Entergy

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 501 858 5000

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U. S. Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Response to Third Request for Additional Information on Probabilistic Safety Assessment Regarding the ANO-2 Power Uprate License Application

Gentlemen:

Entergy Operations, Inc. submitted an "Application for License Amendment to Increase Authorized Power Level," on December 19, 2000 (2CAN120001). Supplemental information regarding the probabilistic safety assessment (PSA) portion of the application was provided in letters dated June 28, 2001 (2CAN060110), and July 24, 2001 (2CAN070105). On October 12, 2001, Entergy responded to a Nuclear Regulatory Commission (NRC) staff request for additional information regarding PSA (2CAN100108).

A follow-up request for additional information was received from the NRC staff on October 29, 2001. Entergy responded in a letter dated November 16, 2001. Prior to mailing the letter, Entergy discussed the proposed responses with the staff during a teleconference on November 14, 2001. During the teleconference the staff indicated that the proposed responses were acceptable and suggested that Entergy mail the letter as written. At the close of the teleconference, the staff requested Entergy to provide additional, related information via telex. The information was telexed on November 15, 2001.

During a subsequent telephone conversation on November 19, 2001, the NRC Project Manager requested that the telexed information be submitted officially on the docket. The enclosure contains a duplication of the information telexed on November 15, 2001. The attachment to this letter restates the staff's question and provides a summary of the ANO response.

This submittal contains no regulatory commitments.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 5, 2001.

Very truly yours,

Glenn R. Ashley
Manager, Licensing

GRA/dwb
Attachment

cc: Mr. Ellis W. Merschoff
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

NRC Senior Resident Inspector
Arkansas Nuclear One
P.O. Box 310
London, AR 72847

Mr. Thomas W. Alexion
NRR Project Manager Region IV/ANO-2
U. S. Nuclear Regulatory Commission
NRR Mail Stop 04-D-03
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Response to NRC Question Asked During November 14, 2001, Teleconference

NRC Question

What is the basis for the value assigned to the Human Failure Event (HFE), "Align EFW/AFW suction source to the QCST (T-41B) (SGTR)" prior to the ANO-2 power uprate? And, what is the basis for its value after power uprate?

ANO Response

The Human Failure Event (HFE) in question is to align the emergency feedwater/auxiliary feedwater suction source to the qualified condensate storage tank (T-41B). This HFE is assigned an event name of QHF2A1CSRP. This HFE was quantified for potential use in the ANO-2 power uprate risk impact analysis, but ultimately it was never used. However, the methods used in assessing its value are consistent with those used for other HFEs.

This event is a proceduralized post-initiator human failure event (Type Cp HFE). As noted in the response to NRC Question 6 in our letter dated October 12, 2001 (2CAN100108), proceduralized post-initiator HFEs were quantified via two complementary approaches: (1) the Human Cognitive Reliability/Operator Reliability Experiments (HCR/ORE) correlation developed by the Electric Power Research Institute (EPRI) in EPRI NP-6560-L, "A Human Reliability Analysis Approach Using Measurements for Individual Plant Examinations," and in EPRI TR-100259, "An Approach to the Analysis of Operator Actions in Probabilistic Risk Assessment," and (2) the cause-based methodology developed by EPRI and documented in EPRI TR-100259. The larger of the two results was used in the risk analysis supporting the ANO-2 power uprate.

The value for HFE QHF2A1CSRP prior to the ANO-2 power uprate is documented on page 1 of the enclosure. The enclosure contains a duplication of the information telexed to the NRC on November 15, 2001. Page 1 is an excerpt from a calculation supporting the ANO-2 power uprate risk impact assessment.

Pages 2 through 4 are excerpts from the Human Reliability Analysis (HRA) EXCEL spreadsheet included in this calculation[1]. Page 2 provides a description of the event. This page shows that 42 minutes was assumed as the available time for operator action and 29 minutes was the required time for this action. Page 3 provides responses associated with the cause-based approach and identifies this HFE as a response type CP1 of the HCR/ORE

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[1] Note that the textual descriptions on pages 2 and 6 regarding times were inadvertently not revised as part of the ANO-2 power uprate assessment. However, the values used to perform the calculation itself were correct (shown on pages 3, 4, 7, and 8). The actual values used have been hand-written on Pages 2 and 6 and are consistent with the values used to perform the calculation. Handwritten notes were added to each page for explanation and were not included in the calculation.

method. Page 4 provides both the HCR/ORE and cause-based HFE values, namely, 3.2E-1 and 2.0E-3. The value of QHF2A1CSRP was taken to be the larger of these two values. Then, the execution error, documented on Page 4 was added to this value. The total value for QHF2A1CSRP prior to the ANO-2 power uprate was 3.2E-1.

