

Severe Accident Analysis Report

Title : Precursor Evaluation for the Keowee Failures of
6/20/97 and 6/23/97

SAAG File No.: 472

Project : Oconee Plant Support

QA Condition: N/A

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1.0 Statement of the Problem

Keowee Unit 1 experienced two different failures during the time period of 6/20/97 to 6/23/97. These failures could have been pre-existing and Keowee Unit 1 may have been inoperable for some time prior to 6/20/97.

The field flashing breaker has been cycling during emergency starts and this condition has apparently contributed to an age related failure of the fuse in the control circuit.

The y-timer relay on ACB-7 drifted from the calibrated setpoint. This caused the breaker to not fully close when demanded and ultimately generated a lock-out on switchgear 1X. This fails the auxiliary ac power system for the unit. The unit will run for some time however on the batteries and this failure can be recovered.

2.0 Objectives

This calculation is intended to address the importance of this condition from a core damage standpoint. The impact on CDF is assessed and a precursor evaluation is performed. This evaluation identifies the increase (delta) in the core damage frequency conditional on the existence of the Keowee failures.

3.0 QA Condition

N/A

4.0 Applicable Procedures, Codes and Standards

- XSAA-104, Work Place Procedure for the Evaluation of Operating Experience Events, Rev. 3, 3/21/96
- XSAA-109, Work Place Procedure for the Quality Assurance of PSAs, Rev. 1, 12/12/95

5.0 Other Design Criteria

None

6.0 FSAR Criteria

None

7.0 Methodology

The Oconee PRA model (revision 2) is used in this assessment. The Keowee failures represent a decrease in the redundancy of the emergency ac power system. Since Keowee is only required during LOOP events, only the T5 initiators need to be considered in the evaluation.

Keowee Unit 1 was aligned to both the underground path and the overhead path during various periods while it was inoperable. This situation is considered in the evaluation by doing two solves. In the first solve the unit is assumed to be aligned to the UG path and the event PK1UNITHYS is set to 1.0 for the solve. In the second case the unit is assumed aligned to the OH path and event PK2UNITHYS is set to 1.0 for the solve. This provides the appropriated CDF for each alignment on an annual basis.

In calculating the overall CDF, the fraction of the time spent in each alignment is applied to the appropriate annual CDF and the number of days in the inoperable condition is used to reduce the CDF from the annual number.

During the 39 day period from 5/11 to 6/20 there were two potential failure mechanisms for Keowee 1. The field flashing breaker failure is more severe in that it is not recoverable. Therefore the CDF contribution from the ACB-7 failure is not considered for that 39 day period in order to avoid double counting on those days.

From 6/9 to 6/11 both Keowee units were in maintenance simultaneously for 39.7 hours (1.6 days). This time is subtracted from the exposure to the field flashing breaker failure since a unit already in maintenance can not fail.

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For 39 hours (1.62 days) in March Keowee Unit 1 was in maintenance. This time is subtracted from the failure exposure time for the ACB-7 failure.

8.0 Assumptions

- The SSF D/G maintenance value is left at the Oconee PRA nominal values. It has been verified that the SSF monthly PM was performed during the period of Keowee inoperability. The unavailability was found to be generally consistent with the assumed value in the PRA.
- The SSF D/G support system maintenance event is set to 0.0 for the analysis as the SSF D/G unavailability would have been too high compared to the available information.
- The calibration drift in the ACB-7 timer begins following the calibration on 11/20/96 and is discovered on 6/23/97. The point of failure is assumed to be the midpoint of this period. Keowee Unit 1 was successfully tested while aligned to the underground path on 1/5/97. This indicates the timer setting was still adequate at this time.
- The ACB-7 problem is assumed to ultimately fail Keowee Unit 1 even when the unit is initially aligned to the overhead path. Since the LOOP CDF is dominated by the T5WEATH, the unit must be transferred to the underground alignment to provide power to Oconee. The unit is assumed to fail at this time.
- If Keowee Unit 1 is generating to the grid, the field flashing breaker problem would not represent a failure mode. Normally the fraction of the time spent generating to the grid is fairly small and has little influence on the results. This is assumed to be true here.
- The ACB-7 failure is a control problem with the breaker. The breaker is physically able to be closed if done correctly. This is similar to the situation from the Keowee PRA where credit was taken for recovering from control failures of the auxiliary power ACBs. A non-recovery probability of 0.5 is applied to the CDF results for the contribution from the ACB-7 problem.
- The Keowee Unit 1 failure as a result of the field flashing breaker failure is assumed to be non-recoverable.

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- Any critical hours on the units in the month of May are assumed to occur after 5/11, that is, the units were critical while the field flashing breaker was inoperable.

9.0 Data

The Keowee Unit 1 fails to start event (PK1UNITHYS) and the Keowee Unit 2 fails to start event (PK2UNITHYS) are set to 1.0 for the respective solves.

The critical hour data used in the analysis is given in the following table.

<u>Oconee Unit</u>	<u>March</u>	<u>April</u>	<u>May</u>	<u>June</u>
1	663.6	472.6	744	312
2	744	518	191	480
3	582.8	719	60.7	480

These values are converted to days for use in the calculation.

Keowee Unit 2 was in maintenance 1.48 hours during the 40 days that the field flashing breaker was inoperable. The unavailability for unit 2 was generally less than this value for the remainder of the time period of interest, but this period is used as a reasonable estimate for the calculation and, therefore, the KU2 maintenance event KK2UNITHYM is set to 1.54E-03.

