Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

April 12, 1978

Mr. George E. Lear, Chief
Operating Reactors - Branch 3
Division of Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Dresden Station Units 2 and 3
Quad-Cities Station Units 1 and 2
Suppression Pool Temperature Transients
NRC Docket Nos. 50-237/249 and 50-254/265

References (a): D. K. Davis letter to R. L. Bolger dated December 12, 1977

(b): C. Reed letter to D. K. Davis dated January 3, 1978

Dear Mr. Lear:

Commonwealth Edison has reviewed Reference (a) and the Dresden Station and Quad-Cities Station Technical Specifications with General Electric in order to provide a technically justified basis upon which suppression pool temperature transient analyses could be performed. This review has generated proposed analysis cases with the initial conditions, event descriptions and assumptions defined. These proposed transient bases are being submitted to fulfill our commitment transmitted by Reference (b).

It is Commonwealth Edison's position that a commitment for the performance of the transient analyses is not currently justified. Although it is recognized that the available test data on suppression pool instability is limited, it is judged that sufficient experience exists in operating facilities to justify continued operation without the need for very costly analysis. This position is justified in the case of the Dresden and Quad-Cities units because of the particular plant unique parameters which contribute to the mitigation of the pool heating transients, e.g., large pool water volume and large pool cooling capacity.

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Please address any additional questions on this matter to this office.

One (1) signed original and fifty-nine (59) copies of this letter are provided for your use.

Very truly yours,

C. Reed

Cordell Reed
Assistant Vice-President

attachment

Suppression Pool Temperature Transient Bases
Dresden Units 2 and 3
Quad Cities Units 1 and 2

Attached are the initial conditions, event sequences, and assumptions that Commonwealth Edison proposes to use to analyze the transients which affect suppression pool temperature. It should be noted that the information provided is based upon the currently defined Technical Specifications for the subject units. It should also be noted that of the four events discussed, Event 2 (Stuck-open relief valve from isolated hot-standby) and Event 4 (Isolation and reactor depressurization) are judged to be trivial because they are non-limiting and would not challenge the bulk suppression pool temperature limit.

EVENT 1* - STUCK-OPEN RELIEF VALVE FROM POWER OPERATION

Initial Conditions

1. Operation at Technical Specification safety analysis steam flow conditions. (QC = 105% rated).
2. Maximum RHR heat exchange service water temperature. (QC = 95°F).
3. Suppression pool temperature at normal power operation Technical Specification limit (T_{op}). (QC = 95°F).
4. Minimum Tech Spec suppression pool water volume. (QC = 112,200 cu. ft.)
5. Drywell air pressure at 1.[illegible] psig or maximum of normal operating band.
6. Drywell air temperature at 135°F. or minimum of normal operating band.
7. Wetwell air pressure at -0.4 psig or maximum of normal operating band.
8. Recirculation pumps operating.

Event Sequence

Time	Temp	Event Description
#t_a = 0.0	T_{op}	SRV fails open#*. Pool temperature alarm at initial Condition 3. Initiate actions to turn RHR loops* on for pool cooling.
t_a + 3 minutes**		RHR loops* on for pool cooling.
t_s	T_s	Reactor Scram*** (T_s = 110°F. for QC).
t_s + 10.5 seconds		Isolation (assuming mechanistic isolation on Lo-Lo level).
t_s + 15 minutes##		2-3 additional RV manually actuated as necessary.
###t_b	T_b	Drywell high pressure trip (QC = 2 psig). RHR automatically switched out of pool cooling mode.
t_b + 30 minutes		Operator vents drywell to Standby Gas Treatment System.

* Corresponds to nonproprietary Question 1(a), two RHR loops available.

** The operator can complete the actions necessary to turn the RHR loops on within three minutes.

*** Mode switch in Shutdown.

#* Quad Cities has one Target Rock combination safety/relief valve (SRV), and 4 Electromatic relief valves. The Target Rock SRV, which has a higher capacity than an Electromatic RV, is assumed to be the relief valve which fails open.

The bulk suppression pool temperature is assumed to be 95°F rather than 120°F when SRV inadvertently fails open. Also, Section 3.7.A.1 in the QC tech specs specifies that the reactor shall be scrammed from any operating condition when the suppression pool temperature reaches 110°F.