The value for HFE QHF2A1CSRP after the ANO-2 power uprate is documented in a similar manner on Pages 5 through 8. The total value for QHF2A1CSRP after the ANO-2 power uprate was 5.0E-1.

Enclosure to Letter 2CAN120103

Duplication of information telexed to the NRC on November 15, 2001
(8 pages)

Level-1 Internal Events Risk Impact Assessment of ANO-2 Power Uprate
Assessment of ANO-2 Power Uprate Related Human Reliability Modeling Changes

Event Name	Description	Available Time		Mean Probability	Error Factor	Basis for Available Time
LHF2RCSDIX	Failure to Manually Open Valve in RCS Drop Leg Flow Path (inside CNMT)	interme diate		1.0E-1	3	No change in time category (short, intermediate, long) due to PU.
LHF2SACIRP	Operator Failure to Manually Override Spurious ACI Signal	120	min	1.0E-4	10	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
LHF2SDCARP	Failure to establish shutdown cooling via LPSI following SGTR	120	min	1.0E-4	10	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
LHF2SDCHXP	Failure to align Heat Exchanger 2E-35A/B for Shutdown Cooling	120	min	1.0E-4	10	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
LHF2SDCTCP	Failure to recover from SDC temperature control failures	120	min	1.0E-4	10	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
PHF2MSSVGP	Failure to maintain ruptured SG pressure less than MSSV setpoint	120	min	1.2E-3	5	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
PHF2SGBOTP	Failure to isolate all flow paths to and from Ruptured SG	1446	min	1.0E-4	10	CENTS Case 19 (RWST "empties")
QHF22P75SP	Failure to establish flow to steam generators from auxiliary feedwater pump	80	min	2.9E-4	10	CENTS Case 9 (ECCS Vent Valve Opened). See Note 1.
QHF2A1CSRP	Align EFW/AFW suction source to the QCST (T-41B) (SGTR)	42	min	3.2E-1	5	CENTS Case 23 (2 phase level reaches top of core). Assumes no delay for HPSI injection.
QHF2A1CSTP	Align EFW/AFW suction source to the QCST (T-41B) (Transient)	80	min	3.3E-3	5	CENTS Case 9 (ECCS Vent Valve Opened). See Note 1.
QHF2A1CSXP	Align EFW/AFW suction source to the QCST (T-41B) (Long term)	122	min	3.7E-3	5	CENTS Case 29 (2 phase level reaches top of core)
QHF2EFWAXX	Failure to manually control EFW pump (2P7A) speed and discharge valves	short		5.0E-2	5	No change in time category (short, intermediate, long) due to PU.
QHF2EFWBLX	Failure to manually control EFW pump (2P7B) speed and discharge valves	long		3.0E-2	5	No change in time category (short, intermediate, long) due to PU.

post-to power uprate

ANO-2 PSA prior to power uprate

Event QHF2A1CSRP
(post-initiator, proceduralized)

Definition

Align EFW/AFW suction source to the QCST (T-41B) (SGTR)

Situation

This activity involves aligning the QCST (T-41B) to provide flow to the EFW if flow from the CST tanks 2T-41A/B and Service Water to EFW fail. Note that aligning the QCST will only be aligned as a backup water source for EFW/AFW if all other sources are unavailable.

This activity involves manually opening one of the 12" suction valves from the QCST to the Unit 2 EFW and AFW pump suction (2CS-816 or 2CS-817). The EFW system operating procedure [1] provides the steps for aligning to the QCST. However, the procedure also includes cautions that the alignment to the QCST is only in an emergency if no other source of makeup to the EFW pumps is available or as directed by an Emergency Operating Procedure.

The limiting time window is ~~30~~ 42 * minutes. The case would involve a Small break LOCA or SGTR as the initiator, a failure of the common CST suction line and a service water failure to at least EFW train. The time to core damage for a Small Break LOCA is ~~30~~ 42 * minutes [2].