The T5WEATH initiator frequency for this evaluation is taken from SAAG file #19 to be 5.3E-03/yr

10.0 Analysis

With these assumptions in mind, the precursor evaluation calculates the conditional core damage frequency for the LOOP initiators with Keowee Unit 1 assumed to be inoperable.

10.1 Fault Tree

The Oconee PRA fault tree model (or2plt24.caf) is modified for this analysis.

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First, all initiators except for the T5FEEDF, T5SUBF, and the T5WEATH are set to false in the tree. The tree is then compressed to eliminate all of the extra logic. The resulting tree is saved as keofuse.caf and a data base with the same name is created.

Second, a change is made to the logic for the swap of the overhead unit (Unit 2 in the model) to the underground path. The event PK2SWAPDHE is a recovery that includes the human action to swap as well as the hardware failures of the Keowee unit. The hardware failures will be explicitly included by modifying the logic under gate PKU2REC and the human error rate will be set to the value of 9E-03 (ABPOPRCDHE) from the KPRA. Gate PKU2REC of the tree contained only the human error event to swap unit 2 to the underground path and the unit 2 maintenance event. Gate PKEOWEE is modified by removing the main transformer failure event (PACKEOMTHF) and moving it to gate PKEOVHD. Gate PKEOWEE is then added to PKU2REC to capture the other failure modes of the overhead unit.

The solve with the KU1 start failure set to 1 is in cut set file keofuse1.cut. The solve with the KU2 start failure set to 1 is in cut set file keofuse2.cut.

10.2 Cut Set Recovery

The cut sets from the solve were processed in the following steps. First, the unit 1 start failure event is set to TRUE and the cut sets are subsumed. This eliminates any other failure modes in the cut sets for unit 1. Second, the cut sets are recovered using the or2all.rul file. Third, the cut set file is then DEL TERMED against or2rec24.cut in order to isolate the new cut sets.

Finally, additional recoveries were applied to the keofuse1.cut file cut sets manually until it appeared that adding further recoveries would only cause cut sets to be truncated. The top 40 cut sets were all recovered and most cut sets below this still needed recovery but would likely have been truncated following recovery. Therefore, the CDF from the top 40 cut sets is used as the basis for the annualized CDF for this case. The cut sets in the

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keofuse2.cut file were smaller than those in the keofuse1.cut file and nearly all were unrecovered. Since most of the recoveries to be applied were 0.1 or less, the CDF contribution when Keowee Unit 1 is on the overhead is estimated as 10% of the keofuse2.cut file probability for this analysis.

The following cut sets were found to be inappropriately recovered and the recoveries seen below were applied.

FEFTDFPTPR	NSF0ASWDHE	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFFSRHE
FEFTDFPTPR	NSFPU02APS	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFFSRHE
FEFTDFPTPR	KK2UNITHYM	NSF0ASWDHE	PK1UNITHYS	T5WEATH	TACWFFSRHE
FEFTDFPTPR	KK2UNITHYM	NSFPU02APS	PK1UNITHYS	T5WEATH	TACWFFSRHE

10.3 Data Changes in the Cut Sets

Within the cut sets the following data changes are made.

NACSUPPTRM is set equal to 0.0.

11.0 Results

11.1 Calculated CDF With Keowee Unit1 Inoperable

The annualized CDF for the case when Keowee Unit 1 is on the UG is estimated to be 5.0E-06, from keofuse1.cut. For the case when it is on the OH the value of 1.3E-06 is assumed.

11.2 Change In CDF for Precursor Evaluation

The change in CDF is calculated by considering the time that Keowee 1 is on the underground and the time that the Oconee units are critical while the inoperable conditions existed. The following spreadsheets contain the calculations for all three Oconee units.

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Unit 1

**Assessment of the impact of the Keowee Unit 1 inoperable condition on
Oconee Units 1, 2 & 3 power operation**

FF Breaker Contribution

ACB-7 Contribution

Annualized increase in CDF as a
result of the condition when KU1 is
on the UG path

5.00E-06

Period of time from 11/20/96 to
6/23/97 in days

225

Annualized increase in CDF as a
result of the condition when KU1 is
on the OH path

1.30E-06

Failure exposure time

112.5

Fraction of time in 1997 that KU1 was
aligned to the underground path

0.368

Time period for contribution from
ACB-7 unavailability

70.88

of days that Oconee Unit 1 is at
power with the FF breaker inoperable

31.4

Number of days during period that
Unit 1 was not operating

14

Increase in CDF as a result of the
condition

2.29E-07

Increase in CDF as a result of the
condition

4.15E-07

Failure of the auxiliary power
ACBs is a recoverable failure as
assumed in the KPRA (failure to
recover = 0.5)

2.07E-07

**The total increase in the CDF for
Oconee Unit 1 for the time period
of Keowee Unit 1 inoperability**

4.4E-07

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Unit 2

**Assessment of the impact of the Keowee Unit 1 inoperable condition on
Oconee Units 1, 2 & 3 power operation**

FF Breaker Contribution

Annualized increase in CDF as a
result of the condition when KU1 is
on the UG path

5.00E-06

Annualized increase in CDF as a
result of the condition when KU1 is
on the OH path

1.30E-06

Fraction of time in 1997 that KU1
was aligned to the underground
path

0.368

of days that Oconee Unit 2 is at
power with the FF breaker
inoperable

26

Increase in CDF as a result of the
condition

1.92E-07

ACB-7 Contribution

Period of time from
11/20/96 to 6/23/97 in
days

225

Failure exposure time

112.5

Time period for
contribution from ACB-7
unavailability

70.88

Number of days during
period that Unit 2 was
not operating

19.5

Annualized increase in
CDF as a result of the
condition

3.75E-07

Failure of the auxiliary
power ACBs is a
recoverable failure as
assumed in the KPRA
(failure to recover = 0.5)

