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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Potential Common Mode Failure of the Safety Related
Static Uninterruptible Power Supply Units

Gentlemen:

The purpose of this letter is to provide you with the results of Waterford 3's assessment regarding a potential common mode failure of the safety related Static Uninterruptible Power Supply Units. LER 97-020-00 dated July 3, 1997 was submitted in letter W3F1-97-0157 to report this condition. Waterford 3 does not consider this condition to be a startup restraint.

On June 4, 1997, during Refueling Outage eight (RF08), with the plant in mode 6, Waterford 3 identified a potential common mode failure associated with the safety related Static Uninterruptible Power Supply (SUPS) units. The condition involves a potential for momentary loss of both trains of safety SUPS power due to a recently recognized race between the SUPS shutting down or entering current limiting mode and the applicable individual load breaker opening to clear a fault. The SUPS wins the race due to the inherent 'fast acting' shut down design characteristics.

Waterford 3 conducted a review and assessment of the condition and identified all affected plant areas. The assessment included a review of the possible events that could initiate the SUPS common mode failure. Events considered included fire,

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flood, moderate energy line break, high energy line break, seismic and tornado missile. Engineering and Operations reviewed wiring diagrams and off-normal procedures to determine the impact of the condition on achieving safe shutdown. Attached is a summary of review and assessment results. Results indicate that Waterford 3 maintains the ability to safely shut the plant down.

The attached assessment summary supports Waterford 3's conclusion that the plant is safe to startup and return to 100% power, upon completion of RF08. Engineering is currently evaluating the best solution of the condition (see attached assessment).

If you have any questions or require additional information, please contact me at (504) 739-6242 or Oscar Pipkins at (504) 739-6707.

Very truly yours,

for

E.C. Ewing
Director
Nuclear Safety & Regulatory Affairs

ECE/OPP/ssf
Attachment

cc: E.W. Merschoff, NRC Region IV
C.P. Patel, NRC-NRR
J. Smith
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NRC Resident Inspectors Office

Assessment of
Potential For SUPS Common Mode Failure

I. CONCLUSION

Waterford 3 Engineering has completed a review of potential safety Static Uninterruptible Power Supply (SUPS) vulnerability to common mode failure. Consideration was given to potential common mode failures due to fire, flood, seismic, moderate energy line break (MELB), high energy line break (HELB), and tornado missile events in applicable plant areas.

Results of the review indicate that the safety SUPS units are not vulnerable to common mode failure due to flood, seismic, HELB and MELB. The HELB jet maps were included in the evaluation. The Containment Building is adequately addressed via required separation, cable size fault characteristics and/or physical location of equipment. There are no high energy line systems in the Fuel Handling Building (FHB).

Potential SUPS common mode failures were determined to exist from two sources:

1) fire damage to cable in plant areas identified in section IV.a of this assessment and

2) tornado missile damage to cables in the 'Q' deck area, as described in section VI.a of this assessment.

The first potential common mode failure source scenario involves a potential for momentary shutdown or current limiting of multiple SUPS units / trains caused by faults induced by fire. Non-safe shutdown cables, unprotected from fire damage became recognized as a factor due to a recently recognized race between individual load breakers and the SUPS inherent fast acting design to shut itself down or limit current to protect itself from faults. This inherent SUPS design is original and is not due to modification. Waterford 3 has initiated fire impairments in the affected areas and has compensatory actions (hourly or continuous fire watches as applicable) in place that are in compliance with the plant's licensing basis and approved fire protection program. The compensatory actions in

place were previously in the approved Waterford 3 Technical Specifications and now reside in the Technical Requirements Manual (TRM). The compensatory measures being applied are consistently applied in the nuclear industry to assure quick identification of, response to and control of potential fires pending completion of corrective actions.