The operator can determine which valve is stuck open within ten minutes.

Above operator action can prevent the drywell pressure from reaching 2 psig by using the torus spray.

Assumptions for Event 1

1. Maximum operating condensate storage water temperature.
2. Normal automatic operation of HPCI, RCIC - but manually controlled thereafter.
3. Both RHR loops available for pool cooling.
4. Vessel liquid mass adjusted to account for subcooled liquid in the RPV and piping.
5. Metal mass adjusted to account for lower temperature of some metal components.
6. Effect of steam void collapse included.
7. Trip volumes for makeup systems adjusted to account for relative elevations in the RPV.
8. RCIC and HPCI allowed to operate to 100 psia.
9. Duty of RHR heat exchangers based on 40 years of crud.
10. CRD flow maintained constant.
11. SRV capacities at 122.5% of ASME rated.
12. Licensed decay heat curve for containment analysis (adjusted to account for delay between scram and isolation).
13. On plants with motor-driven feedwater pumps (QC), the feedwater pumps operate continuously.
14. Event terminates in cold shutdown.

EVENT 2* - STUCK-OPEN RELIEF VALVE FROM ISOLATED HOT STANDBY

Initial Conditions

1. Operation at Technical Specification safety analysis limit steam flow conditions before isolation. (QC = 105% rated).
2. Maximum RHR heat exchanger service water temperature. (QC = 95°F).
3. Suppression pool temperature at normal power operation Technical Specification limit (T_{op}). (QC = 95°F).
4. Minimum Technical Specification suppression pool water volume. (QC = 112,200 cu. ft.).
5. Drywell air pressure at 1.1 psig or maximum of normal operating band.
6. Drywell air temperature at 135°F. or minimum of normal operating band.
7. Wetwell air pressure at -0.4 psig or maximum of normal operating band.
8. Recirculation pumps operating.
9. Reactor pressure when isolated is 920 psig.

Event Sequence

Time (Min.)	Event Description
$t_a = t_s = 0.0$	Pool temperature alarm reactor scram and isolation - Initial Condition 3. Initiate actions to turn RHR loop on for pool cooling.
5_a + 3 minutes**	RHR loop on for pool cooling.
$0 < t < 30$	Reactor pressure maintained using SRV.
t_o	Single SRV sticks open at 120°F.
t_o + 10 minutes ***	2-3 additional SRV opened (by operator).
#t_b	Drywell high pressure switch (QC = 2 psig). RHR automatically switched out of pool cooling mode.
t_b + 30	Operator vents drywell to Standby Gas Treatment System.

The number of SRV's to be manually actuated by the operator to be determined by the analysis.

* Corresponds to nonproprietary Question 1(c). This event does not conform to the plant licensing basis because it requires a transient plus a single failure. Therefore, this event should not be analyzed.

** The operator can complete the actions necessary to turn the RHR loops on within three minutes.

*** The operator can determine which valve is stuck open within ten minutes.

Above operator action can prevent the drywell pressure from reaching 2 psig by using the torus spray.

Assumptions for Event 2

1. Maximum operating condensate storage water temperature.
2. Normal automatic operation of HPCI, RCIC - but manually controlled thereafter.
3. Both RHR loops available for pool cooling.
4. Vessel liquid mass adjusted to account for subcooled liquid in the RPV and piping.
5. Metal mass adjusted to account for lower temperature of some metal components.
6. Effect of steam void collapse included.
7. Trip volumes for makeup systems adjusted to account for relative elevations in the RPV.
8. RCIC and HPCI allowed to operate to 100 psia.
9. Duty of RHR heat exchangers based on 40 years of crud.
10. CRD flow maintained constant.
11. SRV capacities at 122.5% of ASME rated.
12. Licensed decay heat curve for containment analysis (adjusted to account for delay between scram and isolation).
13. On plants with motor-driven feedwater pumps (QC), the feedwater pumps operate continuously.
14. Event terminates in cold shutdown.

