4.0 COREMELT QUANTIFICATION

In this section, the plant coremelt frequency is quantified based on the modeling and data of Sections 1.0, 2.0, and 3.0. The plant coremelt category frequencies are individually quantified to provide input for the plant risk analysis of Section 7.0. The coremelt is also broken down by contributions from initiating events and from support states. The dominant accident sequences are identified.

4.1 QUANTIFICATION OF EVENT TREE NODES

In this section, the support state probabilities and the event tree node probabilities are quantified.

4.1.1 QUANTIFICATION OF SUPPORT STATE PROBABILITIES

The support state model is given in Section 2.0. In this section, the support state probabilities are quantified for the four cases:

1. Transient Case (TRA)

   This case applies to the transient initiating event tree.

2. Loss of Offsite Power Case (LSP)

   This case applies to the loss of offsite power event tree.

3. LOCA Case (LCA)

   This case applies to the following initiating events.

   1. Steam Generator Tube Rupture
   2. Secondary Side Break
   3. Small LOCA
   4. Large LOCA

5. ATWS
6. Interfacing Systems LOCA
7. Vessel Failure

4. Loss of Auxiliary Cooling Case (LC1)

This case applies to the Total Loss of Auxiliary Cooling event.

The data used to quantify the support state probabilities is shown in Table 4.1-1.

In support state quantification, the following modeling assumptions were made:

1. No AC recovery is modeled for the "LOCA" case.

2. The recovery probability of 1 diesel generator within 40 minutes is taken as 30%. This is consistent with Zion Probabilistic Safety Study. The failure to recover both diesel generators is calculated as

$$q_2 = (0.7)^2 = 0.49$$

The failure to recover only 1 diesel generator is calculated as

$$q_1 = (0.3)(0.7) + (0.7)(0.3) = 0.42$$

3. Loss of offsite power probability is calculated as

$$q = \frac{0.12}{365} = 3.3 \times 10^{-4}$$

for a 24 hour mission time. 0.12 is the loss of offsite power initiating event frequency.

4. Offsite recovery in 40 minutes is taken as 0.5. This is consistent with EPRI NP-2301.

5. Upon loss of SWS/CCW, the loss of diesel cooling leading to diesel generator failure is estimated as 0.5; this assumes that 40% of the SWS/CCW failures occur in the Service Water System, which cools the emergency diesel generators.

6. Loss of On-Site Emergency AC Power

The loss of on-site emergency power probabilities are taken from Section 3.1. They are

$q_{both\ buses}$ = [ ] (a,c)

$q_{any\ one\ bus}$ = [ ] (a,c)

7. Loss of IPS Signal

The IPS failure probability is taken from Section 3.2. Since this is a highly redundant system with cross-connects for signal generation, if it fails, it is assumed that the failure will be total. Thus the failure probability of the system is

q = [ ] (a,c)

as estimated in Section 3.2. This failure is dominated by loss of Vital DC power. Note that this failure does not include the failure to trip the reactor. ATWS is treated as an initiating event.

8. Loss of SWS/CCWS Cooling

The system failure probabilities are taken from Section 3.3.

The failure of the both trains is given for two cases:

i) AC power available

(a,c) q = [ ] for transients

(a,c) = [ ] for non-transients

ii) AC power is lost, but on-site emergency power is available:

(a,c) q = [ ] for transients

(a,c) = [ ] for non-transients

One train failure is also taken from Section 3.3. It is conservatively modeled that offsite power is initially lost so that SW pumps of the train must start. The model probability for failure of any train is calculated as

(a,c) q = [ ]

The input data used for support state probability quantification is shown in Table 4.1-1. The calculated support state probabilities are given by Table 4.1-2. The major contributions to support states are listed in Table 4.1-3.

