETER
68   0.0521      XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP2 HX TUBE BDL
69   1           NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
70   0.0         TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                         FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                         CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                         RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                         = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                         FLOW
**71   0.DO        TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
**72   0.DO        TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
**73   0.DO        TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
**74   0.DO        TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**
75     2.249E6     WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**76   0.DO        WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**77   0.DO        WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**78   0.DO        WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**79   0.DO        WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
80     0.0         NTU:  PUMP2 HX NTU
**
*********************           PUMP 3        *********************
*********************        LHSI PUMP DATA   *********************
*********************       1 PUMP OPERATION  *********************
*********************         INJECTION MODE  *********************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
81      5.0     NPOINT: NUMBER OF ENTRIES IN PUMP3 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===============
**
82      395.0   ZHDPMP(1): FIRST ENTRY IN  PUMP3 HEAD TABLE
83      255.0   ZHDPMP(2): NEXT HEAD
84      195.0   ZHDPMP(3): NEXT HEAD
85      180.0   ZHDPMP(4): NEXT HEAD
```

```
86        0.0    ZHDPMP(5): NEXT HEAD
**
** ===============  VOLUMETRIC FLOWS  (GPM) ===============
**
87        0.0    WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP3 TABLE
88     3000.0    WVPMP(2): NEXT VOL. FLOWRATE
89     4000.0    WVPMP(3): NEXT VOL. FLOWRATE
90     4400.0    WVPMP(4): NEXT VOL. FLOWRATE
91     4500.0    WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ===============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
92       15.0     ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP3
93       16.0     ZHDREQ(2): NEXT ENTRY FOR PUMP3
94       20.0     ZHDREQ(3): NEXT ENTRY FOR PUMP3
95       23.0     ZHDREQ(4): NEXT ENTRY FOR PUMP3
96       23.0     ZHDREQ(5): NEXT ENTRY FOR PUMP3
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**    -1     SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**     0     IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**     1     STRAIGHT TUBE HX
**     2     U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**               LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
97   -1          FHXPMP:  TYPE OF HX FOR PUMP3
98   0.0         NTPMP:   NUMBER OF TUBES IN PUMP3 HXS
99   0.0         NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP3 HXS
100  0.0         XIDT: PUMP3 HX TUBE ID
101  0.0         XTT:  PUMP3 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
102  0.0         XTC:  TUBE TO TUBE PITCH IN PUMP3 HX
103  0.0         XS:   SHELL LENGTH IN PUMP3 HX
**104              RGFLHX:  INSIDE FOULING FACTOR
105  0.0         KT:   THERMAL CONDUCTIVITY OF PUMP3 HX TUBES
106  0.0        XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
**107              XIDS:  SHELL INSIDE DIAMETER
108  0.0         XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP3 HX TUBE BDL
109  0.0         NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
110  0.0        TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                        FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                        CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                        RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                        = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                        FLOW
```

```
**111  0.DO       TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
**112  0.DO       TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
**113  0.DO       TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
**114  0.DO       TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**115  311.9      WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**116  0.DO       WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**117  0.DO       WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**118  0.DO       WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**119  0.DO       WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**120  0.DO       NTU:  PUMP3 HX NTU
**
*********************          PUMP 4          *********************
****************** LHSI PUMP FLOW DATA *************************
******************   2 PUMP OPERATION   *************************
******************     INJECTION MODE   *************************
*****************************************************************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
121  5.0       NPOINT: NUMBER OF ENTRIES IN PUMP4 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===============
**
122   395.0    ZHDPMP(1): FIRST ENTRY IN  PUMP4 HEAD TABLE
123   336.0    ZHDPMP(2): NEXT HEAD
124   310.0    ZHDPMP(3): NEXT HEAD
125   266.0    ZHDPMP(4): NEXT HEAD
126     0.0    ZHDPMP(5): NEXT HEAD
**
** ===============  VOLUMETRIC FLOWS  (GPM) ===============
**
127     0.0    WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP4 TABLE
128  1350.0    WVPMP(2): NEXT VOL. FLOWRATE
129  1850.0    WVPMP(3): NEXT VOL. FLOWRATE
130  2650.0    WVPMP(4): NEXT VOL. FLOWRATE
131  2655.0    WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ===============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
132    15.0     ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP4
133    16.0     ZHDREQ(2): NEXT ENTRY FOR PUMP4
134    20.0     ZHDREQ(3): NEXT ENTRY FOR PUMP4
135    23.0     ZHDREQ(4): NEXT ENTRY FOR PUMP4
136    23.0     ZHDREQ(5): NEXT ENTRY FOR PUMP4
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**    -1    SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**     0    IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**     1    STRAIGHT TUBE HX
**     2    U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
```

```
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
137  -1         FHXPMP:  TYPE OF HX FOR PUMP4
138  0.0        NTPMP:   NUMBER OF TUBES IN PUMP4 HXS
139  0.0        NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP4 HXS
140  0.0        XIDT: PUMP4 HX TUBE ID
141  0.0        XTT:  PUMP4 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
142  0.0        XTC:  TUBE TO TUBE PITCH IN PUMP4 HX
143  0.0        XS:   SHELL LENGTH IN PUMP4 HX
**144             RGFLHX:  INSIDE FOULING FACTOR
145  0.0        KT:   THERMAL CONDUCTIVITY OF PUMP4 HX TUBES
146  0.0        XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
**147             XIDS:  SHELL INSIDE DIAMETER
148  0.0        XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP4 HX TUBE BDL
149  0.0        NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
150  0.0        TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                        FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                        CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                        RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                        = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                        FLOW
**151  0.DO       TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
**152  0.DO       TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
**153  0.DO       TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
**154  0.DO       TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**155  0.0        WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**156  0.DO       WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**157  0.DO       WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**158  0.DO       WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**159  0.DO       WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**160  0.DO       NTU:  PUMP4 HX NTU
**
*********************          PUMP 5        *********************
*********************   HHSI PUMP DATA      *********************
*********************   (1 PUMP OPERATION ) *********************
*********************    INJECTION MODE     *********************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
161    5.0     NPOINT: NUMBER OF ENTRIES IN PUMP5 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===============
**
162    6000.0   ZHDPMP(1): FIRST ENTRY IN  PUMP5 HEAD TABLE
163    5800.0   ZHDPMP(2): NEXT HEAD
164    5500.0   ZHDPMP(3): NEXT HEAD
165    3234.0   ZHDPMP(4): NEXT HEAD
166       0.0   ZHDPMP(5): NEXT HEAD
**
** ===============  VOLUMETRIC FLOWS  (GPM) =========
```

```
**
167  0.0        WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP5 TABLE
168  150.0      WVPMP(2): NEXT VOL. FLOWRATE
169  300.0      WVPMP(3): NEXT VOL. FLOWRATE
170  599.0      WVPMP(4): NEXT VOL. FLOWRATE
171  600.0      WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ===========
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
172    10.0     ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP5
173    12.0     ZHDREQ(2): NEXT ENTRY FOR PUMP5
174    15.0     ZHDREQ(3): NEXT ENTRY FOR PUMP5
175    23.0     ZHDREQ(4): NEXT ENTRY FOR PUMP5
176    23.0     ZHDREQ(5): NEXT ENTRY FOR PUMP5
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**    -1    SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**     0    IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**     1    STRAIGHT TUBE HX
**     2    U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
177  -1         FHXPMP:  TYPE OF HX FOR PUMP5
178  0.0        NTPMP:   NUMBER OF TUBES IN PUMP5 HXS
179  0.0        NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP5 HXS
180  0.0        XIDT: PUMP5 HX TUBE ID
181  0.0        XTT:  PUMP5 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
182  0.0        XTC:  TUBE TO TUBE PITCH IN PUMP5 HX
183  0.0        XS:   SHELL LENGTH IN PUMP5 HX
184  0.0        RGFLHX:  INSIDE FOULING FACTOR
185  0.0        KT:   THERMAL CONDUCTIVITY OF PUMP5 HX TUBES
186  0.0        XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
187  0.0        XIDS:   SHELL INSIDE DIAMETER
188  0.0        XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP5 HX TUBE BDL
189  0.0        NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
190  0.0        TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                        FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                        CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                        RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                        = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                        FLOW
191  0.0        TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
192  0.0        TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
193  0.0        TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
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194  0.0        TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**
**195  0.0      WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**196  0.       WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**197  0.       WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**198  0.       WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**199  0.       WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**200  0.       NTU:  PUMP5 HX NTU
**
*********************          PUMP 6          *********************
********************* HHSI PUMP DATA           *********************
********************* (2 PUMP OPERATION)       *********************
*********************  INJECTION MODE          *********************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
201  5.0       NPOINT: NUMBER OF ENTRIES IN PUMP6 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===============
**
202      6000.0    ZHDPMP(1): FIRST ENTRY IN  PUMP6 HEAD TABLE
203      5800.0    ZHDPMP(2): NEXT HEAD
204      5500.0    ZHDPMP(3): NEXT HEAD
205      4900.0    ZHDPMP(4): NEXT HEAD
206         0.0    ZHDPMP(5): NEXT HEAD
**
**** ===============  VOLUMETRIC FLOWS  (GPM)  HALF OF NORMAL VOLUME ===========
****
207         0.0    WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP6 TABLE
208       200.0    WVPMP(2): NEXT VOL. FLOWRATE
209       300.0    WVPMP(3): NEXT VOL. FLOWRATE
210       400.0    WVPMP(4): NEXT VOL. FLOWRATE
211       500.0    WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ===============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
212   10.0       ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP6
213   12.0       ZHDREQ(2): NEXT ENTRY FOR PUMP6
214   15.0       ZHDREQ(3): NEXT ENTRY FOR PUMP6
215   23.0       ZHDREQ(4): NEXT ENTRY FOR PUMP6
216   23.0       ZHDREQ(5): NEXT ENTRY FOR PUMP6
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**     -1     SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**      0     IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**      1     STRAIGHT TUBE HX
**      2     U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
```

```
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
217  -1        FHXPMP:  TYPE OF HX FOR PUMP6
218  0.0       NTPMP:   NUMBER OF TUBES IN PUMP6 HXS
219  0.0       NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP6 HXS
220  0.0       XIDT: PUMP6 HX TUBE ID
221  0.0       XTT:  PUMP6 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
222  0.0       XTC:  TUBE TO TUBE PITCH IN PUMP6 HX
223  0.0       XS:   SHELL LENGTH IN PUMP6 HX
224  0.0       RGFLHX:   INSIDE FOULING FACTOR
225  0.0       KT:   THERMAL CONDUCTIVITY OF PUMP6 HX TUBES
226  0.0       XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
227  0.0       XIDS:   SHELL INSIDE DIAMETER
228  0.0       XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP6 HX TUBE BDL
229  0.0       NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
230  0.0       TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                        FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                        CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                        RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                        = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                        FLOW
**231  0.0       TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
**232  0.0       TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
**233  0.0       TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
**234  0.0       TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**235  0.0       WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**236  0.0       WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**237  0.0       WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**238  0.0       WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**239  0.0       WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**240  0.0       NTU:  PUMP7 HX NTU
**
*************************************************************
*********************        PUMP 7        *********************
*********************  OUTSIDE RECIRC SPRAY *********************
************************  1 PUMP OPERATION  *********************
**
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
241    5.0     NPOINT: NUMBER OF ENTRIES IN PUMP7 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===========
**
242    440.0   ZHDPMP(1): FIRST ENTRY IN  PUMP7 HEAD TABLE
243    360.0   ZHDPMP(2): NEXT HEAD
244    320.0   ZHDPMP(3): NEXT HEAD
245    285.0   ZHDPMP(4): NEXT HEAD
246      0.0   ZHDPMP(5): NEXT HEAD
**
** ===============  VOLUMETRIC FLOWS  (GPM) =========
**
247 0.0        WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP7 TABLE
248 2000.0     WVPMP(2): NEXT VOL. FLOWRATE
249 3000.0     WVPMP(3): NEXT VOL. FLOWRATE
250 3640.0     WVPMP(4): NEXT VOL. FLOWRATE
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251 3700.0     WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ===========
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
252   15.0       ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP7
253   15.0       ZHDREQ(2): NEXT ENTRY FOR PUMP7
254   16.0       ZHDREQ(3): NEXT ENTRY FOR PUMP7
255   16.0       ZHDREQ(4): NEXT ENTRY FOR PUMP7
256   16.0       ZHDREQ(5): NEXT ENTRY FOR PUMP7
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**     -1     SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**      0     IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**      1     STRAIGHT TUBE HX
**      2     U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                    LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
257  1.0         FHXPMP:  TYPE OF HX FOR PUMP7
258  1500.0      NTPMP:   NUMBER OF TUBES IN PUMP7 HXS
259   27.0       NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP7 HXS
260  0.04625     XIDT: PUMP7 HX TUBE ID
261  0.0029      XTT:  PUMP7 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
262  0.0729      XTC:  TUBE TO TUBE PITCH IN PUMP7 HX
263  41.7        XS:   SHELL LENGTH IN PUMP7 HX
264  0.0005      RGFLHX:   INSIDE FOULING DIAMETER
265  8.08        KT:   THERMAL CONDUCTIVITY OF PUMP7 HX TUBES
266  0.635      XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
267  3.23        XIDS:     SHELL INSIDE DIAMETER
268  0.0521      XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP7 HX TUBE BDL
269  1.0         NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
**
**
270    0.0      TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                         FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                         CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                         RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                         = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                         FLOW
271  0.0         TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
272  0.0         TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
273  0.0         TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
274  0.0         TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**
275  2.249E6     WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW   CURVE
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276  0.0        WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW C  URVE
277  0.0        WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW C  URVE
278  0.0        WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW C  URVE
279  0.0        WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW C  URVE
**
280  0.0        NTU:  PUMP7 HX NTU
**
**
*********************         PUMP 8        *********************
*********************     LHSI PUMP DATA    *********************
*********************     1 PUMP OPERATION  *********************
*********************     RECIRCULATION MODE *********************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
281     5.0     NPOINT: NUMBER OF ENTRIES IN PUMP3 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ==============
**
282       395.0    ZHDPMP(1): FIRST ENTRY IN  PUMP3 HEAD TABLE
283       255.0    ZHDPMP(2): NEXT HEAD
284       195.0    ZHDPMP(3): NEXT HEAD
285       180.0    ZHDPMP(4): NEXT HEAD
286         0.0    ZHDPMP(5): NEXT HEAD
**
** ===============  VOLUMETRIC FLOWS  (GPM) ===============
**
287         0.0    WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP3 TABLE
288      3000.0    WVPMP(2): NEXT VOL. FLOWRATE
289      4000.0    WVPMP(3): NEXT VOL. FLOWRATE
290      4400.0    WVPMP(4): NEXT VOL. FLOWRATE
291      4500.0    WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ==============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
292        15.0     ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP3
293        16.0     ZHDREQ(2): NEXT ENTRY FOR PUMP3
294        20.0     ZHDREQ(3): NEXT ENTRY FOR PUMP3
295        23.0     ZHDREQ(4): NEXT ENTRY FOR PUMP3
296        23.0     ZHDREQ(5): NEXT ENTRY FOR PUMP3
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**    -1    SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**     0    IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**     1    STRAIGHT TUBE HX
**     2    U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
```

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**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                   LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**             THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
297    0          FHXPMP:  TYPE OF HX FOR PUMP3
298    0.0        NTPMP:   NUMBER OF TUBES IN PUMP3 HXS
299    0.0        NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP3 HXS
300  0.0          XIDT: PUMP3 HX TUBE ID
301  0.0          XTT:  PUMP3 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
302  0.0          XTC:  TUBE TO TUBE PITCH IN PUMP3 HX
303  0.0          XS:   SHELL LENGTH IN PUMP3 HX
**104               RGFLHX:    INSIDE FOULING FACTOR
305  0.0          KT:   THERMAL CONDUCTIVITY OF PUMP3 HX TUBES
306  0.0         XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
**107               XIDS:     SHELL INSIDE DIAMETER
308  0.0          XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP3 HX TUBE BDL
309  0.0          NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
310  0.0         TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                          FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                          CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                          RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                          = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                          FLOW
**311  0.D0         TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
**312  0.D0         TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
**313  0.D0         TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
**314  0.D0         TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**315  311.9        WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**316  0.D0         WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**317  0.D0         WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**318  0.D0         WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**319  0.D0         WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**320  0.D0         NTU:  PUMP3 HX NTU
**
*********************           PUMP 9          *********************
****************** LHSI PUMP FLOW DATA  *************************
******************   2 PUMP OPERATION   *************************
******************    RECIRCULATION MODE *************************
*****************************************************************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
321  5.0         NPOINT: NUMBER OF ENTRIES IN PUMP4 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===============
**
322   395.0    ZHDPMP(1): FIRST ENTRY IN  PUMP4 HEAD TABLE
323   336.0    ZHDPMP(2): NEXT HEAD
324   310.0    ZHDPMP(3): NEXT HEAD
325   266.0    ZHDPMP(4): NEXT HEAD
326     0.0    ZHDPMP(5): NEXT HEAD
**
** ===============  VOLUMETRIC FLOWS  (GPM) ===============
**
327     0.0    WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP4 TABLE
328  1350.0    WVPMP(2): NEXT VOL. FLOWRATE
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329  1850.0    WVPMP(3): NEXT VOL. FLOWRATE
330  2650.0    WVPMP(4): NEXT VOL. FLOWRATE
331  2655.0    WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ==============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
332    15.0     ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP4
333    16.0     ZHDREQ(2): NEXT ENTRY FOR PUMP4
334    20.0     ZHDREQ(3): NEXT ENTRY FOR PUMP4
335    23.0     ZHDREQ(4): NEXT ENTRY FOR PUMP4
336    23.0     ZHDREQ(5): NEXT ENTRY FOR PUMP4
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**    -1    SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**     0    IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**     1    STRAIGHT TUBE HX
**     2    U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                 LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
337   0         FHXPMP:  TYPE OF HX FOR PUMP4
338  0.0        NTPMP:   NUMBER OF TUBES IN PUMP4 HXS
339  0.0        NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP4 HXS
340  0.0        XIDT: PUMP4 HX TUBE ID
341  0.0        XTT:  PUMP4 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
342  0.0        XTC:  TUBE TO TUBE PITCH IN PUMP4 HX
343  0.0        XS:   SHELL LENGTH IN PUMP4 HX
**144             RGFLHX:    INSIDE FOULING FACTOR
345  0.0        KT:   THERMAL CONDUCTIVITY OF PUMP4 HX TUBES
346  0.0        XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
**147             XIDS:    SHELL INSIDE DIAMETER
348  0.0        XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP4 HX TUBE BDL
349  0.0        NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
350  0.0        TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                        FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                        CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                        RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                        = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                        FLOW
**351  0.DO       TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
**352  0.DO       TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
**353  0.DO       TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
**354  0.DO       TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**355  0.0        WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**356  0.DO       WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
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**357  0.D0       WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**358  0.D0       WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**359  0.D0       WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**360  0.D0       NTU:  PUMP4 HX NTU
**
*********************         PUMP 10        *********************
*********************  HHSI PUMP DATA       *********************
*********************  (1 PUMP OPERATION )  *********************
*********************  RECIRCULATION MODE   *********************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
361    5.0     NPOINT: NUMBER OF ENTRIES IN PUMP5 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===============
**
362   6000.0   ZHDPMP(1): FIRST ENTRY IN  PUMP5 HEAD TABLE
363   5800.0   ZHDPMP(2): NEXT HEAD
364   5500.0   ZHDPMP(3): NEXT HEAD
365   3234.0   ZHDPMP(4): NEXT HEAD
366   0.0      ZHDPMP(5): NEXT HEAD
**
** ===============  VOLUMETRIC FLOWS  (GPM) ===============
**
367  0.0       WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP5 TABLE
368  150.0     WVPMP(2): NEXT VOL. FLOWRATE
369  300.0     WVPMP(3): NEXT VOL. FLOWRATE
370  599.0     WVPMP(4): NEXT VOL. FLOWRATE
371  600.0     WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ===============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
372    10.0     ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP5
373    12.0     ZHDREQ(2): NEXT ENTRY FOR PUMP5
374    15.0     ZHDREQ(3): NEXT ENTRY FOR PUMP5
375    23.0     ZHDREQ(4): NEXT ENTRY FOR PUMP5
376    23.0     ZHDREQ(5): NEXT ENTRY FOR PUMP5
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**    -1     SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**     0     IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**     1     STRAIGHT TUBE HX
**     2     U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
```