The second potential common mode failure source scenario involves the potential for a tornado missile to strike applicable non-safe shutdown cables in the 'Q' deck area. The condition involves cables in two conduits. The assumption is that tornado missile damage induced faults could result in the above mentioned breaker/SUPS race and shutdown / current limiting of multiple SUPS units / trains. Since this SUPS vulnerability was not recognized at the time of the earlier plant walkdowns to identify conduits for tornado missile impact, they were not included in those calculations. The end devices (four rad monitors and two dampers in the FHB) are needed whenever irradiated fuel is in the Spent Fuel Pool. Engineering calculations now demonstrate (considering the additional conduits) that the overall probability of damage by tornado missiles is very low (1.76×10^{-7}) and is within acceptable limits.

Therefore based on the above, Waterford 3 concludes that it is safe in regard to these issues to restart the plant and return to 100% power with the stated compensatory actions in place.

II. SAFETY SIGNIFICANCE

The condition does not introduce new failure modes. The impact of the condition is that it could require the Operator to perform additional realignments of some safe shutdown loads that are sensitive to momentary interruptions/dips in voltage. As the fire progresses, unprotected non-safe shutdown cables, fed from the protected train SUPS unit could become involved in the fire. This could result in recurring instances of the race between the individual load breakers and the SUPS units momentarily shutting down (or entering current limiting mode) to clear the faults. Since the unprotected non-safe shutdown cables remain connected to the SUPS buses after transfer of control to the remote shutdown panel, the potential realignments could continue after control has been transferred. However, assuming the Appendix R fire, the number of recurrences would be limited to the number of unprotected cables within the 20' radius. Also, once a cable faults and clears, it would

no longer be connected to the bus, and therefore would not contribute to further momentary interruptions/dips in voltage. Engineering and Operations have reviewed the safe shutdown loads against wiring diagrams and off-normal procedures to assess the potential impact on safe shutdown and determined that the condition is manageable with existing procedures. The condition would not prevent safe shutdown of the plant. The review was conducted assuming a Control Room / Cable Vault fire which would be the bounding scenario.

There were no actual safety consequences and implications associated with the condition since no actual fire event was involved. The condition does not impact equipment operability. The safe shutdown analysis remains valid. The Fire Protection Program at Waterford 3 is designed upon defense in depth, which remains intact. No actual Waterford 3 events have occurred involving a common mode failure of multiple trains of safety related SUPS units. The potential for common mode failure associated with this condition has existed from initial plant startup. The condition did not compromise the health and safety of the general public.

Engineering calculations demonstrate that the overall probability of damage by tornado missiles is very low (1.76×10^{-7}) and is within acceptable limits. Therefore, the potential of tornado missiles as a source of safety related SUPS common mode failure is not safety significant.

This condition is being reported under separate cover to the NRC in LER-97-020-00.

III. BACKGROUND

Waterford 3 has six safety related SUPS units, two of which were procured from Elgar Corporation (SA & SB) and the other four (MA, MB, MC, and MD) were procured from Solidstate Controls, Inc. (SCI). The Elgar and SCI SUPS units are designed with 10KVA (83 amp @ 120 VAC) and 20KVA (167 amp @ 120VAC) output, respectively. The SUPS units are designed with internal protective features. The SA and SB (Elgar) SUPS units were designed with a fast acting "fault" circuit that shuts off the inverter very rapidly when a fault draws current exceeding 165% of its full load. The Elgar SUPS units will restart approximately 30 cycles after every shutdown until the fault clears. The MA, MB, MC, and MD SUPS units maximum outputs are 120% of the full load. Therefore, any fault that exceeds the 120% limit will cause the SCI SUPS units to go into current limiting mode.