1.87E-07

**The total increase in the CDF for
the time period of Keowee Unit 1
inoperability**

3.8E-07

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Unit 3

Assessment of the impact of the Keowee Unit 1 inoperable condition on
Oconee Units 1, 2 & 3 power operation

FF Breaker Contribution

Annualized increase in CDF as
a result of the condition when
KU1 is on the UG path 5.00E-06

Annualized increase in CDF as
a result of the condition when
KU1 is on the OH path 1.30E-06

Fraction of time in 1997 that
KU1 was aligned to the
underground path 0.368

of days that the FF breaker
is assumed to be inoperable 21

Increase in CDF as a result of
the condition 1.52E-07

**The total increase in the CDF
for the time period of
Keowee Unit 1 inoperability 3.5E-07**

ACB-7 Contribution

Period of time from 11/20/96
to 6/23/97 in days 225

Failure exposure time 112.5

Time period for contribution
from ACB-7 unavailability 70.88

Number of days during
period that Unit 3 was not
operating 17

Annualized increase in CDF
as a result of the condition 3.93E-07

Failure of the auxiliary
power ACBs is a
recoverable failure as
assumed in the KPRA
(failure to recover = 0.5) 1.96E-07

12.0 Conclusions

The following information summarizes the results and conclusions of the analysis. This information was included in the AIT briefing paper.

Impact of the June 20 and 23, 1997 Events on Oconee Units 2 & 3

The impact of the loss of power on the standby bus on Oconee units 2 & 3 is minor. Both units were generating and supplying power to the unit related loads. Offsite power was available throughout the event. Keowee Unit 2 started and was running in standby and capable of supplying power if needed. The 100 kV grid could have been readily connected to CT5 by manipulating the breakers in the Central Switchyard. A Lee combustion turbine could have been reconnected to the dedicated line following the event at Lee.

The unavailability of Keowee Unit 1 would have impacted the design basis accidents in the following manner.

- The Keowee Unit 1 unavailability represents a loss of redundancy to deal with a loss of offsite power at the Oconee Station. This situation did represent a potential for an increase in the calculated risk from LOOP events for the time period of the unavailability. The risk calculation is summarized in the following pages.
- For a loss of coolant accident (and other accidents not involving a loss of offsite power) no impact on the accident mitigation capability existed. All ECCS equipment is functional.
- For the LOCA-LOOP scenario, the unavailability of Keowee unit 1 represented a loss of redundancy in the ability to provide emergency power. The low probability of these two accident occurring together is sufficiently low that the risk implications are insignificant. With a single Keowee unit in operation, all ECCS trains would still have been functional.

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Impact of Potential Past Inoperability of Keowee Unit 1 on Oconee Units 1, 2 & 3

The following information is pertinent to the assessment of the risk impact of the Keowee Unit 1 inoperable condition and has been used in the assessment.

- Keowee Unit 1 was successfully emergency start tested on 5/11/97. This represents the starting point for assuming that the field flashing breaker was in the failed condition.
- The y-timer in ACB-7 was calibrated on November 20, of 1996. Keowee Unit 1 was successfully emergency start tested, while connected to the underground, on 1/5/97. The timer is assumed to have become out of tolerance at the midpoint between the calibration and the failure on 6/23/97. The condition certainly existed no earlier than 1/5/97.
- Keowee Unit 2 unavailability was low during the period from March through June, <0.2%.
- The 1997 critical hours for each of the Oconee units has been used in this calculation.

The core damage risk increase is evaluated for LOOP events. Only these are impacted by the inoperable condition of Keowee Unit 1.

The core damage risk increase, for all Oconee units, associated with the inoperable condition is estimated to be less than 1E-06

The nominal CDF for LOOP events as reported in the Oconee PRA Revision 2 summary report is 6.2E-07/year.

13.0 LER Discussion

The following is provided for input into the LER associated with these events.

The event caused a monetary interruption of AC power to Oconee Unit 1. At the time of the event, the unit was in cold shutdown. The RCS was at approximately 100 °F with approximately 39 psig (nitrogen bubble). The unit had been shutdown for 7 days prior to the event. The decay heat level was in the range of 7 to 8 MW. Offsite power was always available as was Keowee Unit 2 and sources to CT5. This along with the multiple sources of EFW and LPSW resulted in a minimal impact on plant risk. The estimated core damage probability for the event is in the range of 3E-07.

The issue of potential past inoperability has been addressed through a precursor evaluation. This evaluation considered the impact on the LOOP initiated CDF to estimate the increase that resulted from the Keowee inoperability. This includes the impacts of both the field flashing breaker failure as well as the failure experienced on ACB-7. The maximum change in CDF was calculated to occur on Oconee Unit 1. Oconee Unit 1 experienced a change in CDF estimated at less than 5E-07 during the period of interest.

14.0 References

1. Fault Tree or2plt24.caf and the or2 database
2. Phone conversations with Ed Burchfield and Reed Severance of Oconee on 6/28/97 and 6/29/97
3. SAAG file #406.

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ATTACHMENTS

COREMELT = 4.63E-06 (Probability)

TOP 39

Page 1 .