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**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
**377   0          FHXPMP:  TYPE OF HX FOR PUMP5
**378  0.0         NTPMP:   NUMBER OF TUBES IN PUMP5 HXS
**379  0.0         NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP5 HXS
**380  0.0         XIDT: PUMP5 HX TUBE ID
**381  0.0         XTT:  PUMP5 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
**382  0.0         XTC:  TUBE TO TUBE PITCH IN PUMP5 HX
**383  0.0         XS:   SHELL LENGTH IN PUMP5 HX
**384  0.0         RGFLHX:    INSIDE FOULING FACTOR
**385  0.0         KT:   THERMAL CONDUCTIVITY OF PUMP5 HX TUBES
**386  0.0       XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
**387  0.0         XIDS:    SHELL INSIDE DIAMETER
**388  0.0        XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP5 HX TUBE BDL
**389  0.0         NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
**390  0.0       TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                         FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                         CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                         RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                         = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                         FLOW
391  0.0         TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
392  0.0         TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
393  0.0         TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
394  0.0         TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**
**395  0.0       WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**396  0.        WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**397  0.        WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**398  0.        WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**399  0.        WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**400  0.        NTU:  PUMP5 HX NTU
**
*********************          PUMP 11         *********************
********************* HHSI PUMP DATA           *********************
********************* (2 PUMP OPERATION)       *********************
********************* RECIRCULATION MODE       *********************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
401  5.0        NPOINT: NUMBER OF ENTRIES IN PUMP6 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===============
**
402      6000.0    ZHDPMP(1): FIRST ENTRY IN  PUMP6 HEAD TABLE
403      5800.0    ZHDPMP(2): NEXT HEAD
404      5500.0    ZHDPMP(3): NEXT HEAD
405      4900.0    ZHDPMP(4): NEXT HEAD
406         0.0    ZHDPMP(5): NEXT HEAD
**
**** ===============  VOLUMETRIC FLOWS  (GPM)== HALF OF NORMAL VOLUME =========
****
407         0.0    WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP6 TABLE
408       200.0    WVPMP(2): NEXT VOL. FLOWRATE
409       300.0    WVPMP(3): NEXT VOL. FLOWRATE
410       400.0    WVPMP(4): NEXT VOL. FLOWRATE
411       500.0    WVPMP(5): NEXT VOL. FLOWRATE
```

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**
** ===============  REQUIRED NPSH  (M) ===============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
412   10.0      ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP6
413   12.0      ZHDREQ(2): NEXT ENTRY FOR PUMP6
414   15.0      ZHDREQ(3): NEXT ENTRY FOR PUMP6
415   23.0      ZHDREQ(4): NEXT ENTRY FOR PUMP6
416   23.0      ZHDREQ(5): NEXT ENTRY FOR PUMP6
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**    -1    SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**     0    IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**     1    STRAIGHT TUBE HX
**     2    U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**            THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
417   0         FHXPMP:  TYPE OF HX FOR PUMP6
418  0.0        NTPMP:   NUMBER OF TUBES IN PUMP6 HXS
419  0.0        NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP6 HXS
420  0.0        XIDT: PUMP6 HX TUBE ID
421  0.0        XTT:  PUMP6 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
422  0.0        XTC:  TUBE TO TUBE PITCH IN PUMP6 HX
423  0.0        XS:   SHELL LENGTH IN PUMP6 HX
424  0.0        RGFLHX:    INSIDE FOULING FACTOR
425  0.0        KT:   THERMAL CONDUCTIVITY OF PUMP6 HX TUBES
426  0.0        XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
427  0.0        XIDS:     SHELL INSIDE DIAMETER
428  0.0        XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP6 HX TUBE BDL
429  0.0        NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
430  0.0        TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                        FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                        CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                        RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                        = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                        FLOW
**431  0.0        TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
**432  0.0        TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
**433  0.0        TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
**434  0.0        TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**435  0.0        WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**436  0.0        WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**437  0.0        WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**438  0.0        WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**439  0.0        WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
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**440  0.0         NTU:  PUMP7 HX NTU
**
**
*****************************************************************
*********************           PUMP 12        *********************
**************** INSIDE RECIRCULATION SPRAY PUMP ****************
******************       2 PUMP OPERATION     *********************
*****************************************************************
**
**
** DEFINE PUMP FLOW CHARACTERISITCS AND NPSH REQUIREMENTS
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
441     5.0     NPOINT: NUMBER OF ENTRIES IN PUMP2 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===============
**
442      400.0    ZHDPMP(1): FIRST ENTRY IN  PUMP2 HEAD TABLE
443      330.0    ZHDPMP(2): NEXT HEAD
444      290.0    ZHDPMP(3): NEXT HEAD
445      269.0    ZHDPMP(4): NEXT HEAD
446        0.0    ZHDPMP(5): NEXT HEAD
**
**
** ===============  VOLUMETRIC FLOWS  (GPM) ===============
**
447        0.0    WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP2 TABLE
448   2000.0      WVPMP(2): NEXT VOL. FLOWRATE
449   3000.0     WVPMP(3): NEXT VOL. FLOWRATE
450   3300.0     WVPMP(4): NEXT VOL. FLOWRATE
451   3310.0     WVPMP(5): NEXT VOL. FLOWRATE
**
** ===============  REQUIRED NPSH  (M) ===============
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
452     15.0       ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP2
453     15.0       ZHDREQ(2): NEXT ENTRY FOR PUMP2
454     14.0       ZHDREQ(3): NEXT ENTRY FOR PUMP2
455     14.5       ZHDREQ(4): NEXT ENTRY FOR PUMP2
456     14.5       ZHDREQ(5): NEXT ENTRY FOR PUMP2
**
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**     -1     SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**      0     IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**      1     STRAIGHT TUBE HX
**      2     U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
```

```
**                LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**           THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
457   1.0         FHXPMP:  TYPE OF HX FOR PUMP2
458   1500.0      NTPMP:   NUMBER OF TUBES IN PUMP2 HXS
459    27.0       NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP2 HXS
460   0.04625     XIDT: PUMP2 HX TUBE ID
461   0.0029      XTT:  PUMP2 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
462   0.0729      XTC:  TUBE TO TUBE PITCH IN PUMPS HX
463   41.7        XS:   SHELL LENGTH IN PUMP2 HX
464   0.0005        RGFLHX: INSIDE FOULING FACTOR
465    8.08       KT:   THERMAL CONDUCTIVITY OF PUMP2 HX TUBES
466   0.635     XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFL E CUT")
467   3.23          XIDS:  SHELL INSIDE DIAMETER
468   0.0521     XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP2 HX TUBE BDL
469   1             NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
470   0.0          TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                           FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                           CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                           RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                           = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                           FLOW
**471    0.D0        TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
**472    0.D0        TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
**473    0.D0        TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
**474    0.D0        TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**
475     4.498E6     WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW CURVE
**476    0.D0       WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**477    0.D0       WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**478    0.D0       WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
**479    0.D0       WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW CURVE
480      0.0        NTU:  PUMP2 HX NTU
**
**
*****************************************************************
*********************          PUMP 13       ********************
*********************  OUTSIDE RECIRC SPRAY  ********************
*********************  2 PUMP OPERATION      ********************
**
**
**NOTE, IF DESIRED YOU CAN SUPPLY ONE NUMBER--IF DO SO GIVE IT A LARGE
**HEAD, THEN A CONSTANT FLOW MODEL WILL BE USED
481     5.0     NPOINT: NUMBER OF ENTRIES IN PUMP7 HEAD CURVES (5 MAX)
**
** ===============  HEADS  (M) ===========
**
482     440.0   ZHDPMP(1): FIRST ENTRY IN  PUMP7 HEAD TABLE
483     360.0   ZHDPMP(2): NEXT HEAD
484     320.0   ZHDPMP(3): NEXT HEAD
485     285.0   ZHDPMP(4): NEXT HEAD
486       0.0   ZHDPMP(5): NEXT HEAD
**
** ===============  VOLUMETRIC FLOWS  (GPM) =========
**
487 0.0         WVPMP(1): FIRST VOLUMETRIC FLOW ENTRY IN PUMP7 TABLE
488 2000.0      WVPMP(2): NEXT VOL. FLOWRATE
489 3000.0      WVPMP(3): NEXT VOL. FLOWRATE
490 3640.0      WVPMP(4): NEXT VOL. FLOWRATE
491 3700.0      WVPMP(5): NEXT VOL. FLOWRATE
```

```
**
** ===============  REQUIRED NPSH  (M) ===========
**
** FOR NPSH TABLES, THE SAME FLOWS AS WERE GIVEN FOR HEAD CURVES ARE
** ASSUMED TO CORRESPOND TO THE NPSH HEADS GIVEN
**
492   15.0       ZHDREQ(1): FIRST NPSH ENTRY FOR PUMP7
493   15.0       ZHDREQ(2): NEXT ENTRY FOR PUMP7
494   16.0       ZHDREQ(3): NEXT ENTRY FOR PUMP7
495   16.0       ZHDREQ(4): NEXT ENTRY FOR PUMP7
496   16.0       ZHDREQ(5): NEXT ENTRY FOR PUMP7
**
** ===============  HEAT EXCHANGER SPECIFICATIONS (IF ONE EXISTS)  ========
**
**CALCULATIONS CONTROLLED BY HEAT EXCHANGER TYPE
**HEAT EXCHANGER TYPE:
**     -1    SET OUTLET TEMP OF HX TO RWST TEMPERATURE
**      0    IS NO HX--OUTLET TEMP IS CONTMT SUMP TEMP
**      1    STRAIGHT TUBE HX
**      2    U-TUBE HX
**
**IMPORTANT NOTE:
**FOR HX TYPES 1 AND 2 EITHER SUPPLY ALL GEOMETRIC PARAMETERS
**OR THE NTU (NUMBER OF TRANSFER UNITS) PER HX--ALL KNOWN USERS DO
**THE LATTER--NTUS ARE AVAILABLE BY CONSULTING NAMEPLATE DATA AND
**USING GRAPHS IN, FOR EXAMPLE, HOLMAN, HEAT TRANSFER
**ALL PARAMETERS ARE ON A PER HX BASIS
**
**@@@REV 18 NOTE: THE HEAT EXCHANGER TYPE CAN BE CHANGED WITH
**                 LOCAL PARAMETER CHANGE AT TIME ZERO ONLY
**@@@REV 18  UNCOMMENTED AND DEFINED RGFLHX, XIDS - THESE ARE USED IF
**            THE GEOMETRIC PARAMETERS ARE ENTERED (VS. NTU'S)   (BJS)
**
497  1.0         FHXPMP:  TYPE OF HX FOR PUMP7
498  1500.0      NTPMP:   NUMBER OF TUBES IN PUMP7 HXS
499   27.0       NBPMP:   NUMBER OF SHELL SIDE BAFFLES IN PUMP7 HXS
500  0.04625     XIDT: PUMP7 HX TUBE ID
501  0.0029      XTT:  PUMP7 HX TUBE THICKNESS
**@@@REV 18 CORRECTED DEFINITION OF XTC (PITCH, NOT SEPARATION)   (BJS)
502  0.0729      XTC:  TUBE TO TUBE PITCH IN PUMP7 HX
503  41.7        XS:   SHELL LENGTH IN PUMP7 HX
504  0.0005      RGFLHX:   INSIDE FOULING DIAMETER
505  8.08        KT:   THERMAL CONDUCTIVITY OF PUMP7 HX TUBES
506  0.635       XBC:  LARGEST PERP DISTANCE FROM SHELL TO BAFFLE ("BAFFLE CUT")
507  3.23        XIDS:    SHELL INSIDE DIAMETER
508  0.0521      XSTR:  SHELL TO TUBE CLEARANCE AT OUTSIDE OF PUMP7 HX TUBE BDL
509  1.0         NWCW: NUMBER OF POINTS IN COOLING WATER FLOW CURVE
**
**
510    0.0       TIWCW(1): FIRST TIME IN COOLING WATER FLOW CURVE; COOLING WATER
**                         FLOW CAN BE SPECIFIED AS A FUNCTION OF TIME, OR IT
**                         CAN BE CONSTANT. FOR A CONDSTANT COOLING WATER FLOW
**                         RATE, USE A 1 PINT CURVE WITH THE FIRST TIME POINT
**                         = 0 AND THE FIRST FLOW POINT EQUAL TO THE DESIRED
**                         FLOW
511  0.0         TIWCW(2): NEXT TIME IN COOLING WATER FLOW CURVE
512  0.0         TIWCW(3): NEXT TIME IN COOLING WATER FLOW CURVE
513  0.0         TIWCW(4): NEXT TIME IN COOLING WATER FLOW CURVE
514  0.0         TIWCW(5): LAST TIME IN COOLING WATER FLOW CURVE
**
515  4.498E6     WCWPMP(1): FIRST MASS FLOW RATE IN COOLING WATER FLOW   CURVE
516  0.0         WCWPMP(2): NEXT MASS FLOW RATE IN COOLING WATER FLOW C  URVE
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517  0.0        WCWPMP(3): NEXT MASS FLOW RATE IN COOLING WATER FLOW C  URVE
518  0.0        WCWPMP(4): NEXT MASS FLOW RATE IN COOLING WATER FLOW C  URVE
519  0.0        WCWPMP(5): NEXT MASS FLOW RATE IN COOLING WATER FLOW C  URVE
**
520  0.0        NTU:  PUMP7 HX NTU
**
** *PUMP  #520-840 ARE NOT USED HERE, BUT ARE AVAILABLE TO
** DEFINE CHARACTERISITCS FOR ADDITIONAL PUMPS
**
**********************************************************************
**********************************************************************
**       DELETED APLOT SECTION FROM THE DECK (JKB) 3-6-91
**@@@REV 3, THIS PLTMAP SECTION IS NEW
**
** YOU CAN HAVE UP TO 25 PLOT FILES AND UP TO 99 VARIABLES.
** BEGIN EACH PLOT FILE SECTION WITH THE WORD "PLOTFIL" FOLLOWED BY
** THE UNIT NUMBER YOU WANT THE FILE WRITTEN TO.  A NEGATIVE UNIT NO.
** WILL FORCE BINARY OUTPUT.
**
** NEXT, SELECT THE VARIABLES YOU WANT TO BE PLOTTED BY SIMPLY
** SPECIFYING THE VARIABLE NAMES.  PLOT FILES 31 THRU 37 DEFINED BELOW
** ARE IDENTICAL TO THE "OLD" HARDWIRED MAAP PLOT FILES.
**
**@@@REV 18  IDENTICAL REPLACED BY SIMILAR ABOVE SINCE PLOT FILES
**           CONTINUE TO BE EXPANDED
**
**@@@REV 18 - NOTE ALSO THAT FREQ WILL OVERRIDE IPTSAV, IPTSPK AND IPTSMX
**            IN *CONTROL IF THERE IS ANY MISMATCH IN FREQUENCY SPECS.
**
**@@@REV 18   NOTE:  IF YOU ARE RUNNING THE AUX BLDG IN STAND-ALONE MODE
**            AND YOU WANT THE OUTPUT IN BRITISH UNITS, INCLUDE A *BR IN
**            THE *PLTMAP SECTION
**
** FOR THE CASE OF A VARIABLE NOT PRESENT IN THE MAAP COMMON BLOCK BUT
** YOU WANT TO PLOT IT OUT (OR USE IT IN USER DEFINED EVENTS CODES),
** COMMON/XPLTX/ PLT(500) WAS PROVIDED EXPRESSLY FOR THAT PURPOSE.
** INSERT THE LINE  "COMMON/XPLTX/ PLT(500)"  INTO THE ROUTINE THAT
** HAS THE LOCAL VARIABLE YOU WANT TO SAVE, AND ASSIGN THE VALUE OF
** THE VARIABLE TO ONE OF THE ARRAY PLT INDICES.  THEN SELECT THAT
** ARRAY INDICE TO BE PLOTTED IN THE PLOTFIL SECTION.
**
** BE SURE TO END THIS SECTION WITH THE KEYWORD "END", AND **
**  COMMENTING IS ALLOWED.
**JKB 3-6-91
**
**@@@REV 16, PLOT FREQUECNY OPTION ADDED
** A NEW ADDITION TO THE OLD PLTFIL SCHEME IS THE CONSTRAINTS TO
** THE MINIMUM/MAXIMUM PLOT DT AS DETERMINED BY THE AUTODT PLOT SCALER.
** PREVIOUSLY UNDER THE OLD AUTODT SCHEME, THE PLOT SPACING BETWEEN THE
** PLOTTED DATA POINTS CAN BE AS SMALL AS MAAP TIMESTEP OR AS LARGE AS
** THE MAAP RUN TIME.  THIS ADDITION WILL PROVIDE REASONABLE CONTROL OF
** THE WAY PLOTTTING DATA POINTS MAY TURN OUT, EG., ELIMINATION OF
** VERY NOISY (IE., MANY DATA POINTS OVER SMALL TIME INTERVAL) AND
** VERY COARSE (IE., FEW DATA POINTS SPREAD OVER LARGER TIME INTERVAL)
** PLOTS.  PRESENTLY, THE PLOT FREQUENCY IS SET TO A MINMUM OF 1 SEC,
** AND MAXIMUM OF 5 MINUTE AS SPECIFIED BELOW.  SOME MAY FIND THIS
** UNSUITABLE AND MAY WANT TO ALLOW LARGER OR SMALLER FREQUENCY.  THE
** FORMAT TO SPECIFY THE PLOT FREQUENCY CONSTRAINTS IS
**
**         FREQ  <MINIMUM PLOT DT>  <MAXIMUM PLOT DT>
**
** WHERE THE MAX/MIN PLOT DT IS SUPPLIED IN SECONDS.  NOTE THAT PLOT
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** FREQUENCY CONSTRAINTS APPLIES TO ALL PLOT FILES.
**
**@@@REV 16, LOCAL PARAMETER CHANGE TO ADD PLOTFIL ADDED
** PLOT FILES CAN ALSO BE SETUP VIA INPUT DECK THROUGH LOCAL PARAMETER
** CHANGE.  SIMPLY SPECIFY 25,0,0 FOLLOWED BY THE SYNTAX EXPLAINED,
** (PRATICALLY IDENTICAL TO THE SETUP BELOW BUT WITHOUT THE *PLTMAP
** LINE) AND BE SURE TO END PLTMAP INPUT WITH THE KEYWORD END.  NOTE
** THAT IF YOU SPECIFY THE SAME UNIT NUMBER, THE CURRENT PLOTFIL WILL
** SUPERSEDE THE PREVIOUS ONE.
**
**@@@REV 16, TIME OFFSET OPTION ADDED
** FOR CERTAIN APPLICATIONS, IT IS ADVANTANEOUS TO OFFSET THE PLOT
** FILE TIME BY SOME DELTA TIME.  FOR EXAMPLE, LATE INTO A MAAP RUN
** THE RESOLUTION OF TIME INTERVAL IS LOST DUE TO THE LARGE NUMBER IN
** SECONDS EXPRESSED IN E FORMAT.  THIS REOLUTION CAN BE REGAINED BY
** UTILIZING THE TIME OFFSET.  FOR EXAMPLE, IF THE TIME OFFSET IS 10,000.
** SECONDS, THEN THE TIME STORED TO THE PLOT FILE WILL BE MAAP RUN TIME
** MINUS 10,000 SECONDS.  THE FORMAT TO SPECIFY THE TIME OFFSET IS
**
**       TIMOFF  <TIME IN SECONDS TO OFFSET>
**
** AND WILL ONLY APPLY TO THE PLOTFIL IN WHERE TIMOFF IS SPECIFIED.
** THUS, EACH PLOTFIL CAN HAVE ITS OWN TIME OFFSET.
**
**
*********************************************************************
*PLTMAP  (PARAMETER SECTION #25)
*********************************************************************
**
FREQ 1.0 300.0
**          JKB 3-6-91
**
***PLTMAP
*********************************************************************
**                      MAAP PWR PLOT FILES
*********************************************************************
PLOTFIL 31  /  PRIMARY SYSTEM
MCR,MH2CR1,MWCR1,QWCR,TWCR,ZWV,WGUPCR
MH2CB1,PPS,TCMPS,TWUI,TGPS,ZWCPS,WWUL,MWPS,MH2PS1,MDWTOT
MCMTPS,ZWBC,ZWUC,TWBI,TCRHOT,WHLBL,WSGBL,TSGBHP
TGPZ,TWPZ,PPZ,ZWPZ,MH2PZ1,TSR1,WWBB,WGBB,ZWBH,ZWUH,WHLUL,WSGUL,TGUP
WWDCCR,WSTCR,WESFDC,
TIMRAT
**
*********************************************************************
PLOTFIL 32  /  STEAM GENERATOR AND ESF
ZWBS,PBS,TGBS,ZWUS,PUS,TGUS,TWBS,TWUS,QSGTOT,WCDHBS
**@@@REV 18 ADD SG FLOWS
WWBST,WGBST,WSTSG,WWFWBS,WWFWUS
PACUM,ZWRWST,WESFDC,WESFCL,PQT,TWQT,MH2QT1,TD,NCRTEQ
**
**@@@REV 18:  ITEM 7/17-131
**           TRMA,TRMB,TFMC(FLAME TEMPERATURES) ARE REPLACED BY THE MORE
**           MEANINGFUL TGADA,TGADB, TGADC,TGADD,TGADU, THE IDEAL, ADIABATIC,
**           ISCHORIC FLAME TEMPERATURE FOR COMPLETE COMBUSTION WHICH
**           WOULD OCCUR IN A CLOSED CONTAINER WITH NO HEAT LOSSES.  TRUE
**           PEAK VALUES DURING COMBUSTION WILL BE LOWER DUE TO EXPANSION
**           INTO REGIONS THAT ARE NOT BURNING AND DUE TO HEAT LOSSES.
**           IF TGADx AND PGADx DWELL ABOVE CONTAINMENT FAILURE THRESHOLD
**           VALUES, THEN THE POSSIBILITY OF COMBUSTION SHOULD PROBABLY
**           BE CONSIDERED.  NOTE THAT THE VALUES ARE INDEPENDENT OF
**           FLAMMABILITY LIMITS AND THUS HIGH VALUES MAY BRE ATTAINED
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**            WHEN THE GASSES ARE NOT FLAMMABLE.
*********************************************************************
PLOTFIL 33  /  CONTAINMENT
PC,TCMC,TWC,MWC1,TGC,TGADC,PGADC,MH2C1,MCMTC,XCNC1
TGB,PB,TWB,TCMB,ZWB,TGADB,PGADB,MH2B1,MCMTB,XCNB1
TGA,TGADA,PGADA,MH2A1,TCMA,XCNA1,TGD,MH2D1,TGADD,PGADD,TGADU,PGADU
**
**@@@REV 18: ITEM 7/17-131
**            TFMU(FLAME TEMPERATURE) IS REPLACED BY THE MORE
**            MEANINGFUL TGADU(ADIABITIC,ISOCHORIC FLAME TEMPERATURE
**            FOR COMPLETE COMBUSTION)
*********************************************************************
PLOTFIL 34  /  DETAILED PRI. SYSTEM THERMAL HYDRAULIC INFO.
TGCR,TGUP,TGBH,TGBHT,TGBCT,TGBIL,TGBC,TGDC,TGUH,TGUHT
TGUCT,TGUIL,TGUC,TGDM,TPHSF(1),TPHSF(2),TPHSF(3),TPHSF(4),TBH(2,1)
TPHSF(6),TPHSF(7),TPHSF(8),TPHSF(9),TPHSF(10),TPHSF(11),TPHSF(12)
TUH(2,1),TPHSF(14),TPHSF(15),TPHSF(16),TPHSF(17),TPHSF(18),TPHSF(19)
WVUL,WVBL,FLOSS
**
*********************************************************************
PLOTFIL 35  /  FISSION PRODUCT INFO.
FREL(1),FREL(2),FREL(3),FREL(4),FREL(5),FREL(6),FREL(7),FREL(8)
FREL(9),FREL(10),FREL(11),FREL(12),MAIRPS,MAIRC,MFCSIP,MFCSIC
QFPHSF(1),QFPHSF(2),QFPHSF(3),QFPHSF(4),QFPHSF(5),QFPHSF(6),QFPHSF(7)
QFPHSF(8),QFPHSF(9),QFPHSF(10),QFPHSF(11),QFPHSF(12),QFPHSF(13)
QFPHSF(14),QFPHSF(15),QFPHSF(16),QFPHSF(17),QFPHSF(18),QFPHSF(19)
QGFPPS(1),QGFPPS(2),QGFPPS(3),QGFPPS(4),QGFPPS(5),QGFPPS(6),QGFPPS(7)
QGFPPS(8),QGFPPS(9),QGFPPS(10),QGFPPS(11),QGFPPS(12),QGFPPS(13)
QGFPPS(14),LAMSA,LAMSD
**
*********************************************************************
** NOTE: IF YOU HAVE ICE CONDENSOR FOR YOUR PLANT, PLEASE UNCOMMENT
**   THE NEXT TWO LINES.
**   NOTE: ESF PARAMETERS HAVE BEEN SUBSTITUTED HERE INSTEAD OF
**         THE ICE CONDENSOR VARIABLES FOR CONVENIENCE
PLOTFIL 36  /  ESF PARMETERS
**@@@REV 18 THIS PLOTFILE IS NEW
WSPAXX,WSPBXX,WSPCXX,WLPI1X,WLPI2X,WHPIXX,WCHPXX
NPSHAA,NPSHBA,NPSHCA,NPLP1A,NPLP2A,NPHPIA,NPCHPA
NPSHAR,NPSHBR,NPSHCR,NPLP1R,NPLP2R,NPHPIR,NPCHPR
TSPBX,TSPCX,TLPI1X,TCHPX,WMAFWB,WMAFWU,WTAFWB,WTAFWU,ZWCST
MESFCL,MESFHL,MESFDC,MWUHI,MWACUM,MWCI
***********************************************************************
*********************************************************************
** NOTE: IF YOU ARE NOT MODELING THE AUXILARY/REACTOR BUILDING MODEL
**   THAT IS INODRB=0 IN *CONTROL SECTION, COMMENT THIS SECTION OUT.
**
**PLOTFIL 37  /  AUXILARY BUILDING
**ZWRB(1),ZWRB(2),ZWRB(3),ZWRB(4),TGRB(1),TGRB(2),TGRB(3),TGRB(4)
**PRB(1),PRB(2),PRB(3),PRB(4),WRB(1),WRB(2),WRB(3),WRB(4),WRB(5)
**WCCRB(1),WCCRB(2),WCCRB(3),WCCRB(4),WCCRB(5)
**FMSGTP(1),FMSGTP(2),FMSGTP(3),FMSGTP(4),FMSGTP(5),FMSGTP(6)
**FMENVP(1),FMENVP(2),FMENVP(3),FMENVP(4),FMENVP(5),FMENVP(6)
**MFPE(1,1),MFPRB(1,1,1),MFPRB(1,1,2),MFPRB(1,1,3),MFPRB(1,1,4)
**MFPRB(1,1,5)
**
**@@@REV 18, THIS PLOTFILE IS NEW
**   ITEM 7/17-179:
**   VARIABLES ARE IN COMMON BLOCK GENES4
**    ECCS FLOWS, HPSH, AND TEMPERATURES
**    MOTOR DRIVEN AFW : WMAFWB (BROKEN LOOP)
**                       WMAFWU (UNBROKEN LOOP)
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**   TURBINE DRIVE AFW: WTAFWB (BROKEN LOOP)
**                      WTAFWU (UNBROKEN LOOP)
**   CST WATER LEVEL   : ZWCST
**
**  ITEM 7/17-219:
**  VARIABLES ARE IN COMMON BLOCK ES2
**   INTEGRATED MASS OF COLD LEG ESF   : MESFCL
**   INTEGRATED MASS OF HOT LEG ESF    : MESFHL
**   INTEGRATED MASS OF DOWNCOMER ESF : MESFDC
**   INTEGRATED MASS OF UPPER HEAD INJ: MWUHI
**   INTEGRATED MASS FROM ACCUMULATOR : MWACUM
**   INTEGRATED MASS TO CAVITY FLOODING SYSTEM: MWCI
**
************************************************************************
************************************************************************
PLOTFIL 38  /  GENERALIZED ESF PARAMETERS
**
**
PPS          /  PRIMARY SYSTEM PRESSURE
PPZ          /  PRESSURE IN PRESSURIZER
PBS          /  PRESSURE IN BROKEN STEAM GENERATOR
PUS          /  PRESSURE IN UNBROKEN STEAM GENERATOR
PB           /  LOWER COMPARTMENT PRESSURE
PC           /  PRESSURE IN CAVITY
PACUM        /  ACCUMULATOR PRESSURE
**
TWB          /  TEMP OF WATER IN LOWER COMPARTMENT
TGB          /  TEMP OF GAS IN LOWER COMPARTMENT
TCRHOT       /  HOTTEST CORE NODE
TGUP         /  UPPER PLENUM AVERAGE GAS TEMPERATURE
TWPS         /  AVERAGE TEMPERATURE OF WATER IN PRIMARY SYSTEM
TGPS         /  AVERAGE TEMPERATURE OF GAS IN PRIMARY SYSTEM
TGBH         /  TEMPERATURE OF GAS IN BL HOT LEG
TWBS         /  TEMPERATURE OF WATER IN BROKEN SG
TWUS         /  TEMPERATURE OF WATER IN UNBROKEN SG
**
TGCR         /  AVERAGE TEMPERATURE OF GAS IN CORE
TWCR         /  TEMPERATURE OF WATER IN CORE NODE
TCMPS        /  TEMPERATURE OF CORIUM IN PRIMARY SYSTEM
TCMC         /  TEMPERATURE OF CORIUM IN CAVITY
TWC          /  TEMPERATURE OF WATER IN CAVITY
TCMB         /  TEMPERATURE OF CORIUM IN LOWER B COMPARTMENT
TGA          /  TEMPERATURE OF GAS IN UPPER A COMPARTMENT
**
ZWV          /  LEVEL IN REACTOR VESSEL
ZWCPS        /  LEVEL IN PRIMARY SYSTEM
ZWPZ         /  LEVEL OF WATER ABOVE BOTTOM PRESSURIZER
ZWBS         /  LEVEL OF WATER IN DC OF BROKEN SG
ZWUS         /  LEVEL OF WATER IN DC OF UNBROKEN SG
ZWRWST       /  RWST WATER LEVEL
ZWC          /  LEVEL OF WATER IN CAVITY
ZCMB         /  DEPTH OF CORIUM IN LOWER B COMPARTMENT
ZWB          /  LOWER COMPARTMENT WATER LEVEL
ZWD          /  ANNULAR COMPARTMENT WATER LEVEL
**
MDWTOT       /  OVERALL GAIN IN WATER IN SYSTEM
MWEXT        /  MASS OF WATER IN EXTERNAL TANK
MWCST        /  MASS OF WATER IN COND STORAG TANK
MCR          /  MASS CORIUM            CORE
MWPS         /  MASS WATER     PRIMARY SYSTEM
MCMTPS       /  MASS CORIUM     RV LOWER HEAD
MH2PS1       /  MASS H2        PRIMARY SYSTEM
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MH2CR1      /  MASS H2 PRODUCED        CORE
MH2CB1      /  MASS H2 PRODUCED        CONT
MWC1        /  MASS WATER              CAVITY
MCMTC       /  MASS CORIUM             CAVITY
MH2C1       /  MASS H2                 CAVITY
MCMTB       /  MASS CORIUM   LOWER(B) COMPT
MH2B1       /  MASS H2       LOWER(B) COMPT
MH2A1       /  MASS H2       UPPER(A) COMPT
**
WESFHL      /  ESF MASS FLOW RATE INTO HOT LEG
WESFCL      /  ESF MASS FLOW RATE INTO COLD LEG
WWBB        /  BREAK WATER FLOW BROKEN LOOP
WGBB        /  BREAK GAS FLOW   BROKEN LOOP
WWRV        /  MASS FLOW WATER      PZR PORV
WGRV        /  MASS GAS FLOW        PZR PORV
**
WSPTA       /  TOTAL FLOW THROUGH UPPER COMPT SPRAY HEADERS
WCS         /  FLOW RATE OUT OF LOWER COMPARTMENT SUMP
WDCS        /  FLOW RATE OUT OF ANNULAR COMPARTMENT SUMP
**
WWFWBS      /  BROKEN SG FEED WATER FLOW
WWFWUS      /  UNBROKEN SG FEED WATER FLOW
WWSB        /  SGTR BREAK WATER FLOW
WGSB        /  SGTR BREAK STEAM FLOW
WWBST       /  WATER FLOW FROM SG RELIEF VALVE
WGBST       /  STEAM FLOW FROM SG RELIEF VALVE
**
QDECAY      /  DECAY HEAT RATE
QSGTOT      /  TOT HT RATE TO ALL SGS
**
GENIX(1)    /  NPSH AVAILABLE AT CS PUMP INLET (M)
GENIX(2)    /  NPSH AVAILABLE AT IRS PUMP INLET (M)
GENIX(3)    /  NPSH AVAILABLE AT LHSI PUMP INLET (M)
GENIX(4)    /  NPSH AVAILABLE AT HHSI PUMP INLET (M)
GENIX(5)    /  NPSH AVAILABLE AT ORS PUMP INLET (M)
**
GENIX(6)    /  NPSH REQUIRED FOR CS PUMP INLET (M)
GENIX(7)    /  NPSH REQUIRED FOR IRS PUMP INLET (M)
GENIX(8)    /  NPSH REQUIRED FOR LHSI PUMP INLET (M)
GENIX(9)    /  NPSH REQUIRED FOR HHSI PUMP INLET (M)
GENIX(10)   /  NPSH REQUIRED FOR ORS PUMP INLET (M)
**
GENIX(11)   /  FLOW FROM CS PUMP DISCHARGE (KG/S)
GENIX(12)   /  FLOW FROM IRS PUMP DISCHARGE (KG/S)
GENIX(13)   /  FLOW FROM LHSI PUMP DISCHARGE (KG/S)
GENIX(14)   /  FLOW FROM HHSI PUMP DISCHARGE (KG/S)
GENIX(15)   /  FLOW FROM ORS PUMP DISCHARGE (KG/S)
**
GENIX(16)   /  CS PUMP SUCTION FLOW (KG/S)
GENIX(17)   /  IRS PUMP SUCTION FLOW (KG/S)
GENIX(18)   /  LHSI PUMP SUCTION FLOW (KG/S)
GENIX(19)   /  HHSI PUMP SUCTION FLOW (KG/S)
GENIX(20)   /  ORS PUMP SUCTION FLOW (KG/S)
**
GENIX(21)   /  ENHANCEMENT FLOW TO IRS PUMP (KG/S)
GENIX(22)   /  ENHANCEMENT FLOW TO ORS PUMP (KG/S)
**
GENIX(23)   /  WATER MIXTURE TEMPERATURE TO CS PUMP (K)
GENIX(24)   /  WATER MIXTURE TEMPERATURE TO IRS PUMP (K)
GENIX(25)   /  WATER MIXTURE TEMPERATURE TO LHSI PUMP (K)
GENIX(26)   /  WATER MIXTURE TEMPERATURE TO HHSI PUMP (K)
GENIX(27)   /  WATER MIXTURE TEMPERATURE TO ORS PUMP (K)
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**
GENIX(28)    /  DISCHARGE TEMPERATURE FROM CS PUMP (K)
GENIX(29)    /  DISCHARGE TEMPERATURE FROM IRS PUMP (K)
GENIX(30)    /  DISCHARGE TEMPERATURE FROM LHSI PUMP (K)
GENIX(31)    /  DISCHARGE TEMPERATURE FROM HHSI PUMP (K)
GENIX(32)    /  DISCHARGE TEMPERATURE FROM ORS PUMP (K)
**
**
**********************************************************************
**********************************************************************
PLOTFIL 41   /  VA POWER SUMMARY
PPS          /  PRIMARY SYSTEM PRESSURE
PACUM        /  ACCUMULATOR PRESSURE
ZWCPS        /  LEVEL IN PRIMARY SYSTEM
ZWRWST       /  RWST WATER LEVEL
WESFCL       /  ESF MASS FLOW RATE INTO COLD LEG
WESFHL       /  ESF MASS FLOW RATE INTO HOT LEG
WSPTA        /  TOTAL FLOW THROUGH UPPER COMPT SPRAY HEADERS
WSPTB        /  TOTAL FLOW THROUGH LOWER COMPT SPRAY HEADERS
PB           /  LOWER COMPARTMENT PRESSURE
ZWB          /  LOWER COMPARTMENT WATER LEVEL
WCS          /  FLOW RATE OUT OF LOWER COMPARTMENT SUMP
WDCS         /  FLOW RATE OUT OF ANNULAR COMPARTMENT SUMP
ZWD          /  ANNULAR COMPARTMENT WATER LEVEL
**
QESFHL       /  ENERGY INPUT INTO HOT LEG FROM ESF FLOW
QESFCL       /  ENERGY INPUT INTO COLD LEG FROM ESF FLOW
QESFDC       /  ENERGY INPUT INTO DOWNCOMER FROM ESF FLOW
TSPA         /  TEMP OF UPPER COMPT SPRAY FLOW
TSPB         /  TEMP OF LOWER COMPT SPRAY FLOW
WLETUH       /  LETDOWN FLOW FROM UNBROKEN HOT LEG NODE
WLETBH       /  LETDOWN FLOW FROM BROKEN HOT LEG NODE
WLETUC       /  LETDOWN FLOW FROM UNBROKEN COLD LEG NODE
WLETBC       /  LETDOWN FLOW FROM BROKEN COLD LEG NODE
MWEXT        /  MASS OF WATER IN EXTERNAL TANK
FMWEXT       /  MASS RATE OF CHANGE IN EXTERNAL TANK
TWB          /  TEMP OF WATER IN LOWER COMPARTMENT
TWD          /  TEMP OF WATER IN ANNULAR COMPARTMENT
** PRESSURES
**PPS           /  PRESSURE        PRIMARY SYSTEM
**PPZ           /  PRESSURE           PRESSURIZER
**PACUM         /  PRESSURE           ACCUMULATOR
**PBS           /  PRESSURE             BROKEN SG
**PUS           /  PRESSURE           UNBROKEN SG
**PC            /  PRESSURE                CAVITY
**PB            /  PRESSURE        LOWER(B) COMPT
** TEMPERATURES
**TCRHOT        /  TEMP HOTTEST NODE         CORE
**TWCR          /  TEMP WATER                CORE
**TGCR          /  TEMP GAS                  CORE
**TWPS          /  TEMP WATER      PRIMARY SYSTEM
**TGPS          /  TEMP GAS        PRIMARY SYSTEM
**TCMMPP        /  TEMP CORIUM MELT        PR SYS
**TCMPS         /  TEMP CORIUM     PRIMARY SYSTEM
**TGPZ          /  TEMP GAS           PRESSURIZER
**TWPZ          /  TEMP WATER         PRESSURIZER
**TGUP          /  TEMP GAS         UPPER PLENUM
**TGBH          /  TEMP GAS        BROKEN HOT LEG
**TGBHT         /  TEMP GAS   BROKEN SG HL TUBE
**TGUH          /  TEMP GAS      UNBROKE HOT LEG
**TGUHT         /  TEMP GAS  UNBROKE SG HL TUBE
**TSR1          /  TEMP                SURGE LINE
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**TGBS          /  TEMP GAS             BROKEN SG
**TGUS          /  TEMP GAS             UNBROK SG
**TWBS          /  TEMP WATER           BROKEN SG
**TWUS          /  TEMP WATER           UNBROK SG
**TCMMPC        /  TEMP CORIUM MELT        CAVITY
**TCMC          /  TEMP CORIUM             CAVITY
**TWC           /  TEMP WATER              CAVITY
**TGC           /  TEMP GAS                CAVITY
**TFMC          /  TEMP (FLAME)            CAVITY
**TCMB          /  TEMP CORIUM   LOWER(B) COMPT
**TWB           /  TEMP WATER    LOWER(B) COMPT
**TGB           /  TEMP GAS      LOWER(B) COMPT
**TFMB          /  TEMP (FLAME)  LOWER(B) COMPT
**TGA           /  TEMP GAS      UPPER(A) COMPT
**TFMA          /  TEMP (FLAME)  UPPER(A) COMPT
**TVOHIR        /  TEMP WATER   IN RECIRC SPRAY
**TVOHOR        /  TEMP WATER  OUT RECIRC SPRAY
** ELEVATIONS,LEVELS AND DISTANCES
**ZWV           /  LEVEL WATER   REACTOR VESSEL
**ZWCPS         /  LEVEL WATER COLLAPSED PR SYS
**ZWPZ          /  LEVEL WATER ABOVE BOT    PZR
**ZWBS          /  LEVEL WATER     DC BROKEN SG
**ZWUS          /  LEVEL WATER   DC UNBROKEN SG
**ZWRWST        /  LEVEL WATER             RWST
**ZWC           /  LEVEL WATER           CAVITY
**XCNC1         /  DEPTH CONCRET ABLATION   CAV
**ZWB           /  LEVEL WATER   LOWER(B) COMPT
**ZCMB          /  DEPTH CORIUM  LOWER(B) COMPT
**XCNB1         /  DEPTH CONC ABLATION (B)COMPT
****ZWCS          /  DEPTH WATER IN         SUMP
** MASSES
MDWTOT        /  MASS WATER GAIN  (MASS CONS)
MWCST         /  MASS WATER COND STORAGE TANK
MCR           /  MASS CORIUM                CORE
MWCR1         /  MASS WATER                 CORE
MWPS          /  MASS WATER    PRIMARY SYSTEM
MCMTPS        /  MASS CORIUM    RV LOWER HEAD
MH2PS1        /  MASS H2       PRIMARY SYSTEM
MH2PZ1        /  MASS H2          PRESSURIZER
MH2CR1        /  MASS H2 PRODUCED          CORE
MH2CB1        /  MASS H2 PRODUCED          CONT
MWC1          /  MASS WATER              CAVITY
MCMTC         /  MASS CORIUM             CAVITY
MH2C1         /  MASS H2                 CAVITY
MCMTB         /  MASS CORIUM   LOWER(B) COMPT
MH2B1         /  MASS H2       LOWER(B) COMPT
MH2A1         /  MASS H2       UPPER(A) COMPT
** mass flow rates
WESFCL        /  MASS FLOW ESF TO    COLD LEG
WWFWBS        /  MASS FLOW FW       BROKEN SG
WWFWUS        /  MASS FLOW FW     UNBROKEN SG
**WVSCST        /  MASS FLOW          CONT SPRAY
**WVSIRT        /  MASS FLOW      IN RECIRC SPRAY
**WVSORT        /  MASS FLOW     OUT RECIRC SPRAY
WWBB          /  BREAK WATER FLOW BROKEN LOOP
WGBB          /  BREAK GAS FLOW   BROKEN LOOP
WWUB          /  BREAK WATER FLOW UBROKE LOOP
WGUB          /  BREAK GAS FLOW   UBROKE LOOP
WVUL          /  MASS FLOW UP PLEN TO UNBRK L
WVBL          /  MASS FLOW UP PLEN TO BROKE L
WWRV          /  MASS FLOW WATER      PZR PORV
WGRV          /  MASS GAS FLOW        PZR PORV
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WWVP         /  MASS WATER FLOW    RV BREACH
WGVP         /  MASS GAS FLOW      RV BREACH
WCMVP        /  MASS CORIUM FLOW   RV BREACH
WGCFA        /  MASS GAS FLOW (A)CONT BREACH
** HEAT TRANSFER RATES
QDECAY       /  DECAY HEATING RATE
QWCR         /  HT TRAN RATE   CORE TO WATER
QSGTOT       /  TOT HT RATE TO ALL      SGs
FLOSS        /  TOT HT LOSS RCS / DECAY HT
**QVIRHX       /  HT REMOVAL RATE    IRS HT EX
**QVORHX       /  HT REMOVAL RATE    ORS HT EX
**MISCELANEOUS
VFCR         /  VOID FRACTION          CORE
VFPS         /  VOID FRACTION PRIMARY SYSTEM
**
**
**********************************************************************
**THIS FISSION PRODUCT PLOT DATA WILL BE ASTERISKED OUT
**FOR SUCCESS CRITERIA CALCULATIONS AND WILL BE ACTIVATED
**FOR SOURCE TERM CALCULATIONS.
**PLOTFIL 42  /  ADDITIONAL FISSION PRODUCT SUMMARY
** FISSION PRODUCT
**MFPCRT(2)    /  CSI   UNRELEASED MASS IN VESSEL (KG)
**MFPCMT(2)    /  CSI   UNRELEASED MASS EX-VESSEL (KG)
**MFPPST(2)    /  CSI   RELEASED MASS IN-VESSEL   (KG)
**MFPCOT(2)    /  CSI   RELEASED MASS EX-VESSEL   (KG)
**MFPBS(2)     /  CSI   RELEASED MASS BSG         (KG)
**MFPB(2,2)    /  CSI   AEROSOL MASS IN COMP B    (KG)
** FISSION PRODUCT
**MFPCRT(4)    /  SRO   UNRELEASED MASS IN VESSEL (KG)
**MFPCMT(4)    /  SRO   UNRELEASED MASS EX-VESSEL (KG)
**MFPPST(4)    /  SRO   RELEASED MASS IN-VESSEL   (KG)
**MFPCOT(4)    /  SRO   RELEASED MASS EX-VESSEL   (KG)
**MFPBS(4)     /  SRO   RELEASED MASS BSG         (KG)
**MFPB(4,2)    /  SRO   AEROSOL MASS IN COMP B    (KG)
** FISSION PRODUCT
**MFPCRT(6)    /  CSOH  UNRELEASED MASS IN VESSEL (KG)
**MFPCMT(6)    /  CSOH  UNRELEASED MASS EX-VESSEL (KG)
**MFPPST(6)    /  CSOH  RELEASED MASS IN-VESSEL   (KG)
**MFPCOT(6)    /  CSOH  RELEASED MASS EX-VESSEL   (KG)
**MFPBS(6)     /  CSOH  RELEASED MASS BSG         (KG)
**MFPB(6,2)    /  CSOH  AEROSOL MASS IN COMP B    (KG)
** FISSION PRODUCT
**MFPCRT(8)    /  LA2O3 UNRELEASED MASS IN VESSEL (KG)
**MFPCMT(8)    /  LA2O3 UNRELEASED MASS EX-VESSEL (KG)
**MFPPST(8)    /  LA2O3 RELEASED MASS IN-VESSEL   (KG)
**MFPCOT(8)    /  LA2O3 RELEASED MASS EX-VESSEL   (KG)
**MFPBS(8)     /  LA2O3 RELEASED MASS BSG         (KG)
**MFPB(8,2)    /  LA2O3 AEROSOL MASS IN COMP B    (KG)
** FISSION PRODUCT
**FREL(1)      /  NOBLES        RELEASE FRACTION
**FREL(2)      /  CSI           RELEASE FRACTION
**FREL(3)      /  TEO2          RELEASE FRACTION
**FREL(4)      /  SRO           RELEASE FRACTION
**FREL(5)      /  MOO2          RELEASE FRACTION
**FREL(6)      /  CSOH          RELEASE FRACTION
**FREL(7)      /  BAO           RELEASE FRACTION
**FREL(8)      /  LA2O3         RELEASE FRACTION
**FREL(9)      /  CEO2          RELEASE FRACTION
**FREL(10)     /  SB            RELEASE FRACTION
**FREL(11)     /  TE2           RELEASE FRACTION
** FISSION PRODUCT
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```
**VP-END
**
ENDPLOT
**
***********************************************************************
*EVTMESS   (PARAMETER GROUP #26)
***********************************************************************
**
**@@@REV 3, THIS EVTMES SECTION IS NEW
**
** THIS EVTMES SECTION DEFINES THE MAAP EVENT MESSAGES FOR EVENT CODES
**  1 THRU 250 IN THE PWR CODE, AND 1 THRU 300 IN THE BWR CODE.
**
** EXPECTED FORMAT OF THIS SECTION IS;
**
**  <NUMBER>  <FLAG>  <MESSAGE>
**
**  WHERE  <NUMBER> IS THE EVENT CODE NUMBER
**           <FLAG> IS THE EVENT FLAG
**        <MESSAGE> IS THE EVENT CODE MESSAGE
**
** EVENT FLAG TOKENS "0", "1", "T", "F", "TRUE", AND "FALSE" ARE
** ACCEPTABLE.  BE SURE TO END THIS SECTION WITH THE KEYWORD "END".
** ** COMMENTING IS ALLOWED, AND THE FOLLOWING EVENT MESSAGES ARE
** DEFAULT MAAP EVENT CODE MESSAGES, AS PRESENT IN MAAP BLOCK DATA.
** HENCE, THIS SECTION IS NOT NECCESSARY IF YOU LEAVE EVENT MESSAGES
** UNMODIFIED.  NOTE THAT CHARACTER "!" IS TREATED AS A END OF LINE
** DELIMITOR, AND EVERYTHING AFTER "!" IS IGNORED.
**
**@@@REV 18 - DBM, 12/12/91, NEW FEATURE: SUMMARY CONTROL
** TO ACTIVATE USER CONTROL OF SUMMARY OUTPUT, INSERT "SUMMARY CONTROL ON"
** BEFORE FIRST LINE TO BE CONTROLLED.  INSERT "SUMMARY CONTROL OFF" AFTER
** TO DE-ACTIVATE THIS FEATURE.
**
** EXPECTED FORMAT OF SECTION WITH SUMMARY CONTROL ON IS:
** <NUMBER> <FLAG> <ILIST OPT> <MESSAGE>
**
** WHERE <NUMBER>, <FLAG>, AND <MESSAGE> ARE THE SAME AS ABOVE, AND
**      <ILIST OPT> = 0: DO NOT INCLUDE EVENT CODE IN SUMMARY,
**                  = 1: INCLUDE EVENT CODE IN SUMMARY,
**                  = 2: USE PRUNING TECHNIQUE ON EVENT CODE,
**               OR = BLANK: USE DEFAULT VALUE FROM BDATA INITIALIZATION
**
** WARNING: WHEN SUMMARY CONTROL IS ON, <ILIST OPT> WILL BE EXPECTED.
** THEREFORE, ALWAYS INCLUDE <ILIST OPT> WHEN THE EVENT MESSAGE BEGINS WITH
** A 0, 1, OR 2.
***********************************************************************
**
  1  T  BL BK UNCOVERED
  1  F  BL BK COVERED
  2  T  SUPPORT PLATE FAILED
  2  F  SUPPORT PLATE INTACT
  3  T  RV FAILED
  3  F  RV INTACT
  4  T  MAIN COOLANT PUMPS OFF
  4  F  MCP ON
  5  T  HPI ON
  5  F  HPI OFF
  6  T  LPI ON
  6  F  LPI OFF
  7  T  ACCUM NOT FUNCTIONAL
  7  F  ACCUM FUNCTIONAL
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  8  T  ALL CM DISCH IN INITIAL BLWDWN
  9  T  ALL WATER DISCH IN INITL BLWDWN
**JKB 3-6-91
** 10  T  BL BK WATER FLOW EQUIL W INJ
**@@@REV17 IEVNT(10) (NO LONGER USE EQUILIBRIUM BREAK FLOW)
 10  T  BL BK COVERED & MAX BK FLOW LARGER THAN INJ
**JKB 3-6-91
 10  F  NORMAL BL BK FLOW CALC
 11  T  CHARGING PUMPS ON
 11  F  CHARGING PUMPS OFF
 12  T  CM OR CORE CAN STEAM
 12  F  CORE POOL SUBCOOLED
 13  T  REACTOR SCRAM
 13  F  REACTOR AT FULL POWER
 14  T  FP MODELS ON
 14  F  FP MODELS OFF
 15  T  UNBKN LOOP HOMOGENEOUS
 15  F  UNBKN LOOP PHASES SEPERATED
 16  T  RX VENT LINE UNCOVERED
 16  F  RX VENT LINE COVERED
 17  T  CM IN LOWER HEAD POOL
 17  F  NO CM IN LOWER HD POOL
 18  T  H2 PROD IN RV POOL OVER
 19  T  CM QUENCHED IN VESSEL
 19  F  RV CM NOT QNCHED
 20  T  PS SAT ENERGY AVAIL
 20  F  PS AS A WHOLE SUBCOOLED
 21  T  PS PRESSURE CALCULATED
 21  F  PS PRESSURE DETERMINED BY PZR
 22  T  PS SURGE LINE NOZ UNCOVERED
 22  F  PS SURGE LINE NOZ COVERED
 23  T  DWNCMR NODE HAS NO WATER
 23  F  DWNCMR NODE HAS WATER
 24  T  MAKEUP FLOW OFF
 24  F  MAKEUP FLOW ON
 25  T  PS NONEQ THERMO
 25  F  PS EQUIL THERMO
 26  T  PRIMARY POOLS ISOLATED
 26  F  PRIMARY POOLS WELL-MIXED
 27  T  UNBKN LOOPS NOT BLOCKED AT PUMP BOWLS
 27  F  UNBKN LOOPS BLOCKED
 28  T  DWNCMR NOT BLCKD FOR GAS XPORT
 28  F  DWNCMR BLCKD FOR GAS XPORT
 29  T  RX VENT OPEN
 29  F  RX VENT CLOSED
 30  T  PZR HEATERS ON
 30  F  PZR HEATERS OFF
 31  T  PZR SPRAYS ON
 31  F  PZR SPRAYS OFF
 32  T  PZR EMPTY
 32  F  PZR NOT EMPTY
 36  T  PZR POOL SATURATED
 36  F  PZR POOL SUBCOOLED
 38  T  PZR INSUFF ENERGY FOR SAT
 38  F  PZR SYSTEM SAT ENERGY AVAIL
 39  T  PZR EQUIL THERMO
 39  F  PZR NONEQ THERMO
 40  T  PZR SOLID
 40  F  PZR HAS STEAM
 41  T  PZR PRESS DETERMINED BY PRISYS
 41  F  PZR PRESSURE CALCULATED
 42  T  PZR SAFETY VALVE(S) OPEN
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 42  F  PZR SAFETY VALVES CLOSED
 43  T  RV,BK FLOW/SI ACCUM EQUIL;SYSTEM SOLID
 43  F  NORMAL RV,BK FLOW CALC
 44  T  PZR RELIEF VALVE(S) OPEN
 44  F  PZR RELIEF VALVES CLOSED
 45  T  BKN LOOP NOT BLOCKD AT PMP BOWL
 45  F  BKN LOOP BLOCKED
 46  T  LETDOWN FLOW OFF
 46  F  LETDOWN FLOW ON
 47  T  UHI RUPTURE DISK BKN
 47  F  UHI RUPTURE DISK INTACT
 48  T  UHI ACCUM NOT FUNCTIONAL
 48  F  UHI ACCUM FUNCTIONAL
 49  T  CORE HAS UNCOV
 49  F  CORE NEVER UNCOV
 51  T  CAVITY CM CAN STEAM
 51  F  CAVITY POOL SUBCOOLED
 52  T  CAV WALLS TAKEN TO BE SUBMERGED
 52  F  CAV WALLS NOT SUBMERGED
 53  T  CORIUM ENTRAINED FROM C TO A
 53  F  CORIUM NOT ENTRAINED FROM C TO A
 54  T  H2 PRODUCTION COMPLETED IN CAVITY POOL
 55  T  BURN IN PROGRESS IN CAVITY
 55  F  NO BURN IN PROGRESS IN CAVITY
 56  T  WATER ENTRAINED FROM C TO A
 56  F  WATER NOT ENTRAINED FROM CAVITY TO A
 57  T  WATER IN CAVITY
 57  F  CAVITY DRY
 58  T  CORIUM FLOODING IN CAVITY TO B
 58  F  CORIUM NOT FLOODING IN CAVITY TO B
 59  T  WATER FLOODING IN CAVITY TO B
 59  F  WATER NOT FLOODING IN CAVITY TO B
 60  T  GAS XFER FROM C TO RV BLOCKED
 60  F  NORMAL C-RV GAS XFER
 61  T  CORIUM IN CAVITY
 61  F  NO CORIUM IN CAVITY
 62  T  CORIUM FROZEN IN CAVITY
 62  F  CORIUM MOLTEN IN CAVITY
 65  T  CAV CPLD MODEL USED
 65  F  CAV UNCPLD MODEL USED
 66  T  STEAMING IN CAV LIMITED BY FLOODING
 66  F  STEAMING IN CAV NOT FLOODING-LIMITED
 67  T  TUNNEL COVERED/NO CAV NAT CIRC
 67  F  TUNNEL NOT COVERED
 68  T  CAVITY SOLID
 68  F  CAVITY NOT FULL
**@@@REV 18 EVENT MESSAGE 69 REVISED
 69  T  WATER-CORIUM INTERACTION HAS OCCURED IN CAVITY
 69  F  WATER-CORIUM INTERACTION HAS NOT OCCURED IN CAVITY
 70  T  CORIUM IN CONTACT WITH CAVITY FLOOR
 70  F  CORIUM NOT YET IN CONTACT WITH CAVITY FLOOR
 71  T  LOWER CMPT CM CAN STEAM
 71  F  LOWER CMPT POOL SUBCOOLED
 74  T  POOL H2 PRODUCTION COMPLETED IN LOWER CMPT
 75  T  BURN IN PROGRESS IN LOWER CMPT
 75  F  NO BURN IN LOWER CMPT
 79  T  FANS/COOLERS ON
 79  F  FANS/COOLERS OFF
 81  T  WATER ON LOWER CMPT FLOOR
 81  F  LOWER CMPT FLOOR DRY
 82  T  CORIUM IN LOWER CMPT
 82  F  NO CORIUM IN LOWER CMPT
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83	T	CORIUM FROZEN IN LOWER CMPT
83	F	CORIUM MOLTEN IN LOWER CMPT
86	T	LC SPRAYS ON
86	F	LC SPRAYS OFF
92	T	Q/T RUPTURE DISK FAILED
92	F	Q/T RUPTURE DISK INTACT
93	T	QUENCH TANK RD COVERED
93	F	QUENCH TANK RD NOT COV
94	T	Q/T RD OVERFLOWING
94	F	Q/T RD NOT OVERFLOWING
95	T	Q/T CONTAINS WATER
95	F	Q/T EMPTY
96	T	Q/T WATER CAN STEAM
96	F	Q/T WATER SUBCOOLED
101	T	UPPER COMPT WATER CAN STEAM
101	F	UPPER COMPT WATER SUBCOOLED
102	T	BURN IN PROGRESS IN UPPER CMPT
102	F	NO BURN IN UPPER CMPT
103	T	CONTMT SPRAYS ON
103	F	CONTMT SPRAYS OFF
104	T	CONTMT FAILED
104	F	CONTMT INTACT
105	T	WATER IN REFUELING POOL
105	F	NO WATER IN UPPER CMPT
106	T	NEUTRON SHIELD BAGS RUPTURED
106	F	NEUTRON SHIELD BAGS INTACT
107	T	CORIUM IN A
107	F	NO CORIUM IN A
108	T	CORIUM FROZEN IN A
108	F	CORIUM NOT FROZEN IN A
109	T	VP-CONTAINMENT SPRAYS (CS) ON
109	F	VP-CONTAINMENT SPRAYS OFF
110	T	VP-INSUFF NPSH FOR CS
110	F	VP-SUFF NPSH FOR CS
111	T	VP-AUTO ACTUATION SIGNAL FOR IRS RECEIVED
112	T	VP-INSIDE RECIRC SPRAYS (IRS) ON
112	F	VP-INSIDE RECIRC SPRAYS (IRS) OFF
113	T	VP-INSUFF NPSH FOR IRS
113	F	VP-SUFF NPSH FOR IRS
114	T	VP-AUTO ACTUATION SIGNAL FOR ORS RECEIVED
115	T	VP-OUTSIDE RECIRC SPRAYS (ORS) ON
115	F	VP-OUTSIDE RECIRC SPRAYS (ORS) OFF
116	T	VP-INSUFF NPSH FOR ORS
116	F	VP-SUFF NPSH FOR ORS
117	T	VP-MOTOR-DRIVEN AUXILIARY FEEDWATER TO BSTGEN ON
117	F	VP-MOTOR-DRIVEN AUXILIARY FEEDWATER TO BSGTEN OFF
118	T	VP-TURBINE-DRIVEN AUXILIARY FEEDWATER TO BSTGEN ON
118	F	VP-TURBINE-DRIVEN AUXILIARY FEEDWATER TO BSTGEN OFF
119	T	CONTMT FAILED IN A ON PRESS
120	T	CONTMT FAILED IN A ON STRAIN
121	T	WATER IN ANNULAR CMPT
121	F	NO WATER IN ANNULAR CMPT
122	T	BURN IN PROGRESS IN ANNULAR CMPT
122	F	NO BURN IN ANNULAR CMPT
123	T	ANNULAR COMPT WATER CAN STEAM
123	F	ANNULAR COMPT WATER SUBCOOLED
124	T	VP-LOW RWST LEVEL--CONTAINMENT SPRAYS TURNED OFF
126	T	VP-MOTOR-DRIVEN AUXILIARY FEEDWATER TO USTGEN ON
126	F	VP-MOTOR-DRIVEN AUXILIARY FEEDWATER TO USGTEN OFF
127	T	VP-TURBINE-DRIVEN AUXILIARY FEEDWATER TO USTGEN ON
127	F	VP-TURBINE-DRIVEN AUXILIARY FEEDWATER TO USTGEN OFF
129	T	CONTMT FAILED IN D ON PRESS

130 T CONTMT FAILED IN D ON STRAIN
131 T I/C SUMP HAS WATER
131 F I/C SUMP EMPTY
132 T ICE DEPLETED
132 F ICE AVAILABLE
134 T UNBKN LOOP TURBINE AFW ON
134 F UNBKN LOOP TURBINE AFW OFF
135 T BKN LOOP TURBINE AFW ON
135 F BKN LOOP TURBINE AFW OFF
139 T CONTMT SPRAYS TRAIN C ON
139 F CONTMT SPRAYS TRAIN C OFF
140 T TRAIN C SPRAY PUMPS INSUFF NPSH
140 F TRAIN C SPRAY PUMPS NPSH OK
**JKB 3-6-91
141 T BURN IN PROGRESS IN I/C UPPER PLENUM
141 F NO BURN IN I/C UPPER PLENUM
**JKB 3-6-91
**@@@REV 17, EVENT CODES 142 THRU 150 ADDED
142 T LPI TRAIN 2 ON
142 F LPI TRAIN 2 OFF
143 T LPI PUMPS TRAIN 2 INSUFF NPSH
143 F LPI PUMPS TRAIN 2 NPSH OK
144 T CONTMT SPRAY PUMPS DISABLED
144 F CONTMT SPRAY PUMPS OK
145 T B SPRAY PUMPS DISABLED
145 F B SPRAY PUMPS OK
146 T LPI PUMPS TRAIN 1 DISABLED
146 F LPI PUMPS TRAIN 1 OK
147 T LPI PUMPS TRAIN 2 DISABLED
147 F LPI PUMPS TRAIN 2 OK
148 T HPI PUMPS DISABLED
148 F HPI PUMPS OK
149 T CH PUMPS DISABLED
149 F CH PUMPS OK
150 T CONTMT SPRAY PUMPS TRAIN C DISABLED
150 F CONTMT SPRAY PUMPS TRAIN C OK
**JKB 3-6-91
151 T BROKEN S/G DRY
151 F BROKEN S/G NOT DRY
152 T SEC RV OPEN BROKEN S/G
152 F SEC RV NOT OPEN BROKEN S/G
153 T SEC SV(S) OPEN BROKEN S/G
153 F SEC SV(S) NOT OPEN BROKEN S/G
154 T AUX FEEDWATER ON
154 F AUX FEEDWATER OFF
155 T BRKN LOOP STAGNANT
155 F BRKN LOOP CIRCULATING
156 T MSIV CLOSED
156 F MSIV OPEN
157 T MAIN FW OFF
157 F MAIN FW ON
158 T BKN S/G EQUIL THERMO
158 F BKN S/G NONEQ THERMO
159 T BKN LOOP S/G SOLID
159 F BKN LOOP S/G VOIDED
160 T S/G BK UNCOV PRI SIDE
160 F S/G BK COV
161 T UNBKN S/G DRY
161 F UNBKN S/G NOT DRY
162 T SEC RV OPEN UNBROKEN S/G'S
162 F SEC RV NOT OPEN UNBROKEN S/G'S
163 T SEC SV(S) OPEN UNBROKEN S/G'S

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163  F  SEC SV(S) NOT OPEN UNBROKEN S/G'S
164  T  UNBKN LOOP STAGNANT
164  F  UNBKN LOOP CIRCULATING
165  T  BUMP UNBKN LOOPS
166  T  BUMP BKN LOOPS
167  T  UNBKN S/G EQUIL THERMO
167  F  UNBKN S/G NONEQ THERMO
168  T  UNBKN LOOP S/G SOLID
168  F  UNBKN LOOP S/G VOIDED
169  T  S/G BK UNCOV SEC SIDE
169  F  S/G BK COV
171  T  BROKEN LOOP HOMOGENEOUS
171  F  BROKEN LOOP PHASES SEPERATED
172  T  BKN S/G POOL SAT
172  F  BKN S/G POOL SUBCOOL
176  T  BURN IN AUX BLDG
176  F  NO BURN IN AUX BLDG
177  T  AUX SPRAY WATER GONE
178  T  AUX CO2 SUPLY DEPLETD
179  T  SGTS FILTERS FAILED
179  F  SGTS FILTERS OK
**JKB 3-6-91
**@@@REV 17, EVENT CODE 180 ADDED
180  T  AUTODT PLOT SCALING ON
180  F  EQUALLY SPACED PLOT SCALING ON
**JKB 3-6-91
181  T  RECIRC SYSTEM IN OPERATION
181  F  ENGSAFE PUMPS USING RWST
182  T  A SPRAY PUMPS INSUFF NPSH
182  F  A SPRAY PUMPS NPSH OK
183  T  CH PUMPS INSUFF NPSH
183  F  CH PUMPS NPSH OK
184  T  LPI PUMPS INSUFF NPSH
184  F  LPI PUMPS NPSH OK
185  T  HPI PUMPS INSUFF NPSH
185  F  HPI PUMPS NPSH OK
186  T  CONT SUMP WATER AVAIL
186  F  CONT SUMP EMPTY
187  T  RWST WATER DEPLETED
187  F  RWST WATER AVAILABLE
188  T  ACCUMULATOR WATER DEPLETED
188  F  ACCUMULATOR WATER AVAILABLE
189  T  B SPRAY PUMPS INSUFF NPSH
189  F  B SPRAY PUMPS NPSH OK
190  T  UHI ACCUM EMPTY
190  F  UHI ACCUM NOT EMP
191  T  CST WATER DEPLETED
191  F  CST WATER AVAILABLE
192  T  CAV INJ TANK DEPLETED
192  F  CAV INJ WATER AVAILABLE
193  T  LPI SPRAYS INSUFF NPSH
193  F  LPI SPRAYS NPSH OK
**JKB 3-6-91
**194  T  UNBKN BK WATER FLOW EQUIL W INJ
**@@@REV 17, IEVNT(194) (NO LONGER USE EQUILIBRIUM BREAK FLOW)
194  T  UNBKN BK COVERED & MAX BK FLOW LARGER THAN INJ
**JKB 3-6-91
194  F  NORMAL UL BK FLOW CALC
196  T  FAST STM PROPS IN PRI SYS USED
196  F  FULLBLOWN STM PROPS IN PRI SYS
197  T  UNBKN LOOP BK UNCOV
197  F  UNBKN LOOP BK COV
```