Condition Report CR-97-0334 was generated which documented a sequence of events that began with a tripped circuit breaker (PDP 390-SA Circuit 34) at 2131 on February 11, 1997 with the plant in Mode 1 at 100% power. Various plant equipment fed from PDP 390-SA actuated and repositioned. Maintenance later found a shorted isolation relay (CMUEREL 1530 A) on PDP 390-SA circuit 34. This Electro Switch relay internal diode bridge had apparently shorted as a result of being mechanically bound in the high voltage energize mode for an extended period of time. SUPS 3A, feeding PDP 390-SA went into current limit mode and reduced the output voltage to PDP 390-SA. The load breaker (circuit 34) tripped to clear the fault. Shortly thereafter, at 2142 a similar occurrence was experienced when another breaker (PDP 390-SA circuit 44) tripped. After circuits were meggered and checked, on February 12, 1997 at 0140, Operations re-closed PDP 390-SA circuit 44. The breaker tripped again, causing another perturbation of SUPS 3A-S. Once again, equipment fed from PDP 390-SA actuated and repositioned. It was later determined that the breaker was tripping due to a shorted diode bridge on another Electro Switch Relay (ARM EREL 2685). In the cases above, the SUPS experienced a momentary shutdown, inherent to the design of the SUPS. The SUPS units restarted automatically after the individual Load breakers cleared the loads. The condition described above was initiated from failed components, which affected one train of safety SUPS.

Condition Report 97-0988 documents a condition, originally discovered on April 23, 1997 during Refuel 8, wherein it was determined that a fire in the switchgear room could potentially result in the momentary loss of a safety related SUPS. The initial review of the condition indicated that it would only affect one train of SUPS. At that point, the condition was not considered to be reportable. However, after subsequent Engineering discussions with the SUPS vendors and further reviews, Waterford 3 concluded, on June 4, 1997, that potential existed for a common mode failure (momentary shutdown or current limiting) of multiple safety SUPS units / trains. Although the potential SUPS failures would be momentary, the perturbation could be enough to require Operations to manually reset safe shutdown loads on multiple SUPS units / trains. It was determined that the perturbations could result if a fire were to start in plant areas that have unprotected, non-safe shutdown cables from various safety SUPS units, routed less than 20' apart or if the cables were in a plant area susceptible to tornado missile strike damage. This scenario assumes that the cables would fault and that the applicable, individual load breakers

would trip after cycling the SUPS units. The SUPS units shut down / limit current when the resulting fault current and load current exceed the SUPS capacity to supply power. The SUPS would restart, then shut down and repeat this action in rapid succession until the applicable, individual load breaker trips. A four hour call was made to the NRC Operations Center reporting the condition on June 4, 1997 at 1624 (Central Standard Time) in accordance with 10CFR50.72(b)(2)(iii)(A).

With respects to potential tornado missile damage, on October 21, 1996, Entergy, Waterford 3, provided a letter (W3F1-96-0118) to the NRC, regarding tornado missile protection for the Ultimate Heat Sink (UHS). This letter dealt with the evaluation of the vulnerability of some conduit for the UHS routed above the Reactor Auxiliary Building walls to tornado missiles. The letter also provided some perspectives about the design and licensing basis for the UHS and a discussion of the design and licensing basis work planned for tornado missile protection. Another letter (W3F1-97-0132) was submitted to the NRC dated June 4, 1997 which provided an update regarding the resolution of the conduit issue and to apprise the NRC about the follow-up work which has been performed on the design and licensing basis for tornado missile protection. Since October 1996, Waterford 3 personnel have performed various walkdowns and intensive evaluations to identify the cables in the conduits and the affected equipment. A confirmatory calculation verified that the total probability of tornado missiles striking targets was 1.64×10^{-7} which meets the design and licensing basis of record. This probability also reasonably meets the probability acceptance criterion of Regulatory Guide 1.117 which was promulgated after the approval of the Waterford 3 design and licensing basis. Although not required (based on low probability of damage) vulnerable conduits were re-routed.

IV. POTENTIAL FOR COMMON MODE FAILURE DUE TO FIRE

a. Description of all known and suspected areas of concern.