TABLE 4.1-1
DATA USED IN SUPPORT STATE PROBABILITY QUANTIFICATION

NODE	CONDITIONAL	FAILURE PROBABILITY TRA	LSP	LCA	LC1	
OFP	None	$3.3x10^{-4}$	1.0	$3.3x10^{-4}$	$3.3x10^{-4}$	
ONP	Both Buses Fail	[			]	(a,c)
	One of Two Fails					
OFR	None	0.5	0.5	1.0	0.5	
ONR	Both DGs Fail	0.49	0.49	1.0	0.49	
	One of Two Fails	0.42	0.42	1.0	0.42	
	One of One Fails	0.21	0.21	1.0	0.21	
SIG	None	[			]	(a,c)
S/C	Both Trains Fail Offsite AC Available	[			]	(a,c)
	Both Trains Fail Offsite AC Failed					
	One of Two Fails					
	One of One Fails					
DGC	None	0.5	0.5	0.5	0.5	

TABLE 4.1-2

SUPPORT STATE PROBABILITIES

SUPPORT STATES	TRA	LSP	LCA	LC1
SS2				
SS1				
SS12				
SS11				
SS0				
SS02				
SS01				
SS00				

(a,c)

TABLE 4.1-3

MAJOR CONTRIBUTORS TO SUPPORT STATES

Transients:	Probability	Support State	
[		]	(a,c)

Loss of offsite power:

[ ] (a,c)

LOCAs:

[ ] (a,c)

Loss of auxiliary cooling:

[ ] (a,c)

PERCENT CONTRIBUTION OF SUPPORT SYSTEMS TO SUPPORT STATE 0:

Case (Probability)	Onsite AC Power	Percent Contribution SW/CCW	IPS		
TRA	[			]	(a,c)
[				]	(a,c)
LSP	[			]	(a,c)
[				]	(a,c)
LCA	[			]	(a,c)
[				]	(a,c)
LC1	-	100%	-		

4.1.2 QUANTIFICATION OF EVENT TREE NODES

The event tree node probabilities are quantified in this section for use in plant coremelt quantification and dominant accident sequence analysis.

4.1.2.1 INITIATING EVENT FREQUENCIES

The initiating event frequencies are calculated in Section 1.2 and are taken from Table 1.2.1.

4.1.2.2 SUPPORT STATE PROBABILITIES

The support state probabilities are calculated in Section 4.1.2.1 and are given in Table 4.1-4.

4.1.2.3 OTHER EVENT TREE NODES

The other event tree nodes are quantified as follows:

SECONDARY COOLING NODES:

The failure probability of secondary cooling nodes for SC1, SC2, and SC3 are taken directly from Table 3.7.2-2 for support states 2, 1 and 0:

SC1:

$q_2 =$ [

$q_1 =$

$q_0 =$] (a,c)

SC2:

$q_2 =$ [ ] (a,c)

(a,c)

q_1 =

q_0 =

SC3:

(a,c)

q_2 =

q_1 =

q_0 =

The SC4 node takes credit for the startup feedwater system (Section 3.7.1). In this case, only partial credit will be taken for the SUFW system for support state 2. The nodal probability will be calculated as

$$q_2 = q_2\ (SC1) \times 0.1$$

Where only 0.1 credit is taken for SUFW. No credit will be taken for SUFW for support states 1 and 0.

(a,c)

q_2 =

q_1 =

q_0 =

PRIMARY COOLING NODES:

The failure probabilities for primary cooling nodes are taken from Tables 3.4-1 and 3.4-2 and modified for small LOCA cases to account for the operator action (ORH) of depressurizing the primary system through PORVs and starting the RHR pumps after the unlikely event of common cause failure of all four SI pumps. The ORH probability is taken from Table 3.11-1.