198 T CORE COLLAPSED
198 F CORE GEOM NORML
199 T PRI SYS DEPRESS
199 F PRI SYS AT PRESS
200 T DC CD H2 BLOCK OFF
200 F DC H2 BLOCK NORML
201 T UHI DIVERTED TO CORE POOL
201 F UHI MODEL NORMAL
202 T CORE SUBMERGED BLOCK MODEL OFF
202 F BLOCKAGE MODEL NORMAL
203 T HX COOLING WTR OFF
203 F COOLING WATER AVAILABLE
204 T PUMP BOWLS CANNOT CLR DRNG BLWDWN
204 F PBLS CAN CLEAR DRNG BLWDWN
205 T POWER NOT AVAILABLE
205 F POWER AVAILABLE
207 T H2 BURNS ONLY IN ACOMPT
207 F H2 BURN NORML
**@@@REV 18 208 DEFINITION CHANGE FOR INDEPENTDENT ACTIVATION (SE 258)
208 T CLEAR UNBKN PUMP BOWLS
208 F UNBKN PUMP BOWL MODELS NORML
209 T PS BREAK(S) FAILED
209 F PS BREAK(S) NOT ACTIVE
210 T PZR PORV STUCK OPEN
210 F PZR PORV NOT STUCK OPEN
211 T PZR PORV: MAN OPEN
211 F PZR PORV: NOT MAN OPEN
212 T HPI SWITCH: MAN ON
212 F HPI SWITCH: NOT MAN ON
213 T LPI SWITCH: MAN ON
213 F LPI SWITCH: NOT MAN ON
214 T ACCUM BLOCK VALVE: CLOSE
214 F ACCUM NOT BLOCKED
215 T MCP SWITCH OFF OR HI-VIBR TRIP
215 F MCP SWITCH: ON/NO TRIP
216 T HPI FORCED OFF
216 F HPI SWITCH: NOT FORCED OFF
217 T LPI FORCED OFF
217 F LPI SWITCH: NOT FORCED OFF
218 T FANS/COOLER SWITCH: MAN ON
218 F FANS/COOLER SWITCH: NOT MAN ON
219 T CONTMT SPRAY SWITCH: MAN ON
219 F CONTMT SPRAY SWITCH: NOT MAN ON
220 T RECIRC SWITCH: MAN ON
220 F RECIRC SWITCH: OFF
221 T FANS/COOLERS FORCED OFF
221 F FANS/COOLERS SWITCH: NOT MAN OFF
222 T CONTMT SPRAYS FORCED OFF
222 F SPRAYS SWITCH: NOT MAN OFF
223 T PZR SPRAYS FORCED OFF
223 F PZR SPRAYS NOT FORCED OFF
224 T AUX FEED WATER FORCED OFF
224 F AUX FEED WATER SWITCH: AUTO
225 T PZR PORV BLOCKED
225 F PZR PORV AUTO
226 T PZR HTRS FORCED OFF
226 F PZR HTRS SWITCH: AUTO
227 T MANUAL SCRAM
227 F SCRAM SYSTEM AUTO
228 T MAIN FW SHUT OFF
228 F MAIN FW SW: AUTO
229 T RX VENT SWITCH: MAN OPEN

```
229  F  RX VENTS CLOSED
230  T  UHI ACCUM BLOCKED
230  F  UHI ACCUM NOT BLOCKED
231  T  CHARGING PUMP SWITCH: MAN ON
231  F  CHARGING PUMP SWITCH: AUTO
232  T  CHARGING PUMPS FORCED OFF
232  F  CHARGING PUMP SWITCH: AUTO
**@@@REV18: CHANGE 233 LABEL
233  T  BKN S/G PORV OPENED MANUALLY
233  F  BKN S/G PORV AUTO
234  T  RHR SPRAY VALVE MAN OPEN
234  F  RHR SPRAY VALVE MAN CLOSED
235  T  S/G MSIV: FORCED CLOSED
235  F  MSIV SWITCH: AUTO
236  T  S/G MSIV: FORCED OPEN
236  F  S/G MSIV: AUTO
237  T  EXTERNAL RWST SOURCE ON
237  F  NO EXT RWST SOURCE
238  T  V SEQUENCE
238  F  BREAK FLOW TO BCOMPT
239  T  MODEL DEVELPMNT USE
240  T  AUX BLDG SPRAYS ON
240  F  AUX SPRAYS OFF
241  T  CAV INJ PUMP ON
241  F  CAV INJ OFF
242  T  PS MAKEUP OFF
242  F  PS MAKEUP ON
243  T  LETDOWN SWITCH OFF
243  F  LETDOWN SWITCH ON
244  T  BROKEN LOOP IDLED
244  F  BROKEN LOOP NORML
245  T  MAIN FEED NOT OFF AT SCRAM
245  F  MAIN FEED OFF AT SCRAM
246  T  PZR SPR MAN ON
246  F  PZR SPR AUTO
247  T  BUMP BKN LOOP MCPS(TMI)
247  F  BKN LOOP MCP NORML
248  T  FORCE EXECUTION STOP
**JKB3-6-91
**@@@REV 17, EVENT CODE 249 ADDED
249  T  UNBKN S/G PORV OPENED MANUALLY
249  F  UNBKN S/G PORV NOT MAN OPEN
**JKB 3-6-91
250  T  ZERO OUT FRACTIONAL CHANGES IN INTGRT
**JKB 3-6-91
251  T  UNBKN LOOP TURBINE DRIVEN AFW: MAN ON
251  F  UNBKN LOOP TURBINE DRIVEN AFW: NOT MAN ON
252  T  BKN LOOP TURBINE DRIVEN AFW: MAN ON
252  F  BKN LOOP TURBINE DRIVEN AFW: NOT MAN ON
**@@@REV 17, EVENT CODES 253 THRU 257 ADDED
253  T  LPI SWITCH TRAIN 2: MAN ON
253  F  LPI SWITCH TRAIN 2: NOT MAN ON
254  T  LPI TRAIN 2 FORCED OFF
254  F  LPI SWITCH TRAIN 2: NOT FORCED OFF
255  T  CONTMT SPRAY SWITCH TRAIN C: MAN ON
255  F  CONTMT SPRAY SWITCH TRAIN C: NOT MAN ON
256  T  CONTMT SPRAYS TRAIN C FORCED OFF
256  F  SPRAYS SWITCH TRAIN C: NOT MAN OFF
257  T  DONT SCRAM WHEN CHARGING PUMP ON
257  T  SCRAM WHEN CHARGING PUMP ON
**@@@REV 18 258 NEW FOR INDEPENDENT ACTIVATION (SE 208)
258  T  CLEAR BKN PUMP BOWLS
```

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258  F  BKN PUMP BOWL MODELS NORML
**      EVENT CODES 260 - 267 ARE NOT USED WITH MAAP VERSION 17
**
**260  T  VP-CONTAINMENT SPRAYS: MAN ON
**260  F  VP-CONTAINMENT SPRAYS: AUTO
**261  T  VP-CONTAINMENT SPRAYS: FORCED OFF
**261  F  VP-CONTAINMENT SPRAYS: AUTO
**262  T  VP-INSIDE RECIRC SPRAYS: MAN ON
**262  F  VP-INSIDE RECIRC SPRAYS: AUTO
**263  T  VP-INSIDE RECIRC SPRAYS: FORCED OFF
**263  F  VP-INSIDE RECIRC SPRAYS: AUTO
**264  T  VP-OUTSIDE RECIRC SPRAYS: MAN ON
**264  F  VP-OUTSIDE RECIRC SPRAYS: AUTO
**265  T  VP-OUTSIDE RECIRC SPRAYS: FORCED OFF
**265  F  VP-OUTSIDE RECIRC SPRAYS: AUTO
**266  T  VP-BROKEN S/G PORV MANUALLY OPENED
**266  F  VP-BROKEN S/G PORV AUTO
**267  T  VP-UNBROKEN S/G PORV MANUALLY OPENED
**267  F  VP-UNBROKEN S/G PORV AUTO
**
**@@@REV 17, EVENT CODE 320 ADDED FOR THIS SPECIFIC ACTION
**320  T  PRINT AND RESTART THIS TIMESTEP
**@@@REV 18. EVEMT CPDES 320-323 ADDED FOR THESE SPECIFIC ACTIONS
320  T  PRINT AND RESTART THIS TIMESTEP
321  T  FORCE DIRECTED OUTPUT
322  T  PRINT SELECTED VARIABLE LISTS
323  T  FORCE PLOTFILE OUTPUT
**JKB 3-6-91
END
**
****************************************************************************
****************************************************************************
**
**@@@REV 3, THIS INTEGRATION TIMESTEP CONTROL SECTION IS NEW
**
**
** SI UNITS ONLY ALLOWED
**
** ALLOWED SYNTAXES:
**
** 1. FRACTIONAL CHANGE LIMITATION:
** INDEX  R  X-NAME F-NAME F-CHANGE  X-MIN  X-MAX  TRUE  #1  FALSE  #2
** WHERE:
** INDEX = INDEX OF LIMITING VARIABLE
** R = A FRACTIONAL CHANGE (IE, A RATE) LIMITATION
** X-NAME = STATE OR AUX VARIABLE NAME
** F-NAME = RATE OF CHANGE VARIABLE NAME
** F-CHANGE = FRACTIONAL CHANGE
** X-MIN = MINIMUM X VALUE FOR LIMITATION
** X-MAX = MAXIMUM X VALUE FOR LIMITATION
** THE "TRUE  #1" & "FALSE  #2" ARE OPTIONAL:
** TRUE  #1 = USED WHEN EVENT #1 TRUE
** FALSE  #2 = USED WHEN EVENT #2 FALSE
** WHEN CODE #1 IS TRUE THE CONTROL IS ON
** WHEN CODE #2 IS FALSE THE CONTROL IS ON
** EITHER "TRUE" OR "FALSE" , OR BOTH "TRUE" & "FALSE" CONDITIONS CAN BE used
** EXAMPLE:
** 1   R  MSTPS  FMSTPS  0.05  1.E1  1.E10  TRUE  25
** TIMESTEP LIMITING VARIABLE 1 IS MSTPS, RATE OF CHANGE FMSTPS
** ITS FRACTIONAL CHANGE IS 5% MAXIMUM DURING A TIMESTEP
** IF MSTPS < 10 KG IT IS NOT USED TO LIMIT THE TIMESTEP
** IF MSTPS > 1.E10 KG IT IS NOT USED TO LIMIT THE TIMESTEP
```

```
** IT IS USED WHEN EVENT CODE 25 IS TRUE, IE PS NONEQUILIBRIUM THERMO MOdel
**
** 2. THRESHOLD SPECIFIED EXPLICITLY:
** INDEX  T   X-NAME  F-NAME  THRESH
** INDEX  T+  X-NAME  F-NAME  THRESH
** INDEX  T-  X-NAME  F-NAME  THRESH
** WHERE:
** T = A THRESHOLD LIMITATION BOTH ASCENDING AND DESCENDING
** T+ =  AN ASCENDING THRESHOLD LIMITATION
** T- =  A DESCENDING THRESHOLD LIMITATION
** THRESH = THE THRESHOLD VALUE
** EXAMPLE:
** 2    T+  PPS  FPPS  17.5E6
** TIMESTEP LIMITING VARIABLE 2 IS PPS, RATE OF CHANGE IS FPPS
** THE TIMESTEP WILL BE LIMITED IF PPS ATTEMPTS TO CROSS 17.5 MPA
**  IN AN ASCENDING MANNER (IE, AS IF A RELIEF VALVE WERE TO OPEN)
**
**
** 3. THRESHOLD SPECIFIED BY REFERENCE TO PARAMETER INPUT:
** INDEX  T  X-NAME  F-NAME  T-NAME
** WHERE:
** T-NAME = THE VARIABLE NAME FOR THE THRESHOLD
** EXAMPLE:
** 3    T+  PPS  FPPS  PPZSVL
** TIMESTEP LIMITING VARIABLE 3 IS PPS, RATE OF CHANGE IS FPPS
** THE TIMESTEP WILL BE LIMITED IF PPS ATTEMPTS TO CROSS PPZSVL
**  IN AN ASCENDING MANNER (IE, AS IF A SAFETY VALVE WERE TO OPEN)
**  AND PPZSVL IS INPUT IN THE PARAMETER FILE ALREADY AS THE
**  SAFETY VALVE SETPOINT
**
************************************************************************
*INTEGRATION
************************************************************************
**
** ORIGINAL CRITICAL QUANTITIES FOR TIME LOST INFORMATION
**
** CATEGORY 1 -- GAS MASSES
1    R  MSTPS  FMSTPS  0.05  1.E1  1.E10  TRUE  25
2    R  MH2PS  FMH2PS  0.05  1.E1  1.E10
3    R  MSTPZ  FMSTPZ  0.05  1.E1  1.E10  FALSE  39
4    R  MH2PZ  FMH2PZ  0.05  1.E1  1.E10
5    R  MSTB   FMSTB   0.05  1.E1  1.E10
6    R  MH2B   FMH2B   0.05  1.E1  1.E10
**7    R  MSTC   FMSTC   0.05  1.E1  1.E10  FALSE  65
**8    R  MH2C   FMH2C   0.05  1.E1  1.E10
**9    R  MC2C   FMC2C   0.05  1.E1  1.E10
**10  R  MN2C   FMN2C   0.05  1.E1  1.E10
11  R  MSTA   FMSTA   0.05  1.E1  1.E10
12  R  MH2A   FMH2A   0.05  1.E1  1.E10
13  R  MSTD   FMSTD   0.05  1.E1  1.E10
14  R  MH2D   FMH2D   0.05  1.E1  1.E10
15  R  MSTI   FMSTI   0.05  1.E1  1.E10
16  R  MH2I   FMH2I   0.05  1.E1  1.E10
17  R  MSTBS  FMSTBS  0.05  1.E1  1.E10  FALSE  158
18  R  MSTUS  FMSTUS  0.05  1.E1  1.E10  FALSE  167
**19  R  MSTU   FMSTU   0.05  1.E1  1.E10
20  R  MH2U   FMH2U   0.05  1.E1  1.E10
**
** CATEGORY 2 -- WATER & SOLIDS MASSES
21  R  MWBI   FMWBI   0.05  1.E2  1.E10  FALSE  10
22  R  MWUI   FMWUI   0.05  1.E2  1.E10  FALSE  10
23  R  MWPZ   FMWPZ   0.05  1.E2  1.E10
```

```
24  R  MWC    FMWC    0.05  1.E2  1.E10
**25  MU2C = UO2 MASS IN COMPARTMENT C (VARIABLE DUMMIED OUT AS DUM31)
26  R  MACUM  FMACUM  0.05  1.E2  1.E10
27  R  MWCR   FMWCR   0.05  1.E2  1.E10
28  R  MWDC   FMWDC   0.05  1.E2  1.E10
29  R  MUHI   FMUHI   0.05  1.E2  1.E10
**30  MU2B = UO2 MASS IN COMPARTMENT B (VARIABLE DUMMIED OUT AS DUM30)
31  R  MWBS   FMWBS   0.05  1.E2  1.E10  FALSE  158
32  R  MWUS   FMWUS   0.05  1.E2  1.E10  FALSE  167
**
** CATEGORY 3
**33  LIMIT PRESSURE CHANGES ("EXCESS VOLUME") IN PRIMARY SYSTEM & BROKEN S/G
** -- (HARDWIRED AS IN ORIGINAL INTGRT)
**34  UCMB = CORIUM INTERNAL ENERGY IN COMPARTMENT B (NOT USED)
**35  UCMC = CORIUM INTERNAL ENERGY IN COMPARTMENT C (NOT USED)
**
** CATEGORY 4 -- CONTAINMENT GAS TEMPERATURES
36  R  TGC    FTGC    0.02  1.E2  1.E4  FALSE  65
37  R  TGB    FTGB    0.02  1.E2  1.E4
38  R  TGA    FTGA    0.02  1.E2  1.E4
39  R  TGD    FTGD    0.02  1.E2  1.E4
40  R  TGI    FTGI    0.02  1.E2  1.E4
41  R  TGU    FTGU    0.02  1.E2  1.E4
**
** CATEGORY 5 -- HEATUP PROCESSES(OXIDATION,NODAL TEMPERATURE RATES OF CHANGE)
**42  SUBROUTINE HEATUP REQUIRED TIME STEP (HARDWIRED AS IN ORIGINAL INTGRT)
**
** CATEGORY 6 -- CRUST THICKNESS FOR DEBRIS BED CALCULATIONS
43  R  XCRDC  FXCRDC  0.05  1.E-3  1.0
**
** CATEGORY 7 -- PRIMARY SYS & PZR GAS TEMPERATURES
44  R  TGPS   FTGPS   0.02  1.E2   1.E4  TRUE  25
45  R  TGPZ   FTGPZ   0.02  1.E2   1.E4  FALSE  39
**
** CATEGORY 8 -- CONTROL FOR IMPLICIT PRIMARY SYS FLOW ALGORITHM
**46  CIRC SUBROUTINES REQUIRED TIME STEP (HARDWIRED AS IN ORIGINAL INTGRT)
**47  AUX BLBG REQUIRED TIME STEP (HARDWIRED AS IN ORIGINAL INTGRT)
**
** CATEGORY 6 CONTINUED HERE FOR INDEXING
48  R  XCRUC  FXCRUC  0.05  1.E-3  1.0
49  R  XCRDB  FXCRDB  0.05  1.E-3  1.0
50  R  XCRUB  FXCRUB  0.05  1.E-3  1.0
51  R  XCRDA  FXCRDA  0.05  1.E-3  1.0
52  R  XCRUA  FXCRUA  0.05  1.E-3  1.0
**
** NEW ONES: THRESHOLDS
**
** S/G SAFETY VALVE SET POINTS
**
**53  T+  PBS    FPBS1  PSGSVH
**54  T-  PBS    FPBS1  PSGSVL
**55  T+  PUS    FPUS1  PSGSVH
**56  T-  PUS    FPUS1  PSGSVL
**
** S/G RELIEF VALVE SET POINTS
**
**57  T   PBS    FPBS1  PSGRV
**58  T   PUS    FPUS1  PSGRV
**
** PZR RELIEF VALVE SET POINTS
**
**59  T+  PPZ    FPPZ1  PPORVH
```

```
**60  T-  PPZ    FPPZ1  PPORVL
**
** NEW ONES: RATES OF CHANGE
**
**61  R  PPS    FPPS1   0.05  1.E5   1.E10  TRUE   25
**62  R  PPZ    FPPZ1   0.05  1.E5   1.E10  FALSE  39
**63  R  PBS    FPBS1   0.05  1.E5   1.E10  FALSE  158
**64  R  TWCR1  FTWCR1  0.05  1.E2   1.E4   TRUE   25
**65  R  UGPZ   FUGPZ   0.05  1.E2   1.E4   FALSE  39
**66  R  UWDC   FUWDC   0.05  1.E2   1.E4   TRUE   25
**67  R  UWC    FUWC    0.05  1.E2   1.E4   FALSE  65
**68  R  UWD    FUWD    0.05  1.E2   1.E4
**69  R  UWBT   FUWBT   0.05  1.E2   1.E4   FALSE  158
**70  R  UWUT   FUWUT   0.05  1.E2   1.E4   FALSE  167
**71  R  MWBT   FMWBT   0.05  1.E2   1.E10  FALSE  158
**72  R  MWD    FMWD    0.05  1.E2   1.E10
END
**
**
**JKB 3-6-91
**@@@REV 17 COMMENTS TO THIS SECTION ARE CHANGED TO RELFECT REVISED
**          EVENT CODE NUMBERING; SEE THE EVTMES SECTION ABOVE.
*******************************************************************
*USEREVT   (PARAMETER #28)
*******************************************************************
**@@@REV 16, THIS USEREVT SECTION IS NEW
**
** THIS DEFINES THE USER DEFINED EVENT CODES.  THE FOLLOWING SYNTAX
**  SHOWN BELOW ARE WHAT IS NORMALLY EXPECTED IN THE *USEREVT PARAMETER
**  SECTION.  ANYTHING ELSE IS IGNORED AND THE USER IS WARNED.
**
**  1) **          / COMMENTING
**  2) END         / END OF SECTION KEYWORD
**  3) <NUMBER> <EXPRESSION> / USER DEFINED EVENT CODE
**  4) <TRUE>    <MESSAGE>    / USER SUPPLIED TRUE MESSAGE
**     <FALSE>   <MESSAGE>    / USER SUPPLIED FALSE MESSAGE
**  5) SELECT <NUMBER1> <NUMBER2> ... ETC.
**     SELECT ALL
**
**
**  OPTIONAL USER DEFINED EVENT MESSAGE DISCRIPTION MESSAGE CAN FOLLOW
**   THE EVENT CODE EXPRESSION.  THE ONLY RESTRICTION IS THAT SUCH
**   MESSAGE NEED TO CONFORM TO THE FOLLOWING FORMAT AND MUST COME AFTER
**   THE EVENT CODES THE MESSAGES ARE DEFINED FOR.
**
**      <"TRUE"/"FALSE">  <USER DEFINED MESSAGE>
**
**  AND BOTH TRUE AND FALSE MESSAGE OR JUST ONE OR NONE COULD BE SUPPLIED.
**   TOKENS "TRUE", "T", "FALSE", AND "F" ARE ACCEPTABLE.  NOTE THAT THE
**   CODE WILL GENERATE THE EVENT MESSAGE FROM THE USER DEFINED EVENT CODE
**   EXPRESSION, AND SUPERSEDE IT WITH USER'S IF SUPPLIED.
**
**
**  THE SELECT KEYWORD IS USED TO "SELECT" THE USER DEFINED EVENT CODE
**   NUMBERS TO BE WRITTEN TO THE SUMMRY FILE AND LOG FILE IF NEGATIVE
**   WHEN THE CORRESPONDING EVENT CODE NUMBER STATUS HAS CHANGED.  IF
**   YOU WANT ALL, SIMPLY SAY SELECT ALL, AND THEY WILL ALL BE WRITTEN TO
**   THE SUMMRY FILE.  NOTE THAT NO MESSAGE IS WRITTEN TO THE LOG FILE
**   UNLESS YOU SELECTED A NUMBER WITH A NEGATIVE SIGN.  NOTE THAT WHEN
**   AN MAAP OPERATOR EVENT CODE STATUS CHANGED DUE TO USER DEFINED EVENT
**   CODE STATUS CHANGE, IT IS REPORTED TO THE LOG FILE ALWAYS.
**
```

```
**
**   AN VALID USER DEFINED EVENT CODE EXPRESSION FORMAT CONSISTS OF AN
**    EVENT CODE NUMBER AND CORRESPONDING EVENT CODE EXPRESSION, EG.,
**
**       <EVENT CODE NUMBER> <DEFINING EVENT CODE EXPRESSION>
**
**   EVENT CODE NUMBERS 400-699 ARE ALLOCATED FOR USER DEFINED EVENT CODE
**    DEFINITIONS.  ALSO ALLOWED ARE MAAP DEFINED OPERATOR EVENT FLAGS SO
**    THAT THE USER CAN HAVE THE FLEXIBILTY TO CONTROL HARDWIRED MAAP
**    FUNCTIONS, EG., MANUAL SCRAM, TURN CONTAINMENT SPRAYS ON, ETC.
**    THE MAAP OPERATOR EVENT FLAG CODES ARE 200-399.  CONSULT THE MAAP
**    USER MANUAL OR THE *EVTMESS PARAMETER SECTION FOR DEFINITION
**    OF MAAP OPERATOR CODES.
**
**   AN VAILD EVENT EXPRESSION FORMAT IS EXPECTED TO CONFORM TO ONE OF THE
**    FOLLOWING FORMATS:
**
**   1) "EVENT"  <NUMBER>  <"TRUE"/"FALSE"> <"LOCKOUT">
**
**   2) <VARIABLE1/REAL1>  <REAL_OPERATOR>  <VARIABLE2/REAL2>  <"LOCKOUT">
**
**   3) <FORMAT1/FORMAT2> <LOGICAL_OPERATOR> <FORMAT1/FORMAT2> <"LOCKOUT">
**
**    WHERE     "EVENT"  = THE KEYWORD "EVENT"
**             <NUMBER>  = THE CORRESPONDING EVENT CODE NUMBER
**    <"TRUE"/"FALSE">  = THE KEYWORD "TRUE" OR "FALSE"
**
**          <VARIABLE1>  = THE MAAP COMMON BLOCK VARIABLE NAME
**              <REAL1>  = THE NUMBERIC REAL VALUE
**      <REAL_OPERATOR>  = SELF EXPLANATORY (SEE BELOW)
**          <VARIABLE2>  = THE MAAP COMMON BLOCK VARIABLE NAME
**              <REAL2>  = THE NUMBERIC REAL VALUE
**
**            <FORMAT1>  = IS THE FORMAT DEFINED ABOVE
**            <FORMAT2>  = IS THE FORMAT DEFINED ABOVE
** <LOGICAL_OPERATOR>  = SELF EXPLANATORY (SEE BELOW)
**
**          <"LOCKOUT">  = OPTIONAL "LOCKOUT" KEYWORD
**
**   THE FIRST FORMAT TYPE IS DEFINED AS A LOGICAL EXPRESSION, THE
**    SECOND FORMAT TYPE IS DEFINED AS A REAL EXPRESSION, AND THE THIRD
**    FORMAT TYPE IS DEFINED AS AN MULTIPLE EXPRESSION CONSISTING OF A
**    COMBINATIONS OF FORMAT1 AND/OR FORMAT2.
**
**   NOTE THAT "/" USED ABOVE IN DEFINING THE FORMATS IS EXPRESSED AS
**    "EITHER".  THUS THERE ARE TWO LOGICAL EXPRESSION, FOUR REAL
**    EXPRESSION, AND FOUR MULTIPLE EXPRESSION POSSIBLE COMBINATIONS.
**
**   OPTIONAL KEYWORD "LOCKOUT" TOKEN COULD BE ADDED AT END OF LINE.
**    THIS WILL PERMANETLY LOCK THE EVENT CODE TO TRUE ALWAYS ONCE THE
**    DEFINING EXPRESSION IS SATISFIED. TOKENS "L", "LKO", & "LO" ARE
**    ACCEPTABLE.
**
**   ALLOWABLE <REAL_OPERATOR> TOKENS ARE
**
**       >  or GT           (GREATER THAN)
**       <  or LT           (LESS THAN)
**       >= or GE or =>     (GREATER THAN OR EQUAL TO)
**       <= or LE or =<     (LESS THAN OR EQUAL TO)
**       =  or EQ           (EQUAL TO)
**       <> or NE           (NOT EQUAL TO)
**
```

```
**  AND ALLOWABLE <LOGICAL_OPERATOR> TOKENS ARE
**
**      AND or A
**      OR  or O
**
**
**  WE WILL NOW SHOW SOME EXAMPLES OF USER DEFINED EVENT CODES, AND
**   WE'LL START WITH A SIMPLE EXPRESSION AND END WITH A MULTIPLE
**   EXPRESSION EXAMPLE.
**
**  LET'S SAY WE HAVE THE FOLLOWING SIMPLE EXPRESSION;
**
**     401 PPS > 1.E6
**
**  EVENT CODE 401 IS TRUE WHEN PPS, THE REACTOR VESSEL PRESSURE, IS
**   GREATER THAN 1.E6 PASCALS, OTHERWISE IT IS FALSE.
**
**
**  THE SECOND EXAMPLE INVOLVING MULTIPLE EXPRESSION, AS SHOWN IS;
**
**     402 TGPS > 450 AND EVENT 401 TRUE LOCKOUT
**
**  EVENT CODE 402 IS SET PERMANETLY TRUE WHEN TGPS, THE REACTOR GAS
**   TEMPERATURE, IS GREATER THAN 450 KELVINS AND WHEN EVENT CODE 401
**   IS TRUE.
**
**
**  TWO IMPORTANT NOTES MUST BE MADE.  THE FIRST IS THAT ALL NUMBERS
**   ARE EXPECTED TO BE IN SI UNITS.  THIS IS DONE TO PREVENT CONFUSION
**   AS TO WHAT MAAP COMMON BLOCK VARIABLES HAVE DEFINING UNITS NUMBERS
**   ASSIGNED.  THOSE THAT DO, CAN BE EASILY CONVERETED TO/FROM SI AND
**   BRITISH UNITS.  THOSE THAT DO NOT ARE ALWAYS IN SI UNITS.  SINCE NOT
**   ALL MAAP COMMON BLOCK VARIABLES HAVE DEFINING UNIT NUMBERS, THE
**   POTENIAL TO CONFUSE WHAT TYPE OF NUMBERS TO INPUT IS GREAT AND WE
**   WANT TO AVOID THIS SITUATION.  HOPEFULLY THIS WOULD BE RECIFIED IN
**   THE NEAR FUTURE.
**
**  THE SECOND NOTE IS THAT USER DEFINED EVENT CODES ARE EVALUATED
**   IMMEDIATELY AFTER MAAP EVENT CODES ARE EVALUATED.  USER DEFINED
**   EVENT CODES ARE EVALUATED SEQUENTIALLY FROM 400 TO 699 FIRST, AND
**   THEN USER DEFINED EVENT CODES 200-399 (WHICH HAVE A ONE TO ONE
**   CORRESPONDENCE WITH MAAP OPERATOR EVENT CODES) ARE EVALUATED NEXT.
**   THIS IS IMPORTANT TO NOTE SINCE IF THE EVALUATION OF AN EVENT CODE
**   DEPENDS ON THE STATUS OF ANOTHER EVENT CODE, YOU'LL WANT TO BE
**   SURE THAT THE "OTHER" EVENT CODE HAS ALREADY BEEN EVALUTED FIRST.
**
**  USER DEFINED EVENT CODES CAN ALSO BE DEFINED IN THE INPUT DECK VIA
**   LOCAL PARAMETER CHANGE.  SPECIFY 28,0,0 FOLLOWED BY THE SYNTAX
**   EXPLAINED ABOVE.  BE SURE TO END WITH THE KEYWORD END.
**
**  IT IS HOPED THAT THE ABOVE DESCRIPTIONS SHOULD BE MORE THAN ADQUATE
**   IN EXPLAINING THE PURPOSE OF USER DEFINED EVENTS.
**
**@@@REV 17, CLARIFICATION
** AS WAS PREVIOUSLY STATED EARLIER, PLACING A *SI AT THE END OF THE
** PARAMETER FILE WOULD MAKE THE CODE EXPECT THE INPUT DECK EXPECT SI
** UNITS FOR INPUT NUMBERS, AND ALL OUTPUT FILES WOULD BE IN SI UNITS.
** CONVERSLY, IF *BR WAS PLACED AT THE END OF THE PARAMETER FILE, INPUT
** UNITS WOULD BE EXPECTED TO BE IN BRITISH UNITS, AND ALL OUTPUT FILES
** WOULD BE IN BRITISH UNITS.
**@@@REV 18, NOTE THAT USER-DEFINED EVENTS ARE VERY USEFUL FOR MODELING
**          OPERATING PROCEDURES
```

```
**
*************************************************************************
**PRTLIS  (PARAMETER GROUP #31)
*************************************************************************
**@@@REV 18, NEW PARAMETER SECTION FOR DEFINGING VARIABLE LISTS
** UP TO 25 LISTS OF 99 VAIABLES EACH CAN BE DEFINED
**
** EXAMPLE
**LIST #1 TO UNIT 6
**PPS, IEVNT(322)
**
** WHENEVER THE ACTION "PRINT LIST1" IS TAKEN, THE VARIABLES IN LIST 1 WILL
** BE PRINTED WITH THEIR VALUES.  THE TIME IS INCLUDED WITH EACH LIST.  THE
** MOST RECENT LIST DEFINITION WILL BE USED.  I.E., IF LIST #1 IS REDEFINED
** IN THE INPUT DECK, THE EXAMPLE SHOWN HERE WILL BE OVERWRITTEN.
END
*BR
```

F.6 SENSITIVITY CALCULATION RESULTS

This section contains the North Anna IPE level 2 sensitivity calculation results.

Table F.6-1 provides the sensitivity to the probability of induced RCS failures. Table F.6-2 shows the sensitivity to alpha mode Containment failure probability. Table F.6-3 is the sensitivity study for the probability to cool the debris in-vessel for several plant conditions. Table F.6-4 provides the sensitivity to the amount of hydrogen produced in-vessel. Table F.6-5 is the sensitivity to the increase/decrease in the probability of a large DCH. Table F.6-6 shows the sensitivity to the uncontrolled hydrogen burn probability. Table F.6-7 presents the sensitivity to the Containment failure pressure set point. Table F.6-8 is the sensitivity to the assumptions on recirculation spray failure. Table F.6-9 is a sensitivity study on the assumptions for debris cooled ex-vessel. Table F.6-10 shows the sensitivity for late recirculation spray failure. Table F.6-11 provides the sensitivity to the Event V frequency. And finally, Table F.6-12 is the sensitivity to the frequency for the loss of Containment isolation.

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Drawing Number	Title
	Reactor Vessel (Sectional View) & Reactor Vessel Head Vent Subsystem
	Reactor Vessel & Internals Assemblies
11715-FM-1A	Mach. Loc. - Reactor Cont. Sh 1
11715-FM-1B	Mach. Loc. - Reactor Cont. Sh 2
11715-FM-1C	Mach. Loc. - Reactor Cont. Sh 3
11715-FM-1D	Mach. Loc. - Reactor Cont. Sh 4
11715-FM-1E	Mach. Loc. - Reactor Cont. Sh 5
11715-FM-1F	Mach. Loc. - Reactor Cont. Sh 6
11715-FM-1G	Mach. Loc. - Reactor Cont. Sh 7
11715-FM-2A	Arrgt Auxiliary Building - Sh 1
11715-FM-2B	Arrgt Auxiliary Building - Sh 2
11715-FM-2C	Arrgt Auxiliary Building - Sh 3
11715-FM-2D	Arrgt Auxiliary Building - Sh 4
11715-FM-2E	Arrgt Auxiliary Building - Sh 5
11715-FM-2F	Arrgt Auxiliary Building - Sh 6
11715-FM-2G	Arrgt Auxiliary Building - Sh 7
11715-FP-4A	Flow Diagram Recirculation Spray System - Sh 1

Drawing Number	Title
11715-FP-4B	Flow Diagram Recirculation Spray System - Sh 2
11715-FP-4C	Flow Diagram Recirculation Spray System - Sh 3
11715-FP-4D	Flow Diagram Recirculation Spray System - Sh 4
11715-FP-4E	Flow Diagram Recirculation Spray System - Sh 5
11715-FP-4F	Flow Diagram Recirculation Spray System - Sh 6
11715-FP-4G	Flow Diagram Recirculation Spray System - Sh 7
11715-FM-35A	Quench and Recirculation Spray Systems Sh 1
11715-FM-35B	Quench and Recirculation Spray Systems Sh 2
11715-FM-091A	Quench Spray System Sh 1
11715-FM-091B	Quench Spray System Sh 2
11715-FV-1A	Reactor Containment Schedule of Piping Penetrations Sh 1
11715-FV-1B	Reactor Containment Schedule of Piping Penetrations Sh 2
11715-FV-1C	Reactor Containment Schedule of Piping Penetrations Sh 3
11715-FV-1F	Liner Details, React or Containment
11715-FV-1P	Reactor Containment Sump Pit Screen Location
11715-FY-1A	Plot Plan
11715-FY-1B	Site Utilization Plan
11715-FC-15A	Foundation Material Details Reactor Containment Sh 1
11715-FC-15E,F	Exterior Concrete Details Reactor Containment Sh 13
11715-FC-15G,H	Exterior Concrete Details Reactor Containment Sh 14
11715-FP-9A	Reactor Coolant Piping Sh 1
11715-FP-9B	Reactor Coolant Piping Sh 2
11715-FM-93A	Flow/Valve Operating Numbers Diagram Reactor Coolant System Loop A
11715-FM-93A	Flow/Valve Operating Numbers Diagram Reactor Coolant System Loop B
11715-FM-93A	Flow/Valve Operating Numbers Diagram Reactor Coolant System Loop C
11715-FM-93B	Flow/Valve Operating Numbers Diagram Reactor Coolant System Sh 1
11715-FM-93B	Flow/Valve Operating Numbers Diagram Reactor Coolant System Sh 2
11715-FM-94A	Flow/Valve Operating Numbers Diagram Residual Heat Removal System Sh 1
11715-FM-94A	Flow/Valve Operating Numbers Diagram Residual Heat Removal System Sh 2
11715-FM-95A	Flow/Valve Operating Numbers Diagram Chemical & Volume Control System Sh 1
11715-FM-95A	Flow/Valve Operating Numbers Diagram Chemical & Volume Control System Sh 2
11715-FM-95B	Flow/Valve Operating Numbers Diagram Chemical & Volume Control System Sh 3

Drawing Number	Title
11715-FM-79A	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 1
11715-FM-79A	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 2
11715-FM-79A	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 3
11715-FM-79A	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 4
11715-FM-79A	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 5
11715-FM-79B	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 6
11715-FM-79B	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 7
11715-FM-79B	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 1
11715-FM-79B	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 2
11715-FM-79C	Flow/Valve Operating Numbers Diagram Component Cooling Water System Sh 3
Westinghouse Dwg 1098J10	Pressurizer

TABLE F.2-1
PLANT DAMAGE STATE BINNING LOGIC RULES