The manipulation time is 29 minutes. This time is based on 15 minutes to perform and brief the Standard Post Trip Actions [3] and an additional 14 minutes to manually open the valves for the QCST. (note that time was changed so that the time window was not 0 which would cause an error in the spreadsheet.)

The median response time is assumed to be 10 minutes. The operators are expected to check the suction source for EFW and AFW. Annunciators for EFW A and B Suction Pressure High/Low would alarm. The operators would check that the MOVs are open and that the CST level is adequate. They might spend some time trying to establish flow to the pumps from the CST, but would likely call the Unit 1 operators and notify them that they are aligning to the QCST. Since establishing EFW and AFW flow would be a high priority, the response time is expected to be short. Ten minutes is assumed because the operators would probably attempt to restore flow from the CST first. Note that this response time may be non-conservative if the cutset involves a failure of a SW suction valve (2CV-0711-2 or 2CV-0716-1) because the operators might attempt to open those valves first. However, the manipulation time and response time for opening the SW suction valve would be lower than for opening the QCST valves. Since the failure porobability of this event is 1.0, it has no consequence on the results.

* This textual description was not revised as part of the power uprate assessment. Actual values for the time window are shown on the next page.

Critical Assumptions

1. The shift manager will promptly recognize the failure of the CSTs and SW and decide to swap to the QCST.

Event Timeline

Event	Time	Description
1	0	Scram event occurs, Initiator likely includes loss of SW.
2	>0	EFW initiates, but has no suction source because the CST line is closed.
3	~~30~~ 42 * min	Core damage occurs following SLOCA or SGTR with on core heat removal.

ANO-2 PSA prior

Event QHF2A1CSRP
(post-initiator, proceduralized)

HCR/ORE Assessment of p_c

Parameter	Time	Cue/Response	Standard Deviation	
System time window (T_{sw})	42 min	CP1	Generic	0.57
Manipulation time (T_m)	29 min	PWR	User-calculated	
Median response time ($T_{1/2}$)	10 min	Basis for standard deviation:	Generic value for cue/resp	
Time window (T_w)	13 min		p_c(HCR/ORE) =	3.2E-1

Cause-Based Analysis of p_c

Decision Tree (a)	Indication	CR indication	Warning/alt. in	Training on		**Basic Failure**	
Data not	available in CR?	accurate?	procedure?	indication?	**Outcome**	**Probability**	
available	yes	yes	yes	yes	[a]	neg	
Review	Self-Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes		no	no	**non-rec prob**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (b)	Low vs. high	Check vs.	Front vs.	Alarmed vs.		**Basic Failure**	
Data not	workload	monitor	back panel	not alarmed	**Outcome**	**Probability**	
attended to	high	check	front panel	alarmed	[h]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?	yes/cues		yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (c)	Indication	Good vs. bad	Formal com-			**Basic Failure**	
Data misread or	easy to locate?	indicator	munications?		**Outcome**	**Probability**	
miscommunicated	yes	good	yes		[a]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?			yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (d)	All cues	Warning of	Specific	General		**Basic Failure**	
Information	as stated?	differences?	training?	training	**Outcome**	**Probability**	
misleading	yes	n/a	n/a	n/a	[a]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes	yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (e)	Obvious vs.	Single vs.	Graphically	Placekeeping		**Basic Failure**	
Relevant step in	hidden	multiple	distinct?	aids?	**Outcome**	**Probability**	
procedure missed	obvious	multiple	no	yes	[g]	6.0E-3	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?	yes/cues	yes	yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level	high	high	no credit	no credit	no credit	2.5E-1	**1.5E-3**
Decision Tree (f)	Standard,	All required	Training			**Basic Failure**	
Misinterpret	clear wording?	information?	on step?		**Outcome**	**Probability**	
instruction	yes	yes	yes		[a]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes	yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (g)	"Not"	"And" or "or"	Both "and"	Practiced		**Basic Failure**	
Misinterpret	statement?	statement?	and "or"?	scenario?	**Outcome**	**Probability**	
decision logic	yes	no	no	yes	[e]	2.0E-3	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes	yes	no	no	**rec. prob.**	**Failure Prob.**
Dependence level		high	high	no credit	no credit	2.5E-1	**5.0E-4**
Decision Tree (h)	Belief in	Adverse	Reasonable	Verbatim		**Basic Failure**	
Deliberate	adequacy?	consequence?	alternative?	compliance?	**Outcome**	**Probability**	
violation	yes	n/a	n/a	n/a	[a]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes	yes			**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
						p_c(caused-based approach) =	**2.0E-3**