SI1:

$$q_2 = \left[\right.$$
$$q_1 =$$
$$q_0 = \left. \right]$$

(a,c)

SI2: These failure probabilities are directly taken from Table 3.4-2.

$$q_2 = \left[\right.$$
$$q_1 =$$
$$q_0 = \left. \right]$$

(a,c)

CONTAINMENT SPRAY NODES:

The failure probabilities are taken from Section 3.5.3.1 as:

$$q_2 = \left[\right.$$
$$q_1 =$$
$$q_0 = \left. \right]$$

(a,c)

After total loss of AC power and coremelt, recovery of CSP is taken as $q_0 = 0.5$

CONTAINMENT FAN COOLER NODES:

This failure does not include effects of degraded environment after coremelt. Such effects are to be included in the containment event tree whenever applicable. The failure probabilities are taken from Table 3.6-3 as follows:

i) No loss of offsite power

(a,c) q_2 =

q_1 =

q_0 =

ii) After loss of offsite power

(a,c) q_2 =

q_1 =

q_0 =

LONG TERM COOLING NODES:

Credit is taken for possible switchover to RHR pumps in the form of operator action ORH (Table 3.11-1). The probabilities are taken from Table 3.2-1 for failure of SI pump trains;

(a,c) i) Small LOCA
CFC available

q_2 =

q_1 =

q_0 =

ii) Small LOCA
No CFC available

(a,c) q_2 =

q_1 =

q_0 =

iii) Large LOCA
CFC available

$q_2 =$ [ ]
$q_i =$ [ ]
$q_o =$ [ ] (a,c)

iv) Large LOCA
No CFC available

$q_2 =$ [ ]
$q_1 =$ [ ]
$q_o =$ [ ] (a,c)

SLL: SEAL LOCA NODE:

The seal LOCA probability is calculated as a product of loss of BSI system probability and the occurrence of seal LOCA (after loss of BSI) probability. BSI failure probability is taken from Table 3.8-2 as

$q_{BSI} =$ [ ] (a,c)

The probability of an appreciable seal LOCA following BSI failure is assigned as

$q_{seal} =$ [ ] (a,c)

Then the nodal probability is calculated as

$q_o =$ [ ] (a,c)

LCO: CONSEQUENTIAL LOCA NODE:

This node is assigned a probability of

$q_2 =$ [ ]
$q_1 =$ [ ] (a,c)

The q_2 probability is assigned based on the discussion in Section 1.2.5: a,c) the consequential LOCA adds [ ] to the small LOCA initiating event frequency. The probability of q_1 is conservatively taken to be an order of magnitude higher than q_2 to account for additional challenges due to being in a degraded support state.

REC: RECOVERY OF AC/IPS

This probability represents either the recovery of AC power or start-up of pumps by operators (in case only IPS is lost) after 40 minutes after a transient event and before coremelt. It is assigned a value of 0.5 based on time available before coremelt in providing opportunity to recover AC power (on-site or offsite) or manual start of pumps after loss of automatic signal.

ACR: RECOVERY OF POWER AFTER 40 MINUTES:

This probability represents power recovery after 40 minutes into the accident and before coremelt. It is assigned a value of 0.5 based on availability of 2 to 3 hours before coremelt after initiation of a small seal LOCA. Potentially the accumulators and CRTs may also be used to replenish water inventory in the vessel, thus extending this time further.

$q_3 = 0.5$

ACC: ACCUMULATOR NODE:

The accumulator failure probability is taken from Table 3.4-8 as

(a,c) q = [ ]

for a 2/3 success criteria.

SOF: STEAM GENERATOR OVERFILL NODE:

The failure probability of the automatic SG drain feature (SOF) is calculated as

$q = [\quad]$ **(a,c)**

in Section 3.9.3.1. If this automatic capability fails, the SG is assumed to overfill and a SG safety is assumed to fail in an open position. Core melt can be prevented if the operator depressurizes the RCS by opening the pressurizer PORVs, thus lowering primary pressure. The probability of such an operator action is taken from Table 3.11-1 (OBL) as

$q = 0.01$

Thus the nodal failure probability is calculated as:

$q_2 =$ [

$q_1 =$

$q_o =$] **(a,c)**

PRR: PRESSURE RELIEF IN ATWS:

From previous work, the failure of this node is estimated to be

$q = 5.0 \times 10^{-3}$

This includes failure of relief and safety valves in the primary system to open to mitigate the pressure increases during early stages of an ATWS event.