```
   LOGIC RULES for  REV2NAPS.PDD
               Rule for   CONBYPASS
 IF A:VX == FAILURE;
 THEN EVENT V;
 IF A:T7 == FAILURE   * A:P   == FAILURE;
 IF A:T7 == FAILURE   * A:SGI== FAILURE;
 IF A:T7 == FAILURE   * A:O   == FAILURE;
 IF A:T7 == FAILURE   * A:D1 == FAILURE   * A:L == FAILURE;
 THEN SGTR;
 DEFAULT NO BYPASS;
               Rule for   CONISOLAT
 IF A:H1 == FAILURE;
 IF A:H2 == FAILURE;
 THEN ISOLATED;
 IF A:IS == FAILURE;
 IF A:D3 == SUCCESS * A:Rs == FAILURE;
 IF A:D3 == SUCCESS * A:Ch == FAILURE;
 IF A:H2 == SUCCESS * A:Rs == FAILURE;
 IF A:H2 == SUCCESS * A:Ch == FAILURE;
 IF A:H1 == SUCCESS * A:Rs == FAILURE;
 IF A:H1 == SUCCESS * A:Ch == FAILURE;
 THEN NOT ISOLATED;
 IF A:IS != FAILURE;
 THEN ISOLATED;
               Rule for   TRANLOCA
 IF A:A   == FAILURE;
 IF A:RX  == FAILURE;
 THEN LARGE LOCA;
 IF A:S1  == FAILURE;
 IF A:S2  == FAILURE;
 IF A:T7 == FAILURE;
 IF A:Q == FAILURE;
 IF A:P == SUCCESS;
 IF A:S1c == FAILURE;
 IF A:T4 == FAILURE * A:O == FAILURE;
 IF A:T6 == FAILURE * A:O == FAILURE;
 IF A:T8 == FAILURE * A:O == FAILURE;
 IF A:T1Tr == FAILURE * A:O == FAILURE;
 IF A:T2Tr == FAILURE * A:O == FAILURE;
 IF A:T3Tr == FAILURE * A:O == FAILURE;
 IF A:T9ATr == FAILURE * A:O == FAILURE;
 IF A:T9BTr == FAILURE * A:O == FAILURE;
 THEN SMALL/MED LOCA;
 DEFAULT TRANSIENT;
               Rule for   SBO
 IF A:T1A    == FAILURE;
 IF A:T8     == FAILURE * A:RC1 != SUCCESS;
 IF A:T6     == FAILURE * A:RC1 != SUCCESS;
```

TABLE F.2-1 (Continued)
PLANT DAMAGE STATE BINNING LOGIC RULES