EVENT 3* - SMALL BREAK ACCIDENT WITH ADS

Initial Conditions

1. Operation at Technical Specification safety analysis limit steam flow conditions. (QC = 105% rated).
2. Maximum RHR heat exchanger service water temperature. (QC = 95°F).
3. Suppression pool temperature at normal power operation Technical Specification limit (T_{op}). (QC = 95°F).
4. Minimum Technical Specification suppression pool water volume. (QC = 112,200 cu. ft.).
5. Recirculation pumps operating.

Event Sequence

Time (Min.)	Event Description
0.0	SBA occurs
	ADS blows down the plant**

No operator actions assumed, event runs to completion.

The suppression pool temperature versus discharge mass flux is determined by the analysis.

* Corresponds to nonproprietary Question 1(d).

** ADS valves out of service as allowed in Technical Specifications.

(QC) = 1 ADS valve allowed out of service.

Assumptions for Event 3

1. Maximum operating condensate storage water temperature.
2. HPCI failure, no credit taken for RCIC.
3. Both RHR loops available for pool cooling.
4. Vessel liquid mass adjusted to account for subcooled liquid in the RPV and piping.
5. Metal mass adjusted to account for lower temperature of some metal components.

6. Effect of steam void collapse included.

7. Trip volumes for makeup systems adjusted to account for relative elevations in the RPV.

8. Duty of RHR heat exchangers based on 40 years of crud.

9. No offsite power.

10. SRV capacities at 122.5% of ASME rated.

11. Licensed decay heat curve for containment analysis (adjusted to account for delay between scram and isolation).

12. On plants with motor-driven feedwater pumps (QC), the feedwater flow stops when the accident begins (see 9, above).

13. Event terminates in cold shutdown.

14. LPCI mode of RHR, LPCS, and ADS available.

15. Limiting small line break.

16. ADS valves out of service as allowed in Technical Specifications.

EVENT 4* - ISOLATION AND REACTOR DEPRESSURIZATION

Initial Conditions

1. Operation at Technical Specification safety analysis limit steam flow conditions. (QC = 105% rated).
2. Maximum RHR heat exchanger service water temperature. (QC = 95°F).
3. Suppression pool temperature at normal power operation Technical Specification limit (T_{op}). (QC = 95°F).
4. Minimum Technical Specification suppression pool water volume. (QC = 112,200 cu. ft.).
5. Recirculation pumps operating.

Event Sequence

Time (Min.)	Event Description
$t_a = t_s = 0.0$	Pool temperature alarm; reactor isolation and scram - Initial Condition 3. Initiate actions to turn RHR loops on for pool cooling.
t_a + 3 minutes**	Both RHR loops on for pool cooling.
$0 < t < t_c$	Reactor pressure maintained using SRV (intermittent operation).
t_c	Initiate cooldown at $\leq$ 100°F/hr. using SRV and RV's at 120°F.***
t_b	Drywell high pressure trip (QC = 2 psig). RHR automatically switched out of pool cooling mode.
t_b + 30	Operator vents drywell to Standby Gas Treatment System.

* Corresponds to nonproprietary Question 1(e).

** The operator can complete the actions necessary to turn the RHR loops on within three minutes.

*** If only one RHR loop is available, cooldown rate is not limited to 100°F/hr.

Assumptions for Event 4

1. Maximum operating condensate storage water temperature.
2. Normal automatic operation of HPCI, RCIC - but manually controlled thereafter.

3. Both RHR loops available for pool cooling.

4. Vessel liquid mass adjusted to account for subcooled liquid in the RPV and piping.

5. Metal mass adjusted to account for lower temperature of some metal components.

6. Effect of steam void collapse included.

7. Trip volumes for makeup systems adjusted to account for relative elevations in the RPV.

8. RCIC and HPCI allowed to operate to 100 psia.

9. Duty of RHR heat exchangers based on 40 years of crud.

10. CRD flow maintained constant.

11. SRV capacities at 122.5% of ASME rated.

12. Licensed decay heat curve for containment analysis (adjusted to account for delay between scram and isolation).

13. On plants with motor-driven feedwater pumps (QC), the feedwater pumps operate continuously.

14. Event terminates in cold shutdown.

EVENT 1* - STUCK-OPEN RELIEF VALVE FROM POWER OPERATION

Initial Conditions

1. Operation at Technical Specification safety analysis limit steam flow conditions. (D2/3 = 105% rated).
2. Maximum containment cooling heat exchanger service water temperature. (D2/3 = 95°F).
3. Suppression pool temperature at normal power operation Technical Specification limit (T_{op}). (D2/3 = 95°F).
4. Minimum Tech Spec suppression pool water volume. (D2/3 = 112,000 cu. ft.).