ANO-2 PSA prior

Event QHF2A1CSRP
(post-initiator, proceduralized)

Task Analysis for Execution Phase

Once the diagnosis is made to align the Unit 2 EFW pumps to the QCST, the operators would call the Unit 1operators to inform them that the QCST is being used and verify that Unit 1 EFW is not currently using the QCST as its sole makeup source. Then the operator would open one of the two 12" suction valves (2CS-816 or 2CS-817) to allow flow to the EFW header.

From an error standpoint, the operators could fail to open the valves or open the wrong valves. However, based on PID M-204, the only other valves from the QCST that are greater than 6" are the suction valves for the Unit 1 EFW. Therefore, the valves are taken to be set apart from other valves that could be mistaken for the Unit 2 QCST valves.

Assessment of p_e

Stress Level	high	NUREG/	Recovery Potential				Recovered
	Basic	CR-1278	Self-Review		Other Crew		Failure
Execution Failure	HEP	Source	Depend.	Prob.	Depend.	Prob.	Probability
Failure to open 2CS-816 or 2CS-817	6.0E-3	20-7 (3)	high	5.0E-1	moderate	1.5E-1	4.5E-4
Open the wrong valve for QCST cross-tie	6.0E-3	20-13 (2)	high	5.0E-1	moderate	1.5E-1	4.5E-4

p_e = 8.9E-4

References

	Procedure	Number	Revision
1.	Emergency Feedwater System Procedure	2106.006	052-00-0

Other References

2. Calculation 97-E-0036-01, Revision 1, Supplement 1
3. Lewis, S.R. "Input Information for the Human Reliability Analysis". Memorandum to Entergy Operations, Inc., April 13, 2000.

Summary of Results

Value for p_c (HCR/ORE method)	3.2E-1	*(value applied)*
Value for p_c (cause-based method)	2.0E-3	
Value for p_e	8.9E-4	
		Error factor
Total probability for event	3.2E-1	5

Description of ORE method is not shown on this page.

Level-1 Internal Events Risk Impact Assessment of ANO-2 Power Uprate
Assessment of ANO-2 Power Uprate Related Human Reliability Modeling Changes

Event Name	Description	Available Time		Mean Probability	Error Factor	Basis for Available Time
						with Rev. 2.1
LHF2RCSDIX	Failure to Manually Open Valve in RCS Drop Leg Flow Path (inside CNMT)	interme diate		1.0E-1	3	No change in time category (short, intermediate, long) due to PU.
LHF2SACIRP	Operator Failure to Manually Override Spurious ACI Signal	112	min	1.0E-4	10	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
LHF2SDCARP	Failure to establish shutdown cooling via LPSI following SGTR	112	min	1.0E-4	10	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
LHF2SDCHXP	Failure to align Heat Exchanger 2E-35A/B for Shutdown Cooling	112	min	1.0E-4	10	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
LHF2SDCTCP	Failure to recover from SDC temperature control failures	112	min	1.0E-4	10	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
PHF2MSSVGP	Failure to maintain ruptured SG pressure less than MSSV setpoint	112	min	1.6E-3	5	Pre-PU value is assumed to be the same as used in the Rev 2.1 analysis. The time available for post-PU case is pre-PU value divided by 1.075 to account for PU effect.
PHF2SGBOTP	Failure to isolate all flow paths to and from Ruptured SG	1318	min	1.0E-4	10	CENTS Case 20 (RWST "empties")
QHF22P75SP	Failure to establish flow to steam generators from auxiliary feedwater pump	68	min	5.8E-4	10	CENTS Case 11 (ECCS Vent Valve Opened). See Note 3
QHF2A1CSRP	Align EFW/AFW suction source to the QCST (T-41B) (SGTR)	39	min	5.0E-1	5	CENTS Case 25 (2 phase level reaches top of core). Assumes no delay for HPSI injection.
QHF2A1CSTP	Align EFW/AFW suction source to the QCST (T-41B) (Transient)	68	min	1.0E-2	5	CENTS Case 11 (ECCS Vent Valve Opened). See Note 3
QHF2A1CSXP	Align EFW/AFW suction source to the QCST (T-41B) (Long term)	113	min	6.5E-3	5	CENTS Case 31 (2 phase level reaches top of core).
QHF2EFWAXX	Failure to manually control EFW pump (2P7A) speed and discharge valves	short		5.0E-2	5	No change in time category (short, intermediate, long) due to PU.
QHF2EFWBLX	Failure to manually control EFW pump (2P7B)	long		3.0E-2	5	No change in time category (short, intermediate,