Probability	%	Class	Inputs						
0.00E+00	100.0%		DDC3DCABYF	DDCUN31DIM	NSF0RCMDHE	T5SUBF	TACSFF2RHE		
0.00E+00	100.0%		DDCBATADEX	DDCBATBDEX	FEFTDFPTPR	KK1BOTHHYM	T5WEATH	TRCSRVLDEX	TACWFF5RHE
			PAC0T5WDEX						
0.00E+00	100.0%		DDCBATADEX	DDCBATBDEX	FEFTDFPTPR	PACXCT4THF	T5WEATH	TRCSRVLDEX	TACWFF5RHE
0.00E+00	100.0%		DDCBATADEX	DDCBATBDEX	FEFTDFPTPR	PK0KEORCOM	T5WEATH	TRCSRVLDEX	TACWFF6RHE
0.00E+00	100.0%		FEFTDFPTPR	KK1BOTHHYM	NCW0125VVT	T5WEATH	TACWFF1RHE	PAC0T5WDEX	
0.00E+00	100.0%		FEFTDFPTPR	KK1BOTHHYM	NSF0ASWDHE	T5WEATH	TACWFF1RHE	PAC0T5WDEX	
0.00E+00	100.0%		FEFTDFPTPR	NCW0125VVT	PACXCT4THF	T5WEATH	TACWFF1RHE		
0.00E+00	100.0%		FEFTDFPTPR	NSF0ASWDHE	PACXCT4THF	T5WEATH	TACWFF1RHE		
0.00E+00	100.0%		KK1BOTHHYM	NACSFDDGDM	T5WEATH	TACWFF2RHE	PAC0T5WDEX		
0.00E+00	100.0%		KK1BOTHHYM	NACSFDDGDM	T5WEATH	TACWFF3RHE	PAC0T5WDEX		
0.00E+00	100.0%		KK1BOTHHYM	NSF0RCMDHE	PACLEESCTR	T5SUBF	TACSFF3RHE		
0.00E+00	100.0%		KK1BOTHHYM	NSF0RCMDHE	T5WEATH	TACWFF2RHE	PAC0T5WDEX		
0.00E+00	100.0%		KK1BOTHHYM	NSFCON2CMS	T5WEATH	TACWFF2RHE	PAC0T5WDEX		
0.00E+00	100.0%		NACSFDDGDM	PACXCT4THF	T5WEATH	TACWFF2RHE			
0.00E+00	100.0%		NACSFDDGDM	PK0KEORCOM	T5WEATH	TACWFF3RHE			
0.00E+00	100.0%		NACSFDDGDM	PACXCT4THF	T5WEATH	TACWFF3RHE			
0.00E+00	100.0%		NACSFDDGDM	PK0KEORCOM	T5WEATH	TACWFF4RHE			
0.00E+00	100.0%		NSF0RCMDHE	PACXCT4THF	T5WEATH	TACWFF2RHE			
0.00E+00	100.0%		NSF0RCMDHE	PK0KEORCOM	T5WEATH	TACWFF3RHE			
0.00E+00	100.0%		NSF0RCMDHE	PK0KEOSCOM	T5WEATH	TACWFF2RHE			
0.00E+00	100.0%		NSF3F01FLF	PACXCT4THF	T5WEATH	TACWFF2RHE			
0.00E+00	100.0%		NSF3FL2FLF	PACXCT4THF	T5WEATH	TACWFF2RHE			
0.00E+00	100.0%		NSFCON2CMS	PACXCT4THF	T5WEATH	TACWFF2RHE			

Report Summary:

Filename: C:\DATA\OR2\CUT_SETS\KEOFUSE1.CUT

Print date: 7/2/97 3:06 PM

Not sorted

Cutset Report

COREMELT = 5.72E-06 (Probability)