Event Sequence

Time	Temp	Event Description
#t_a = 0.0	T_{op}	SRV fails open. Pool temperature at initial Condition 3. Initiate actions to turn containment cooling loops* on for pool cooling.
t_a + 3 minutes**		Containment cooling loops* on for pool cooling.
t_s	T_s	Reactor Scram*** (T_s = 110°F. for D2/3).
t_s + 10.5 secondss		Isolation (assuming mechanistic isolation on low-low reactor water level).
t_s + 1 minutes		Manually initiate isolation condenser.
t_s + 10 minutes##		2-3 additional SRV manually actuated as necessary.
###t_b	T_b	Drywell high pressure trip (D2/3 = 2 psig). Containment cooling automatically switched out of pool cooling mode.
t_b + 30 minutes		Operator vents drywell to Standby Gas Treatment System.

* Corresponds to nonproprietary Question 1(a), two containment cooling loops available.

** The operator can complete the actions necessary to turn the containment cooling loops on within three minutes.

*** Mode switch in Shutdown.

The bulk suppression pool temperature is assumed to be 95°F rather than 120°F when an SRV inadvertently fails open. Also, Section 3.7.A.1 in the D2/3 tech specs specifies that the reactor shall be scrammed from any operating condition when the suppression pool temperature reaches 110°F.

The operator can determine which valve is stuck open within ten minutes.

The operator can prevent the drywell pressure from reaching 2 psig by using the torus spray.

Assumptions for Event 1

1. Maximum operating condensate storage water temperature.
2. Normal automatic operation of HPCI, but manually controlled thereafter.
3. Both containment cooling loops available for pool cooling.
4. Vessel liquid mass adjusted to account for subcooled liquid in the RPV and piping.
5. Metal mass adjusted to account for lower temperature of some metal components.
6. Effect of steam void collapse included.
7. Trip volumes for makeup systems adjusted to account for relative elevations in the RPV.
8. Duty of containment cooling heat exchangers based on 40 years of crud.
9. CRD flow maintained constant.
10. SRV capacities at 122.5% of ASME rated.
11. Licensed decay heat curve for containment analysis (adjusted to account for delay between scram and isolation).
12. Motor-drive feedwater pumps on continuously.
13. Event terminates in cold shutdown.

EVENT 2* - STUCK-OPEN RELIEF VALVE FROM ISOLATED HOT STANDBY

Initial Conditions

1. Operation at Technical Specification safety analysis limit steam flow conditions before isolation. (D2/3 = 105% rated).
2. Maximum containment cooling heat exchanger service water temperature. (D2/3 = 95°F).
3. Suppression pool temperature at normal power operation Technical Specification limit (T_{op}). (D2/3 = 95°F).
4. Minimum Technical Specification suppression pool water volume (D2/3 - 112,000 cu. ft.).
5. Reactor pressure when isolated is 920 psig.

Event Sequence

Time (Min.)	Event Description
$t_a = t_s = 0.0$	An abnormal operational transient has occurred, which resulted in reactor scram and isolation. The suppression pool temperature is T_{op} (Initial Condition 4). The operator initiates actions to turn the containment cooling loop on for pool cooling.
t_a + 3 minutes**	Containment Cooling loop on for pool cooling.
$0 < t < 30$	Reactor pressure maintained using isolation condenser.
t_o	Single SRV fails open at 95°F.
t_o + 10 minutes***	2-3 additional SRV opened (by operator).
#t_b	Drywell high pressure trip (D2/3 = 2 psig). Containment cooling automatically switched out of pool cooling mode.
t_b + 30	Operator vents drywell to Standby Gas Treatment System.

The number of SRV's to be manually actuated by the operator to be determined by the analysis.