after power uprate

ANO-2 PSA after power uprate

Event QHF2A1CSRP
(post-initiator, proceduralized)

Definition

Align EFW/AFW suction source to the QCST (T-41B) (SGTR)

Situation

This activity involves aligning the QCST (T-41B) to provide flow to the EFW if flow from the CST tanks 2T-41A/B and Service Water to EFW fail. Note that aligning the QCST will only be aligned as a backup water source for EFW/AFW if all other sources are unavailable.

This activity involves manually opening one of the 12" suction valves from the QCST to the Unit 2 EFW and AFW pump suction (2CS-816 or 2CS-817). The EFW system operating procedure [1] provides the steps for aligning to the QCST. However, the procedure also includes cautions that the alignment to the QCST is only in an emergency if no other source of makeup to the EFW pumps is available or as directed by an Emergency Operating Procedure.

The limiting time window is ~~30~~ 39 * minutes. The case would involve a Small break LOCA or SGTR as the initiator, a failure of the common CST suction line and a service water failure to at least EFW train. The time to core damage for a Small Break LOCA is ~~30~~ 39 * minutes [2].

The manipulation time is 29 minutes. This time is based on 15 minutes to perform and brief the Standard Post Trip Actions [3] and an additional 14 minutes to manually open the valves for the QCST. (note that time was changed so that the time window was not 0 which would cause an error in the spreadsheet.)

The median response time is assumed to be 10 minutes. The operators are expected to check the suction source for EFW and AFW. Annunciators for EFW A and B Suction Pressure High/Low would alarm. The operators would check that the MOVs are open and that the CST level is adequate. They might spend some time trying to establish flow to the pumps from the CST, but would likely call the Unit 1 operators and notify them that they are aligning to the QCST. Since establishing EFW and AFW flow would be a high priority, the response time is expected to be short. Ten minutes is assumed because the operators would probably attempt to restore flow from the CST first. Note that this response time may be non-conservative if the cutset involves a failure of a SW suction valve (2CV-0711-2 or 2CV-0716-1) because the operators might attempt to open those valves first. However, the manipulation time and response time for opening the SW suction valve would be lower than for opening the QCST valves. Since the failure porobability of this event is 1.0, it has no consequence on the results.

* same note as page 2 of this fax

Critical Assumptions

1. The shift manager will promptly recognize the failure of the CSTs and SW and decide to swap to the QCST.

Event Timeline

Event	Time	Description
1	0	Scram event occurs, Initiator likely includes loss of SW.
2	>0	EFW initiates, but has no suction source because the CST line is closed.
3	~~30~~ 39 * min	Core damage occurs following SLOCA or SGTR with on core heat removal.

ANO-2 PSA after

Event QHF2A1CSRP
(post-initiator, proceduralized)

HCR/ORE Assessment of p_c

Parameter	Time	Cue/Response		Standard Deviation
System time window (T_{sw})	39 min	CP1	Generic	0.57
Manipulation time (T_m)	29 min	PWR	User-calculated	
Median response time ($T_{1/2}$)	10 min	Basis for standard deviation:	Generic value for cue/resp	
Time window (T_w)	10 min		p_c(HCR/ORE) =	5.0E-1