TO 1E-8

Probability	%	Class	Inputs					
9.78E-07	17.1%		NSF0RCMDHE	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
4.76E-07	25.4%		NACSFDDGGR	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF3RHE	
4.19E-07	32.8%		NACSFDDGDM	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
2.84E-07	37.7%		NSFCON2CMS	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
2.46E-07	42.0%		NSF0RCMDHE	PK1UNITHYS	PK2UNITHYS	T5WEATH	TACWFF2RHE	
1.67E-07	44.9%		KK2UNITHYM	NSF0RCMDHE	PK1UNITHYS	T5WEATH	TACWFF2RHE	
1.60E-07	47.7%		NSF0RCMDHE	PK1UNITHYS	PK2UNITHYR	T5WEATH	TACWFF3RHE	
1.30E-07	50.0%		NACSFDDGGR	PK1UNITHYS	PK2UNITHYR	T5WEATH	TACWFF4RHE	
1.30E-07	52.3%		NSF3F01FLF	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
1.30E-07	54.6%		NSF3FL2FLF	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
1.20E-07	56.6%		NACSFDDGGR	PK1UNITHYS	PK2UNITHYS	T5WEATH	TACWFF3RHE	
1.05E-07	58.5%		NACSFDDGDM	PK1UNITHYS	PK2UNITHYS	T5WEATH	TACWFF2RHE	
8.14E-08	59.9%		KK2UNITHYM	NACSFDDGGR	PK1UNITHYS	T5WEATH	TACWFF3RHE	
7.69E-08	61.3%		NSF3PU1DPS	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
7.62E-08	62.6%		NSF3PU1DPM	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
7.39E-08	63.9%		FEFSWAPDHE	NSF0ASWDHE	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF1RHE
7.16E-08	65.1%		KK2UNITHYM	NACSFDDGDM	PK1UNITHYS	T5WEATH	TACWFF2RHE	
7.12E-08	66.4%		NSFCON2CMS	PK1UNITHYS	PK2UNITHYS	T5WEATH	TACWFF2RHE	
6.93E-08	67.6%		FEFTDFPTPR	NSF0ASWDHE	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF5RHE
6.84E-08	68.8%		NACSFDDGDM	PK1UNITHYS	PK2UNITHYR	T5WEATH	TACWFF3RHE	
5.87E-08	69.8%		NSFTIMEDHE	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
4.85E-08	70.7%		KK2UNITHYM	NSFCON2CMS	PK1UNITHYS	T5WEATH	TACWFF2RHE	
4.77E-08	71.5%		FEFSWAPDHE	PK1UNITHYS	PK2SWAPDHE	RRC0004DEX	T5WEATH	TRCSRVLDEX TACWFF1RHE
4.64E-08	72.3%		NSFCON2CMS	PK1UNITHYS	PK2UNITHYR	T5WEATH	TACWFF3RHE	
4.47E-08	73.1%		FEFTDFPTPR	PK1UNITHYS	PK2SWAPDHE	RRC0004DEX	T5WEATH	TRCSRVLDEX TACWFF5RHE
4.29E-08	73.8%		FEFSWAPDHE	PK1UNITHYS	PK2SWAPDHE	RRC0066PRC	T5WEATH	TACWFF1RHE
4.02E-08	74.5%		FEFTDFPTPR	PK1UNITHYS	PK2SWAPDHE	RRC0066PRC	T5WEATH	TACWFF5RHE
3.70E-08	75.2%		NACSFDDGDS	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
3.42E-08	75.8%		NHP3398MVO	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
3.42E-08	76.4%		NSF3082MVO	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
3.42E-08	77.0%		NSF3097MVO	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
3.25E-08	77.6%		NSF3F01FLF	PK1UNITHYS	PK2UNITHYS	T5WEATH	TACWFF2RHE	
3.25E-08	78.1%		NSF3FL2FLF	PK1UNITHYS	PK2UNITHYS	T5WEATH	TACWFF2RHE	
3.13E-08	78.7%		NDCDCSFBYF	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
3.03E-08	79.2%		NACDJPUGPS	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
2.93E-08	79.7%		NACSFDDLHE	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
2.93E-08	80.2%		NSFRMULHE	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE	
2.51E-08	80.7%		FEFSWAPDHE	NCW0125VVT	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF1RHE
2.35E-08	81.1%		FEFTDFPTPR	NCW0125VVT	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF5RHE
2.33E-08	81.5%		-T5SUBF	-KK1BOTHYH	NSF0RCMDHE	PACLEE2DHE	PK1UNITHYS	T5FEEDF
2.33E-08	81.9%		NACDJ01HXF	PK1UNITHYS	PK2UNITHYR	T5WEATH		
2.33E-08	82.3%		NACDJ02HXF	PK1UNITHYS	PK2UNITHYR	T5WEATH		