```
IF A:T1Tr  == FAILURE * A:RC1 != SUCCESS;
IF A:T2Tr  == FAILURE * A:RC1 != SUCCESS;
IF A:T2ATr == FAILURE * A:RC1 != SUCCESS;
IF A:T3Tr  == FAILURE * A:RC1 != SUCCESS;
IF A:T9ATr == FAILURE * A:RC1 != SUCCESS;
IF A:T9BTr == FAILURE * A:RC1 != SUCCESS;
THEN YES;
DEFAULT NO;
            Rule for   POWRECOV
IF A:B    == SUCCESS;
IF A:B1   == SUCCESS;
IF A:RC2  == SUCCESS;
THEN PRIOR RV FAIL;
IF A:B2   == SUCCESS;
IF A:RC3  == SUCCESS;
THEN PRIOR CONT FAIL;
DEFAULT NO POWER REC;
            Rule for   RECSPRAYS
IF A:Rs    == SUCCESS;
IF A:SPRAY == SUCCESS;
THEN YES;
DEFAULT NO;
            Rule for   CNHEATREM
IF A:Ch   == SUCCESS;
THEN YES;
DEFAULT NO;
            Rule for   INVESSINJ
IF A:H1 == FAILURE;
IF A:H2 == FAILURE;
THEN FAILED;
IF A:A == FAILURE * A:H1 == SUCCESS * A:Dh == SUCCESS;
IF A:A == FAILURE * A:D3 == SUCCESS * A:Rs == SUCCESS;
IF A:RX== FAILURE * A:D3 == SUCCESS * A:Rs == SUCCESS;
IF A:RX== FAILURE * A:Qs == SUCCESS * A:Rs == SUCCESS;
IF A:S1 == FAILURE * A:H1 == SUCCESS;
IF A:S1 == FAILURE * A:H2 == SUCCESS;
IF A:S2 == FAILURE * A:H2 == SUCCESS;
THEN ON;
IF A:A == FAILURE * A:H1 == SUCCESS * A:Dh == FAILURE;
IF P:SBO==NO *P:RCSPRESS!=LO LO * A:H1==SUCCESS;
IF A:S2 == FAILURE * A:H1 == SUCCESS;
THEN LPI DEADHEAD;
IF P:POWRECOV==PRIOR RV FAIL * P:RCSPRESS !=LO LO*A:H1==SUCCESS;
THEN RECOVERED;
DEFAULT FAILED;
```

TABLE F.3-1
SUMMARY OF CONTAIN 5-CELL DCH SENSITIVITY STUDY
(From Table 3.3 of NUREG/CR-4896)

Run No.	Variations From Base Case	Max. Pressure (bars)
1	Base Case	7.2
2	No Trapping	7.9
3	$lambda_{tr}$ = 4 $lambda_{tr}$ (base)	6.7
4	$lambda_{tr}$ = 10 $lambda_{tr}$ (base)	6.4
5	No H_2 Recombination	7.1
6	E-Error Fix	7.0
7	Unconditional H_2 Burn	9.3
8	UCHB, No Trapping	9.8
9	UCHB, $lambda_{tr}$ = 4 $lambda_{tr}$ (base)	8.8
10	UCHB, $lambda_{tr}$ = 10 $lambda_{tr}$ (base)	8.4
11	UCHB, E-Error Fix	9.1
12	UCHB (10-Sec. Duration)	9.3
13	UCHB at 9380 Sec.	9.6
14	1-mm Particles	6.9
15	UCHB, 1-mm Particles	9.0
16	10-Second Blowdown	9.5
17	UCHB, 10-Second Blowdown	12.3
18	$2x10^4$ Kg Cavity Water	8.8
19	Cavity Water, UCHB	11.6
20	Chemical reaction thresh = 400 $^{\circ}K$	7.2
21	No Trapping and $D_d = \infty$	7.9
22	Baker Diffusivity	7.0
23	30% In-Vessel Zr Oxidation	7.4
24	30% In-Vessel Zr Oxidation, UCHB	9.5
25	Case 24, Adjusted H_2 Inventory	9.1
26	50% Core Injection	6.5
27	25% Core Injection	5.9
28	50% Core Injection, UCHB	8.5
29	25% Core Injection, UCHB	7.6
30	C106, Cess-Lian Emiss.	7.0
31	C106, Modak Emiss.	6.8
32	C106, Cess-Lian, UCHB	9.1
33	C106, Modak, UCHB	8.9

TABLE F.3-2
SUMMARY OF DET ENDPOINT PRESSURES EXTRACTED FROM NUREG/CR-4896

DET Endpoint Number	Bases NUREG/CR-4896 Table 3.3 Run Number	Corrected[a] Peak Containment Pressure bar (psia)
1 - 3	24	9.3 * 1.17[d] - 1.7[c] = 9.2 (135)
4 - 6	23	7.2 * 1.17 - 1.7 = 6.7 (99)
7 - 9	28	8.3 * 1.17 + .2[b] - 1.7 = 8.2 (121)
10	26	6.3 * 1.17 + .2 - 1.7 = 5.9 (86)
11 - 13	29	7.4 * 1.17 + .2 - 1.7 = 7.2 (105)
14	27	5.7 * 1.17 + .2 - 1.7 = 5.2 (76)
15 - 17	11	9.1 * 1.17 - 1.7 = 8.9 (132)
18 - 19	6	7.0 * 1.17 - 1.7 = 6.5 (95)
20 - 22	28	8.3 * 1.17 - 1.7 = 8.0 (118)
23	26	6.3 * 1.17 - 1.7 = 5.7 (83)
24 - 26	29	7.4 * 1.17 - 1.7 = 7.0 (102)
27	27	5.7 * 1.17 - 1.7 = 5.0 (73)
32 - 35	24	9.3 * 1.17 = 10.9 (160)
36 - 38	23	7.2 * 1.17 = 8.4 (124)
39 - 42	28	8.3 * 1.17 + .2[b] = 9.9 (146)
43 - 45	26	6.3 * 1.17 + .2 = 7.6 (111)
46 - 48	29	7.4 * 1.17 + .2 = 8.9 (130)
49 - 51	27	5.7 * 1.17 + .2 = 6.9 (101)
52 - 55	11	9.1 * 1.17 = 10.6 (157)
56 - 58	6	7.0 * 1.17 = 8.2 (120)
59 - 62	28	8.3 * 1.17 = 9.7 (143)
63 - 65	26	6.3 * 1.17 = 7.4 (108)
66 - 68	29	7.4 * 1.17 = 8.7 (127)
69 - 71	27	5.7 * 1.17 = 6.7 (98)

(a) Pressure correction of (-) 0.2 bar to account for error in CONTAIN reaction energy calculation (see page 41 in NUREG/CR-4891).
(b) Pressure addition of (+) 0.2 bar to account for difference between high in-vessel Zr oxidation cases and low in-vessel Zr oxidation cases (see Table 3.3 Runs 1 and 23 in NUREG/CR-4896).
(c) Sequences with sprays on at vessel failure are estimated to have a peak pressure rise 1.7 bar (25 psi) lower than an equivalent sequence without sprays.
(d) Pressure correction (factor of 1.17) to account for higher NAPS power rating to containment volume ratio (vs. that for Surry).

TABLE F.3-3
DISCRETIZED NORTH ANNA CONTAINMENT FRAGILITY CURVE

PSIG	PSIA	PF	CLEAK	CRUPT	CCATRP	PNOF	PLEAK	PRUPT	PCATRP
70	85	0.000	1.000	0.000	0.000	1.000	0.000	0.000	0.000
71	86	0.000	0.990	0.010	0.000	1.000	0.000	0.000	0.000
72	87	0.001	0.980	0.020	0.000	0.999	0.001	0.000	0.000
73	88	0.001	0.970	0.030	0.000	0.999	0.001	0.000	0.000
74	89	0.002	0.960	0.040	0.000	0.998	0.002	0.000	0.000
75	90	0.002	0.950	0.050	0.000	0.998	0.002	0.000	0.000
76	91	0.004	0.953	0.047	0.000	0.996	0.003	0.000	0.000
77	92	0.005	0.957	0.043	0.000	0.995	0.005	0.000	0.000
78	93	0.007	0.960	0.040	0.000	0.993	0.007	0.000	0.000
79	94	0.008	0.964	0.046	0.000	0.992	0.008	0.000	0.000
80	95	0.010	0.967	0.033	0.000	0.990	0.010	0.000	0.000
81	96	0.012	0.966	0.034	0.000	0.988	0.012	0.000	0.000
82	97	0.014	0.965	0.035	0.000	0.986	0.014	0.000	0.000
83	98	0.016	0.965	0.035	0.000	0.984	0.015	0.001	0.000
84	99	0.018	0.964	0.036	0.000	0.982	0.017	0.001	0.000
85	100	0.020	0.963	0.037	0.000	0.980	0.019	0.001	0.000
86	101	0.022	0.953	0.047	0.000	0.978	0.021	0.001	0.000
87	102	0.024	0.942	0.058	0.000	0.976	0.023	0.001	0.000
88	103	0.027	0.932	0.068	0.000	0.973	0.025	0.002	0.000
89	104	0.029	0.921	0.079	0.000	0.971	0.027	0.002	0.000
90	105	0.031	0.911	0.089	0.000	0.969	0.028	0.003	0.000
91	106	0.037	0.903	0.097	0.000	0.963	0.033	0.004	0.000
92	107	0.042	0.896	0.104	0.000	0.958	0.038	0.004	0.000
93	108	0.048	0.888	0.112	0.000	0.952	0.043	0.005	0.000
94	109	0.053	0.881	0.119	0.000	0.947	0.047	0.006	0.000
95	110	0.059	0.873	0.127	0.000	0.941	0.052	0.007	0.000
96	111	0.066	0.873	0.127	0.000	0.934	0.058	0.008	0.000
97	112	0.073	0.872	0.128	0.000	0.927	0.064	0.009	0.000
98	113	0.081	0.872	0.128	0.000	0.919	0.070	0.010	0.000
99	114	0.088	0.871	0.129	0.000	0.912	0.077	0.011	0.000
100	115	0.095	0.871	0.129	0.000	0.905	0.083	0.012	0.000
101	116	0.104	0.872	0.128	0.000	0.896	0.090	0.013	0.000
102	117	0.112	0.873	0.127	0.000	0.888	0.098	0.014	0.000
103	118	0.121	0.874	0.126	0.000	0.879	0.106	0.015	0.000
104	119	0.129	0.875	0.125	0.000	0.871	0.113	0.016	0.000
105	120	0.138	0.876	0.124	0.000	0.862	0.121	0.017	0.000
106	121	0.152	0.882	0.118	0.000	0.848	0.134	0.018	0.000
107	122	0.166	0.888	0.112	0.000	0.834	0.147	0.019	0.000
108	123	0.180	0.893	0.107	0.000	0.820	0.161	0.019	0.000
109	124	0.194	0.899	0.101	0.000	0.806	0.174	0.020	0.000
110	125	0.208	0.905	0.095	0.000	0.792	0.188	0.020	0.000

TABLE F.3-3 (Continued)
DISCRETIZED NORTH ANNA CONTAINMENT FRAGILITY CURVE

PSIG	PSIA	PF	CLEAK	CRUPT	CCATRP	PNOF	PLEAK	PRUPT	PCATRP
111	126	0.229	0.910	0.090	0.000	0.771	0.209	0.021	0.000
112	127	0.251	0.916	0.084	0.000	0.749	0.230	0.021	0.000
113	128	0.272	0.921	0.079	0.000	0.728	0.251	0.021	0.000
114	129	0.294	0.927	0.073	0.000	0.706	0.272	0.022	0.000
115	130	0.315	0.932	0.068	0.000	0.685	0.294	0.021	0.000
116	131	0.325	0.910	0.090	0.000	0.675	0.296	0.029	0.000
117	132	0.335	0.887	0.113	0.000	0.665	0.297	0.038	0.000
118	133	0.345	0.865	0.135	0.000	0.655	0.298	0.047	0.000
119	134	0.355	0.842	0.158	0.000	0.645	0.299	0.056	0.000
120	135	0.365	0.820	0.180	0.000	0.635	0.299	0.066	0.000
121	136	0.381	0.794	0.203	0.003	0.619	0.303	0.077	0.001
122	137	0.397	0.769	0.226	0.005	0.603	0.306	0.090	0.002
123	138	0.414	0.743	0.250	0.008	0.586	0.307	0.103	0.003
124	139	0.430	0.718	0.273	0.010	0.570	0.308	0.117	0.004
125	140	0.446	0.692	0.296	0.013	0.554	0.309	0.132	0.006
126	141	0.463	0.662	0.323	0.015	0.537	0.307	0.150	0.007
127	142	0.480	0.633	0.350	0.017	0.520	0.303	0.168	0.008
128	143	0.496	0.603	0.378	0.020	0.504	0.299	0.187	0.010
129	144	0.513	0.574	0.405	0.022	0.487	0.294	0.208	0.011
130	145	0.530	0.544	0.432	0.024	0.470	0.288	0.229	0.013
131	146	0.547	0.516	0.458	0.026	0.453	0.282	0.251	0.014
132	147	0.563	0.488	0.484	0.028	0.437	0.275	0.273	0.016
133	148	0.580	0.461	0.510	0.029	0.420	0.267	0.296	0.017
134	149	0.596	0.433	0.536	0.031	0.404	0.258	0.320	0.019
135	150	0.613	0.405	0.562	0.033	0.387	0.248	0.345	0.020
136	151	0.639	0.421	0.538	0.041	0.361	0.269	0.344	0.026
137	152	0.665	0.437	0.515	0.048	0.335	0.291	0.342	0.032
138	153	0.691	0.453	0.491	0.056	0.309	0.313	0.339	0.039
139	154	0.717	0.469	0.468	0.063	0.283	0.336	0.335	0.045
140	155	0.743	0.485	0.444	0.071	0.257	0.360	0.330	0.053
141	156	0.767	0.455	0.448	0.096	0.233	0.349	0.344	0.074
142	157	0.791	0.425	0.453	0.122	0.209	0.336	0.358	0.097
143	158	0.815	0.396	0.457	0.147	0.185	0.322	0.373	0.120
144	159	0.839	0.366	0.462	0.173	0.161	0.307	0.387	0.145
145	160	0.863	0.336	0.466	0.198	0.137	0.290	0.402	0.171
146	161	0.883	0.317	0.456	0.227	0.117	0.280	0.403	0.200
147	162	0.903	0.298	0.447	0.256	0.097	0.269	0.403	0.231
148	163	0.923	0.278	0.437	0.285	0.077	0.257	0.404	0.263
149	164	0.943	0.259	0.428	0.314	0.057	0.244	0.403	0.296
150	165	0.963	0.240	0.418	0.343	0.037	0.231	0.403	0.330
151	166	0.968	0.235	0.402	0.363	0.032	0.227	0.389	0.352

TABLE F.3-3 (Continued)
DISCRETIZED NORTH ANNA CONTAINMENT FRAGILITY CURVE

PSIG	PSIA	PF	CLEAK	CRUPT	CCATRP	PNOF	PLEAK	PRUPT	PCATRP
152	167	0.972	0.230	0.387	0.384	0.028	0.223	0.376	0.373
153	168	0.977	0.224	0.371	0.404	0.023	0.219	0.363	0.395
154	169	0.981	0.219	0.356	0.425	0.019	0.215	0.349	0.417
155	170	0.986	0.214	0.340	0.445	0.014	0.211	0.335	0.439
156	171	0.987	0.172	0.325	0.503	0.013	0.169	0.320	0.497
157	172	0.988	0.129	0.309	0.561	0.012	0.128	0.306	0.554
158	173	0.990	0.087	0.294	0.619	0.010	0.086	0.291	0.613