A review was conducted to identify the areas where the SUPS load cables are routed. This review was conducted to establish the susceptibility of the SUPS units to fire induced faults. The susceptibility was evaluated based on the Appendix R separation requirement of twenty feet between redundant trains. Areas containing applicable cables which receive power from the safety related SUPS units, that fail to meet the

separation requirement of Appendix R, Section III.G.2 are listed below. The circuits in the Reactor Containment Building were examined and are not affected because the circuits meet the cable size and distance requirements to limit short circuit current to where the SUPS can handle it or they meet the Appendix R separation requirement.

The affected areas from a fire perspective are:

Reactor Auxiliary Building Elevation + 7

Reactor Auxiliary Building Elevation +21 Switchgear Rooms

Reactor Auxiliary Building Elevation +35 Cable Vault, Electrical Penetration Area 'A', Relay Room

Reactor Auxiliary Building Elevation +46 Control Room

Reactor Auxiliary Building Elevation +46 Control Room HVAC, Corridor, QSPDS

Reactor Auxiliary Building Elevation -35 Corridor

Reactor Auxiliary Building Elevation -4 Wing

Fuel handling Building +21 & +1

+21 'Q' deck, + 21 Wing

+21 CCW Heat Exchanger A & B

Reactor Auxiliary Building +46 Heating & Ventilation Chiller Room

The conduits involved carry safety related cables and therefore are seismically mounted. Therefore it is not credible to assume damage will occur to the cables due to a seismic event.

b. Compensatory actions.

In accordance with Waterford 3 Technical Requirements Manual (TRM) LCO 3.7.11 action statement, the plant established a continuous fire watch in the 'Q' deck area and hourly fire watches in other applicable areas. These compensatory actions were previously included in the

approved Waterford 3 Technical Specifications and now reside in the TRM. The continuous (vs hourly) fire watch was required in the 'Q' deck area since there is no fire detection in that area.

Continuous fire watches will be required any time transient combustibles are in affected risk significant areas. Continuous fire watches are required, in accordance with the Fire Protection Program for any hot work performed in the affected areas. The applicable risk significant areas (during power operations) are the Control Room, the H&V Mechanical Equipment Room (primarily, the Essential Chillers), and the +21 Switchgear areas.

c. Corrective Actions

A fire area by fire area review (for affected areas) has been performed, assessing the fire related considerations and fire protection features. The areas in which affected cables are routed are provided with automatic analog addressable fire detection capability (except in the 'Q' deck area) which would sense the development of a fire in its incipient stages and provide Control Room notification of the fire location. Several of these areas are also equipped with automatic fire suppression capability that would act to suppress or contain a fire. Manual fire fighting capability is provided to these locations in the form of a class 1 standpipe system and portable fire extinguishers. The fire duration within the affected fire areas are considered to be low with the exception of the Cable Vault / Control Room. However these areas are either continually manned or equipped with full area automatic suppression and detection capability. Transient fire loadings, in the risk significant areas as identified by the IPEEE fire analysis, are being provided with a continuous fire watch (as a compensatory measure) to ensure that assumptions have not been invalidated.

The following is a list of the docketed analyzed fire durations for each affected fire area:

Table 1

Area Description	Fire Area	Detection	Suppression	Fire Duration
RAB-35 Corridor	RAB 39	Y	Y	45 min
RAB-4 Wing	RAB 32	Y	Partial	15 min
RAB+7	RAB 27	Y	Y	60 min
RAB+21 Switchgear room	RAB 8A	Y	Y	45 min
	RAB 8B	Y	Y	45 min
	RAB 8C	Y	Y	45 min
RAB+35 Cable Vault	RAB 1E	Y	Y	135 min
RAB+35 Elec Penetration 'A'	RAB 6	Y	Y	75 min
RAB+35 Relay Room	RAB 7	Y	Y	15 min
RAB+46 Control Room HVAC	RAB 1B	Y	N	30 min
	RAB 1C	Y	N	15 min
	RAB 2	Y	Partial	45 min
FHB+21	FHB	Y	N	7 min
RAB+21 Q Deck	CTA	Partial	N	15 min
RAB+21 Wing	RAB 25	Y	N	56 min
RAB +21 CCW HX A & B	RAB 17	Y	Y	13 mmin
	RAB 18	Y	Y	2 min

Engineering evaluated all SUPS non-safe shutdown loads to determine whether the control cables meet the requirements specified in Table 2 (below) and/or Appendix R separation criteria.