CON: INTERFACING SYSTEMS LOCA OCCURS IN CONTAINMENT:

The failure of the return path to the EWST in case of the most credible interfacing systems LOCA event (RHR suction path) is estimated to be

(a,c) q = [ ]

This estimation is carried out as follows:

q = MOV along the EWST path is closed + Pipe or RHR Pump Seal Break

The first contribution is dominated by misposition after maintenance
(a,c) [ ]. The second contribution is taken to be the same magnitude as the first; thus the total failure is:

(a,c) q = [ ]

OPERATOR ACTIONS:

The operator action failure probabilities are taken from Table 3.11-1 as

OFB	$q_2 = 5 \times 10^{-3}$	$q_1 = 0.01$	q_0 = N/A
OST	$q_2 = 0.01$	$q_1 = 0.01$	$q_0 = 0.1$
ORT	$q_2 = 0.01$	$q_1 = 0.01$	$q_0 = 0.01$
OLT	$q_2 = 0.01$	$q_1 = 0.01$	q_0 = N/A

TABLE 4.1-4

EVENT TREE NODE QUANTIFICATION

NODE	CONDITIONAL	SS1	SS2	SS3	
S01	None				(a,c)
S02					
S03					
S04					
S05					
S06					
S07					
S08					
S09					
S10					
SC1	None				
SC2					
SC3					
SC4					
SI1	None				
SI2					
ACC					
CSP	None				
	Small Loca				
CFC	No loss of offsite power				
	After loss of offsite power				
LTC	Small LOCA with CFC				
	Small LOCA no CFC				
	Large LOCA with CFC				
	Large LOCA no CFC				

TABLE 4.1-4 (Cont)

EVENT TREE NODE QUANTIFICATION

NODE	CONDITIONAL	SS1	SS2	SS3
OFB		5×10^{-3}	1×10^{-2}	-
OST		1×10^{-2}	1×10^{-2}	1×10^{-1}
ORT		1×10^{-2}	1×10^{-2}	1×10^{-2}
OLT		1×10^{-2}	1×10^{-2}	-
LCO		[		] (a,c)
SLL				
ACR				
SOF				
PRR				
CON				

4.2 QUANTIFICATION OF COREMELT FREQUENCY

The coremelt frequency is quantified by using the initiating event frequencies of Section 1.0, event trees of Section 2.0, and the nodal probabilities of Section 4.1. The results are tabulated by

1. Coremelt Categories
2. Initiating Events
3. Support States

in Table 4.2-1. Note that this table also contains the conditional probability of coremelt, given the occurrence of the initiating event. This conditional probability is a measure of the plant's ability to withstand a given initiating event.

TABLE 4.2-1

PLANT COREMELT FREQUENCY AND CONTRIBJTORS

COREMELT FREQUENCY BY COREMELT STATE

[ ] (a,c)

4.3 ANALYSIS OF COREMELT CONTRIBUTORS

The dominant accident sequences contributing to coremelt are listed in Table 4.3-1. This table also shows the failed event tree nodes in each event sequence. The percent contribution of the top 20 event sequences to the total coremelt is given by Table 4.3-2.

By examining Table 4.2-3, one notes that the coremelt risk is driven by [ ] (a,c)

An importance ranking analysis of the major event tree nodes is also presented. The importance (IMP(X)) of a system (X) is defined to be

$$IMP(X) = \sum_{i=1}^{N} q_i(X)/q_T$$

where N = Number of dominant sequences;

$q_i(X)$ = Frequency of the i^{th} sequence if it contains the failure of the system X;

$q_i(X)$ = 0 if the i^{th} sequence does not contain the failure of the system X;

q_T = Total plant coremelt frequency

Table 4.3-3 ranks the systems and operator actions by their importance.