159	174	0.991	0.044	0.278	0.677	0.009	0.044	0.276	0.671
160	175	0.992	0.002	0.263	0.735	0.008	0.002	0.261	0.729
161	176	0.993	0.002	0.259	0.739	0.007	0.002	0.257	0.734
162	177	0.994	0.001	0.255	0.744	0.006	0.001	0.253	0.739
163	178	0.995	0.001	0.251	0.748	0.005	0.001	0.250	0.744
164	179	0.996	0.000	0.247	0.753	0.004	0.000	0.246	0.750
165	180	0.997	0.000	0.243	0.757	0.003	0.000	0.242	0.755
166	181	0.997	0.000	0.194	0.806	0.003	0.000	0.194	0.803
167	182	0.997	0.000	0.146	0.854	0.003	0.000	0.145	0.852
168	183	0.998	0.000	0.097	0.903	0.002	0.000	0.097	0.901
169	184	0.998	0.000	0.049	0.951	0.002	0.000	0.048	0.949
170	185	0.998	0.000	0.000	1.000	0.002	0.000	0.000	0.998
171	186	0.998	0.000	0.000	1.000	0.002	0.000	0.000	0.998
172	187	0.998	0.000	0.000	1.000	0.002	0.000	0.000	0.998
173	188	0.999	0.000	0.000	1.000	0.001	0.000	0.000	0.999
174	189	0.999	0.000	0.000	1.000	0.001	0.000	0.000	0.999
175	190	0.999	0.000	0.000	1.000	0.001	0.000	0.000	0.999
176	191	0.999	0.000	0.000	1.000	0.001	0.000	0.000	0.999

PSIG = Containment pressure - gauge
PSIA = Containment pressure - absolute
PF = Cumulative probability of Containment Failure
PNOF = 1 - PF
CLEAK = Conditional probability of leak type failure (conditional on failure)
CRUPT = Conditional probability of rupture type failure
CCATRP = Conditional probability of catastrophic rupture type failure
PLEAK = PF x CLEAK = Absolute probability of leak type failure (conditional on failure)
PRUPT = PF x CRUPT = Absolute probability of rupture type failure
PCATRP = PF x CCATRP = Absolute probability of catastrophic rupture type failure

TABLE F.6-1
SENSITIVITY TO INDUCED RCS FAILURE PROBABILITIES

Case No's: A1,A2

Purpose: To assess the importance of assumptions regarding induced RCS failure probabilities on:

a. the relative frequency of SGTRs (release category 24),

b. the relative frequency of debris cooled in-vessel sequences and

c. the relative frequency of time of containment failure.

Approach: Vary the probability values for event "Mode of Induced Primary System Failure" in the DET of the same name from their base case values as shown below.

Base Case Probabilities		Sensitivity Probabilities	A1	A2
For High RCS Pressures (2000 < Press < 2335 psig)				
No RCS Failure	= 0.9	No RCS Failure =	1	0
Hot Leg Failure	= 0.1	Hot Leg Failure =	0	1
SGTR	= 0.0	SGTR =	0	0
For Hi-Hi RCS Pressures (Press. > 2335 psig)				
No RCS Failure	= 0.285	No RCS Failure =	1	0
Hot Leg Failure	= 0.7	Hot Leg Failure =	0	1
SGTR	= 0.015	SGTR =	0	0

TABLE F.6-1 (Continued)
SENSITIVITY TO INDUCED RCS FAILURE PROBABILITIES

Results:

a. SGTR Release Category 24 frequency

Base Case	A1	A2
7.38E-6 (10.8)[a]	7.01E-6 (10.3)	7.01E-6 (10.3)

b. Frequency of debris cooled in-vessel sequences

Base Case	A1	A2
7.09E-6 (10.4)	6.29E-6 (9.2)	7.44E-6 (10.9)

c. Frequency of time of containment failure sequences

	Base Case	A1	A2
No Failure	4.32E-5 (63.5)	4.44E-5 (65.3)	4.31E-5 (63.4)
Early Failure	7.60E-7 (1.1)	1.56E-6 (2.3)	4.77E-7 (0.70)
Late Failure	6.94E-6 (10.2)	6.78E-6 (10.0)	7.10E-6 (10.4)
Meltthrough	7.42E-7 (1.1)	2.05E-7 (.30)	9.52E-7 (1.4)

Note:
(a) Percent of total source term frequency

TABLE F.6-2
SENSITIVITY TO ALPHA MODE CONTAINMENT FAILURE PROBABILITY

Case No's:	B1,B2
Purpose:	To assess the importance of assumptions regarding sensitivity to Alpha Mode containment failure probability on the Source Term Category 19 frequency.
Approach:	To vary the probability for event "No Alpha Mode Containment Failure" in the DET of the same name from their base case values plus or minus a factor of 10.
Results:	ALPHA Mode Source Term Category 19 frequency

Base Case	B1	B2
1.45E-7 (0.21)[a]	1.45E-6 (2.1)	1.45E-8 (0.02)

Note:

(a) Percent of total source term frequency

TABLE F.6-3
SENSITIVITY TO THE PROBABILITY OF DEBRIS COOLING IN-VESSEL

Case No's: C1,C2, D1,D2, E1,E2, F1,F2

Purpose: To assess the importance of assumptions regarding sensitivity to In-vessel Debris Cooling on the change in relative frequency of debris cooled in-vessel.

Approach: Vary the probability values for event "Debris Cooled In-vessel" in the DET of the same name from their base case values as shown below.

<u>Sensitivity Probabilities</u>

Case C: LBLOCA w/o Accumulator but with LHSI

C1 In-vessel cooling probability = 0
C2 In-vessel cooling probability = 1

Case D: Induced Hot Leg failure and late LHSI

D1 In-vessel cooling probability = 0
D2 In-vessel cooling probability = 1

Case E: Power recovery after core damage but prior to RV failure

E1 In-vessel cooling probability = 0
E2 In-vessel cooling probability = 1

Case F: All sequences (combined cases C, D and E)

F1 In-vessel cooling probability = 0
F2 In-vessel cooling probability = 1

TABLE F.6-3 (Continued)
SENSITIVITY TO THE PROBABILITY OF DEBRIS COOLING IN-VESSEL

Results:

a. LBLOCA w/o Accumulator but with LHSI

Base Case	C1	C2
7.09E-6 (10.4)[a]	4.32E-6 (6.4)	7.24E-6 (10.6)

b. Induced Hot Leg failure and late LHSI

Base Case	D1	D2
7.09E-6 (10.4)	6.27E-6 (9.2)	7.18E-6 (10.6)

c. Power recovery after core damage but prior to RV failure

Base Case	E1	E2
7.09E-6 (10.4)	3.63E-6 (5.3)	8.58E-6 (12.6)

d. Cases C,D and E combined

Base Case	F1	F2
7.09E-6 (10.4)	2.96E-8 (0.04)	8.82E-6 (13.0)

Note:

(a) Percent of total source term frequency

TABLE F.6-4
SENSITIVITY TO AMOUNT OF HYDROGEN PRODUCED IN-VESSEL

Case No's: G1,G2

Purpose: To assess the importance of assumptions regarding the amount of Zirconium oxidation on the relative frequency of time of containment failure.

Approach: Vary the probability values for event "Mode of Early Containment Failure" in the DET of the same name from their base case values shown below.

Sensitivity Probabilities

Case G: Amount of H_2 produced In-Vessel

G1 < 40% Zr oxidation probability = 1
G2 > 40% Zr oxidation probability = 1

Results: Amount of H_2 produced In-Vessel

	Base Case	G1	G2
No Failure	4.32E-5 (63.5)[a]	4.31E-5 (63.4)	4.33E-5 (63.7)
Early Failure	7.60E-7 (1.1)	8.41E-7 (1.2)	6.78E-7 (1.0)
Late Failure	6.94E-6 (10.2)	6.91E-6 (10.2)	6.97E-6 (10.3)
Late-Late Failure	7.42E-7 (1.1)	7.42E-7 (1.1)	7.42E-7 (1.1)

Note:
(a) Percent of total source term frequency

TABLE F.6-5
SENSITIVITY TO THE PROBABILITY OF A LARGE DCH

Case No's: H1,H2

Purpose: To assess the importance of assumptions regarding the sensitivity to increase/decrease of the probability of a large DCH by a factor of 10 on the relative frequency of time of containment failure.

Approach: Vary the probability values for event "Mode of Early Containment Failure" in the DET of the same name from their base case values shown below.

<u>Sensitivity Probabilities</u>

Case H: Increase/Decrease probability of large DCH by 10

H1 Increase probability by factor of 10
H2 Decrease probability by factor of 10

Results: Increase/Decrease probability of large DCH by 10

	Base Case	H1	H2
No Failure	4.32E-5 (63.5)[(a)]	4.11E-5 (60.4)	4.34E-5 (63.8)
Early Failure	7.60E-7 (1.1)	3.48E-6 (5.1)	4.90E-7 (0.7)
Late Failure	6.94E-6 (10.2)	6.28E-6 (9.2)	7.00E-6 (10.3)
Late-Late Failure	7.42E-7 (1.1)	7.36E-7 (1.1)	7.42E-7 (1.1)

Note:
(a) Percent of total source term frequency

TABLE F.6-6
SENSITIVITY TO THE PROBABILITY OF AN UNCONDITIONAL HYDROGEN BURN

Case No's: I1,I2

Purpose: To assess the importance of assumptions regarding the probability of unconditional hydrogen burn on the relative frequency of time of containment failure.

Approach: Vary the probability values for event "Mode of Early Containment Failure" in the DET of the same name from their base case values shown below.

Sensitivity Probabilities

Case I Vary probability of unconditional hydrogen burn (UCHB)

I1 Set probability of UCHB = 0
I2 Set probability of UCHB = 1

Results: Vary probability of UCHB

	Base Case	I1	I2
No Failure	4.32E-5 (63.5)[(a)]	4.36E-5 (64.1)	4.12E-5 (60.6)
Early Failure	7.60E-7 (1.1)	2.02E-7 (0.3)	3.75E-6 (5.5)
Late Failure	6.94E-6 (10.2)	7.10E-6 (10.4)	5.96E-6 (8.8)
Late-Late Failure	7.42E-7 (1.1)	7.43E-7 (1.1)	7.36E-7 (1.1)

Note:
(a) Percent of total source term frequency

TABLE F.6-7
SENSITIVITY TO CONTAINMENT FAILURE PRESSURE SET POINT

Case No's: J1,J2,J3

Purpose: To assess the importance of assumptions regarding the probability of the containment failure pressure on the relative frequency of time of containment failure.

Approach: Vary the probability values for event "Mode of Early Containment Failure" in the DET of the same name from their base case values shown below.

<u>Sensitivity Probabilities</u>

Case J Vary probabilities of containment set point pressure

J1 5th percentile (108 psia), if $p \geq 108$ Prob of CF=1, $p < 108$ Prob of CF=0

J2 50th percentile (143 psia), if $p \geq 143$ Prob of CF=1, $p < 143$ Prob of CF=0

J3* 95th percentile (162 psia), if $p \geq 162$ Prob of CF=1, $p < 162$ Prob of CF=0

Results: Vary probabilities of containment set point pressure

	Base Case	J1	J2
No Failure	4.32E-5 (63.5)[a]	4.20E-5 (61.8)	4.36E-5 (64.1)
Early Failure	7.60E-7 (1.1)	2.51E-6 (3.7)	2.66E-7 (0.4)
Late Failure	6.94E-6 (10.2)	6.43E-6 (9.5)	7.06E-6 (10.4)
Late-Late Failure	7.42E-7 (1.1)	7.38E-7 (1.1)	7.43E-7 (1.1)

Notes:

* J3 was not run since no total pressures exceed 162 psia.

(a) Percent of total source term frequency.

TABLE F.6-8
SENSITIVITY TO THE PROBABILITY OF
RECIRCULATION SPRAY FAILURE

Case No's: K1

Purpose: To assess the importance of assumptions regarding the impact of no spray failure on:

a. the relative frequency of time of containment failure

b. the relative frequency of time of recirculation spray failure