Cause-Based Analysis of p_c

Decision Tree (a)	Indication	CR indication	Warning/alt. in	Training on		**Basic Failure**	
Data not	available in CR?	accurate?	procedure?	indication?	**Outcome**	**Probability**	
available	yes	yes	yes	yes	[a]	neg	
Review	Self-Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes		no	no	**non-rec prob**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (b)	Low vs. high	Check vs.	Front vs.	Alarmed vs.		**Basic Failure**	
Data not	workload	monitor	back panel	not alarmed	**Outcome**	**Probability**	
attended to	high	check	front panel	alarmed	[h]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?	yes/cues		yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (c)	Indication	Good vs. bad	Formal com-			**Basic Failure**	
Data misread or	easy to locate?	indicator	munications?		**Outcome**	**Probability**	
miscommunicated	yes	good	yes		[a]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?			yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (d)	All cues	Warning of	Specific	General		**Basic Failure**	
Information	as stated?	differences?	training?	training	**Outcome**	**Probability**	
misleading	yes	n/a	n/a	n/a	[a]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes	yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (e)	Obvious vs.	Single vs.	Graphically	Placekeeping		**Basic Failure**	
Relevant step in	hidden	multiple	distinct?	aids?	**Outcome**	**Probability**	
procedure missed	obvious	multiple	no	yes	[g]	6.0E-3	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?	yes/cues	yes	yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level	high	high	no credit	no credit	no credit	2.5E-1	**1.5E-3**
Decision Tree (f)	Standard,	All required	Training			**Basic Failure**	
Misinterpret	clear wording?	information?	on step?		**Outcome**	**Probability**	
instruction	yes	yes	yes		[a]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes	yes/cues	no	no	**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
Decision Tree (g)	"Not"	"And" or "or"	Both "and"	Practiced		**Basic Failure**	
Misinterpret	statement?	statement?	and "or"?	scenario?	**Outcome**	**Probability**	
decision logic	yes	no	no	yes	[e]	2.0E-3	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes	yes	no	no	**rec. prob.**	**Failure Prob.**
Dependence level		high	high	no credit	no credit	2.5E-1	**5.0E-4**
Decision Tree (h)	Belief in	Adverse	Reasonable	Verbatim		**Basic Failure**	
Deliberate	adequacy?	consequence?	alternative?	compliance?	**Outcome**	**Probability**	
violation	yes	n/a	n/a	n/a	[a]	neg	
Review	Self Review	Extra Crew	STA Review	Shift Change	TSC/EOF	**Composite**	**Recovered**
Recovery credit?		yes	yes			**rec. prob.**	**Failure Prob.**
Dependence level							**0.0E+0**
						p_c(caused-based approach) =	**2.0E-3**

ANO-2 PSA after

Event QHF2A1CSRP
(post-initiator, proceduralized)

Task Analysis for Execution Phase

Once the diagnosis is made to align the Unit 2 EFW pumps to the QCST, the operators would call the Unit 1operators to inform them that the QCST is being used and verify that Unit 1 EFW is not currently using the QCST as its sole makeup source. Then the operator would open one of the two 12" suction valves (2CS-816 or 2CS-817) to allow flow to the EFW header.

From an error standpoint, the operators could fail to open the valves or open the wrong valves. However, based on PID M-204, the only other valves from the QCST that are greater than 6" are the suction valves for the Unit 1 EFW. Therefore, the valves are taken to be set apart from other valves that could be mistaken for the Unit 2 QCST valves.

Assessment of p_e

Stress Level	high	NUREG/	Recovery Potential				Recovered
	Basic	CR-1278	Self-Review		Other Crew		Failure
Execution Failure	HEP	Source	Depend.	Prob.	Depend.	Prob.	Probability
Failure to open 2CS-816 or 2CS-817	6.0E-3	20-7 (3)	high	5.0E-1	moderate	1.5E-1	4.5E-4
Open the wrong valve for QCST cross-tie	6.0E-3	20-13 (2)	high	5.0E-1	moderate	1.5E-1	4.5E-4

p_e = 8.9E-4

References

	Procedure	Number	Revision
1.	Emergency Feedwater System Procedure	2106.006	052-00-0

Other References

2. Calculation 97-E-0036-01, Revision 1, Supplement 1
3. Lewis, S.R. "Input Information for the Human Reliability Analysis". Memorandum to Entergy Operations, Inc., April 13, 2000.

Summary of Results

Value for p_c (HCR/ORE method)	**5.0E-1**	***(value applied)***
Value for p_c (cause-based method)	**2.0E-3**	
Value for p_e	**8.9E-4**	
		Error factor
Total probability for event	**5.0E-1**	**5**