* Corresponds to nonproprietary Question 1(c). This event does not conform to the plant licensing basis because it requires a transient plus a single failure. In addition, due to the emergency condensers, relief valves are not used for cooldown in an isolated hot standby condition. Therefore, this event should not be analyzed.

** The operator can complete the actions necessary to turn the containment cooling loop on within three minutes.

*** The operator can determine which valve is stuck open within ten minutes.

The operator can prevent the drywell pressure from reaching 2 psig by using the torus spray.

Assumptions for Event 2

1. Maximum operating condensate storage water temperature.
2. Normal automatic operation of HPCI, but manually controlled thereafter.
3. Both containment cooling loops available for pool cooling.
4. Vessel liquid mass adjusted to account for subcooled liquid in the RPV and piping.
5. Metal mass adjusted to account for lower temperature of some metal components.
6. Effect of steam void collapse included.
7. Trip volumes for makeup systems adjusted to account for relative elevations in the RPV.
8. Duty of containment cooling heat exchangers based on 40 years of crud.
9. CRD flow maintained constant.
10. SRV capacities at 122.5% of ASME rated.
11. Licensed delay heat curve for containment analysis (adjusted to account for delay between scram and isolation).
12. Motor-driven feedwater pumps on continuously.
13. Event terminates in cold shutdown.

EVENT 3* - SMALL BREAK ACCIDENT WITH ADS

Initial Conditions

1. Operation at Technical Specification safety analysis limit steam flow conditions. (D2/3 = 105% rated).
2. Maximum containment cooling heat exchanger service water temperature. (D2/3 = 95°F).
3. Suppression pool temperature at normal power operation Technical Specification limit (T_{op}). (D2/3 = 95°F).
4. Minimum Technical Specification suppression pool water volume. (D2/3 = 112,000 cu. ft.).

Event Sequence

Time (Min.)	Event Description
0.0	SBA occurs during normal power operation**
	ADS blows down the plant

No operator actions assumed, event runs to completion.

The maximum suppression pool temperature is determined by the analysis.

* Corresponds to nonproprietary Question 1(d).

** The bulk suppression pool temperature is assumed to be 95°F rather than 120°F when the SBA occurs. Also, Section 3.7.A.1 specifies that the reactor shall be scrammed from any operating condition when the suppression pool temperature reaches 110°F.

Assumptions for Event 3

1. Maximum operating condensate storage water temperature.
2. HPCI failure (ADS would not activate if HPCI was operative).
3. Both containment spray loops available for pool cooling.
4. Vessel liquid mass adjusted to account for subcooled liquid in the RPV and piping.
5. Metal mass adjusted to account for lower temperature of some metal components.

6. Effect of steam void collapse included.

7. Trip volumes for makeup systems adjusted to account for relative elevations in the RPV.

8. Duty of containment cooling heat exchangers based on 40 years of crud.

9. No offsite power.

10. SRV capacities at 122.5% of ASME rated.

11. Licensed decay heat curve for containment analysis (adjusted to account for delay between scram and isolation).

12. The feedwater flow stops when the accident begins (see 9, above).

13. Event terminates in cold shutdown.

14. LPCI, core spray, and ADS available.

15. Limiting small line break.

16. One ADS valve out of service as allowed in Technical Specifications.

EVENT 4* - ISOLATION AND REACTOR DEPRESSURIZATION

Initial Conditions

1. Operation at Technical Specification safety analysis limit steam flow conditions. (D2/3 = 105% rated).

2. Maximum containment cooling heat exchanger service water temperature. (D2/3 = 95°F).

3. Suppression pool temperature at normal power operation Technical Specification limit (T_{op}). (D2/3 = 95°F).

4. Minimum Technical Specification suppression pool water volume. (D2/3 = 112,000 cu. ft.).

5. Recirculation pumps operating.

Event Sequence

Dresden Units 2 and 3 are depressurized from an isolated condition using the emergency condenser. If a relief valve# inadvertently failed open, the event sequence would be the same as that for Event 2. Otherwise, D2/3 does not use relief valves for cooldown, and this event would not occur.

Assumptions for Event 4

None

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or safety-relief valve