Approach: The sensitivity of the early recirculation spray failure DET was determined by simplifying the "Mode of Recirculation Failure" tree to indicate failure unless the sprays operate early and there is no alpha mode failure.

Results: Assess impact of no spray failure on the time of containment failure frequency

	Base Case	K1
No Containment Failure	4.32E-5 (63.5) [a]	4.35E-5 (64.0)
Early Failure	7.60E-7 (1.1)	7.60E-7 (1.1)
Late Failure	6.94E-6 (10.2)	6.65E-6 (9.8)
Late-Late Failure	7.42E-7 (1.1)	7.38E-7 (1.1)
RS Continuous & Early CF	5.53E-7 (0.8)	5.60E-7 (0.8)
RS Early & Early CF	4.84E-9 (.007)	4.90E-9 (.007)
RS Late & Early CF	3.77E-9 (.006)	0.0 (0.0)
RS Never & Early CF	1.97E-7 (0.3)	1.95E-7 (0.3)
RS Continuous & Late CF	2.46E-6 (3.6)	2.47E-6 (3.6)
RS Early & Late CF	2.68E-7 (0.4)	2.69E-7 (0.4)
RS Late & Late CF	5.72E-9 (.008)	0.0 (0.0)
RS Never & Late CF	4.20E-6 (6.2)	3.91E-6 (5.8)

TABLE F.6-8 (Continued)
SENSITIVITY TO THE PROBABILITY OF RECIRCULATION SPRAY FAILURE

	Base Case	K1
RS Continuous, Not Iso	8.88E-8 (0.1)	8.88E-8 (0.1)
RS Never, Not Isolated	3.14E-8 (.05)	3.14E-8 (.05)
Σ RS Continuous	3.14E-6 (4.6)	3.15E-06 (4.6)
Σ RS Early	2.73E-7 (0.4)	2.74E-07 (0.4)
Σ RS Late	9.49E-9 (.01)	0.0 (0.0)
Σ RS Never	4.43E-6 (6.5)	4.14E-06 (6.1)

Note:
(a) Percent of total source term frequency

TABLE F.6-9
SENSITIVITY TO THE PROBABILITY OF DEBRIS COOLING EX-VESSEL

Case No's: L1,L2, M1,M2, N1,N2,N3

Purpose: To assess the importance of assumptions regarding the impact of debris location and depth on time of containment failure.

L - Debris Dispersed out of Cavity
M - Depth of Debris Pool
N - Debris Cooled

Approach: Vary the probability values for event "Debris Cooled Ex-Vessel" in the DET of the same name from the base case values shown below.

Sensitivity Probabilities

L1 - Debris is dispersed out of Cavity
L2 - Debris not dispersed out of Cavity
M1 - Depth of debris is shallow
M2 - Depth of debris is deep
N1 - Debris is cooled ex-vessel
N2 - Debris not cooled ex-vessel
N3 - All probabilities at base value except first branch is set cooled = 0, not cooled = 1

Results: Vary probability for dispersed debris, depth of debris, location of dispersed debris and whether debris is cooled ex-vessel.

	Base Case	L1	L2
No Failure	4.32E-5 (63.5) [a]	4.37E-5 (64.3)	4.23E-5 (62.2)
Early Failure	7.60E-7 (1.1)	7.60E-7 (1.1)	7.60E-7 (1.1)
Late Failure	6.94E-6 (10.2)	6.94E-6 (10.2)	6.94E-6 (10.2)
Late-Late Failure	7.42E-7 (1.1)	6.99E-7 (1.0)	1.12E-6 (1.6)

Note:
(a) Percent of total source term frequency

TABLE F.6-9 (Continued)
SENSITIVITY TO THE PROBABILITY OF DEBRIS COOLING EX-VESSEL

	Base Case	M1	M2
No Failure	4.32E-5 (63.5)	4.37E-5 (64.3)	3.32E-5 (4.4)
Early Failure	7.60E-7 (1.1)	7.60E-7 (1.1)	7.60E-7 (1.1)
Late Failure	6.94E-6 (10.2)	6.88E-6 (10.1)	6.99E-6 (10.3)
Late-Late Failure	7.42E-7 (1.1)	2.58E-7 (0.4)	1.57E-6 (2.3)

Base Case	N1	N2	N3
No Containment Failure			
4.32E-5 (63.5)	4.40E-5 (64.7)	4.09E-5 (60.1)	4.32E-5 (63.5)
Early Failure			
7.60E-7 (1.1)	7.60E-7 (1.1)	7.60E-7 (1.1)	7.60E-7 (1.1)
Late Failure			
6.94E-6 (10.2)	6.86E-6 (10.1)	7.13E-6 (10.5)	6.94E-6 (10.2)
Late-Late Failure			
7.42E-7 (1.1)	4.10E-9 (.006)	2.83E-6 (4.2)	7.42E-7 (1.1)

Note:
(a) Percent of total source term frequency

TABLE F.6-10
SENSITIVITY TO THE PROBABILITY OF
LATE RECIRCULATION SPRAY FAILURE

Case No: 01

Purpose: To assess the importance of assumptions regarding the impact of late recirculation spray failure on:

a. the relative frequency of time of containment failure

b. the relative frequency of time of recirculation spray failure

Approach: The sensitivity of the late recirculation spray failure DET was determined by simplifying the tree to indicate success if the sprays were already operating. No spray failure was assumed due to Containment environment.

Results: A comparison of the failure probabilities is made against the base case below.

	Base Case	01
Continuous with Early CF	5.53E-7 (0.8)	5.58E-7 (0.8)
Early Only with Early CF	4.84E-9 (.007)	0 0
Late Only with Early CF	3.77E-9 (.006)	3.82E-9 (.006)
Never with Early CF	1.97E-7 (0.3)	1.97E-7 (0.3)
Continuous with Late CF	2.46E-6 (3.6)	2.73E-6 (4.0)
Early Only with Late CF	2.68E-7 (0.4)	0 0
Late Only with Late CF	5.72E-9 (.008)	6.37E-9 (.009)
Never with Late CF	4.20E-6 (6.2)	4.20E-6 (6.2)
Continuous - Not Isolated	8.88E-8 (0.1)	8.88E-8 (0.1)
Never - Not Isolated	3.14E-8 (.05)	3.14E-8 (.05)

Note:
(a) Percent of total source term frequency

TABLE F.6-11
SENSITIVITY TO THE EVENT V FREQUENCY

Case No: P1, P2

Purpose: To assess the importance of assumptions regarding the inpact Event V.

Approach: Vary the frequencies for PDS 24 to determine sensitivity from the base case. The frequencies for the two sensitivities are determined using the NUREG/CR-4550 frequencies for the .05th and .95th quantile. The values are determined through an expert elicitation process and the results are listed below (see page 5-4 of NUREG/CR-4550 Vol. 2):

	Quantile	Total Frequency
Base	-	1.6E-6
P1	.05th	3.9E-11
P2	.95th	5.1E-6

Results: A comparison of the failure probabilities is made against the base case below.

	Base Case	P1	P2
STC 22	1.36E-6 (2.0)	3.32E-11 (0.)	4.34E-6 (6.4)
STC 23	2.40E-7 (0.35)	5.85E-12 (0.)	7.65E-7 (1.1)
STC 24	7.38E-6 (10.9)	7.38E-6 (10.9)	7.38E-6 (10.9)
Early Failure	7.60E-7 (1.1)	7.60E-7 (1.1)	7.60E-7 (1.1)
STC Heading 0	6.80E-5 (100.)	6.64E-5 (97.6)	7.15E-5 (105.1)

Note:
(a) Percent of total source term frequency

TABLE F.6-12
SENSITIVITY TO THE PROBABILITY FOR THE LOSS OF CONTAINMENT ISOLATION

Case No: Q1, Q2

Purpose: To assess the importance of assumptions regarding the loss of containment isolation

Approach: Vary the possible values for failure to isolate the containment. This probability is the sum of the probability of failure to close both isolation valves in the vacuum pump suction line and the probability of the 'core vulnerable' sequences (i.e., sequences where the Containment failure causes the core melt thus resulting in vessel failure into an open Containment). The base case quantification of the plant damage state logic diagram results in a frequency for the fraction of sequences not isolated equal to 1.5E-7 per year. This frequency is further divided into a fraction with and without recirculation spray. In order to perform the sensitivities, the frequencies in plant damage states 1 and 2 were changed by a factor of ten in each direction.

Results: A comparison of the failure probabilities is made against the base case below.

	Base Case	Q1	Q2
STC 17	8.88E-8 (0.1)	8.85E-7 (1.3)	8.85E-9 (.01)
STC 18	3.14E-8 (0.05)	3.14E-7 (0.5)	3.14E-9 (.005)
STC 19	1.45E-7 (0.2)	1.45E-7 (0.2)	1.45E-7 (0.2)
STC 20	7.06E-6 (10.4)	7.06E-6 (10.4)	7.06E-6 (10.4)
STC 21	2.96E-8 (0.04)	2.95E-7 (.4)	2.95E-9 (.004)
STC 22	1.36E-6 (2.0)	1.36E-6 (2.0)	1.36E-6 (2.0)
STC 23	2.40E-7 (0.4)	2.40E-7 (0.4)	2.40E-7 (0.4)
STC 24	7.38E-6 (10.9)	7.38E-6 (10.9)	7.38E-6 (10.9)
Early Failure	7.60E-7 (1.1)	7.60E-7 (1.1)	7.60E-7 (1.1)

TABLE F.6-12 (Continued)
SENSITIVITY TO THE PROBABILITY FOR THE LOSS OF CONTAINMENT ISOLATION

	Base Case	Q1	Q2
RS Cont. & Early CF	5.53E-7 (0.8)	5.53E-7 (0.8)	5.53E-7 (0.8)
RS Early & Early CF	4.84E-9 (.007)	4.84E-9 (.007)	4.84E-9 (.007)
RS Late & Early CF	3.77E-9 (.006)	3.77E-9 (.006)	3.77E-9 (.006)
RS Never & Early CF	1.97E-7 (0.3)	1.97E-7 (0.3)	1.97E-7 (0.3)
STC Heading 0	6.80E-5 (100.)	6.93E-5 (101.9)	6.78E-5 (99.7)

Note:
(a) Percent of total source term frequency

DIAGRAM: REVONAPS.PDD 2 OCT 92 DATA FILE: 27 SEP 92 Sum = 6.797E-005

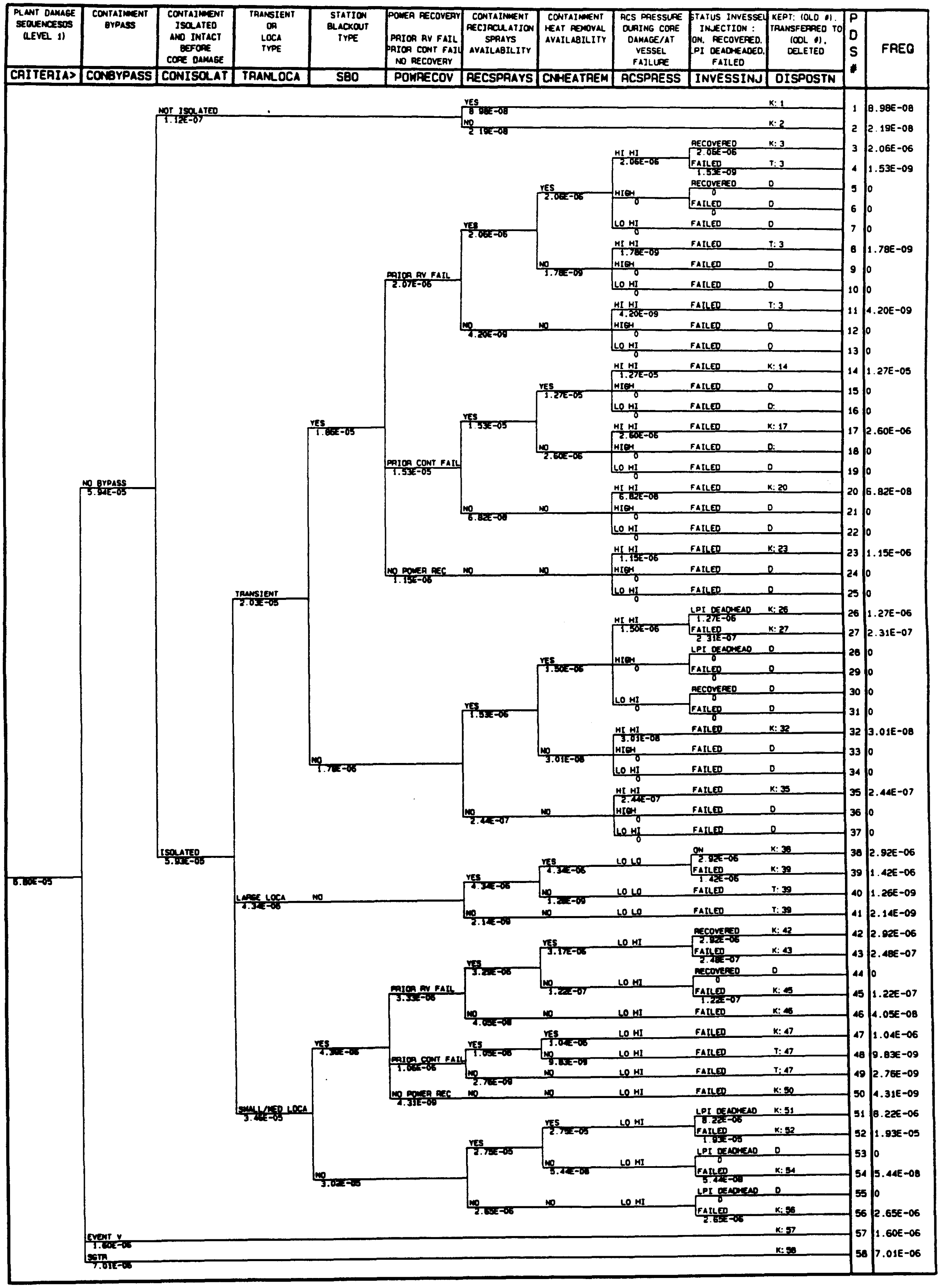


FIGURE F.2-1 Initial Plant Damage State Logic Diagram

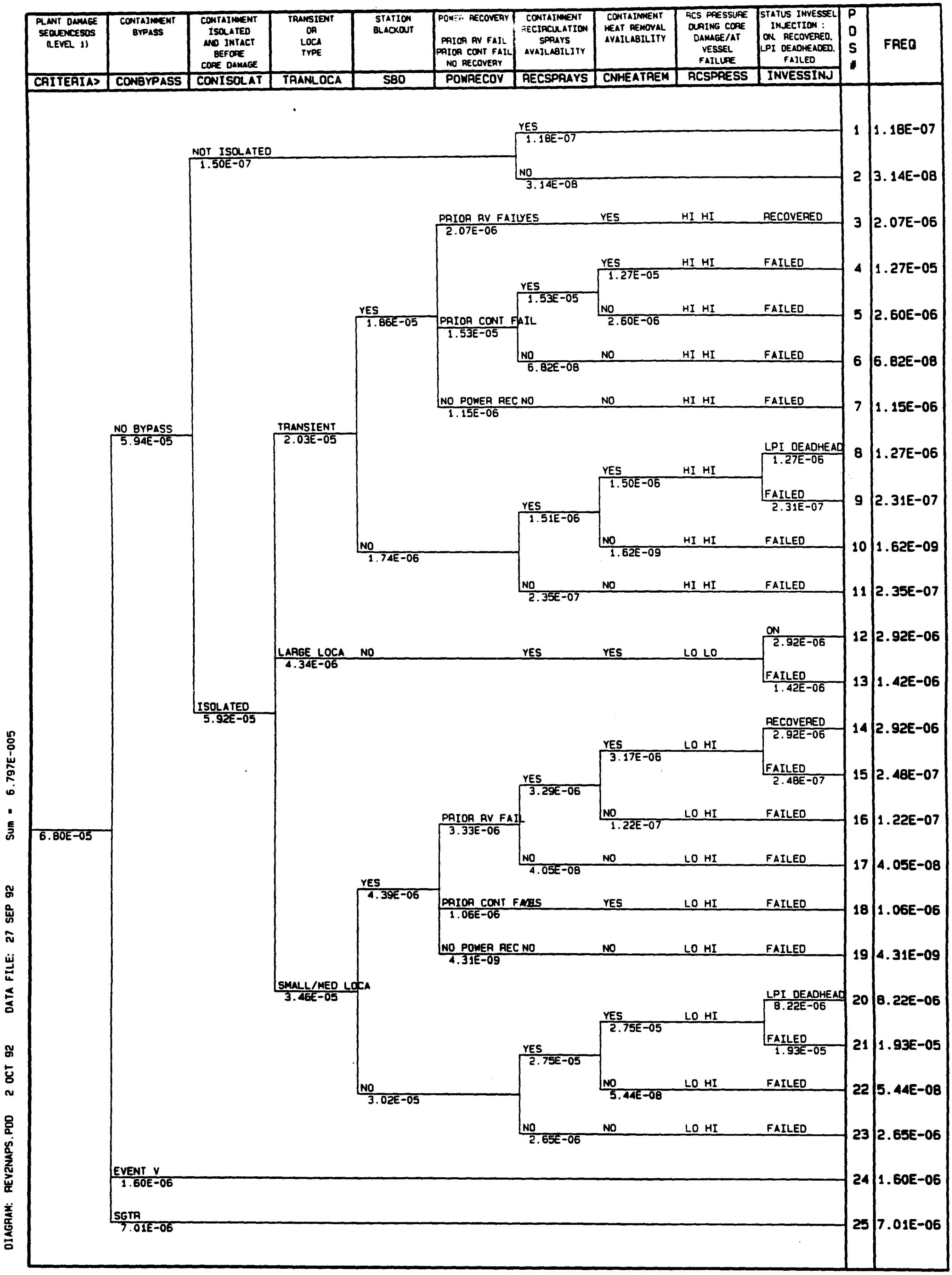


FIGURE F.2-2 NAPS Plant Damage State Logic Diagram

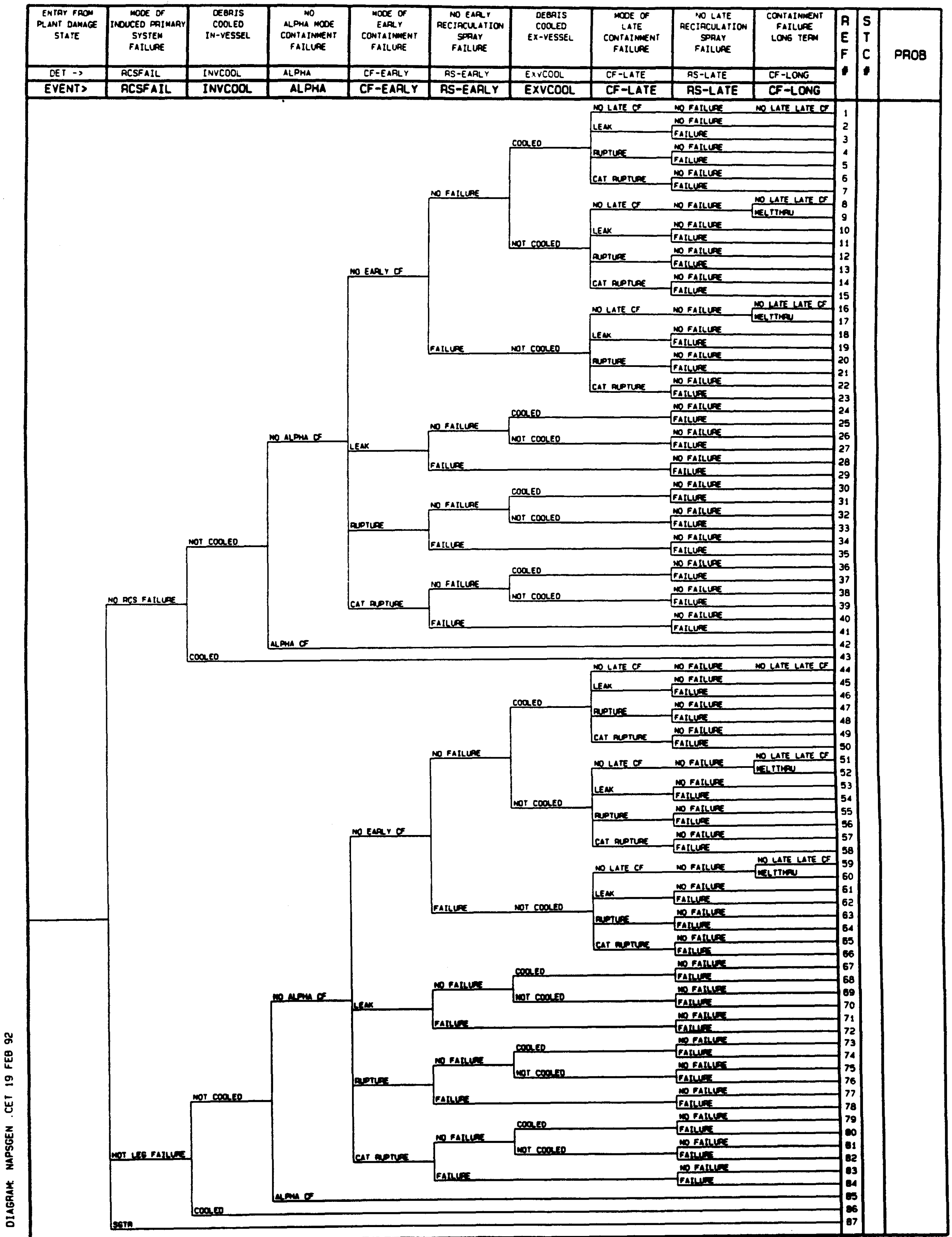


FIGURE F.3-1
CONTAINMENT EVENT TREE FOR PLANT DAMAGE STATES 3 THROUGH 23

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
LEVEL 2
GENERAL CONTAINMENT EVENT TREE
REV. 0

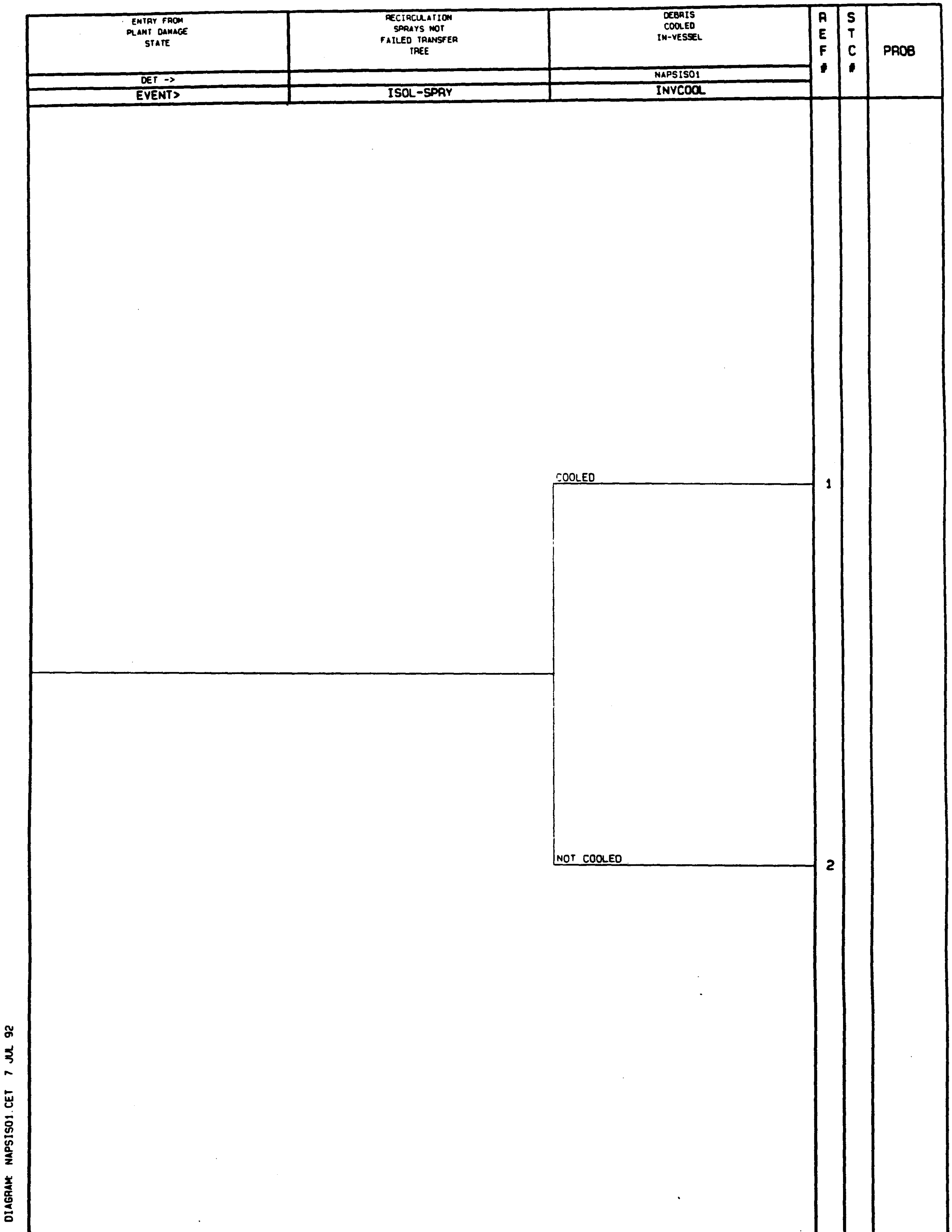


FIGURE F.3-2
TRANSFER TREE FOR PLANT DAMAGE STATE 1

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
LEVEL 2
CONTAINMENT EVENT TREE FOR
LOSS OF ISOLATION WITH OPERABLE RECIRCULATION SPRAYS

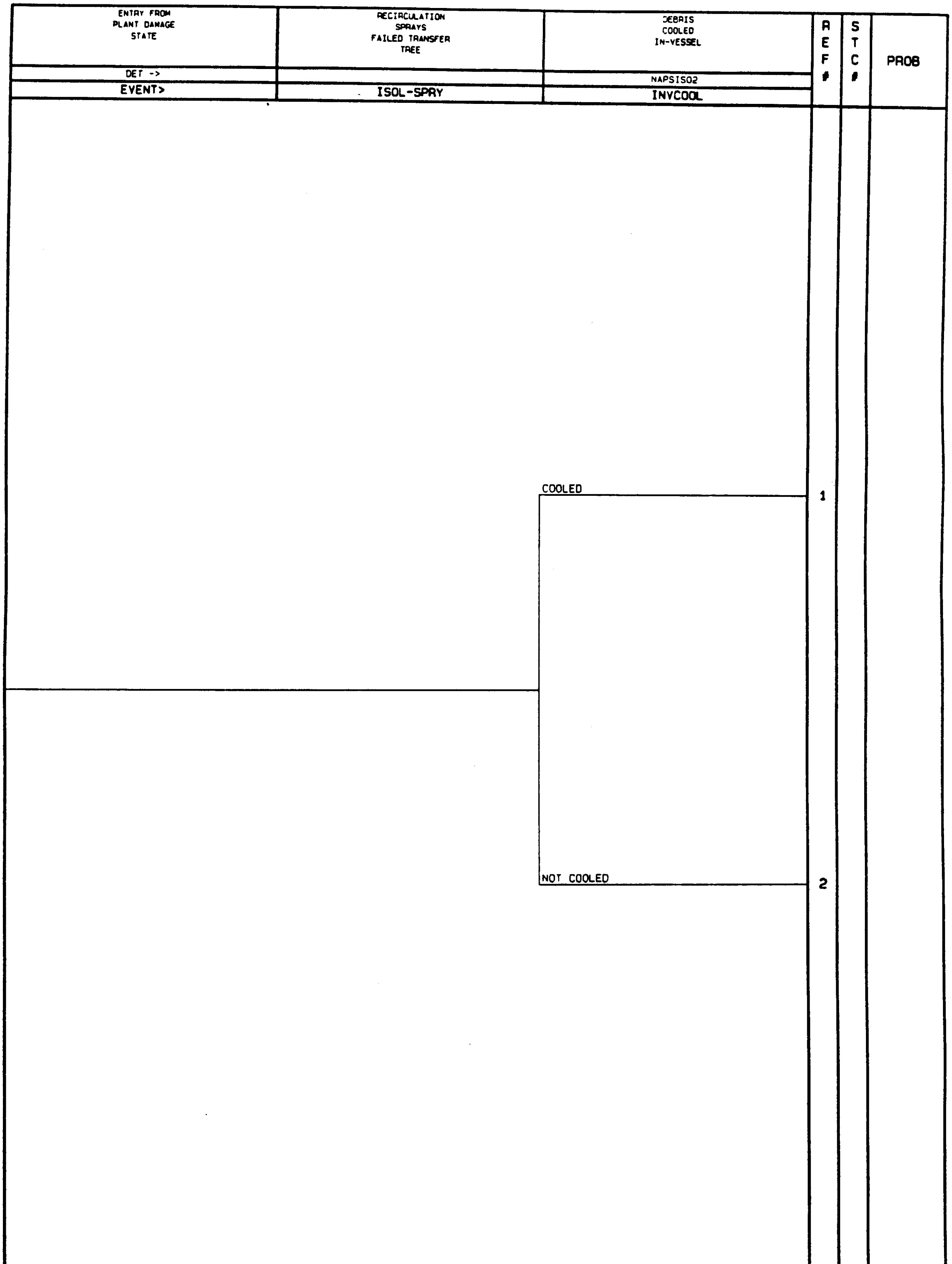


DIAGRAM: NAPSISO2.CET 7 JUL 92

FIGURE F.3-3
TRANSFER TREE FOR PLANT DAMAGE STATE 2

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
LEVEL 2
CONTAINMENT EVENT TREE FOR
LOSS OF ISOLATION WITH FAILED RECIRCULATION SPRAYS

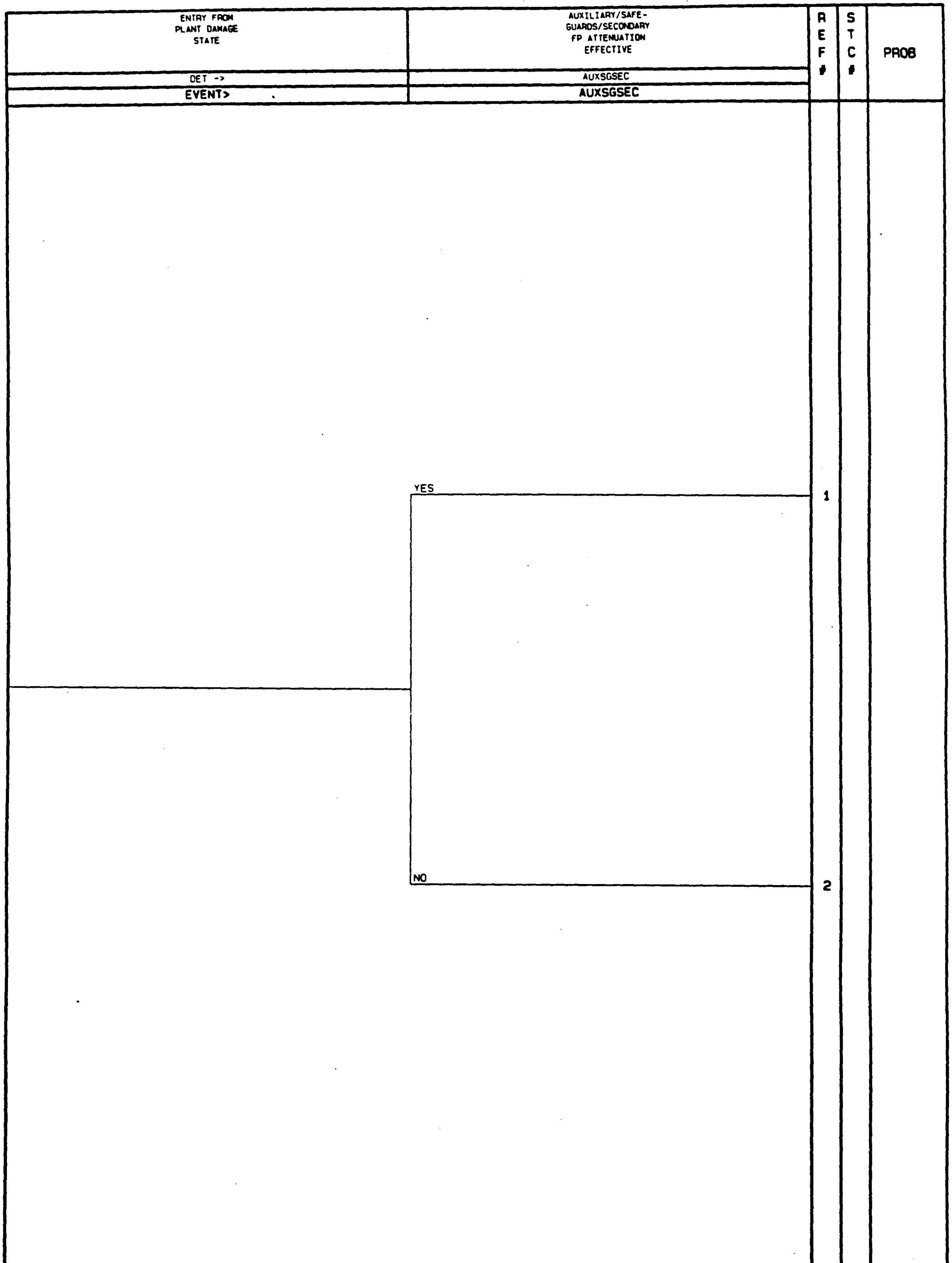


DIAGRAM NAPSV .CET 19 FEB 92

FIGURE F.3-4

TRANSFER TREE FOR PLANT DAMAGE STATE 24

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
LEVEL 2
"CONTAINMENT" EVENT TREE FOR CONTAINMENT BYPASS EVENT V SEQUENCES

ENTRY FROM PLANT DAMAGE STATE	AUXILIARY/SAFE-GUARDS/SECONDARY FP ATTENUATION EFFECTIVE	REF #	STC #	PROB
DET ->	AUXSGSEC			
EVENT>	AUXSGSEC			
NO		1		

DIAGRAM: NAPSSGTR.CET 19 FEB 92

FIGURE F.3-5
TRANSFER TREE FOR PLANT DAMAGE STATE 25

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
LEVEL 2
"CONTAINMENT" EVENT TREE FOR STEAM GENERATOR TUBE RUPTURE CONTAINMENT BYPASS SEQUENCES
REV. 0

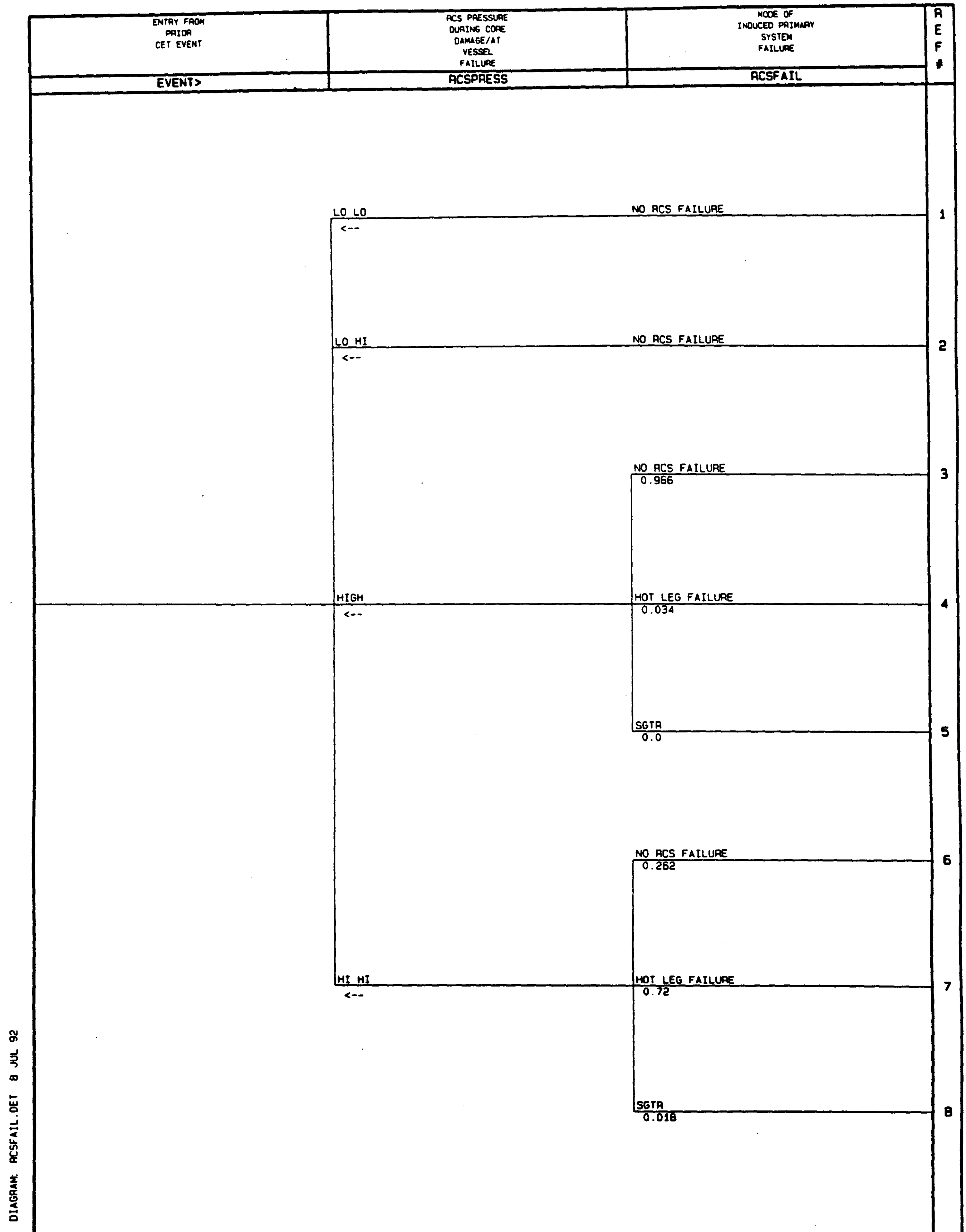


FIGURE F.3-6
DET FOR MODE OF INDUCED PRIMARY SYSTEM FAILURE

VIRGINIA ELECTRIC POWER COMPANY NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
MODE OF INDUCED PRIMARY SYSTEM FAILURE DECOMPOSITION EVENT TREE REV. 0

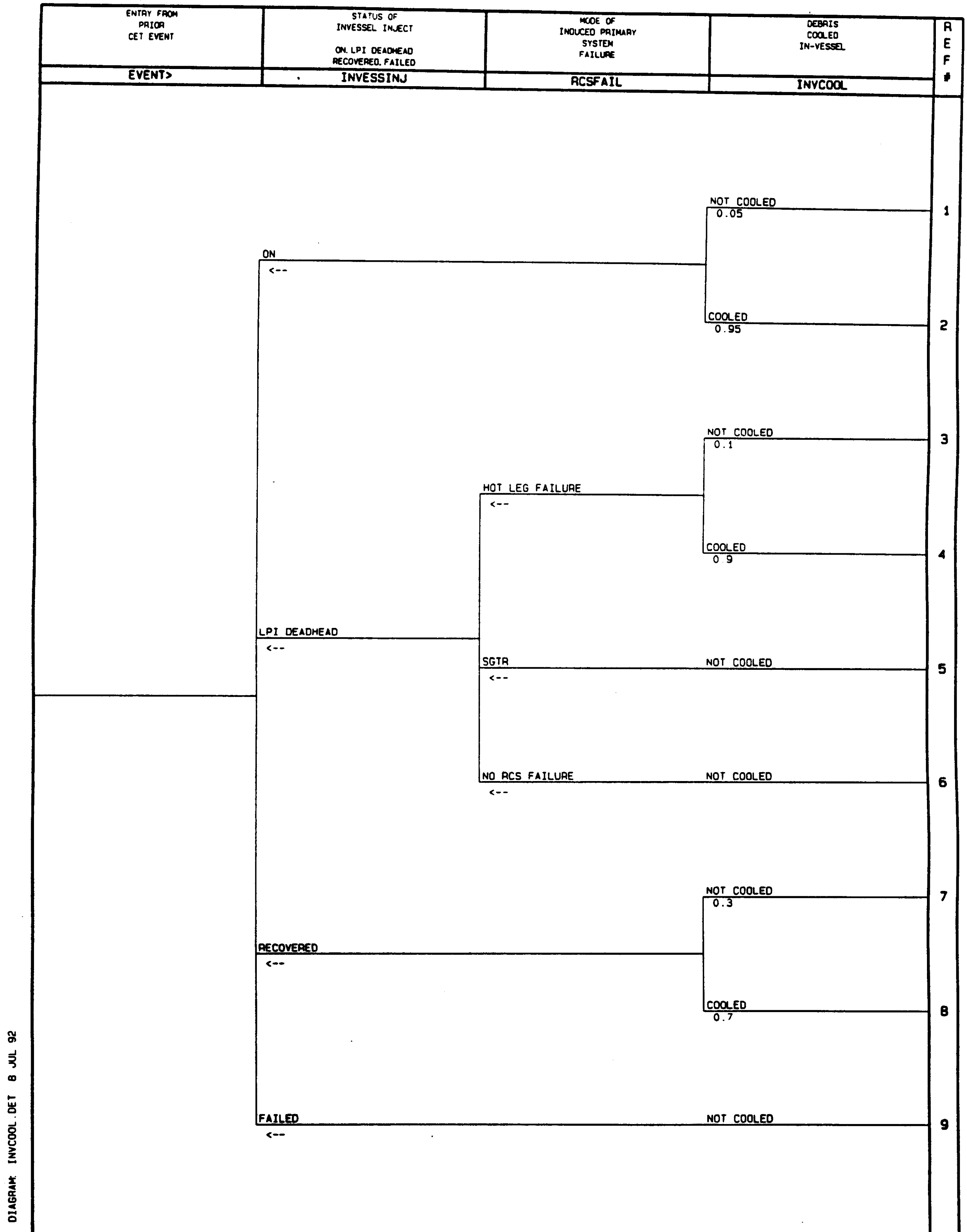


FIGURE F.3-7
DET FOR DEBRIS COOLED IN-VESSEL

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
DEBRIS COOLED IN-VESSEL
DECOMPOSITION EVENT TREE
REV. 0