Probability	%	Class	Inputs						
2.22E-08	83.1%		KK2UNITHYM	NSF3F01FLF	PK1UNITHYS	T5WEATH	TACWFF2RHE		
2.22E-08	83.5%		KK2UNITHYM	NSF3FL2FLF	PK1UNITHYS	T5WEATH	TACWFF2RHE		
2.15E-08	83.8%		-T5SUBF	-KK1BOTHYHM	NSF0RCMDHE	PACLEESCTR	PK1UNITHYS	PK2UNITHYS	T5FEEDF
2.14E-08	84.2%		NAC3X12CLC	PK1UNITHYS	PK2UNITHYR	T5WEATH			
2.14E-08	84.6%		NAC3X2ACLC	PK1UNITHYS	PK2UNITHYR	T5WEATH			
2.14E-08	85.0%		NAC3X2CCLC	PK1UNITHYS	PK2UNITHYR	T5WEATH			
2.14E-08	85.3%		NAC3X3ACLC	PK1UNITHYS	PK2UNITHYR	T5WEATH			
2.14E-08	85.7%		NAC3X4CCLC	PK1UNITHYS	PK2UNITHYR	T5WEATH			
2.14E-08	86.1%		NAC3X5ACLO	PK1UNITHYS	PK2UNITHYR	T5WEATH			
2.14E-08	86.5%		NACOTS4C4C	PK1UNITHYS	PK2UNITHYR	T5WEATH			
2.12E-08	86.8%		NSF3F01FLF	PK1UNITHYS	PK2UNITHYR	T5WEATH	TACWFF3RHE		
2.12E-08	87.2%		NSF3FL2FLF	PK1UNITHYS	PK2UNITHYR	T5WEATH	TACWFF3RHE		
2.06E-08	87.6%		FEFTDFPTPR	NSFPU02APS	PK1UNITHYS	PK2UNITHYS	T5WEATH		
2.05E-08	87.9%		FEFTDFPTPR	NSFASWZLHE	PK1UNITHYS	PK2UNITHYR	T5WEATH		
1.92E-08	88.3%		FEFTDFPTPR	NSFPU02APM	PK1UNITHYS	PK2UNITHYS	T5WEATH		
1.89E-08	88.6%		FEFTDFPTPR	NSF0ASWDHE	PK1UNITHYS	PK2UNITHYR	T5WEATH	TACWFF6RHE	
1.86E-08	88.9%		FEFSWAPDHE	NSF0ASWDHE	PK1UNITHYS	PK2UNITHYS	T5WEATH		
1.78E-08	89.2%		FEFSWAPDHE	PK1UNITHYS	PK2UNITHYR	RRC0004DEX	T5WEATH	TRCSRVLDEX	
1.74E-08	89.5%		FEFTDFPTPR	NSF0ASWDHE	PK1UNITHYS	PK2UNITHYS	T5WEATH	TACWFF5RHE	
1.67E-08	89.8%		FEFTDFPTPR	PK1UNITHYS	PK2UNITHYR	RRC0004DEX	T5WEATH	TRCSRVLDEX	TACWFF5RHE
1.61E-08	90.1%		FEFTDFPTPR	NCW0268MVO	PK1UNITHYS	PK2UNITHYS	T5WEATH		
1.61E-08	90.4%		FEFTDFPTPR	NCW0287MVO	PK1UNITHYS	PK2UNITHYS	T5WEATH		
1.60E-08	90.7%		FEFSWAPDHE	PK1UNITHYS	PK2UNITHYR	RRC0066PRC	T5WEATH		
1.60E-08	90.9%		NDC0CSFBCF	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.56E-08	91.2%		NACDJ01HXF	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.56E-08	91.5%		NACDJ02HXF	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.54E-08	91.8%		NSFCON1CMR	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF3RHE		
1.54E-08	92.0%		NSFCON2CMR	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF3RHE		
1.50E-08	92.3%		FEFTDFPTPR	PK1UNITHYS	PK2UNITHYR	RRC0066PRC	T5WEATH	TACWFF5RHE	
1.48E-08	92.6%		-T5SUBF	-KK1BOTHYHM	NACSFDDGDM	PACLEED2DHE	PK1UNITHYS	PK2UNITHYR	T5FEEDF
1.47E-08	92.8%		NSFTIMEDHE	PK1UNITHYS	PK2UNITHYS	T5WEATH	TACWFF2RHE		
1.44E-08	93.1%		NAC3X12CLC	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.44E-08	93.3%		NAC3X2ACLC	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.44E-08	93.6%		NAC3X2CCLC	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.44E-08	93.8%		NAC3X3ACLC	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.44E-08	94.1%		NAC3X4CCLC	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.44E-08	94.3%		NAC3X5ACLO	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.44E-08	94.6%		NACOTS4C4C	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.43E-08	94.8%		FEFTDFPTPR	NAC01BLCLT	PK1UNITHYS	PK2UNITHYR	T5WEATH		
1.43E-08	95.1%		FEFTDFPTPR	NAC01BRCLT	PK1UNITHYS	PK2UNITHYR	T5WEATH		
1.38E-08	95.3%		FEFTDFPTPR	NSFASWZLHE	PK1UNITHYS	PK2UNITHYS	T5WEATH		
1.32E-08	95.5%		KK2UNITHYM	NSF3PU1DPS	PK1UNITHYS	T5WEATH	TACWFF2RHE		
1.30E-08	95.8%		KK2UNITHYM	NSF3PU1DPM	PK1UNITHYS	T5WEATH	TACWFF2RHE		
1.30E-08	96.0%		NDCSF4BCDT	PK1UNITHYS	PK2UNITHYR	T5WEATH			
1.27E-08	96.2%		FEFSWAPDHE	KK2UNITHYM	NSF0ASWDHE	PK1UNITHYS	T5WEATH	TACWFF1RHE	
1.26E-08	96.4%		NSF3PU1DPS	PK1UNITHYS	PK2UNITHYR	T5WEATH	TACWFF3RHE		
1.25E-08	96.7%		NSF3PU1DPM	PK1UNITHYS	PK2UNITHYR	T5WEATH	TACWFF3RHE		
1.20E-08	96.9%		FEFSWAPDHE	PK1UNITHYS	PK2UNITHYS	RRC0004DEX	T5WEATH	TRCSRVLDEX	
1.19E-08	97.1%		FEFTDFPTPR	KK2UNITHYM	NSF0ASWDHE	PK1UNITHYS	T5WEATH	TACWFF5RHE	
1.17E-08	97.3%		NAC3X12CLC	PK1UNITHYS	PK2SWAPDHE	T5WEATH	TACWFF2RHE		

Cutset Report

COREMELT = 1.19E-05 (Probability)