TABLE 4.3-1

DOMINANT ACCIDENT SEQUENCES

FREQUENCY	PERCENT	COREMELT	EVENT TREE	SEQ NO	SUP STATE	FAILED NODES

(a,c)

TABLE 4.3-2

PERCENT CONTRIBUTION OF DOMINANT ACCIDENT SEQUENCES

Event Sequence	% Contribution

(a,c)

TABLE 4.3-2 (cont.)

PERCENT CONTRIBUTION OF DOMINANT ACCIDENT SEQUENCES

Event Sequence	% Contribution

(a,c)

TABLE 4.3-2 (cont.)

PERCENT CONTRIBUTION OF DOMINANT ACCIDENT SEQUENCES

Event Sequence	% Contribution

(a,c)

TABLE 4.3-2 (cont.)

PERCENT CONTRIBUTION OF DOMINANT ACCIDENT SEQUENCES

Event Sequence	% Contribution	
[	]	(a,c)
TOTAL	[98.6]	(a,c)

TABLE 4.3-3

IMPORTANCE RANKING OF EVENT NODES

System Description (Event Tree Node)	Importance

(a,c)

4.4 SENSITIVITY OF PLANT COREMELT FREQUENCY TO SYSTEM RELIABILITIES

This section presents an analysis in which several event tree node probabilities are changed to assess the sensitivity of the plant coremelt frequency to system reliabilities. Eight cases are studied below and are compared with the WAPWR base case results. Some of these cases attempt to simulate effects of new systems on plant coremelt frequency. Note that these cases are strictly for sensitivity analysis purposes. They are not backed-up by detailed analysis of the implied system changes. The results of these cases are summarized in Table 4.4-1.

CASE 1 4 DGS

In this case, the failure probability of both main emergency bases is decreased by an order of magnitude:

q = [ ] for ONP node in support state event tree. **(a,c)**

This case simulates a four-diesel on-site power design. As expected from the system importance analysis, the plant coremelt frequency is cut in half as a result of this change. The summary of the analysis is given by Tables 4.4-2 and 4.4-3.

CASE 2 2 BSI PUMPS

In this case, the failure probability of the back-up seal injection system is decreased by an order of magnitude: thus the event tree node SS2 has q = [ ] **(a,c)**

This case simulates a 2-Pump BSI system. The results of the analysis are summarized in Tables 4.4-4 and 4.4-5. The plant coremelt frequency is cut in half as expected from the system importance analysis.

CASE 3 PASSIVE STEAM CONDENSER

In this case, the failure probability of the secondary cooling nodes for support state 0 are reduced by an order of magnitude. This case simulates the passive steam condenser design for EFWS. The plant coremelt frequency is
(a,c) reduced by [ ]%. The nodal probabilities used are

(a,c)

q_o = [ ] for SC1;

q_o = [ ] for SC2;

q_o = [ ] for SC3;

q_o = [ ] for SC4.

The results are summarized in Tables 4.4-6 and 4.4-7.

CASE 4 BSI NOT PRESENT

In this case, the BSI system is removed from the design to assess its impact on plant coremelt frequency. The event tree node SLL has the failure probability of

$$q_o = 0.5$$

(a,c) The plant coremelt frequency increases by [ ] fold. The results are summarized in Tables 4.4-8 and 4.4-9.

CASE 5 NO AUTOMATIC SOF SYSTEM

In this case, the automatic steam generator overfill protection system is removed from the design. The event tree node is now driven by the operator action of feed and bleed and has the probability

$q_2 = q_1 = 0.01$

$q_0 = 1.0$

The resulting plant coremelt frequency has [ ]. The results are summarized in Tables 4.4-10 and 4.4-11. **(a,c)**

CASE 6 LESS RELIABLE ECCS

In this case, the failure probabilities of event tree nodes involving ACC, SI and LTC are increased to simulate a less reliable (less redundant) ECCS. The accumulator failure probability is increased by an order of magnitude to simulate a 3/3 success criteria; the short term cooling (SI) node failure probability is also increased by an order of magnitude. The long term cooling node (LTC) probabilities are increased by three orders of magnitude (for support state 2) to simulate a no EWST case where switchover to recirculation is needed and only two SI pumps are present for this purpose. The failure probabilities used are given below:

ACC:

q = [ ] **(a,c)**

SI1: **(a,c)**

q_2 = [

q_1 =

q_0 =]

SI2: **(a,c)**

q_2 = [

q_1 =

q_0 =]

LTC:	q_2	q_1	q_0
Small LOCA with CFC	1.1×10^{-4}	1.1×10^{-3}	1.0
Small LOCA no CFC	2.7×10^{-4}	1.6×10^{-3}	1.0
Large LOCA with CFC	1.3×10^{-4}	1.5×10^{-3}	1.0
Large LOCA no CFC	2.8×10^{-4}	3.1×10^{-3}	1.0

The plant coremelt frequency becomes [2.5×10^{-6}] after this change. The results are summarized in Tables 4.4-12 and 4.4-13.

A more detailed analysis of Long Term Cooling in a standard four-loop Westinghouse PWR yields an unavailability of LTC for Small LOCA with CFC of a,c) roughly [ ] and LTC For Large LOCA with CFC of about [ ]. The unavailability of these alternative system designs is impacted by piggy-back operation (RHR to HHSI) and by the existence of two RHR trains of equipment. Analysis of such a system in the APWR yields a core melt frequency of about (a,c) [ ]. This frequency is dominated by failure of Long Term Cooling following either Small LOCA or transient with consequential LOCA.

CASE 7 LESS RELIABLE OPERATOR ACTIONS

In this case, the sensitivity of the plant coremelt frequency to operator actions (in event tree nodes) is studied. The failure probabilities of event tree nodes containing operator actions (such as OA, SOF, LTC and SI1) are increased by a factor of 3. This is the error factor usually associated with HEPs in NUREG-1278 for probabilities in the range $q > 10^{-4}$. The plant coremelt frequency is not appreciably affected by this change. The results are summarized in Tables 4.4-14 and 4.4-15.

CASE 8 CONVENTIONAL W PWR DESIGN

In this case the following changes to the event tree node probabilities are made to simulate a conventional W PWR design:

1. BSI is not present;

2. Automatic Steam Generator Overfill Protection System is not present;

3. Startup feedwater system is not present;

4. Interfacing systems LOCA occurs outside the containment.

5. ECCS failure probabilities are increased as in Case 6 above for ACC, SI and LTC nodes.

6. Secondary cooling failure probabilities are increased by an order of magnitude.

The plant coremelt frequency becomes [ ]/year; this value is consistent with coremelt frequencies obtained in recent PRA's for conventional W PWR plants. **(a,c)**

The analysis is summarized by Tables 4.4-16 and 4.4-17.

4.4.1 SENSITIVITY ANALYSIS SUMMARY

Case	Plant Coremelt Frequency	
WAPWR (BASE) CASE	[	(a,c)
CASE 1: 4 DGS		
CASE 2: 2 BSI PUMPS		
CASE 3: PASSIVE STEAM CONDENSER		
CASE 4: NO BSI SYSTEM		
CASE 5: NO SOF SYSTEM		
CASE 6: LESS RELIABLE ECCS		
CASE 7: OPERATOR ACTION FAILURES 3 TIMES		
CASE 8: CONVENTIONAL WPWR DESIGN	]	

TABLE 4.4-2

ACCIDENT SEQUENCES FOR CASE 1

FREQUENCY	PERCENT	COREMELT	EVENT TREE	SEQ NO	SUP STATE	FAILED NODES

(a,c)

TABLE 4.4-3

COREMELT CONTRIBUTORS FOR CASE 1

COREMELT FREQUENCY BY COREMELT STATE

(a,c)

TABLE 4.4-4

ACCIDENT SEQUENCES FOR CASE 2

FREQUENCY	PERCENT	COREMELT	EVENT TREE	SEQ NO	SUP STATE	FAILED NODES

(a,c)