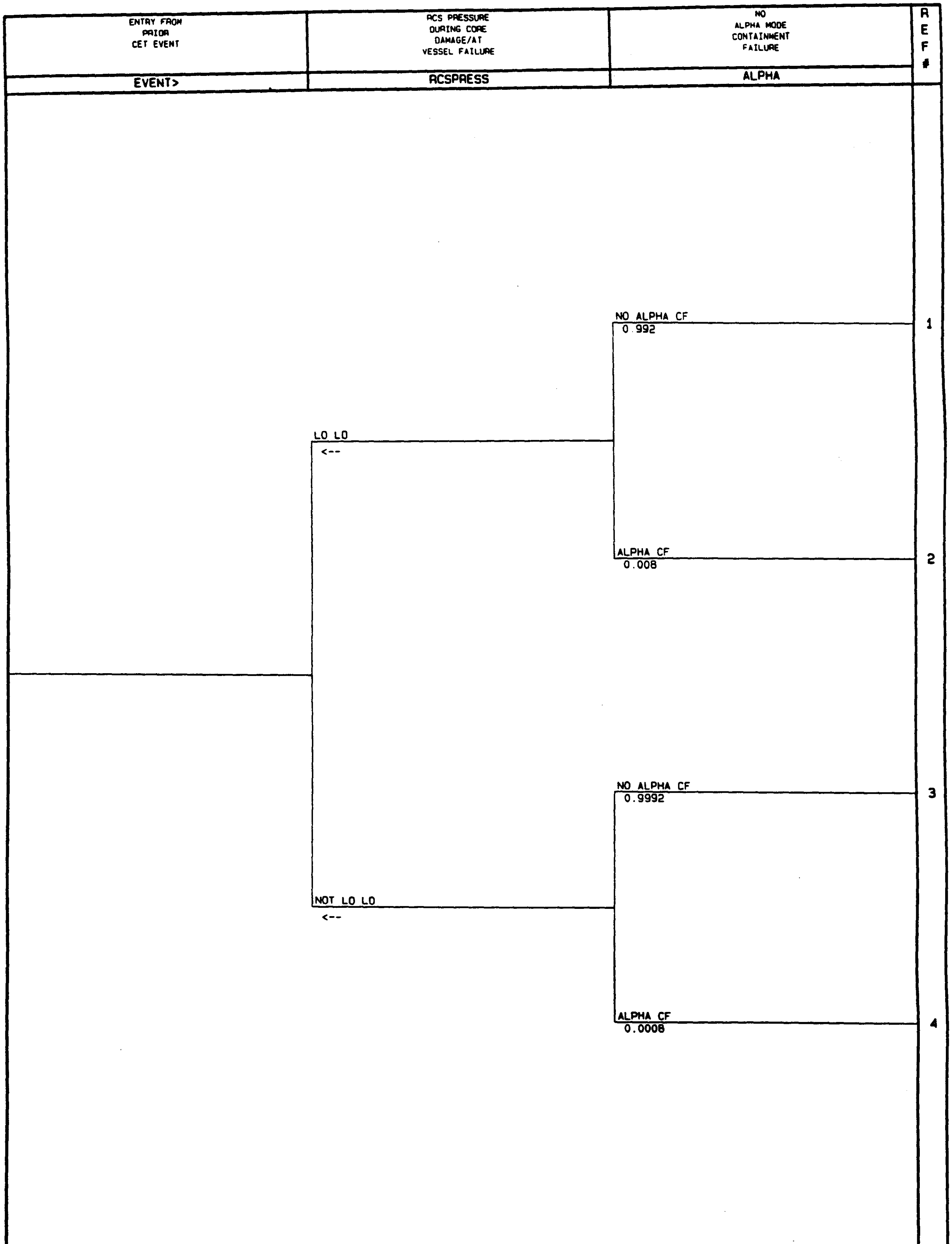


DIAGRAM: ALPHA.DET 6 JUL 92

FIGURE F.3-8

DET FOR NO ALPHA MODE CONTAINMENT FAILURE

VIRGINIA ELECTRIC POWER COMPANY NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
NO ALPHA MODE CONTAINMENT FAILURE DECOMPOSITION EVENT TREE REV. 0

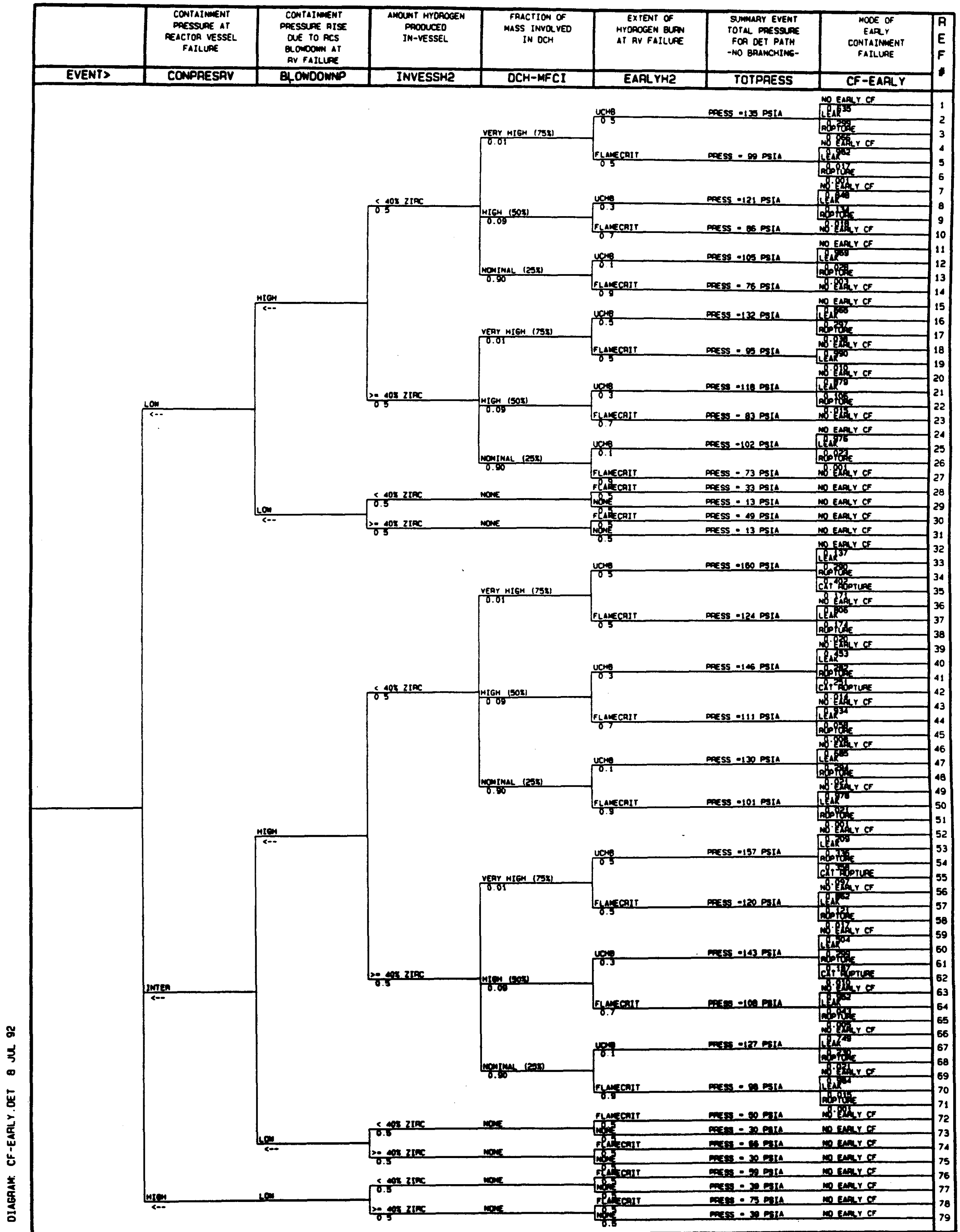


FIGURE F.3-9
DET FOR MODE OF EARLY CONTAINMENT FAILURE

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
MODE OF EARLY CONTAINMENT FAILURE
DECOMPOSITION EVENT TREE
REV. 0

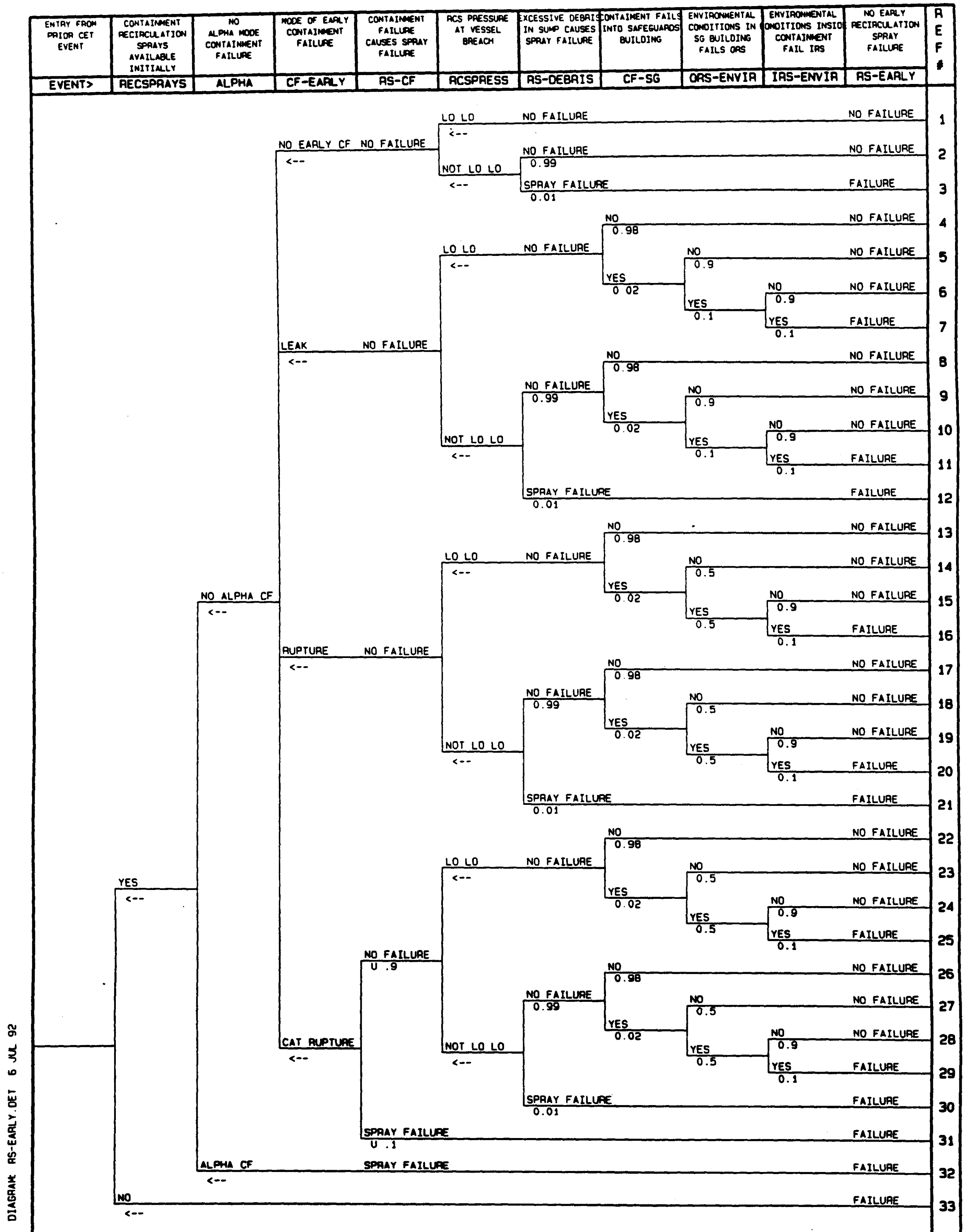


FIGURE F.3-10
DET FOR NO EARLY RECIRCULATION SPRAY FAILURE

VIRGINIA ELECTRIC POWER COMPANY NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
NO EARLY RECIRCULATION SPRAY FAILURE DECOMPOSITION EVENT TREE REV. 0

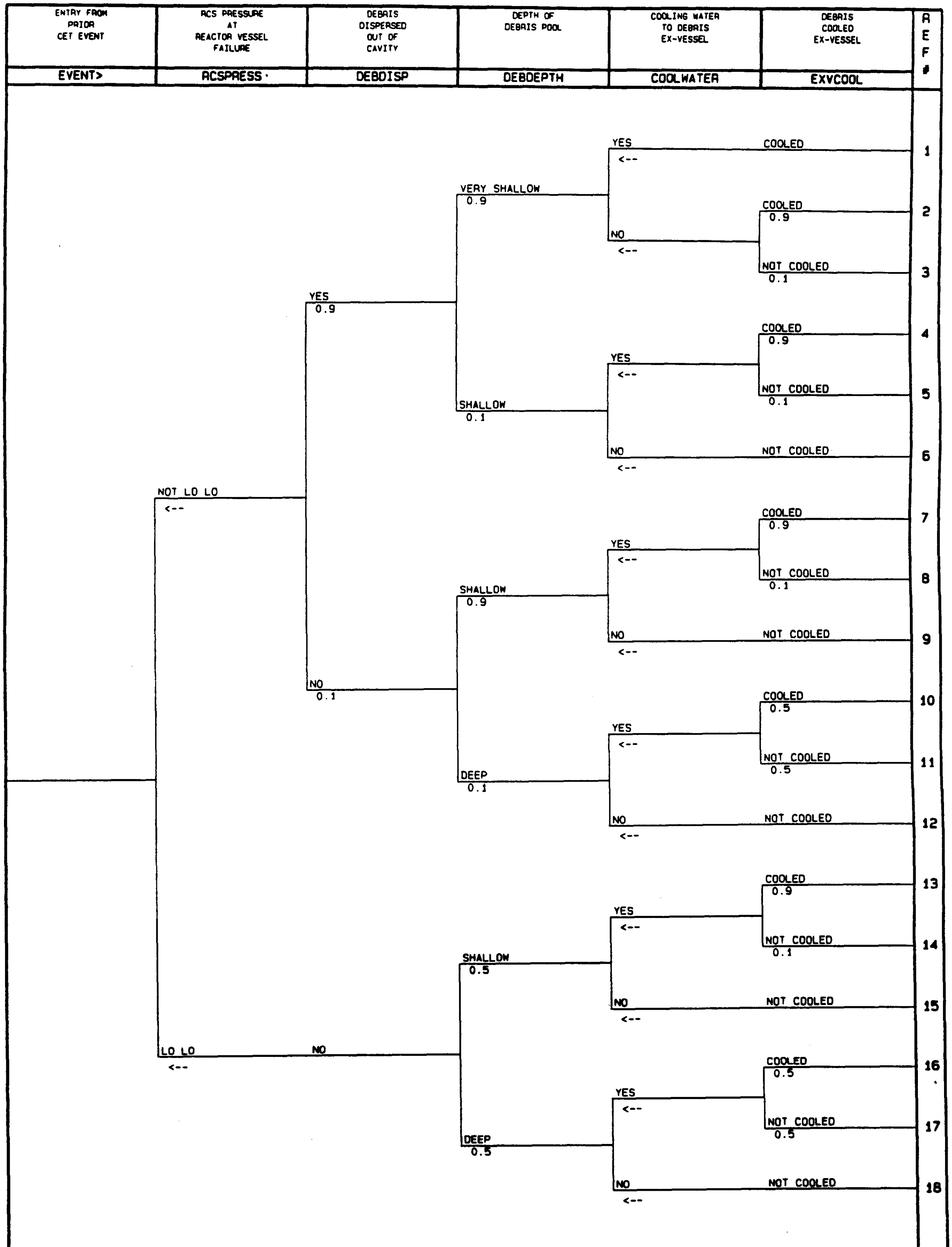


DIAGRAM: EXVCOOL.DET 8 JUL 92

FIGURE F.3-11
DET FOR DEBRIS COOLED EX-VESSEL

VIRGINIA ELECTRIC POWER COMPANY NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
DEBRIS COOLED EX-VESSEL DECOMPOSITION EVENT TREE REV. 0

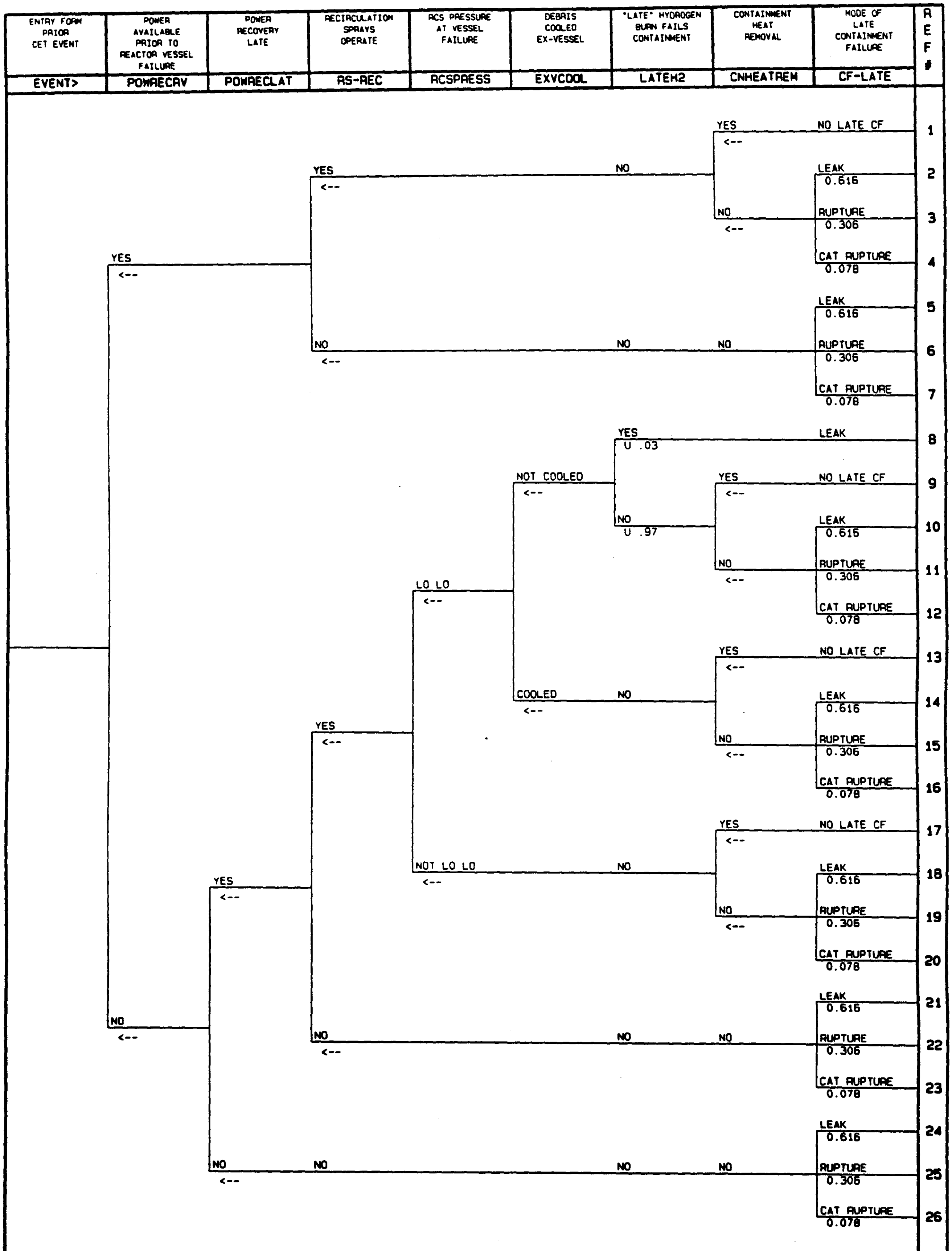


DIAGRAM: CF-LATE.DET 7 JUL 92

FIGURE F.3-12
DET FOR MODE OF LATE CONTAINMENT FAILURE

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
MODE OF LATE CONTAINMENT FAILURE
DECOMPOSITION TREE
REV. 0

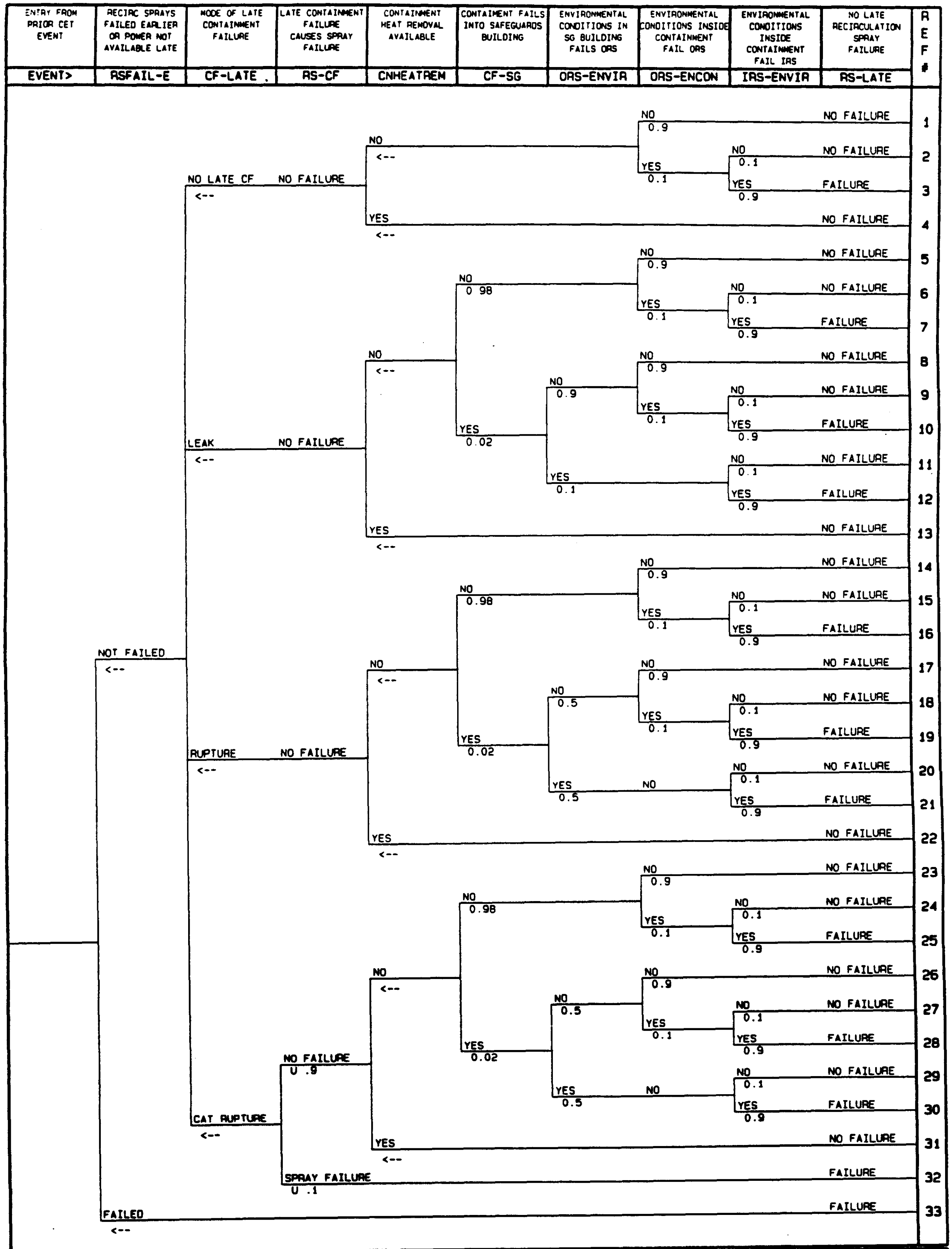


DIAGRAM: RS-LATE.DET 23 SEP 92

FIGURE F.3-13
DET FOR LATE RECIRCULATION SPRAY FAILURE

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
NO LATE RECIRCULATION SPRAY FAILURE
DECOMPOSITION EVENT TREE
REV. 0

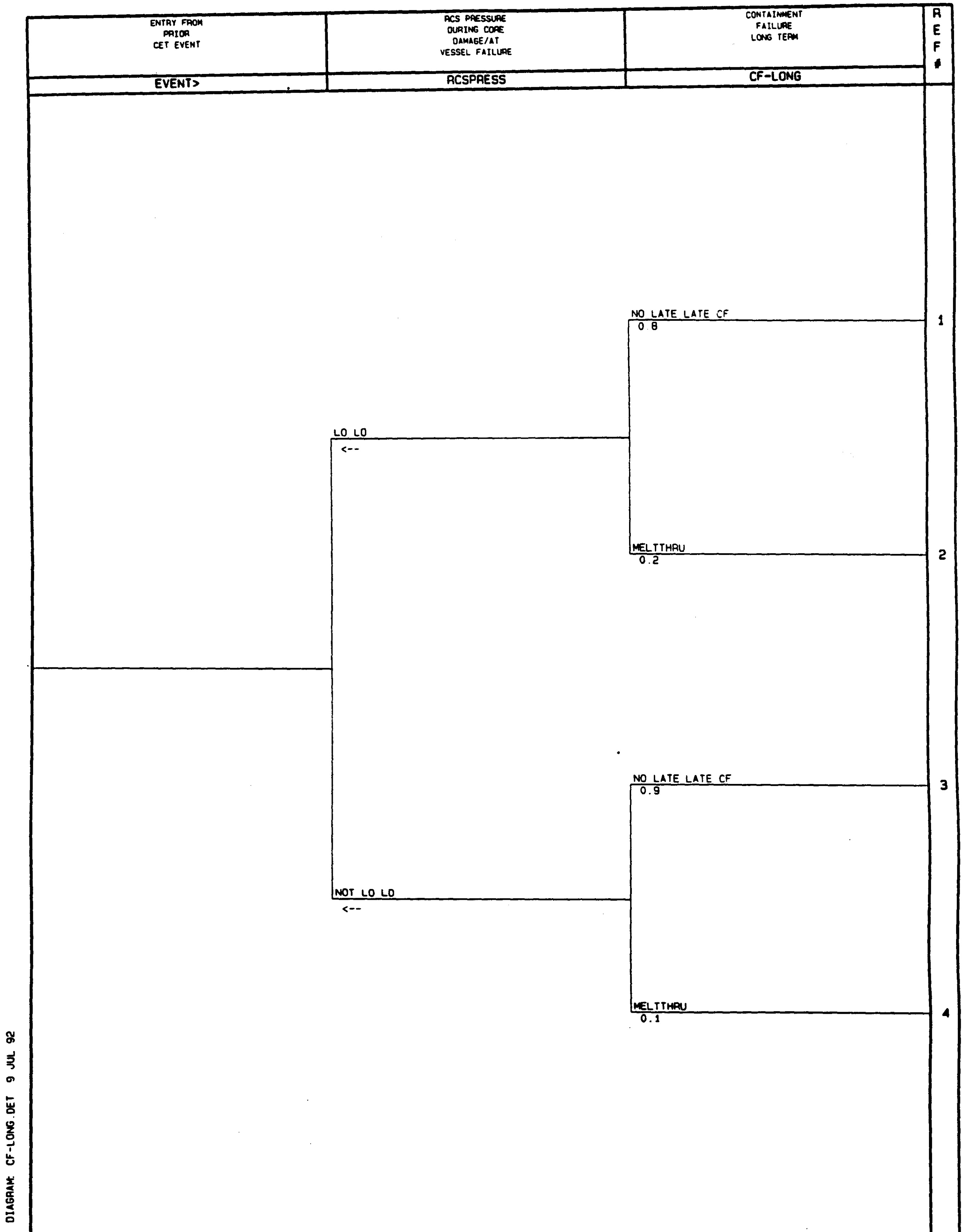


FIGURE F.3-14
DET FOR CONTAINMENT FAILURE LONG TERM

VIRGINIA ELECTRIC POWER COMPANY NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
CONTAINMENT FAILURE LONG TERM DECOMPOSITION EVENT TREE REV. 0

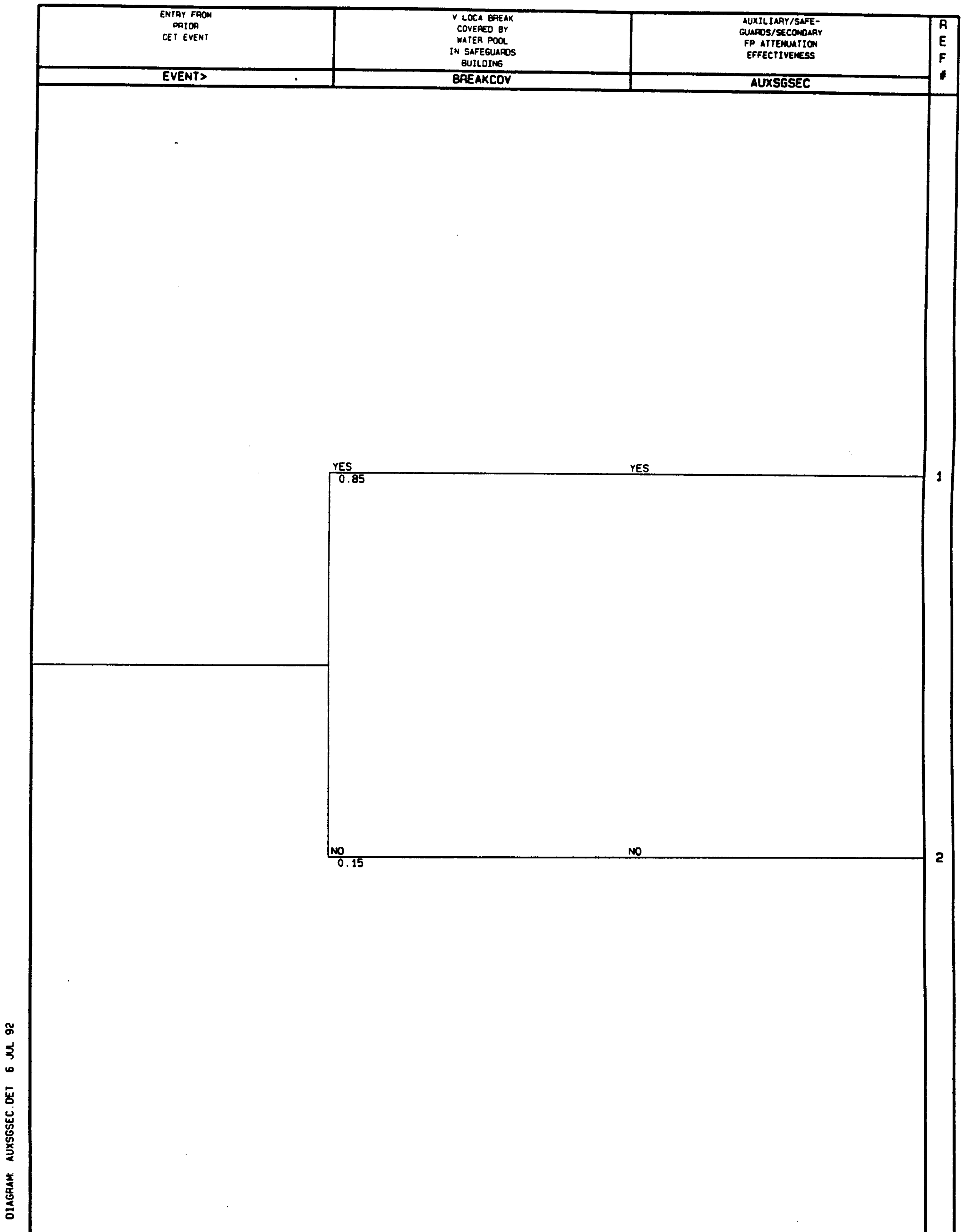


FIGURE F.3-15
DET FOR EVENT V SAFEGUARDS BUILDING
FP RETENTION EFFECTIVENESS

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
EVENT V SAFEGUARDS BUILDING FP RETENTION EFFECTIVENESS
DECOMPOSITION EVENT TREE
REV. 0

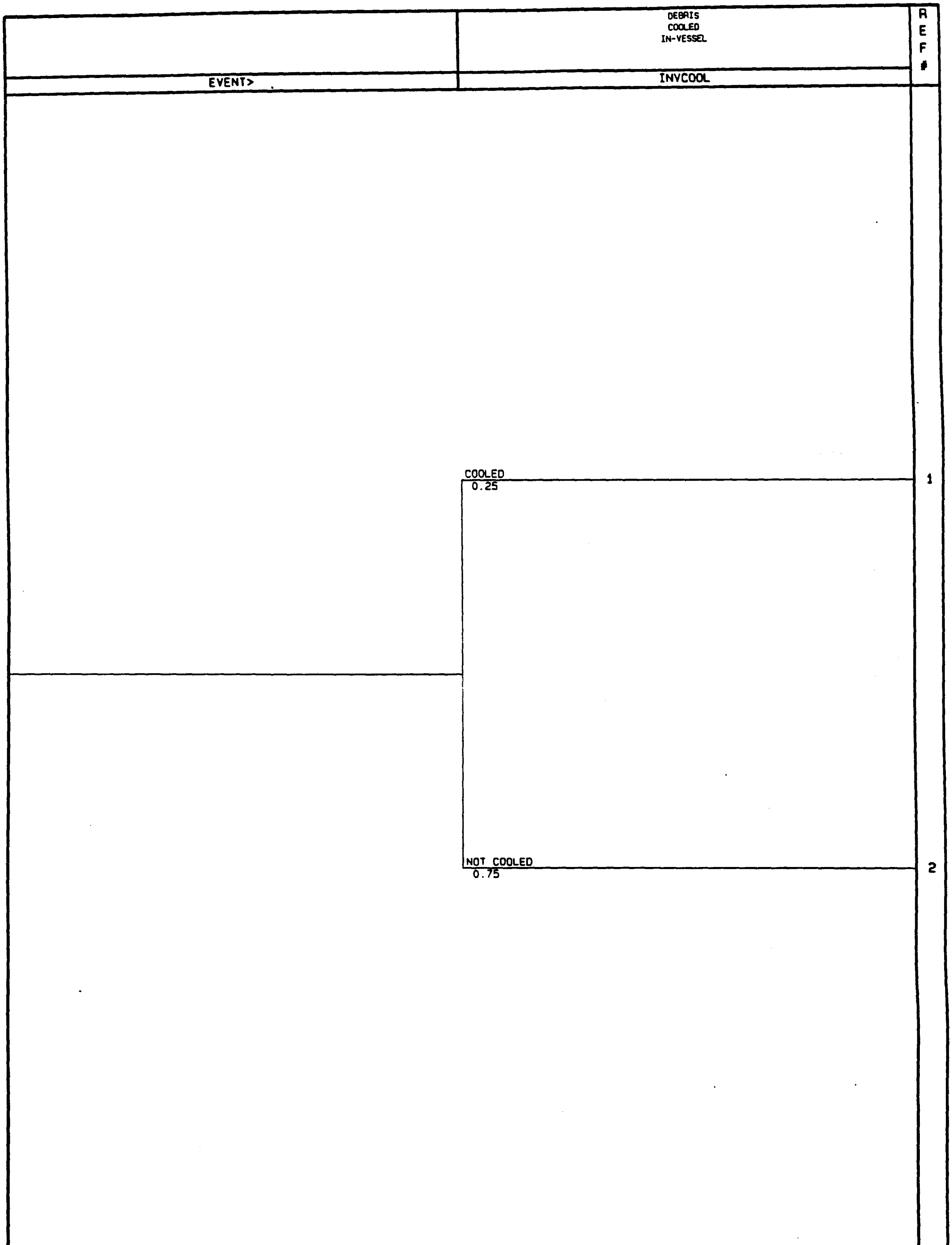


DIAGRAM: NAPSISO1.DET 8 JUL 92

FIGURE F.3-16
DET FOR IN-VESSEL COOLING FOR LOSS OF ISOLATION SEQUENCES WITH OPERABLE RECIRCULATION SPRAYS

VIRGINIA ELECTRIC POWER COMPANY
NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
IN-VESSEL COOLING FOR LOSS OF ISOLATION SEQUENCES
DECOMPOSITION EVENT TREE
REV. 0

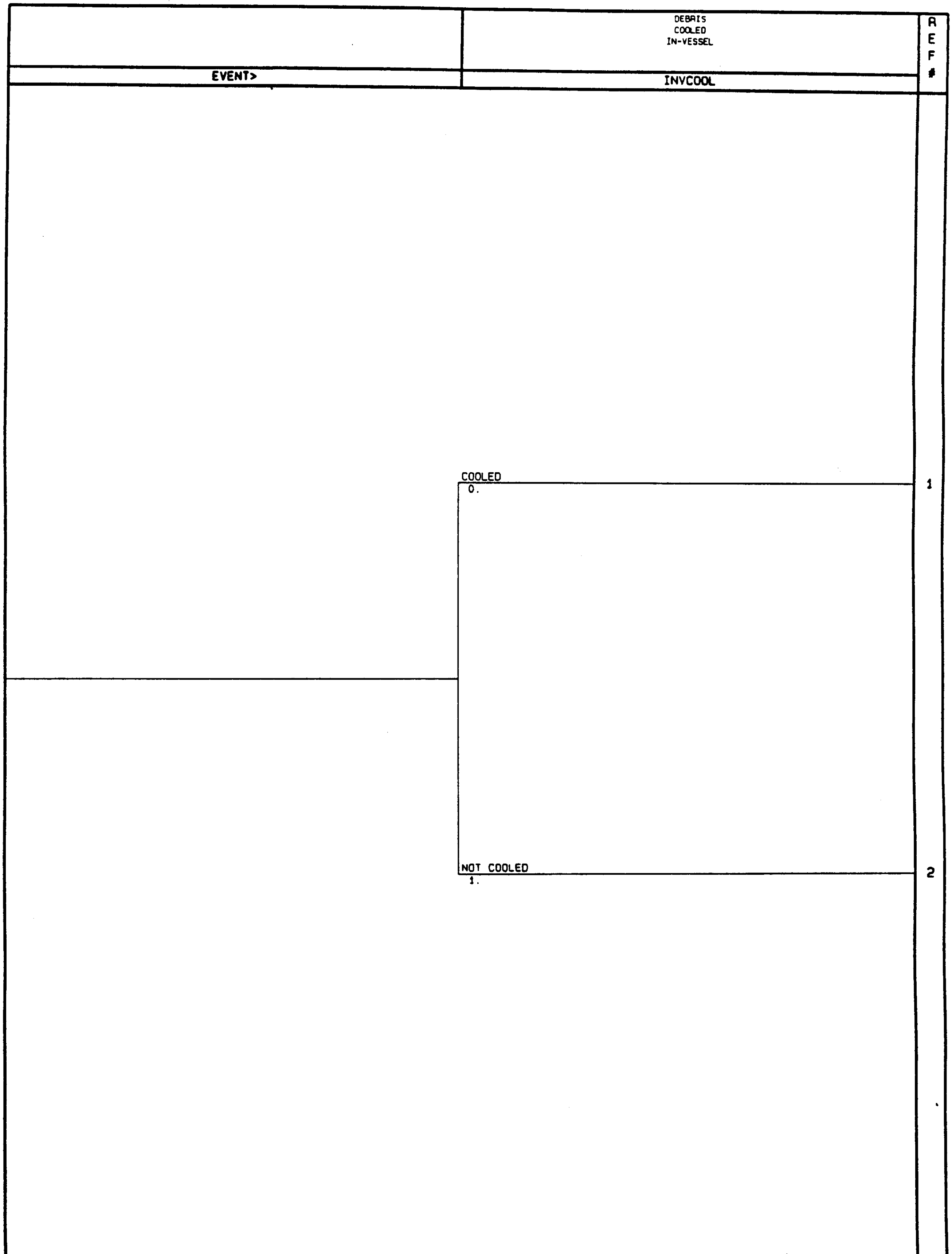


DIAGRAM: NAPSISO2.DET 8 JUL 92

FIGURE F.3-17
DET FOR IN-VESSEL COOLING FOR LOSS OF ISOLATION SEQUENCES WITH FAILED RECIRCULATION SPRAYS

VIRGINIA ELECTRIC POWER COMPANY NORTH ANNA POWER STATION INDIVIDUAL PLANT EXAMINATION PRA
IN-VESSEL COOLING FOR LOSS OF ISOLATION SEQUENCES DECOMPOSITION EVENT TREE REV. 0

DIAGRAM: NAPSISO1.CET 7 JUL 92 DATA FILE: REV2_1.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

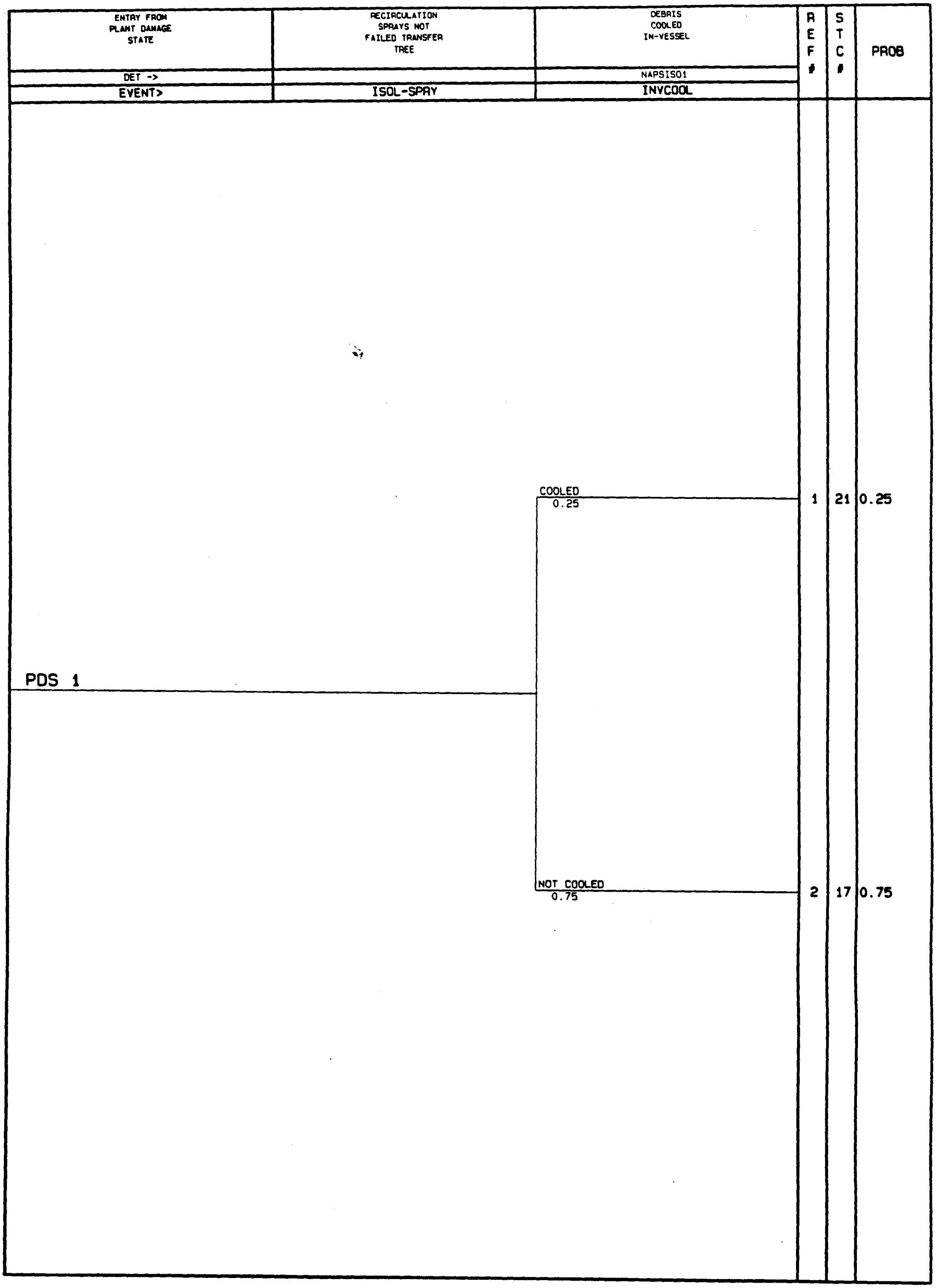


FIGURE F.4-1 Containment Event Tree for PDS 1

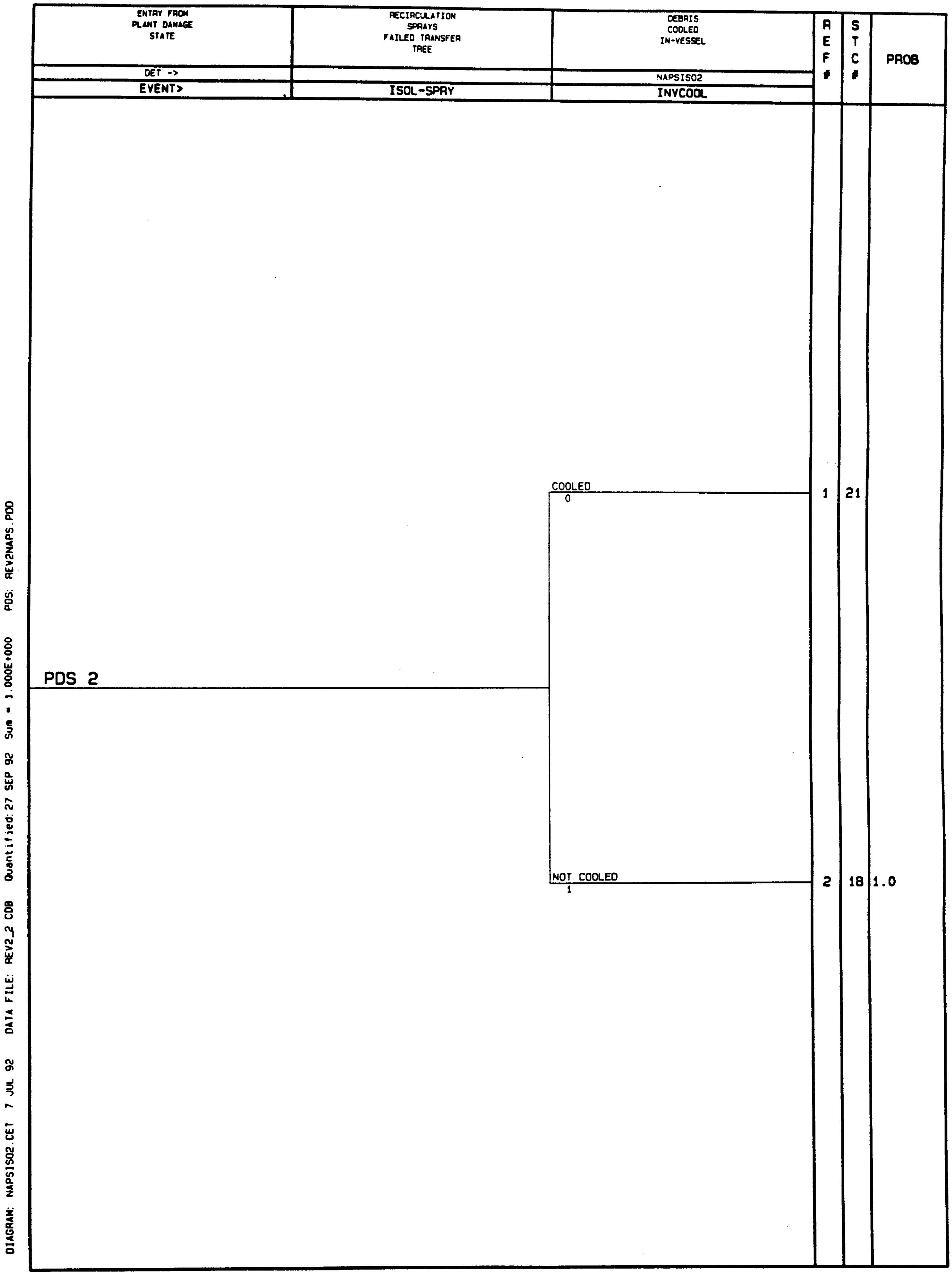


FIGURE F.4-2 Containment Event Tree for PDS 2

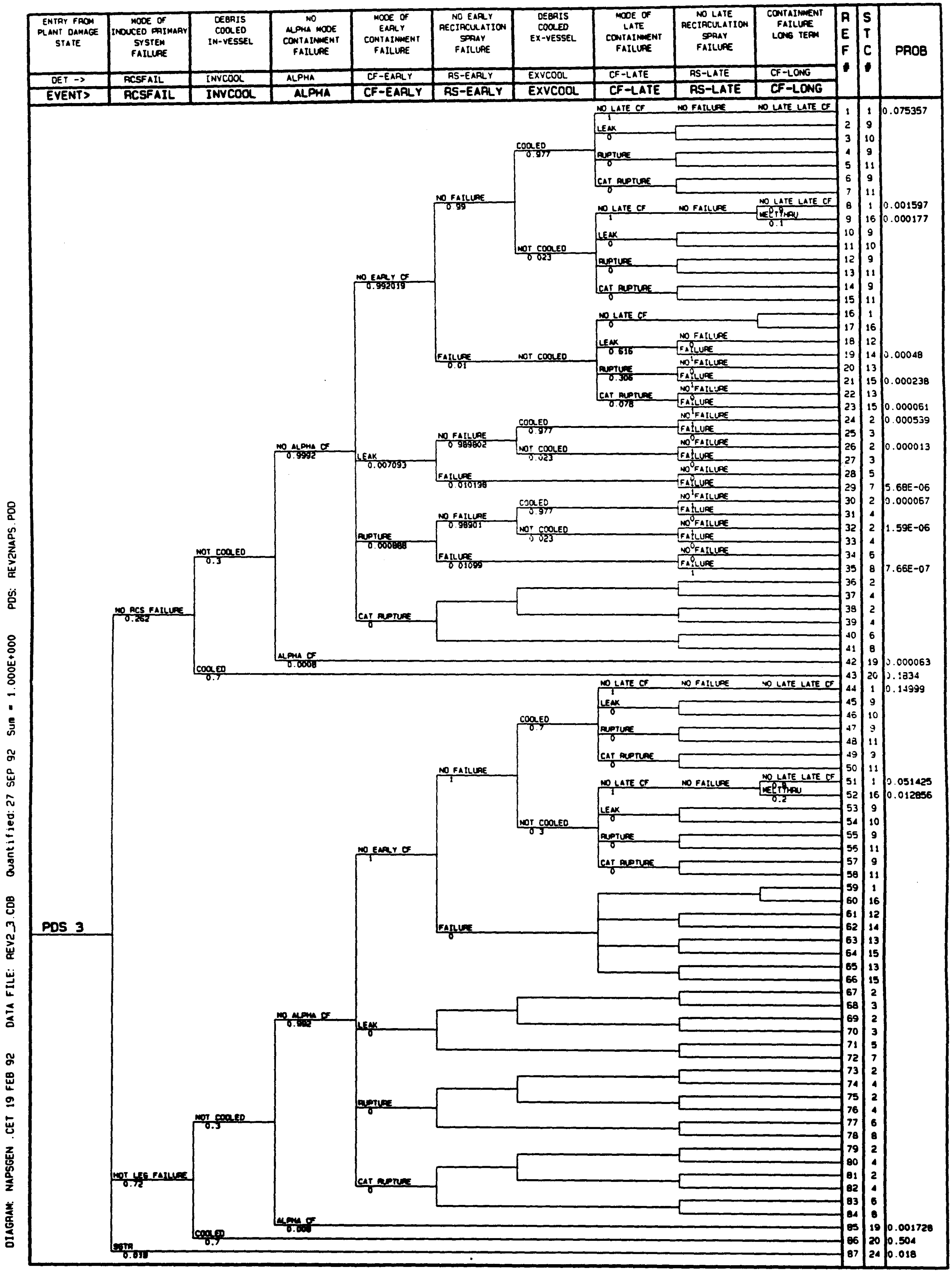


FIGURE F.4-3 Containment Event Tree for PDS 3

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_4.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDO

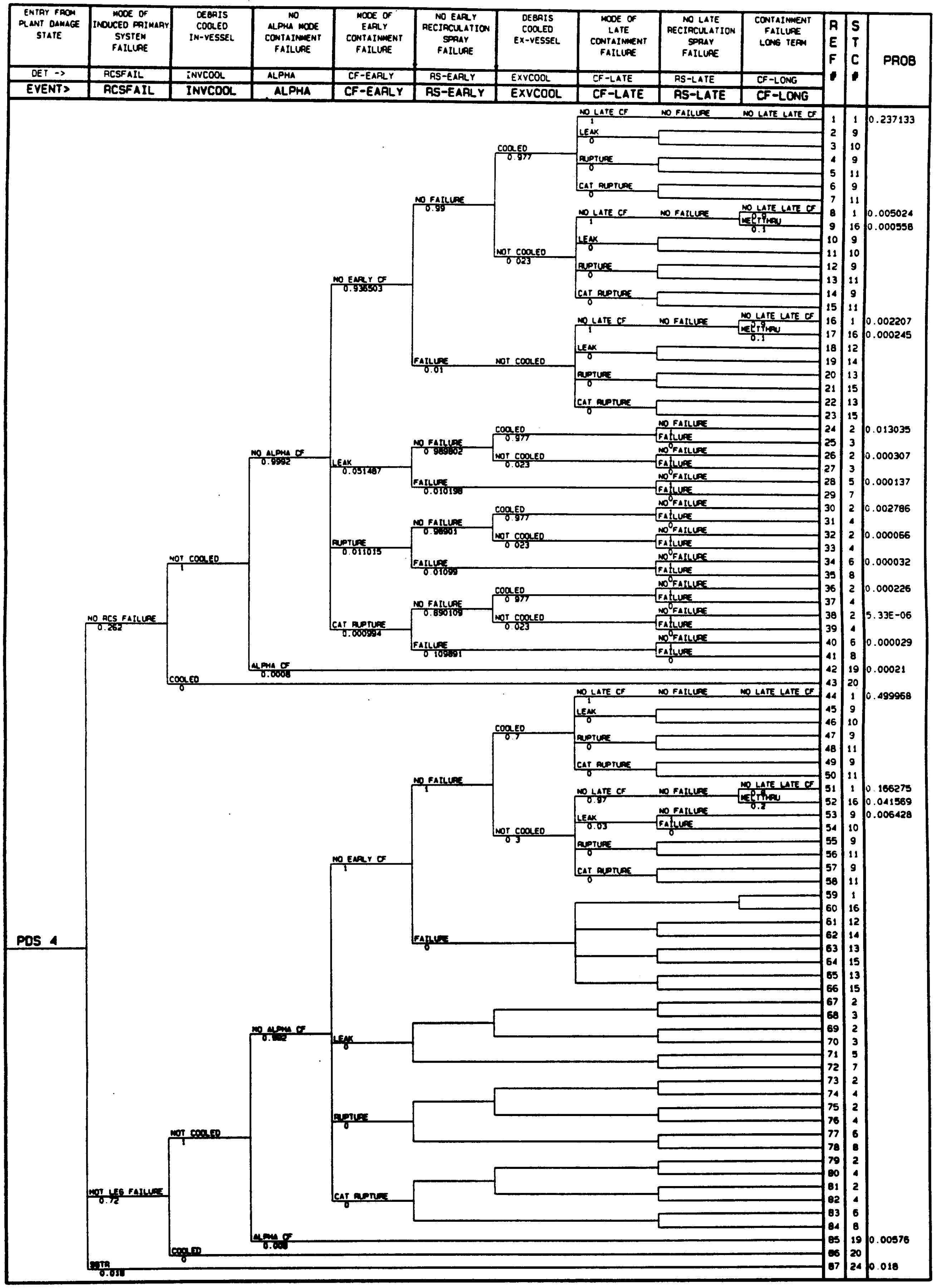


FIGURE F.4-4 Containment Event Tree for PDS 4

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_5.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

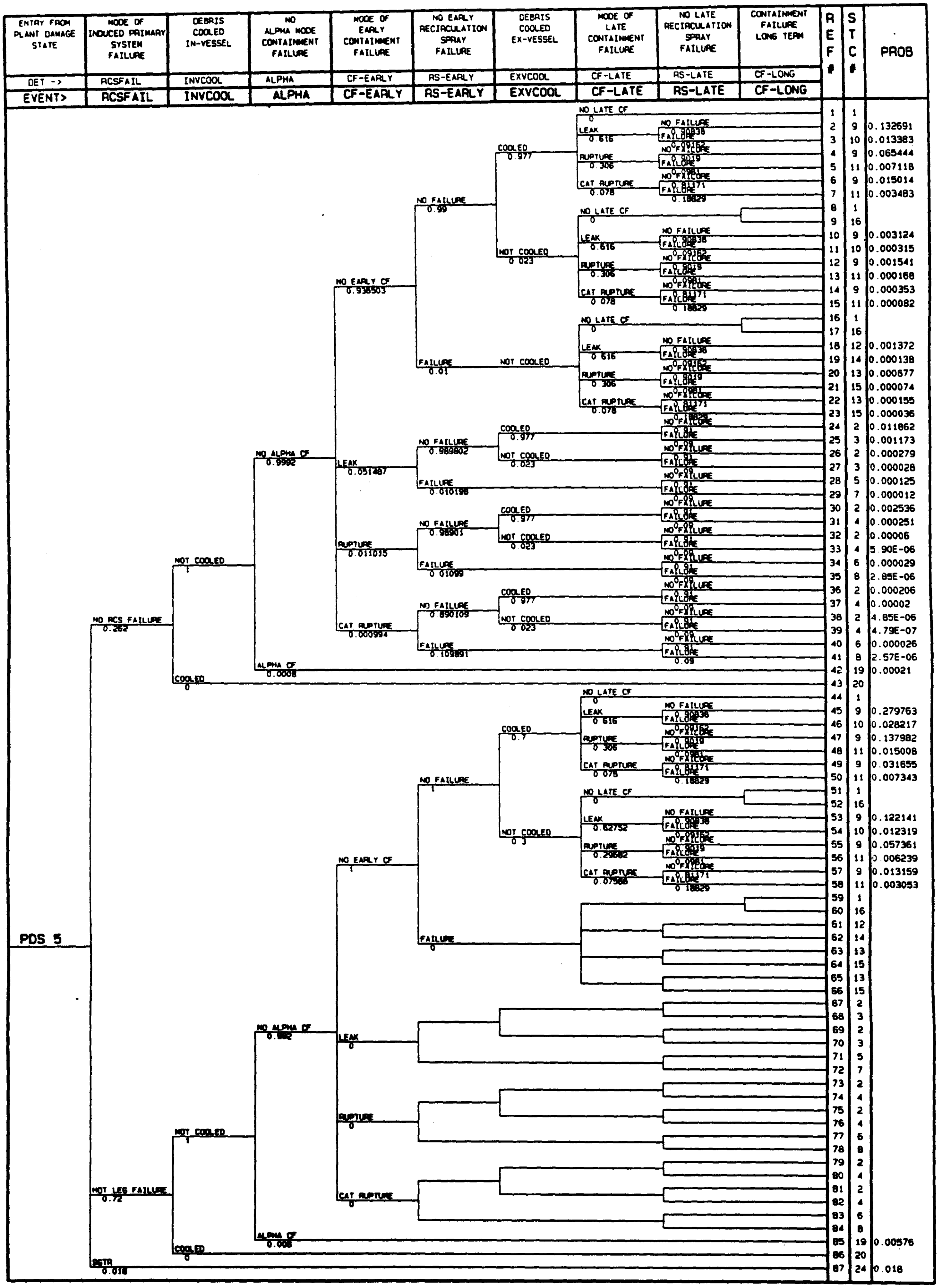


FIGURE F.4-5 Containment Event Tree for PDS 5

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_6 CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

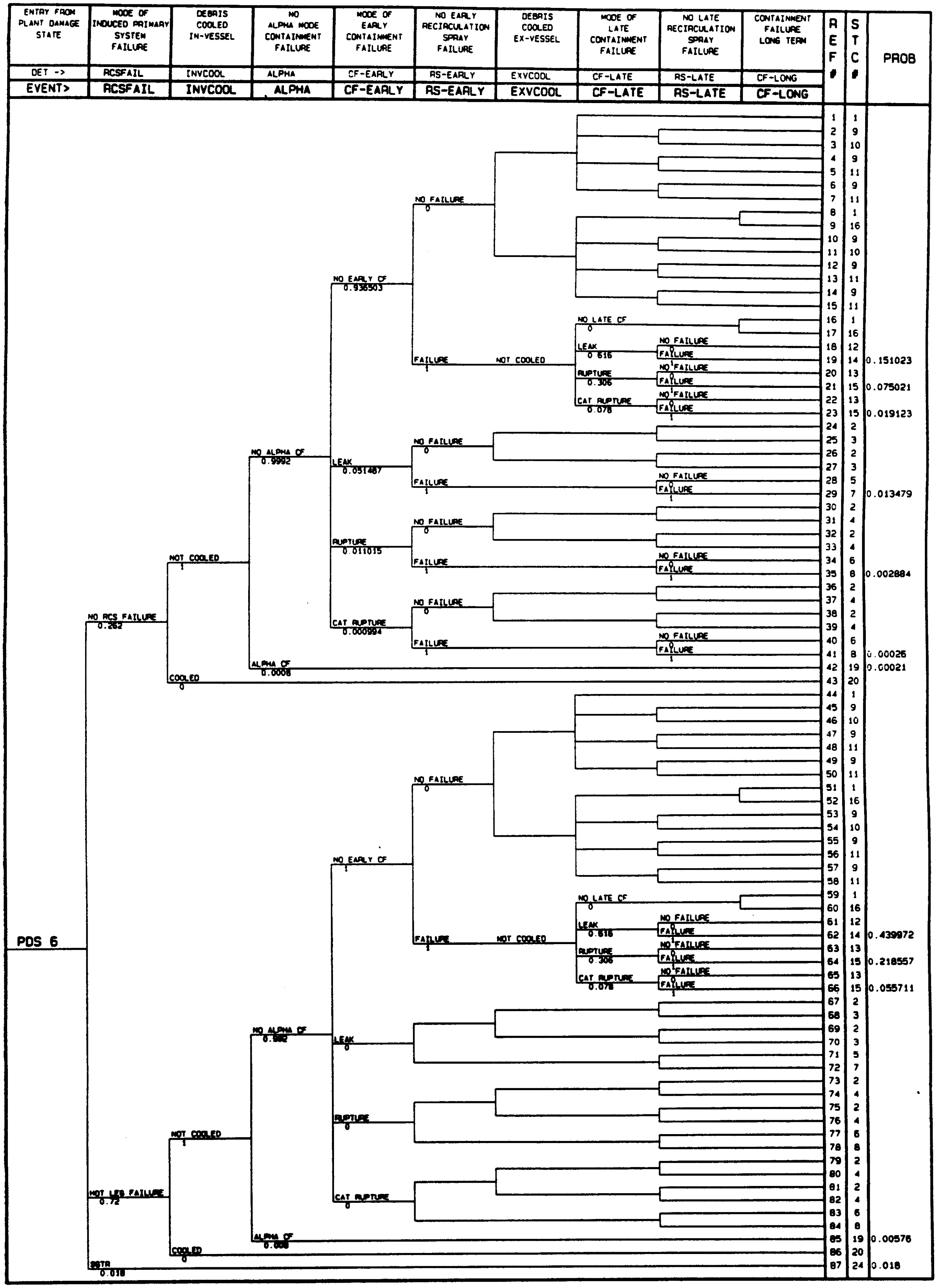


FIGURE F.4-6 Containment Event Tree for PDS 6

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_7.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDO

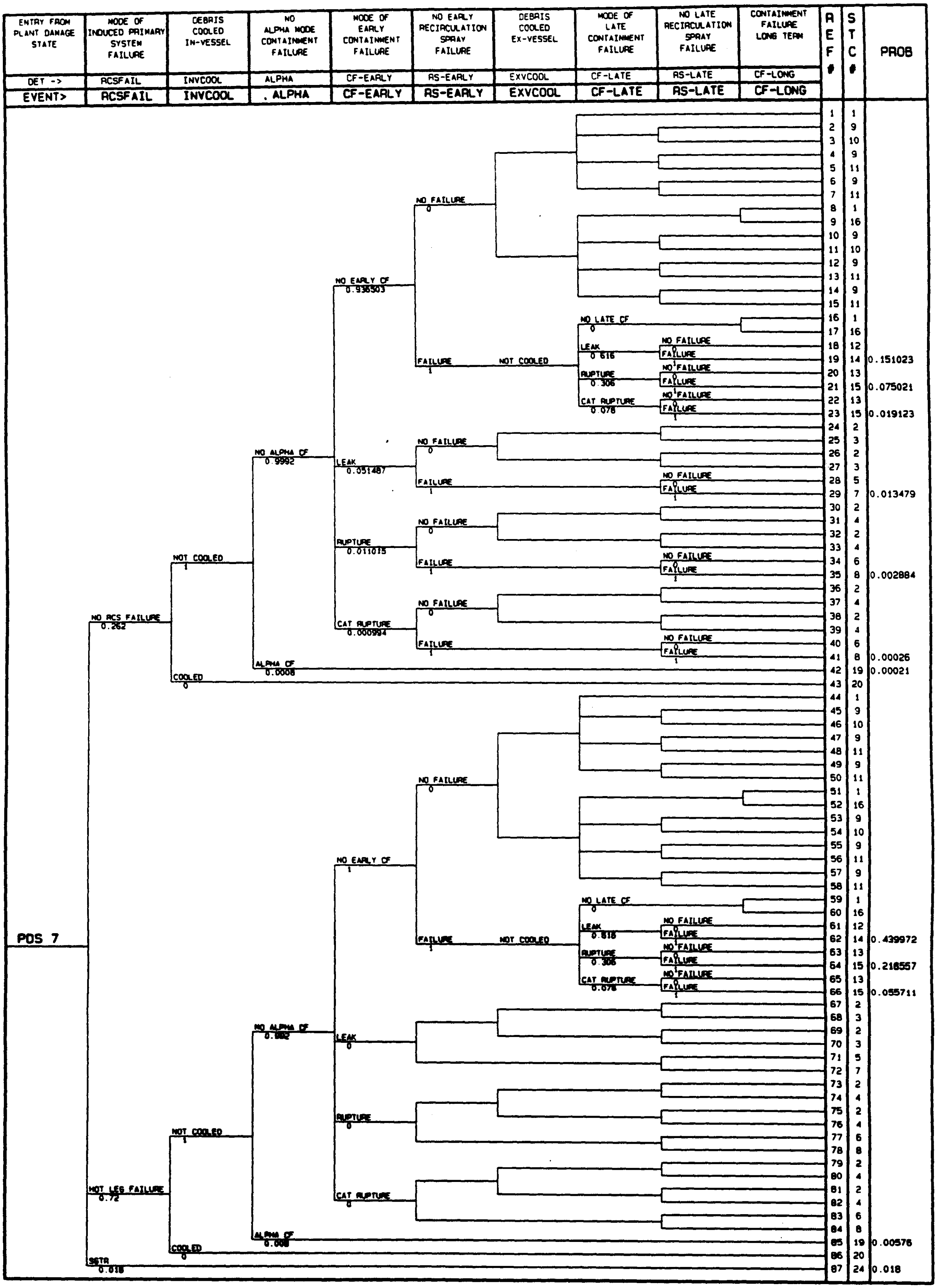
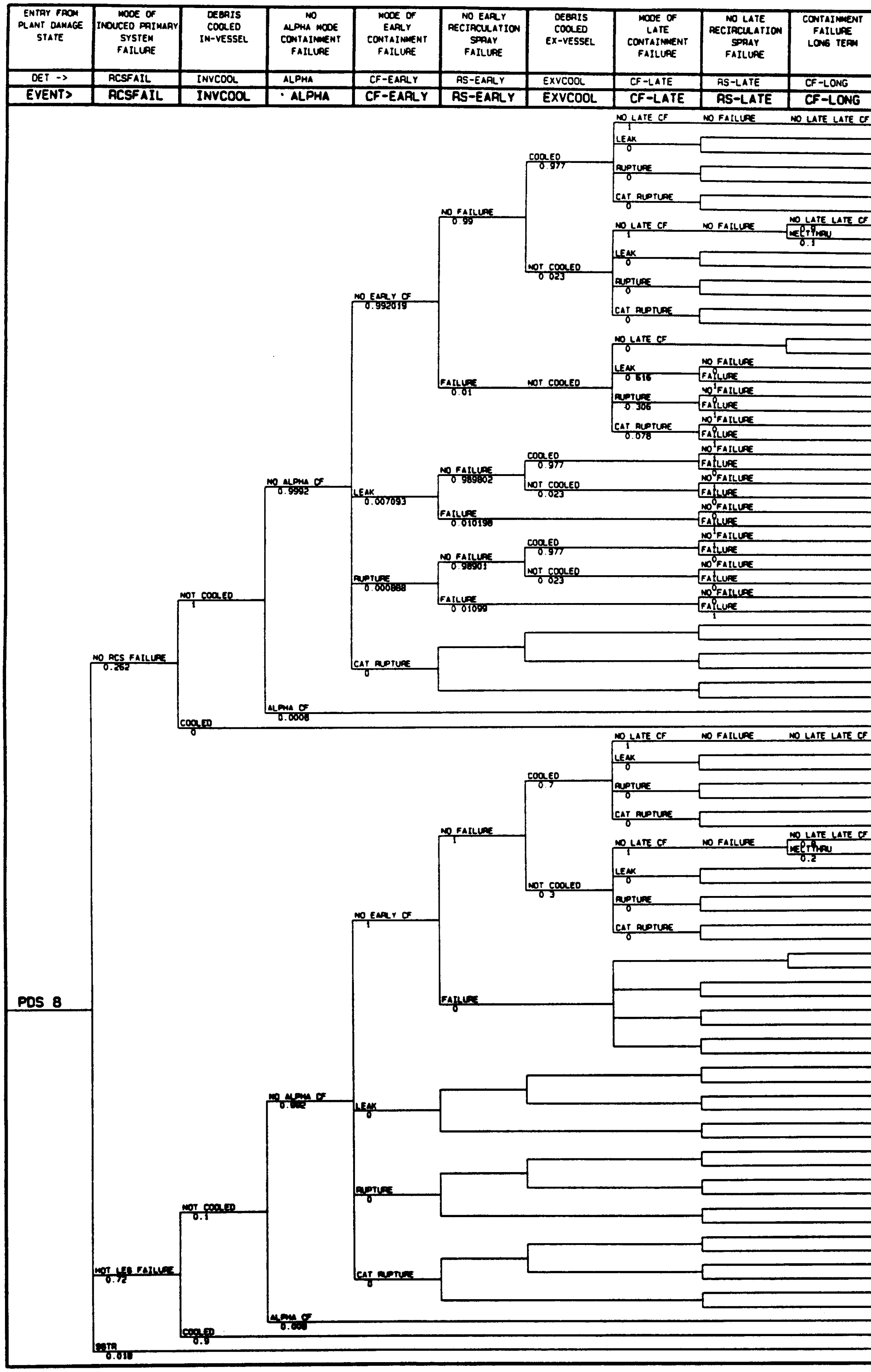


FIGURE F.4-7 Containment Event Tree for PDS 7



REF #	STC #	PROB
1	1	0.251191
2	9	
3	10	
4	9	
5	11	
6	9	
7	11	
8	1	0.005322
9	16	0.000591
10	9	
11	10	
12	9	
13	11	
14	9	
15	11	
16	1	
17	16	
18	12	
19	14	0.0016
20	13	
21	15	0.000795
22	13	
23	15	0.000203
24	2	0.001796
25	3	
26	2	0.000042
27	3	
28	5	
29	7	0.000019
30	2	0.000225
31	4	
32	2	5.29E-06
33	4	
34	6	
35	8	2.55E-06
36	2	
37	4	
38	2	
39	4	
40	6	
41	8	
42	19	0.00021
43	20	
44	1	0.049997
45	9	
46	10	
47	9	
48	11	
49	9	
50	11	
51	1	0.017142
52	16	0.004285
53	9	
54	10	
55	9	
56	11	
57	9	
58	11	
59	1	
60	16	
61	12	
62	14	
63	13	
64	15	
65	13	
66	15	
67	2	
68	3	
69	2	
70	3	
71	5	
72	7	
73	2	
74	4	
75	2	
76	4	
77	6	
78	8	
79	2	
80	4	
81	2	
82	4	
83	6	
84	8	
85	19	0.000576
86	20	0.648
87	24	0.018

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_8.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

FIGURE F.4-8 Containment Event Tree for PDS 8

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_9.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

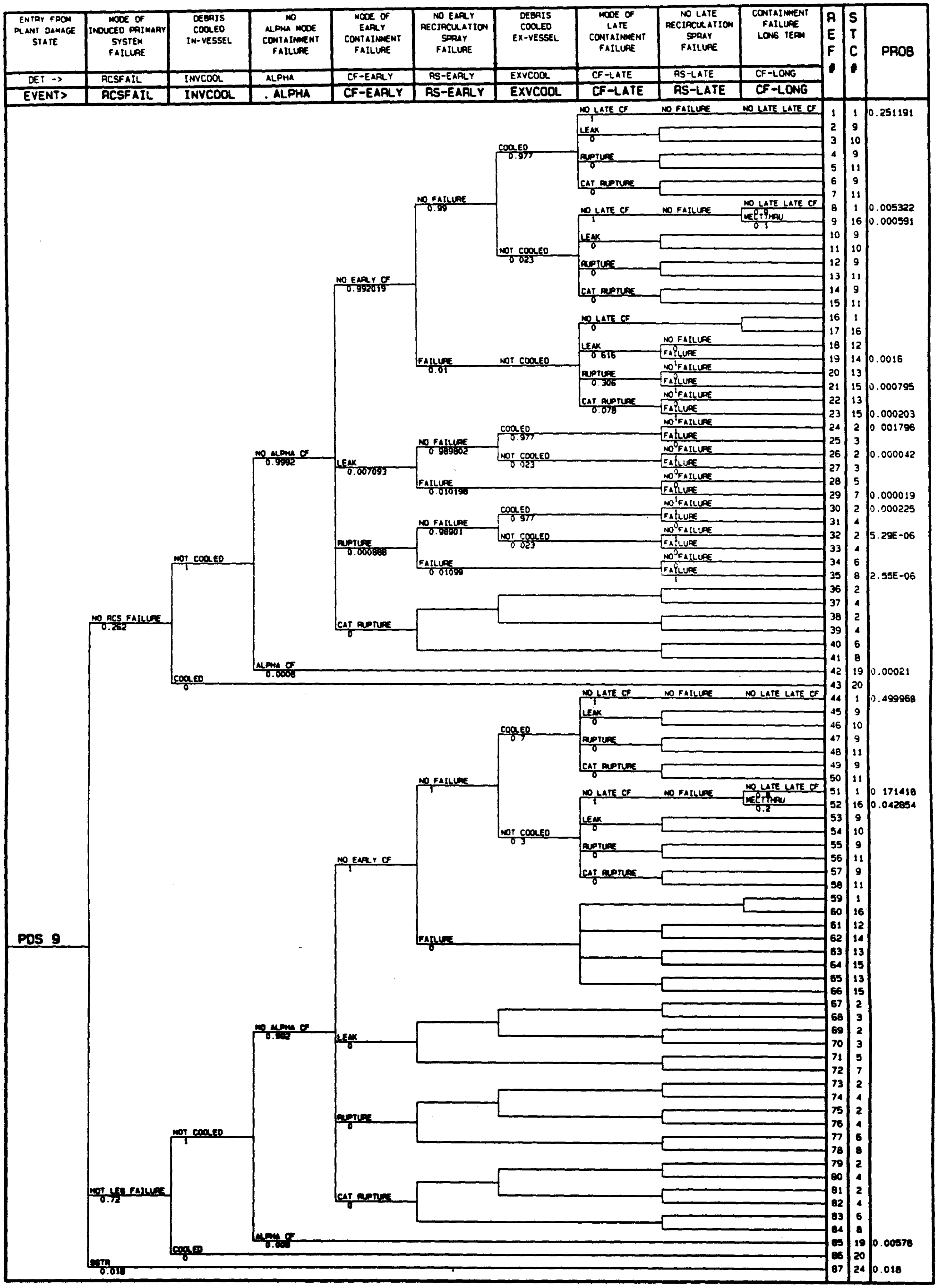


FIGURE F.4-9 Containment Event Tree for PDS 9

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_10.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

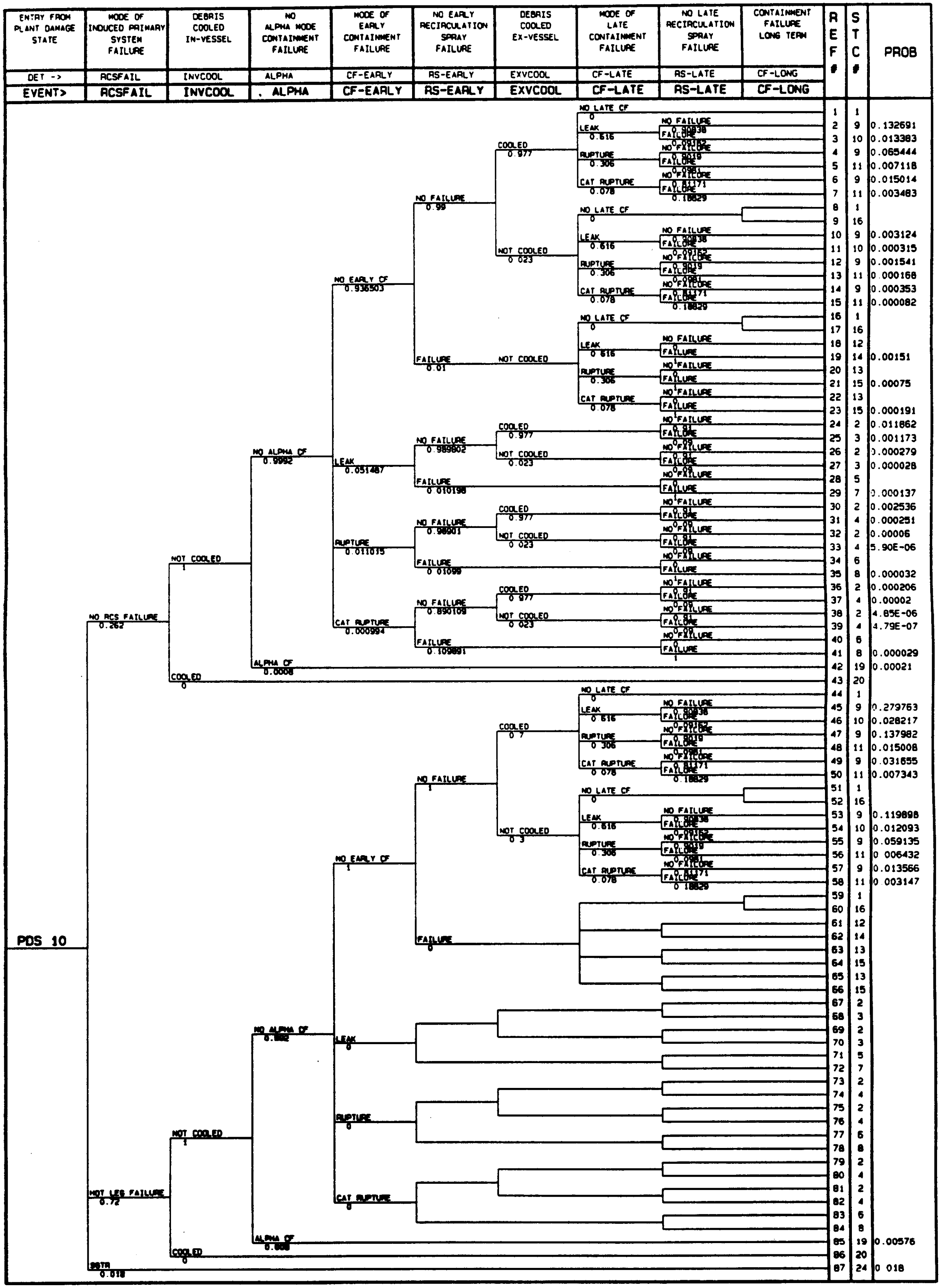


FIGURE F.4-10 Containment Event Tree for PDS 10

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_11.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

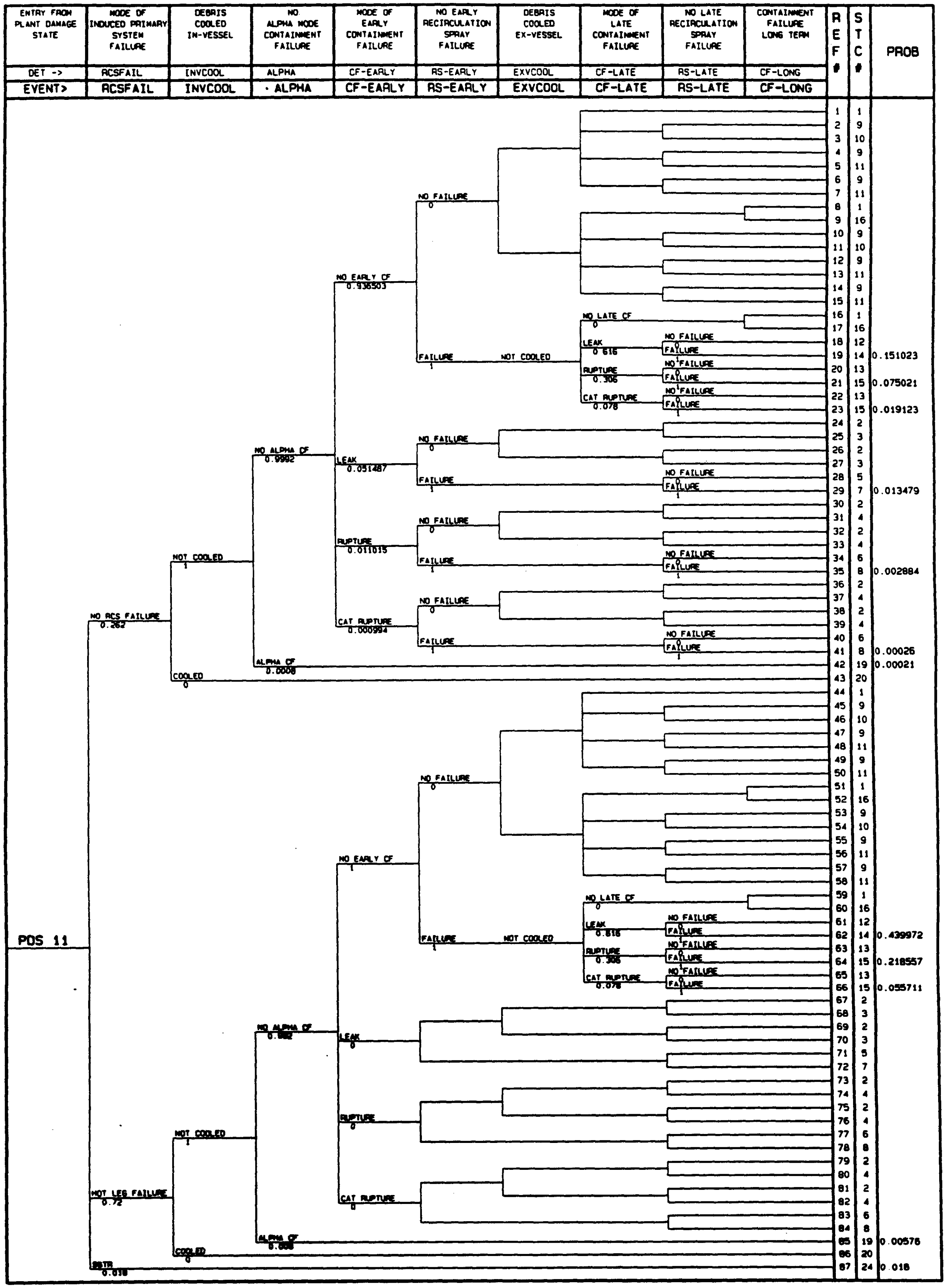


FIGURE F.4-11 Containment Event Tree for PDS 11

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_12.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.POD

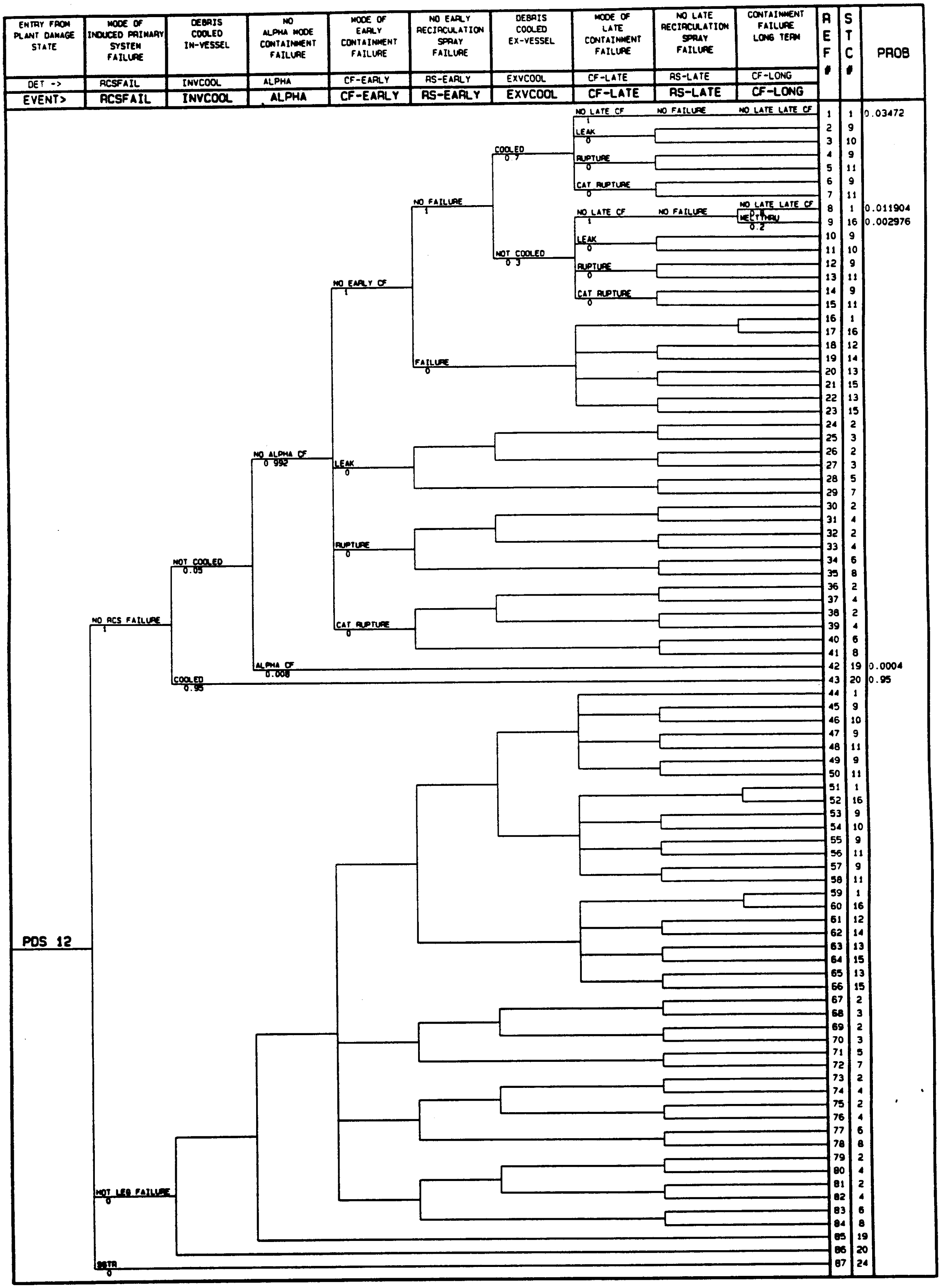


FIGURE F.4-12 Containment Event Tree for PDS 12

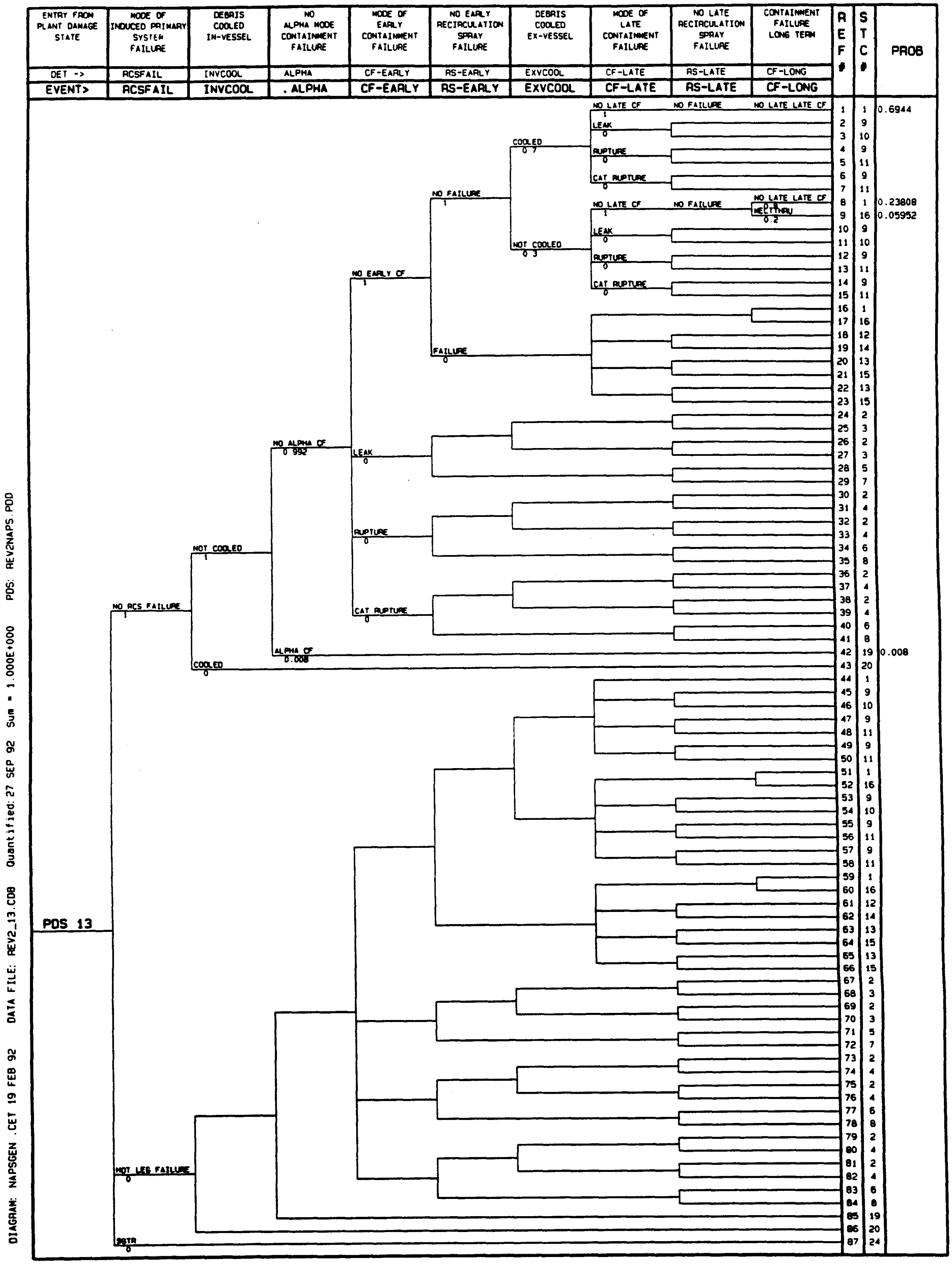


FIGURE F.4-13 Containment Event Tree for PDS 13

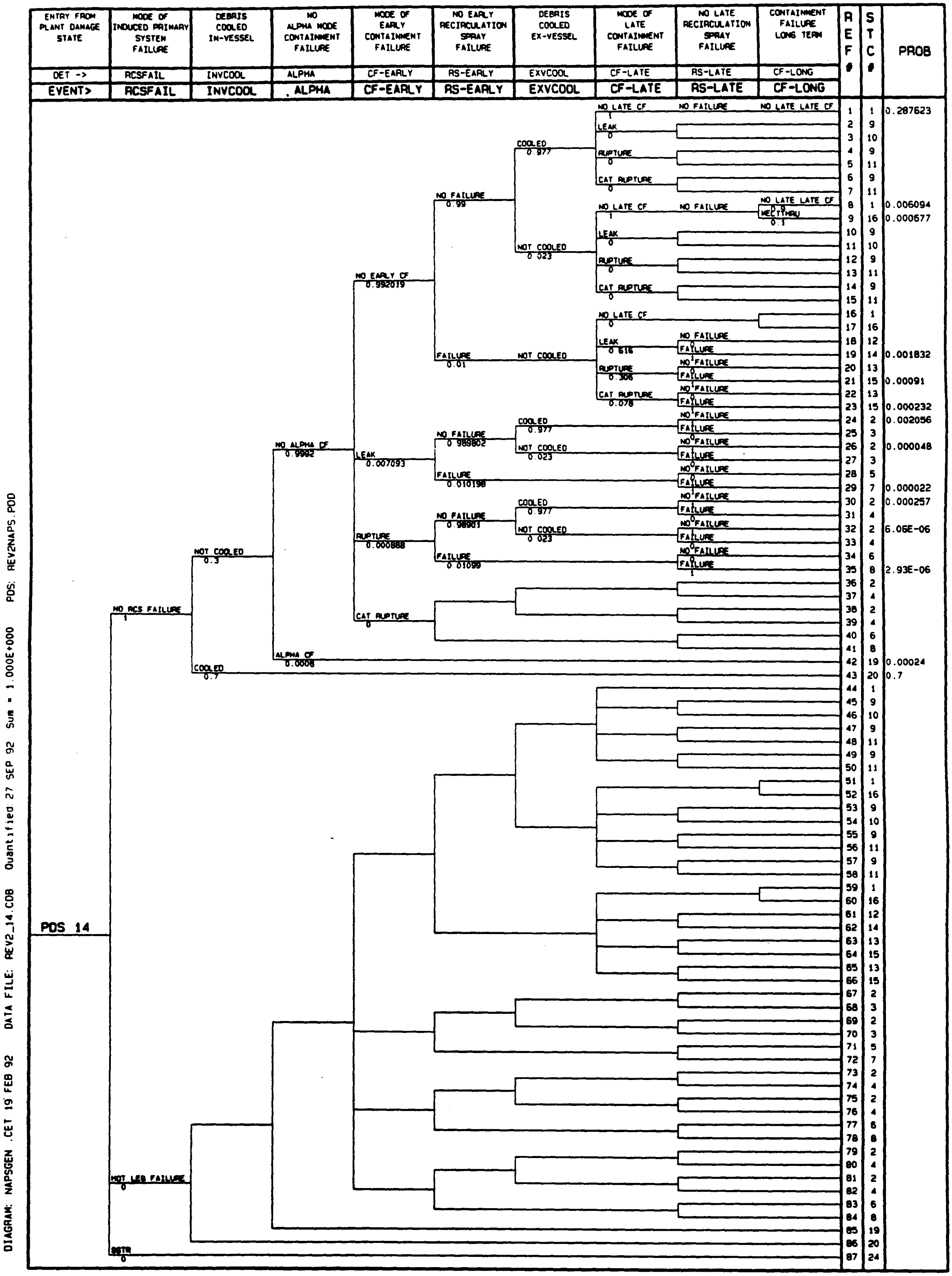


FIGURE F.4-14 Containment Event Tree for PDS 14

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_15.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

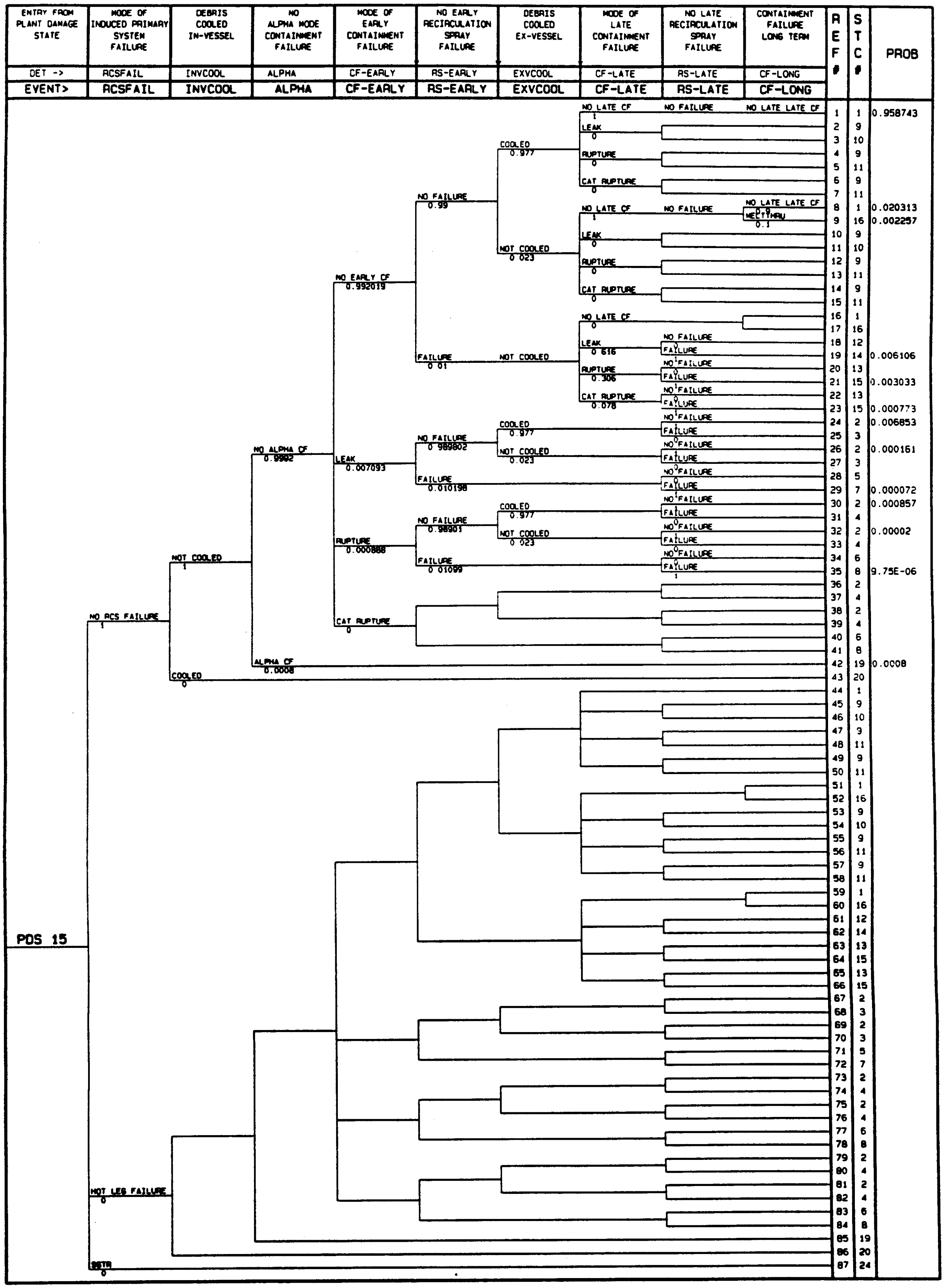
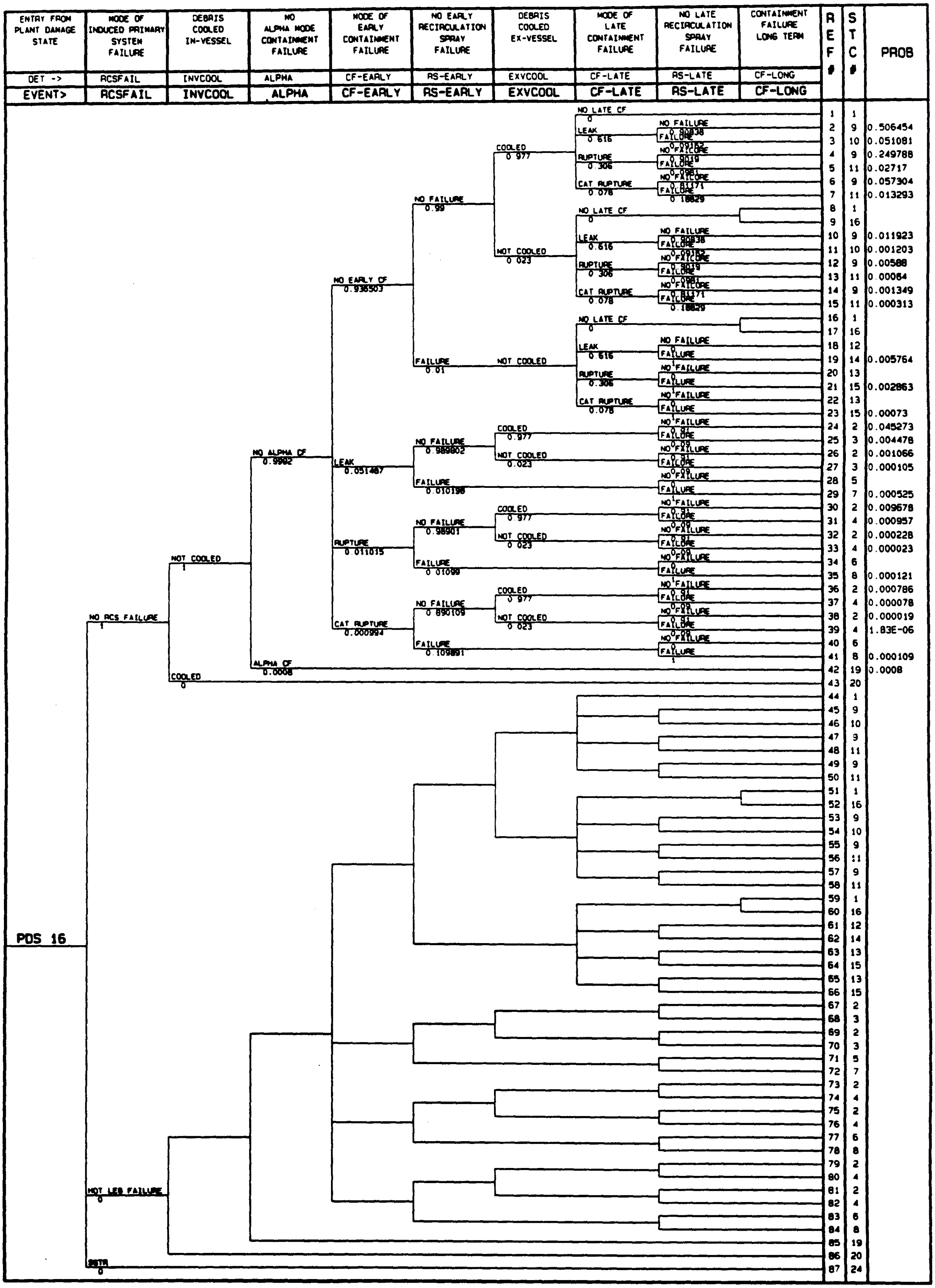


FIGURE F.4-15 Containment Event Tree for PDS 15

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_16.CDB Quantified:27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD



REF #	STC #	PROB
1	1	
2	9	0.506454
3	10	0.051081
4	9	0.249788
5	11	0.02717
6	9	0.057304
7	11	0.013293
8	1	
9	16	
10	9	0.011923
11	10	0.001203
12	9	0.00588
13	11	0.00064
14	9	0.001349
15	11	0.000313
16	1	
17	16	
18	12	
19	14	0.005764
20	13	
21	15	0.002863
22	13	
23	15	0.00073
24	2	0.045273
25	3	0.004478
26	2	0.001066
27	3	0.000105
28	5	
29	7	0.000525
30	2	0.009678
31	4	0.000957
32	2	0.000228
33	4	0.000023
34	6	
35	8	0.000121
36	2	0.000786
37	4	0.000078
38	2	0.000019
39	4	1.83E-06
40	6	
41	8	0.000109
42	19	0.0008
43	20	
44	1	
45	9	
46	10	
47	9	
48	11	
49	9	
50	11	
51	1	
52	16	
53	9	
54	10	
55	9	
56	11	
57	9	
58	11	
59	1	
60	16	
61	12	
62	14	
63	13	
64	15	
65	13	
66	15	
67	2	
68	3	
69	2	
70	3	
71	5	
72	7	
73	2	
74	4	
75	2	
76	4	
77	6	
78	8	
79	2	
80	4	
81	2	
82	4	
83	6	
84	8	
85	19	
86	20	
87	24	

FIGURE F.4-16 Containment Event Tree for PDS 16

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_17.COB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.POD

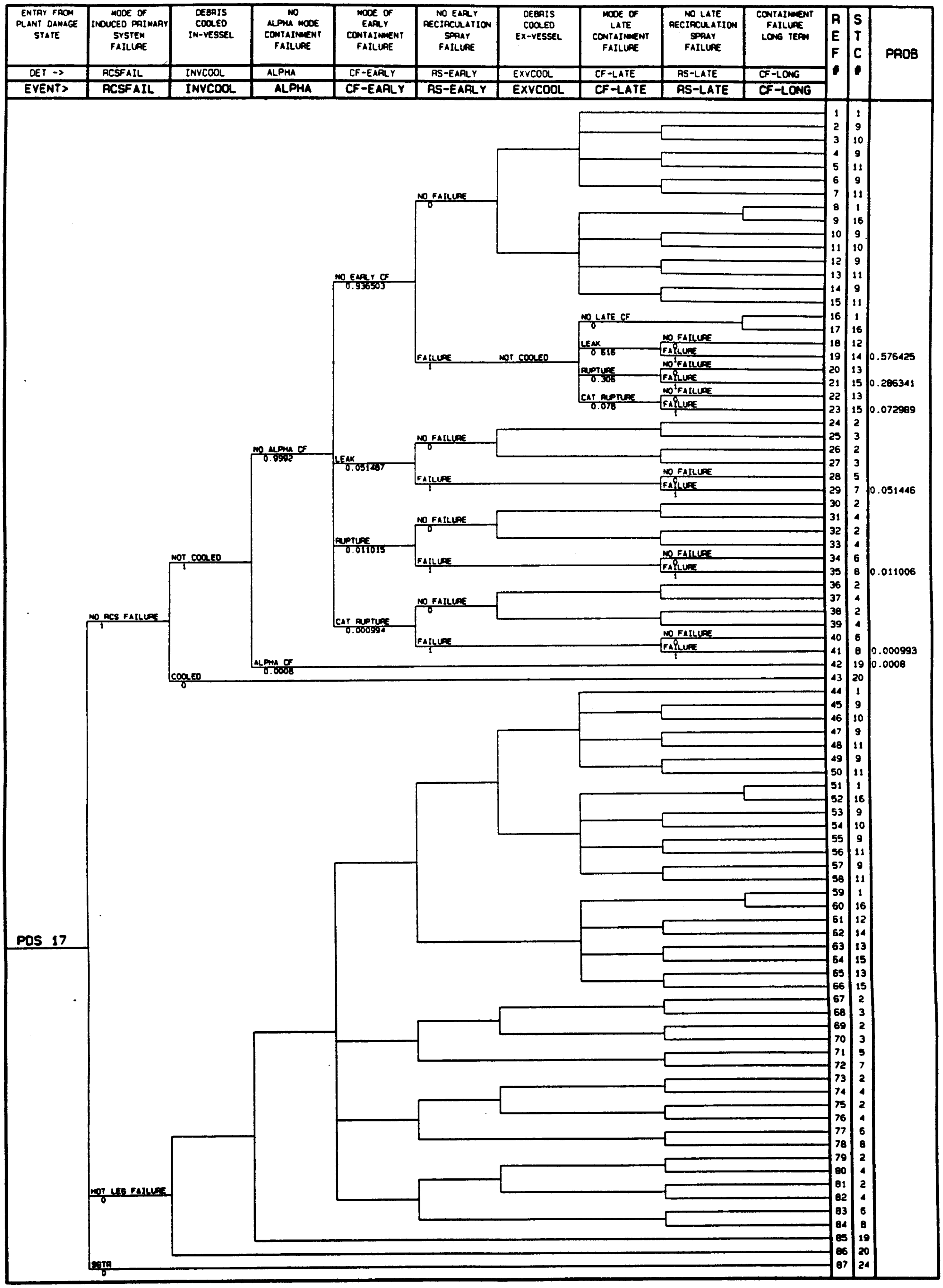


FIGURE F.4-17 Containment Event Tree for PDS 17

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_18.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDO

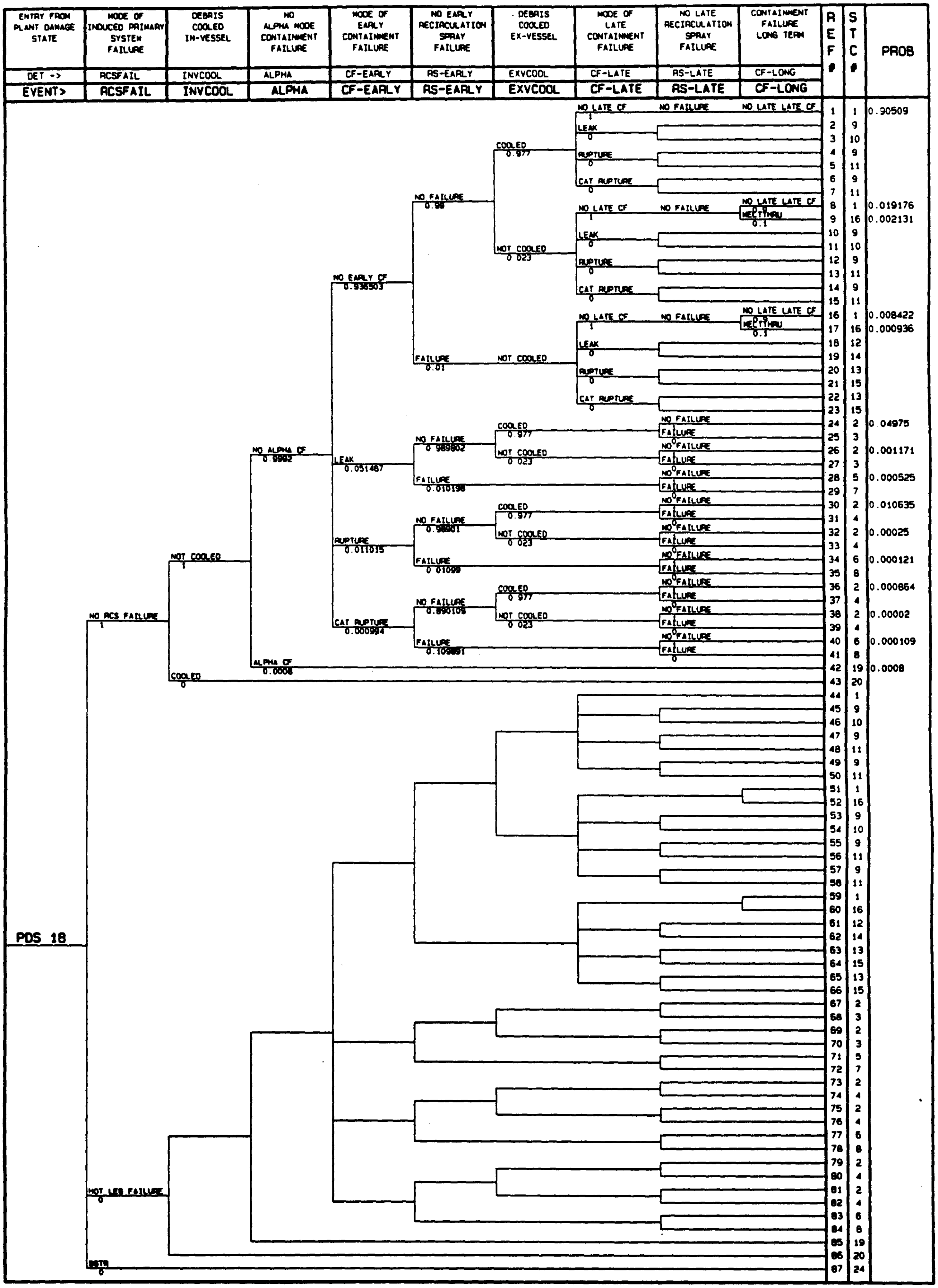
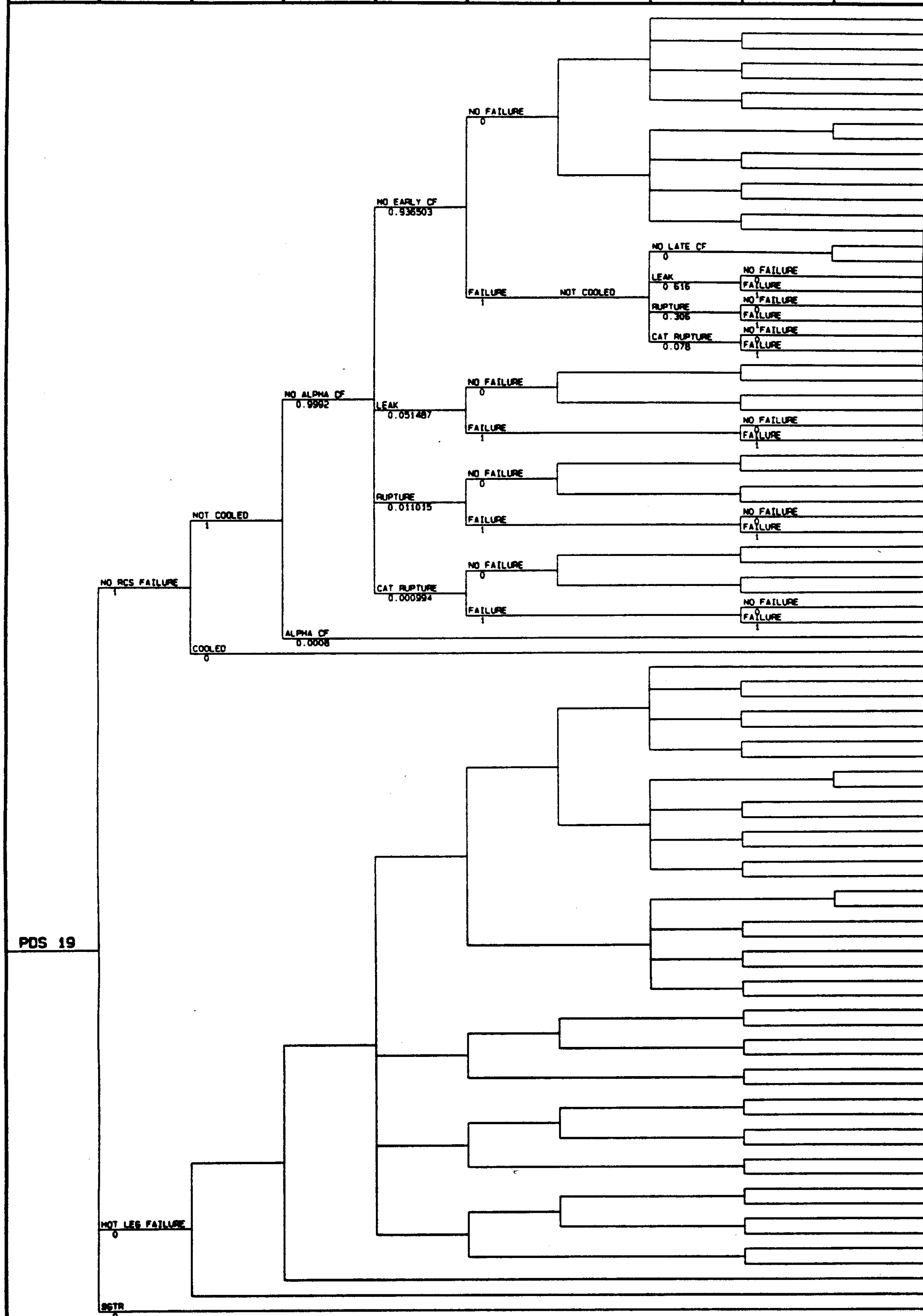


FIGURE F.4-18 Containment Event Tree for PDS 18

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_19.COB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD



REF #	STC #	PROB
1	1	
2	9	
3	10	
4	9	
5	11	
6	9	
7	11	
8	1	
9	16	
10	9	
11	10	
12	9	
13	11	
14	9	
15	11	
16	1	
17	16	
18	12	
19	14	0.576425
20	13	
21	15	0.286341
22	13	
23	15	0.072989
24	2	
25	3	
26	2	
27	3	
28	5	
29	7	0.051446
30	2	
31	4	
32	2	
33	4	
34	6	
35	8	0.011006
36	2	
37	4	
38	2	
39	4	
40	6	
41	8	0.000993
42	19	0.0008
43	20	
44	1	
45	9	
46	10	
47	9	
48	11	
49	9	
50	11	
51	1	
52	16	
53	9	
54	10	
55	9	
56	11	
57	9	
58	11	
59	1	
60	16	
61	12	
62	14	
63	13	
64	15	
65	13	
66	15	
67	2	
68	3	
69	2	
70	3	
71	5	
72	7	
73	2	
74	4	
75	2	
76	4	
77	6	
78	8	
79	2	
80	4	
81	2	
82	4	
83	6	
84	8	
85	19	
86	20	
87	24	

FIGURE F.4-19 Containment Event Tree for PDS 19

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_20.COB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

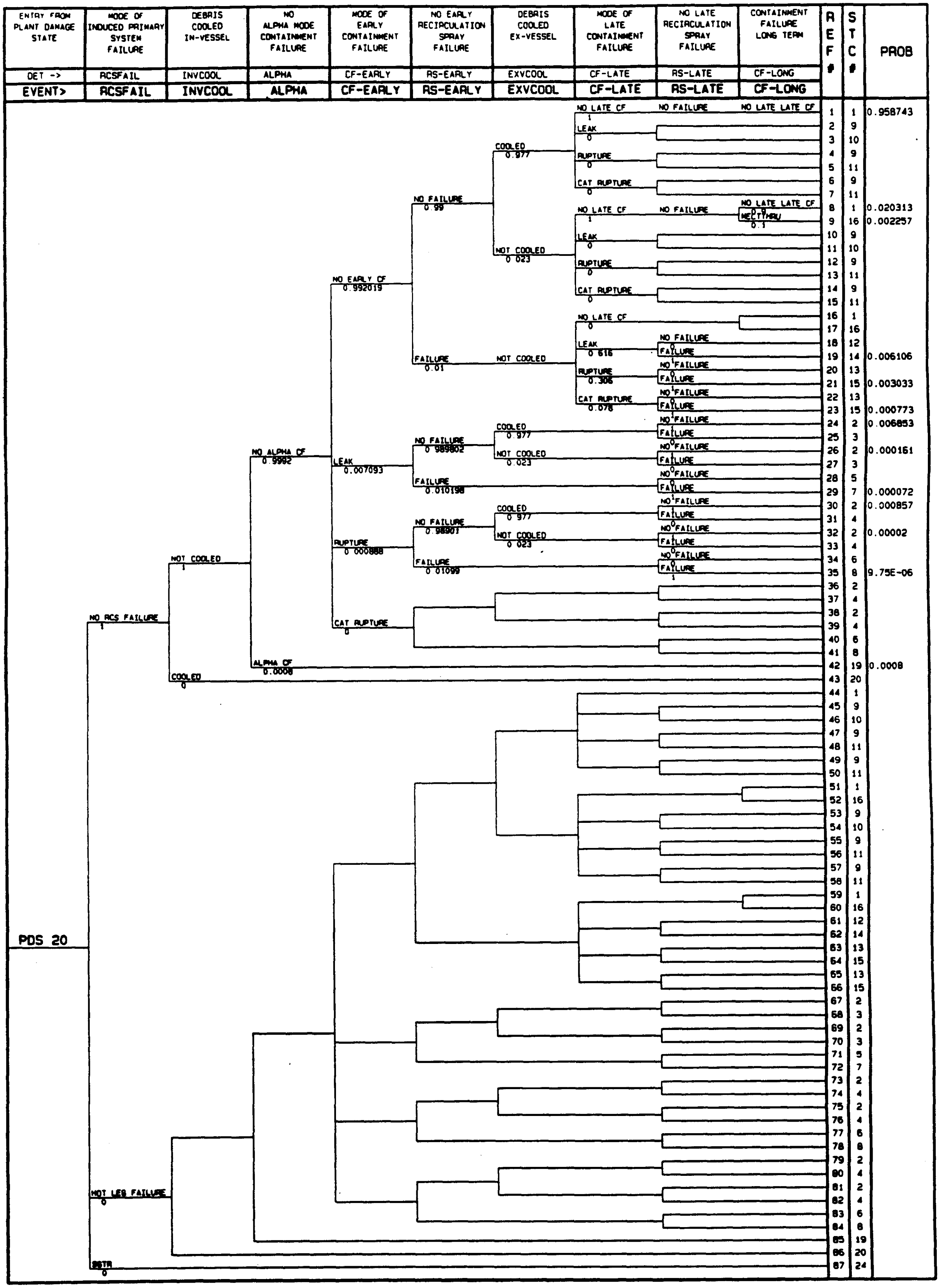


FIGURE F.4-20 Containment Event Tree for PDS 20

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_21.COB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

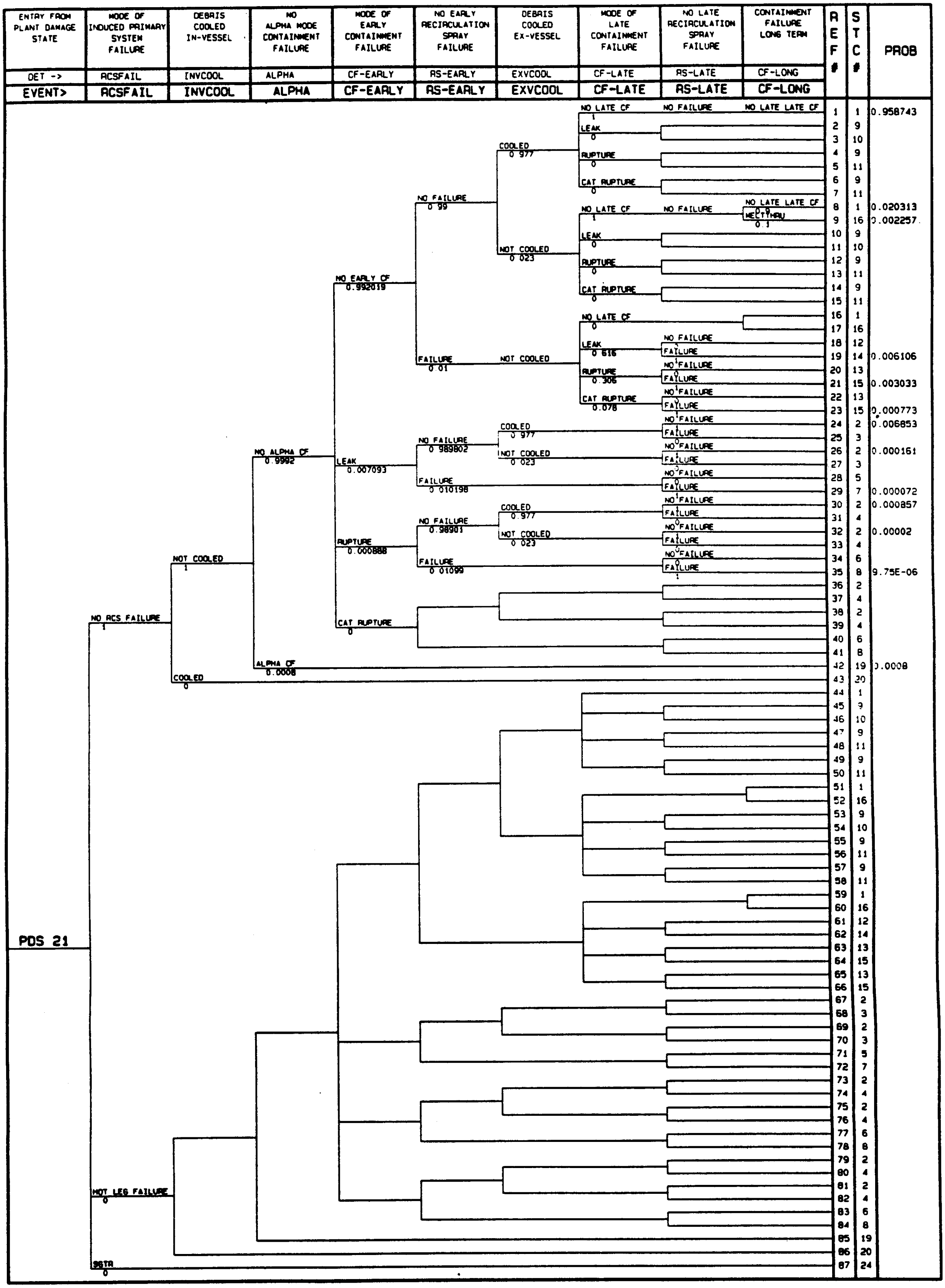


FIGURE F.4-21 Containment Event Tree for PDS 21

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_22.COB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDO

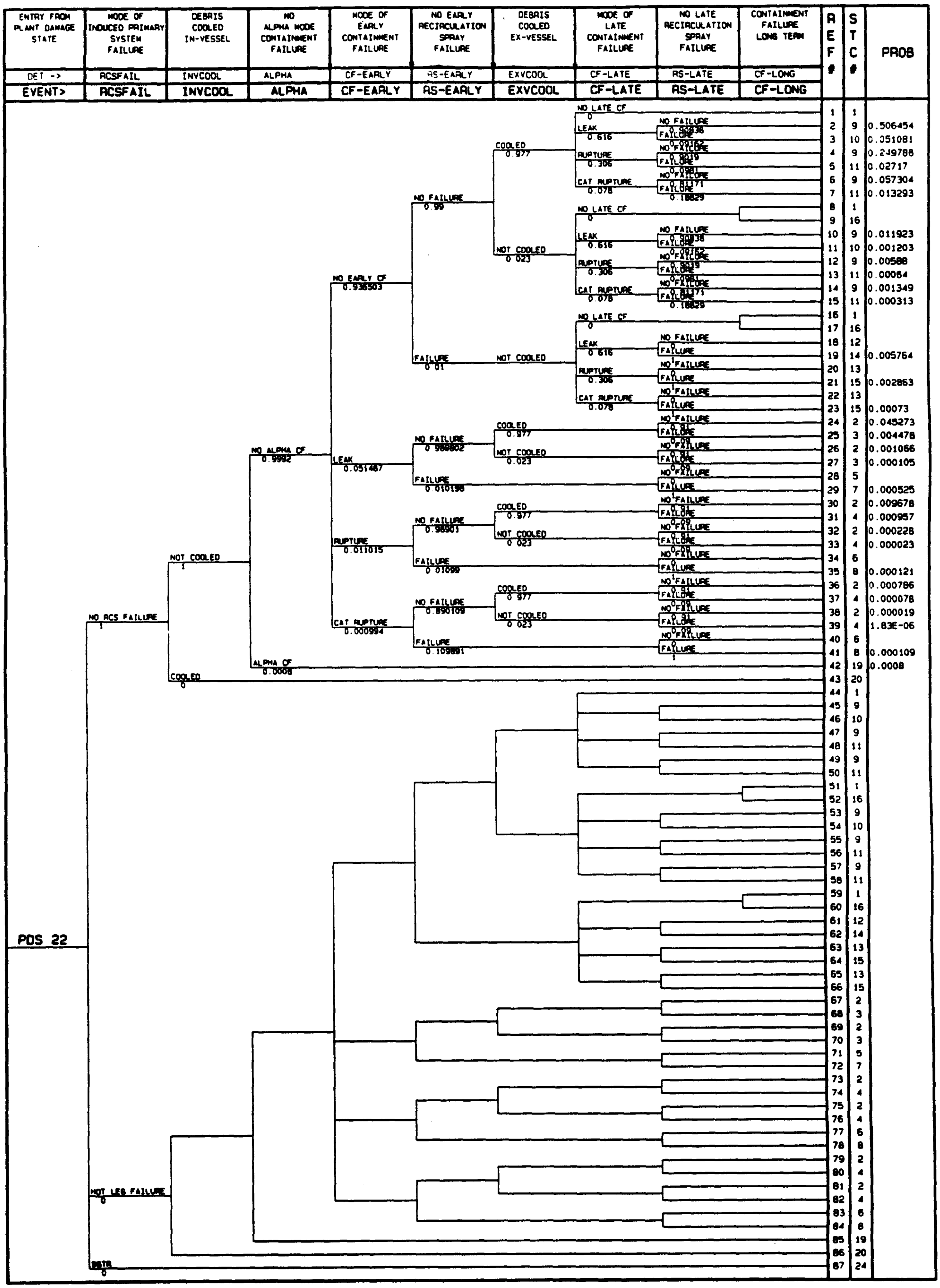


FIGURE F.4-22 Containment Event Tree for PDS 22

DIAGRAM: NAPSGEN .CET 19 FEB 92 DATA FILE: REV2_23.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

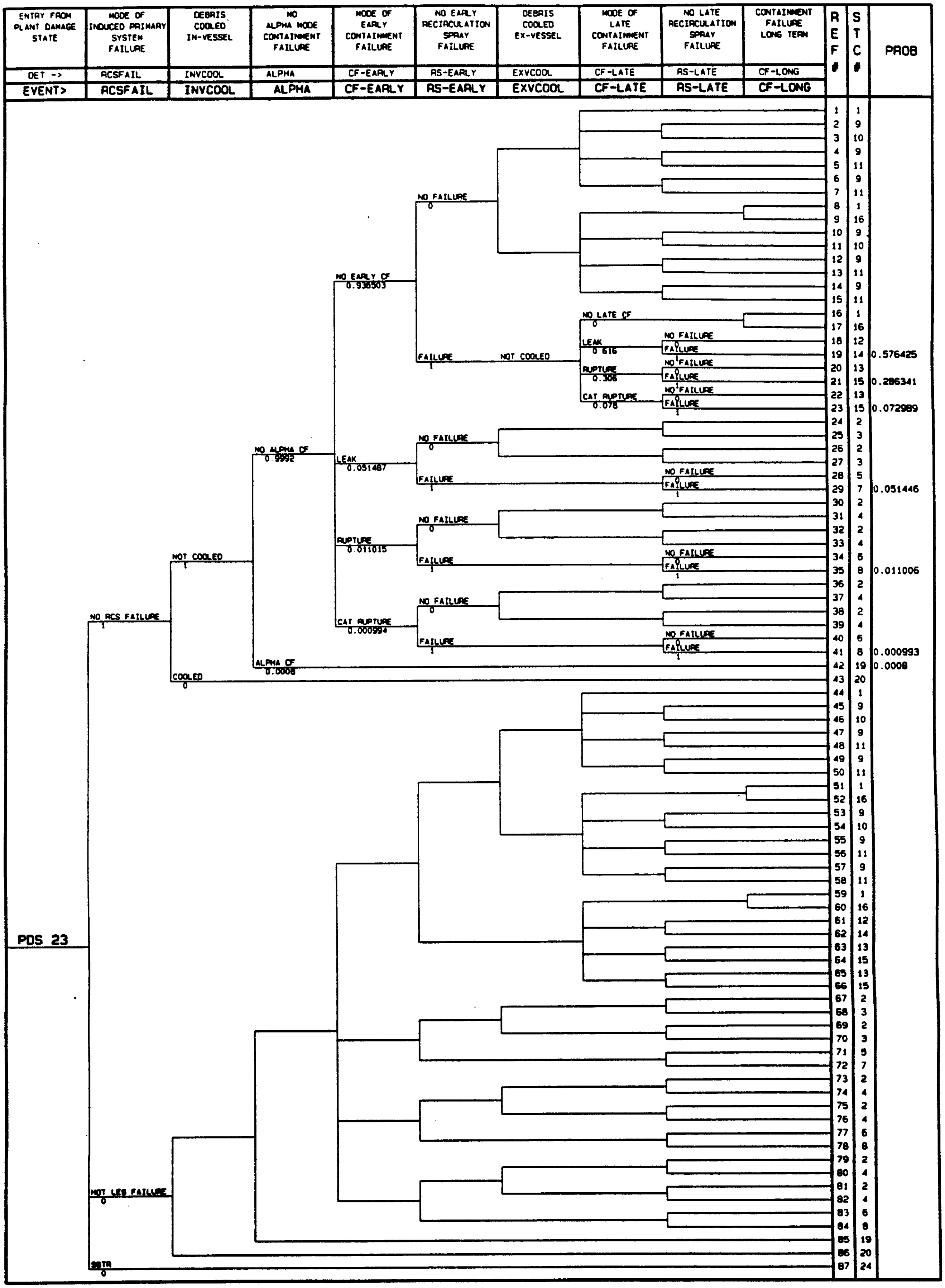


FIGURE F.4-23 Containment Event Tree for PDS 23

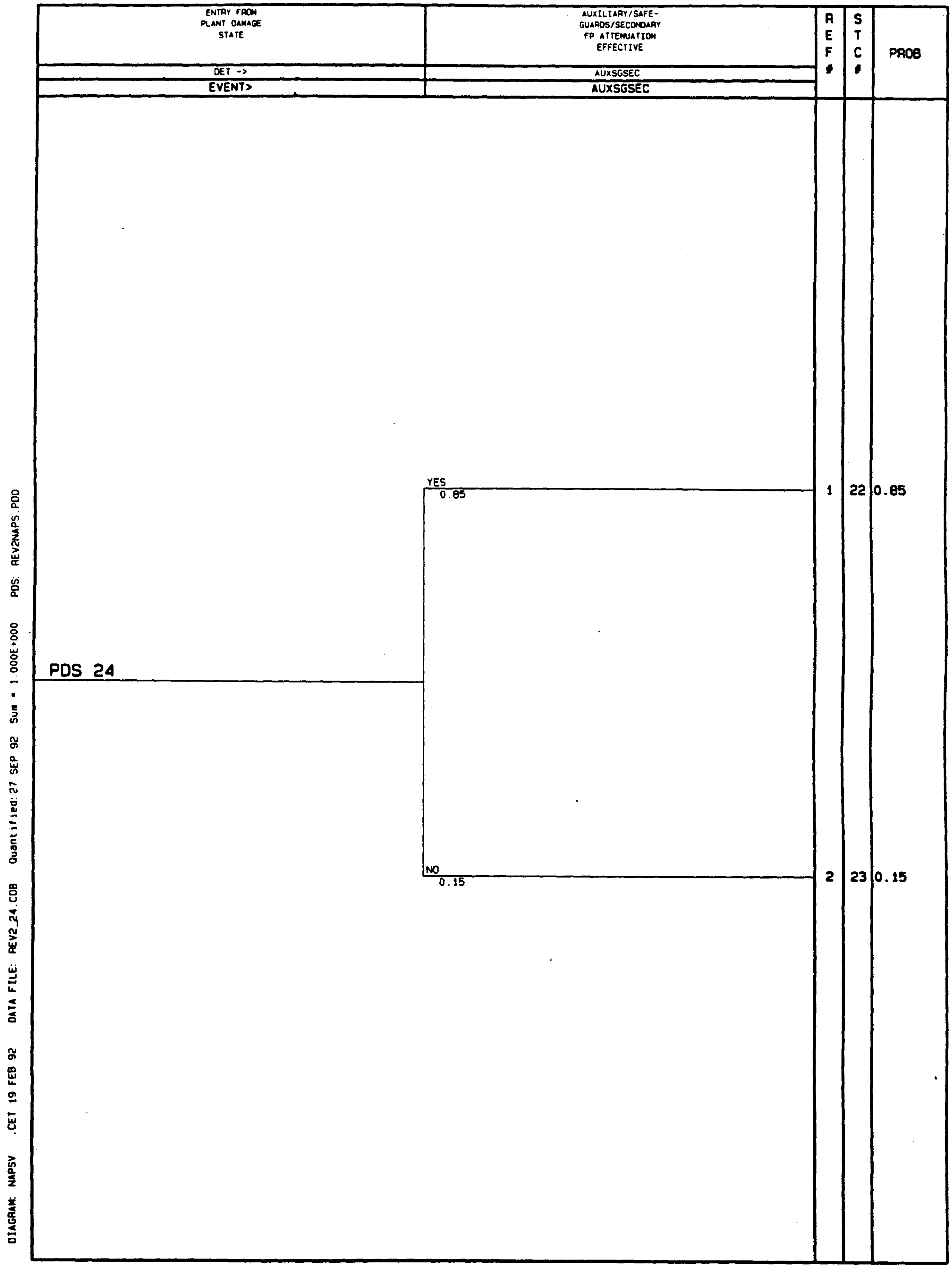


FIGURE F.4-24 Containment Event Tree for PDS 24

DIAGRAM: NAPSSGTR.CET 19 FEB 92 DATA FILE: REV2_25.CDB Quantified: 27 SEP 92 Sum = 1.000E+000 PDS: REV2NAPS.PDD

ENTRY FROM PLANT DAMAGE STATE	AUXILIARY/SAFE-GUARDS/SECONDARY FP ATTENUATION EFFECTIVE	REF #	STC #	PROB
DET ->	AUXSGSEC			
EVENT>	AUXSGSEC			
PDS 25	NO	1	24	1.0

FIGURE F.4-25 Containment Event Tree for PDS 25