Table 2

Cable Size	Ω per 1000 ft	Distance From SUPS A	Distance From SUPS B
#14	3.2574Ω	220 ft	215 ft
#12	2.0527Ω	348 ft	341 ft
#10	1.2894Ω	555 ft	543 ft
#8	0.8127Ω	880 ft	860 ft
#4	0.3259Ω	2,194 ft	2,145 ft

Engineering and Operations reviewed drawings and procedures to assess the impacts of momentary loss of power on SUPS safe shutdown loads. Results of the reviews indicated that the perturbations have no significant impact on safe shutdown. Either the safe shutdown loads would come back after brief interruption, or would not have time to change state or were addressed in existing Operations off-normal procedures for restoring the plant after the loss of a SUPS or after a spurious ESFAS actuation.

Operators are being briefed in shift turnover meetings about the potential impacts of the condition on their activities during a fire in the affected areas. No new procedures are required to mitigate the potential event.

Fire detection will be installed in the 'Q' deck area. Once the installation is complete, the fire watch activity in that area will be adjusted from continuous to hourly in accordance with the Fire Protection Program. A work authorization (WA) repair package is being developed for this work.

The following design changes are being evaluated:

1) providing capability to clear faults on the affected circuits without causing unnecessary circuit interruptions for safe shutdown loads through use of appropriate fusing.
2) meeting the requirements of 10CFR50, Appendix R, Section III.G.2.c for the affected circuits in one or more fire areas by enclosing the circuits in a fire barrier having a 1-hour rating, where fire detection and automatic suppression is provided in the fire area.
3) upgrading at least one train of safety related SUPS.

d. Schedule For Completion of Action

The 'Q' deck fire detection installation is planned to be completed by the end of 1997.

SUPS upgrade is planned to be complete by the end of Refuel 9 unless an alternate corrective measure is selected in the interim.

e. Why it's acceptable to change modes/startup prior to completing corrective actions.

Engineering and Operations have reviewed the safe shutdown loads against wiring diagrams and off-normal procedures to assess the potential impact on safe shutdown and determined that the condition is

manageable with existing procedures. The condition would not prevent safe shutdown of the plant. The review was conducted assuming a Control Room / Cable Vault fire which would be the bounding scenario. The condition does not impact equipment operability. The safe shutdown analysis remains valid. The Fire Protection Program at Waterford 3 is designed upon defense in depth, which remains intact.

Fire watches have been and continue to be the accepted industry compensatory action for inoperable fire barriers such as those required by Appendix R, Section III.G.2. Waterford 3's licensing basis TRM 3.7.11 action statement provides for operating with one or more of the required fire rated assemblies inoperable. The action statement requires providing compensatory measures in the form of hourly or continuous fire watches. This same requirement was formerly part of the Waterford 3 Technical Specifications and was transferred intact to the TRM.

V. POTENTIAL FOR COMMON MODE FAILURE DUE TO FLOOD, MELB AND HELB JETS

a. Description of suspected areas of concern.

For flood considerations, the areas known and suspected of concern are those areas with end devices fed by the safety related SUPS units. Conduit routes are not of particular concern for this potential mode of failure, since the cables are in sealed conduits and have jackets that can be submerged in water without faulting. Therefore rooms where end devices are located were walked down to observe approximate height of the end device terminations. The assumption is that a fault would occur if the water level in the room reaches the height of the terminations. Also considered in this review was the existence of a credible source of internal flooding in or adjacent to the area of concern. The areas were broken down into the major areas of:

1) Reactor Containment Building (RCB),
2) Reactor Auxiliary Building (RAB), and
3) Fuel Handling Building (FHB)

The areas were evaluated for flooding associated with High Energy Line Break (HELB) and Moderate Energy Line Break (MELB). The HELB jet maps were also evaluated for the areas of concern.