TABLE 4.4-5

COREMELT CONTRIBUTORS FOR CASE 2

COREMELT FREQUENCY BY COREMELT STATE

(a,c)

TABLE 4.4-6

ACCIDENT SEQUENCES FOR CASE 3

FREQUENCY	PERCENT	COREMELT	EVENT TREE	SEQ NO	SUP STATE	FAILED NODES

(a,c)

TABLE 4.4-7

COREMELT CONTRIBUTORS FOR CASE 3

COREMELT FREQUENCY BY COREMELT STATE

(a,c)

TABLE 4.4-8

ACCIDENT SEQUENCES FOR CASE 4

FREQUENCY	PERCENT	COREMELT	EVENT TREE	SEQ NO	SUP STATE	FAILED NODES

(a,c)

7896Q:1D

TABLE 4.4-9

COREMELT CONTRIBUTORS FOR CASE 4

COREMELT FREQUENCY BY COREMELT STATE

(a,c)

TABLE 4.4-10

ACCIDENT SEQUENCES FOR CASE 5

FREQUENCY	PERCENT	COREMELT	EVENT TREE	SEQ NO	SUP STATE	FAILED NODES

(a,c)

TABLE 4.4-11

COREMELT CONTRIBUTORS FOR CASE 5

COREMELT FREQUENCY BY COREMELT STATE

(a,c)

TABLE 4.4-12

ACCIDENT SEQUENCES FOR CASE 6

FREQUENCY	PERCENT	COREMELT	EVENT TREE	SEQ NO	SUP STATE	FAILED NODES

(a,c)

TABLE 4.4-12

ACCIDENT SEQUENCES FOR CASE 6

[ ] (a,c)

TABLE 4.4-13

COREMELT CONTRIBUTORS FOR CASE 6

COREMELT FREQUENCY BY COREMELT STATE

(a,c)

TABLE 4.4-14

ACCIDENT SEQUENCES FOR CASE 7

FREQUENCY	PERCENT	COREMELT	EVENT TREE	SEQ NO	SUP STATE	FAILED NODES

(a,c)

TABLE 4.4-15

COREMELT CONTRIBUTORS FOR CASE 7

COREMELT FREQUENCY BY COREMELT STATE

[ ] (a,c)

TABLE 4.4-16

ACCIDENT SEQUENCES FOR CASE 8

FREQUENCY	PERCENT	COREMELT	EVENT TREE	SEQ NO	SUP STATE	FAILED MODES

(a,c)

TABLE 4.4-16

ACCIDENT SEQUENCES FOR CASE 8

[ ] (a,c)

TABLE 4.4-17

COREMELT CONTRIBUTORS FOR CASE 8

COREMELT FREQUENCY BY COREMELT STATE

(a,c)

4.5 CONSERVATISM IN COREMELT STATE CLASSIFICATION

The point estimate analysis indicates that the coremelt state with Transient-Early Melt-No Containment Safeguards (TE) is the major contributor to the plant coremelt frequency. However, a more detailed analysis could be performed to point out that some of the event sequences included in the TE coremelt state are actually either late coremelts (TL) or coremelts with containment safeguards available (TEFC or TLFC). The reasons for the above contention are briefly described below:

1. For the support states, a 24-hour mission time is used for loss of offsite power and SW/CCW cooling. Thus, failure of a support system during the 24 hour period is treated as if it occurs at the beginning of the event sequence. This leads to a conservative classification of many event sequences as early melts.

   The same argument also applies to secondary cooling where a 24-hour mission time is used. Thus, many potential late failures are classified as early ones.

2. The coremelt progress and vessel failure in many TE event sequences will take a long time considering the WAPWR's larger vessel, ACC, and CRT volumes which make recovery of support systems realistic. Thus, in some event sequences, the time may be available for at least recovery of containment cooling (fan coolers and/or containment sprays), even if coremelt and vessel failure occurs. Thus, many TE sequences might become TEFC.