Probability	%	Class	Inputs							
1.68E-06	14.2%		NSFORCMDHE	PK1UNITHYR	PK2UNITHYS	T5WEATH				
1.26E-06	24.7%		NACSFDDGDR	PK1UNITHYS	PK2UNITHYS	T5WEATH				
1.13E-06	34.2%		NSFORCMDHE	PK1UNITHYS	PK2UNITHYS	T5WEATH				
7.19E-07	40.3%		NACSFDDGDM	PK1UNITHYR	PK2UNITHYS	T5WEATH				
4.87E-07	44.4%		NSFCON2CMS	PK1UNITHYR	PK2UNITHYS	T5WEATH				
4.84E-07	48.5%		NACSFDDGDM	PK1UNITHYS	PK2UNITHYS	T5WEATH				
3.28E-07	51.2%		NSFCON2CMS	PK1UNITHYS	PK2UNITHYS	T5WEATH				
2.23E-07	53.1%		NSF3F01FLF	PK1UNITHYR	PK2UNITHYS	T5WEATH				
2.23E-07	55.0%		NSF3FL2FLF	PK1UNITHYR	PK2UNITHYS	T5WEATH				
2.00E-07	56.7%		FEFTDFPTPR	NSF0ASWDHE	PK1UNITHYR	PK2UNITHYS	T5WEATH			
1.56E-07	58.0%		-KK2UNITHYM	KK1BOTHDEX	NACSFDDGDR	PK13CLSDEX	PK2UNITHYS	T5WEATH		
1.50E-07	59.3%		NSF3F01FLF	PK1UNITHYS	PK2UNITHYS	T5WEATH				
1.50E-07	60.5%		NSF3FL2FLF	PK1UNITHYS	PK2UNITHYS	T5WEATH				
1.40E-07	61.7%		-KK2UNITHYM	KK1BOTHDEX	NSFORCMDHE	PK13CLSDEX	PK2UNITHYS	T5WEATH		
1.35E-07	62.8%		FEFTDFPTPR	NSF0ASWDHE	PK1UNITHYS	PK2UNITHYS	T5WEATH			
1.32E-07	63.9%		NSF3PU1DPS	PK1UNITHYR	PK2UNITHYS	T5WEATH				
1.31E-07	65.0%		NSF3PU1DPM	PK1UNITHYR	PK2UNITHYS	T5WEATH				
1.23E-07	66.1%		NACSFDDGDR	PK1UNITHYR	PK2UNITHYS	T5WEATH	TACWFF4RHE			
1.10E-07	67.0%		KK1RUNSDEX	NACSFDDGDR	PK13CLSDEX	PK2UNITHYS	T5WEATH			
1.01E-07	67.9%		NSFTIMEDHE	PK1UNITHYR	PK2UNITHYS	T5WEATH				
9.91E-08	68.7%		KK1RUNSDEX	NSFORCMDHE	PK13CLSDEX	PK2UNITHYS	T5WEATH			
8.88E-08	69.4%		NSF3PU1DPS	PK1UNITHYS	PK2UNITHYS	T5WEATH				
8.80E-08	70.2%		NSF3PU1DPM	PK1UNITHYS	PK2UNITHYS	T5WEATH				
8.40E-08	70.9%		DDCBATADEX	DDCBATBDEX	FEFSWAPDHE	PK1UNITHYR	PK2UNITHYS	T5WEATH	TRCSRVLDEX	
8.27E-08	71.6%		NSFORCMDHE	PACXCT4THF	T5WEATH	TACWFF2RHE				
7.81E-08	72.2%		FEFTDFPTPR	PK1UNITHYS	PK2UNITHYS	RRC0066PRC	T5WEATH			
6.78E-08	72.8%		FEFTDFPTPR	NCW0125VVT	PK1UNITHYR	PK2UNITHYS	T5WEATH			
6.78E-08	73.4%		NSFTIMEDHE	PK1UNITHYS	PK2UNITHYS	T5WEATH				
6.35E-08	73.9%		NACSFDDGDS	PK1UNITHYR	PK2UNITHYS	T5WEATH				
6.00E-08	74.4%		-KK2UNITHYM	KK1BOTHDEX	NACSFDDGDM	PK13CLSDEX	PK2UNITHYS	T5WEATH		
5.88E-08	74.9%		NHP3398MVO	PK1UNITHYR	PK2UNITHYS	T5WEATH				
5.88E-08	75.4%		NSF3082MVO	PK1UNITHYR	PK2UNITHYS	T5WEATH				
5.88E-08	75.9%		NSF3097MVO	PK1UNITHYR	PK2UNITHYS	T5WEATH				
5.75E-08	76.4%		DDCBATADEX	DDCBATBDEX	FEFTDFPTPR	PK1UNITHYR	PK2UNITHYS	T5WEATH	TRCSRVLDEX	
			TACWFF6RHE							
5.65E-08	76.9%		DDCBATADEX	DDCBATBDEX	FEFSWAPDHE	PK1UNITHYS	PK2UNITHYS	T5WEATH	TRCSRVLDEX	
5.38E-08	77.3%		-KK2UNITHYM	DDCBATADEX	DDCBATBDEX	FEFTDFPTPR	KK1BOTHDEX	PK13CLSDEX	PK2UNITHYS	
			T5WEATH	TRCSRVLDEX						
5.38E-08	77.8%		NDCDCSFBYF	PK1UNITHYR	PK2UNITHYS	T5WEATH				
5.36E-08	78.2%		KK1BOTHYM	NSFORCMDHE	T5WEATH	TACWFF2RHE	PAC0T5WDEX			
5.30E-08	78.7%		DDC1DCBDM	DDCUN31DIM	NSFORCMDHE	PK2UNITHYS	T5FEEDF			