1) RCB - Flooding, HELB and MELB

Results of Engineering evaluation demonstrated that potential for SUPS common mode failure is adequately addressed inside the Containment Building either by required separation, cable size fault characteristics and/or physical location of the equipment.

2) RAB - Flooding, HELB, and MELB

The criteria employed in the flooding analysis are based on Branch Technical Positions APCSB 3-1, "Protection against postulated Piping Failure in Fluid Systems Outside Containment" and MEB 3-1, "Postulated Break and Leakage Locations in fluid system piping outside Containment." Arbitrary intermediate breaks were eliminated by Generic Letter 87-11 and MEB 3-1 Rev. 2.

The high energy systems which are considered for pipe rupture analysis outside the Containment are:

- Chemical and Volume Control System (Charging and Letdown)
- Steam Generator Blowdown System
- Main Steam and Feed Water

The effects of the high energy pipe break flooding from the above mentioned systems are not critical for the following reasons.

CVCS Charging and Letdown Piping Breaks

The CVCS Charging and Letdown piping is a maximum of 2-1/2" nominal size and is routed through a pipe chase from the penetration to the Charging Pump room and the Letdown Heat Exchanger area. The flooding of the pipe chase due to breaks in CVCS charging or letdown piping inside is bounded by the following flood analysis.

Steam Generator Blowdown Piping Breaks

The Blowdown (BD) System piping in the penetration area is a maximum 4" nominal size. If there is a break in this system, the BD system water goes to the floor at elevation -4.0'. The floor is not compartmentalized and the drains located in the floor will conduct the fluid to sumps at elevation -35.0'. This prevents the flood level from reaching safety related

equipment on -4.0' elevation. The engineering evaluation determined that SUPS common mode failure due to CVCS (charging and letdown) and Blowdown line breaks does not exist and no further evaluation is necessary.

Main Steam and Feedwater Piping Breaks

Consequences of flooding from failure of Main Steam and Feedwater lines is not considered because the piping is located on the roof of RAB +69.0' elevation and the roof drains will prevent fluid accumulation. Since the Main Steam and Feedwater piping is routed outside, on top of the RAB roof, and the RAB +46 wing area locations, flooding is not a concern for these areas.

The engineering evaluation determined that the potential for SUPS common mode failure does not exist on the RAB +69.0' roof and in the +46 wing area locations.

The fluid jets from the CVCS (Letdown and Charging) lines will be confined to the pipechase and separate compartments and will not affect equipment potential to affect SUPS common mode failure.

The high energy piping system in the RAB (Charging and Letdown, Blowdown, Feedwater and Main Steam) will not have any adverse environmental effect due to pipe break in CVCS, FW and MS lines for the above stated reasons. A break in a Steam Generator Blowdown system will not result in any adverse environmental impact on the equipment potential to affect SUPS common mode failure. The only concern of steam due to HELB exists in -4 west side wing area of RAB due to a Blowdown line. Four rad monitors located there are qualified for harsh environment and therefore a concern does not exist. These four radiation monitors are RM80s, located in room B110 at RB-4, Col 8A and LY, located underneath the Containment personnel hatch access stairs.

These RM80s are identified as ARMIRE5024, 5025, 5026, & 5027 and are used to generate the CPIS. The environmental qualification performed on the RM80 is documented in EQ File 08.03E per test report E-225-996 dated July 1981. The tested Area Radiation Monitor RM80 was subjected to an environmental extremes test at 90 °F and 98% relative humidity while being tested for functionality. This test unit was

also subjected to an age conditioning margin test which included a total of 27 hours at 140 °F and 80-90% relative humidity in nine separate 3 hour cycles while being functionally tested. There were no reported failures of the test specimen during the elevated periods of temperature and humidity.