Probability	%	Class	Inputs						
5.29E-08	79.6%		DDCBATADEX	DDCBATBDEX	FEFTDFPTPR	PK1UNITHYS	PK2UNITHYS	T5WEATH	TRCSRVLDEX
			TACWFF5RHE						
5.21E-08	80.0%		NACDJPUGPS	PK1UNITHYR	PK2UNITHYS	T5WEATH			
5.04E-08	80.4%		NACSFDDLHE	PK1UNITHYR	PK2UNITHYS	T5WEATH			
5.04E-08	80.9%		NSFRMULHE	PK1UNITHYR	PK2UNITHYS	T5WEATH			
4.80E-08	81.3%		FEFTDFPTPR	NSF0ASWDHE	PACXCT4THF	T5WEATH	TACWFF1RHE		
4.56E-08	81.6%		FEFTDFPTPR	NCW0125VVT	PK1UNITHYS	PK2UNITHYS	T5WEATH		
4.27E-08	82.0%		NACSFDDGGS	PK1UNITHYS	PK2UNITHYS	T5WEATH			
4.24E-08	82.4%		KK1RUNSDEX	NACSFDDGDM	PK13CLSDEX	PK2UNITHYS	T5WEATH		
4.07E-08	82.7%		NSFCON1CMR	PK1UNITHYS	PK2UNITHYS	T5WEATH			
4.07E-08	83.0%		NSFCON2CMR	PK1UNITHYS	PK2UNITHYS	T5WEATH			
4.07E-08	83.4%		-KK2UNITHYM	KK1BOTHDDEX	NSFCON2CMS	PK13CLSDEX	PK2UNITHYS	T5WEATH	
4.02E-08	83.7%		NACSFDDGGR	PACXCT4THF	T5WEATH	TACWFF3RHE			
3.95E-08	84.1%		NHP3398MVO	PK1UNITHYS	PK2UNITHYS	T5WEATH			
3.95E-08	84.4%		NSF3082MVO	PK1UNITHYS	PK2UNITHYS	T5WEATH			
3.95E-08	84.7%		NSF3097MVO	PK1UNITHYS	PK2UNITHYS	T5WEATH			
3.81E-08	85.0%		DDCBATADEX	DDCBATBDEX	FEFTDFPTPR	KK1RUNSDEX	PK13CLSDEX	PK2UNITHYS	T5WEATH
			TRCSRVLDEX						
3.62E-08	85.4%		NDCDCSFBYF	PK1UNITHYS	PK2UNITHYS	T5WEATH			
3.54E-08	85.7%		NACSFDDGDM	PACXCT4THF	T5WEATH	TACWFF2RHE			
3.50E-08	85.9%		NACDJPUGPS	PK1UNITHYS	PK2UNITHYS	T5WEATH			
3.47E-08	86.2%		-T5SUBF	-KK1BOTHHYM	NSF0RCMDHE	PACLEE2DHE	PK1UNITHYR	PK2UNITHYS	T5FEEDF
3.39E-08	86.5%		DDC1DCBBYF	DDCUN31DIM	NSF0RCMDHE	PACLOOPDEX	PK2UNITHYS	T5FEEDF	
3.39E-08	86.8%		NACSFDDLHE	PK1UNITHYS	PK2UNITHYS	T5WEATH			
3.39E-08	87.1%		NSFRMULHE	PK1UNITHYS	PK2UNITHYS	T5WEATH			
3.25E-08	87.4%		NSF0RCMDHE	PK0KEORCOM	T5WEATH	TACWFF3RHE			
3.11E-08	87.6%		FEFTDFPTPR	KK1BOTHHYM	NSF0ASWDHE	T5WEATH	TACWFF1RHE	PAC0T5WDEX	
2.88E-08	87.9%		FEFTDFPTPR	NSFPU02APS	PK1UNITHYR	PK2UNITHYS	T5WEATH		
2.87E-08	88.1%		KK1RUNSDEX	NSFCON2CMS	PK13CLSDEX	PK2UNITHYS	T5WEATH		
2.69E-08	88.3%		FEFTDFPTPR	NSFPU02APM	PK1UNITHYR	PK2UNITHYS	T5WEATH		
2.64E-08	88.6%		NACSFDDGGR	PK0KEORCOM	T5WEATH	TACWFF4RHE			
2.61E-08	88.8%		KK1BOTHHYM	NACSFDDGGR	T5WEATH	TACWFF3RHE	PAC0T5WDEX		
2.60E-08	89.0%		FEFSWAPDHE	NSF0ASWDHE	PK1UNITHYR	PK2UNITHYS	T5WEATH		
2.40E-08	89.2%		NSFCON2CMS	PACXCT4THF	T5WEATH	TACWFF2RHE			
2.33E-08	89.4%		-T5SUBF	-KK1BOTHHYM	NSF0RCMDHE	PACLEE2DHE	PK1UNITHYS	PK2UNITHYS	T5FEEDF
2.29E-08	89.6%		KK1BOTHHYM	NACSFDDGDM	T5WEATH	TACWFF2RHE	PAC0T5WDEX		
2.27E-08	89.8%		DDC1DCBBDM	DDCUN31DIM	NACSFDDGDM	PK2UNITHYS	T5FEEDF		
2.26E-08	90.0%		FEFTDFPTPR	NCW0268MVO	PK1UNITHYR	PK2UNITHYS	T5WEATH		
2.26E-08	90.2%		FEFTDFPTPR	NCW0287MVO	PK1UNITHYR	PK2UNITHYS	T5WEATH		
2.23E-08	90.4%		NSF0RCMDHE	PACS226SWT	PACS22TSWT	PK2UNITHYS	T5FEEDF		
2.19E-08	90.5%		NACDJ01HXF	PK1UNITHYR	PK2UNITHYS	T5WEATH			
2.19E-08	90.7%		NACDJ02HXF	PK1UNITHYR	PK2UNITHYS	T5WEATH			
2.15E-08	90.9%		-T5SUBF	-KK1BOTHHYM	NSF0RCMDHE	PACLEESCTR	PK1UNITHYS	PK2UNITHYS	T5FEEDF
2.02E-08	91.1%		NAC3X12CLC	PK1UNITHYR	PK2UNITHYS	T5WEATH			
2.02E-08	91.2%		NAC3X2ACLC	PK1UNITHYR	PK2UNITHYS	T5WEATH			
2.02E-08	91.4%		NAC3X2CCLC	PK1UNITHYR	PK2UNITHYS	T5WEATH			
2.02E-08	91.6%		NAC3X3ACLC	PK1UNITHYR	PK2UNITHYS	T5WEATH			
2.02E-08	91.8%		NAC3X4CCLC	PK1UNITHYR	PK2UNITHYS	T5WEATH			
2.02E-08	91.9%		NAC3X5ACLO	PK1UNITHYR	PK2UNITHYS	T5WEATH			
2.02E-08	92.1%		NACOTS4C4C	PK1UNITHYR	PK2UNITHYS	T5WEATH			