The operator for valve 3CC-F131B located in the RAB -35 corridor near column line 11A, 12A, J and H is above one foot off the floor and there are no High Energy lines in this area. Other affected areas do not have HELB steam and jet exposure.

Leakage crack qualification is required for the moderate energy systems. A moderate energy piping system is defined as: Any system, or portion of a system, where the maximum operating temperature is 200 °F or less and maximum operating pressure is 275 psig or less, during normal plant operating conditions.

If stresses in the pipe are below the threshold value defined in the MEB 3-1, then cracks are postulated in the pipe for that point.

For piping sizes 1" outside diameter and under, no cracks are postulated.

Based on the above criteria, Calculation MN(Q)-3-5 and MN(Q)-3-6 were initiated to identify all the moderate energy lines in the critical areas of the RAB.

In the above calculation, flow rates from the cracks for each of the critical lines (which produces the worst flooding) are calculated and then the particular area is reviewed to determine the flow out via drains. The net flow rate for any particular area is the total crack flow rate minus the total drain flow rate for that area.

Based on the above computed net flow rate, the time to flood any particular area to a depth of one foot is determined by the following equation.

Time for 1 foot flood in the Area = Floor Area / Net Flow Rate

Per FSAR condition 3.6A.6.4.2e, thirty minutes from event alarm to the completion of protective action such as closing or opening valve., shutting off or starting a pump etc. is considered to be ample time.

Failure of flood and equipment drain piping, so that it will not convey water, has not been the design basis for Waterford 3. However, even if such failure were to occur, water would be conveyed to the lowest elevation in the building by stairways, elevator shafts, equipment hatches, etc.

Answer to the FSAR question 010.34 states that an evaluation of flooding potential was performed by determining the maximum flow from the two largest lines and then doubling this to account for all other lines.

A. 7CC12-38, maximum flow of 318 gpm and
B. 7CW16-31, maximum flow of 214 gpm

The RAB is divided into two sections at the -35.00' elevation where all fluid will accumulate from postulated break in high and moderate energy lines.

1. Between Columns G and L, 1A to 12A. This section has approximately 13,000 ft^2 area in which the flow from the various cracks would eventually collect. Assuming all of the flow collects there, it would take a minimum of 91 minutes to reach a depth of 12 inches.

2. Wing Area, between Columns L and N, $2A_z$ and $11A_z$. This section has approximately 7,000 ft^2 in which the flow from the various cracks would eventually collect. Assuming all of the flow collects there, it would take a minimum of 49 minutes to reach a depth of 12 inches.

In these two areas, safety related equipment of SUPS common mode failure concern are mounted on a pedestal at least 12" high. The safety related instrument cabinets are empty of essential components for at least the bottom 18 inches. In order to provide positive indication in the control room of a flood condition, four Seismic Category I, Class 1E level switches are installed in these two areas on the floor at -35.00' elevation. These switches will raise an alarm should the water reach a depth of approximately three inches. The operator will have sufficient time after the alarm is sounded to stop the flooding process before it reaches a depth which would compromise the safe shutdown capability. All equipment in the affected areas with potential Appendix R concern (Common mode failure for SUPS) are located at least 1 foot above the flood level and therefore flooding is not a concern for the SUPS common mode failure.

Jet and pipe whip due to moderate energy line break is not a design basis for Waterford 3 and this section is not applicable for SUPS common mode failure assessment. High temperature steam is not an EQ concern for moderate energy lines.

3) FHB - Flooding, HELB, and MELB

HIGH ENERGY SYSTEMS

No high energy systems are located in the Fuel Handling Building and therefore flooding, steam and jet impingement due to high energy pipe break is not a credible event at all floor elevations in the FHB.

MODERATE ENERGY SYSTEMS

The following systems are included in the flooding evaluation inside the FHB:

1) Fuel Pool system
2) Fire Protection system

Maximum fluid flow rate based on above assumptions and line sizes, was computed to be very small. This fluid will be conveyed to the -35.00 ft elevation of the FHB. It is calculated that at the end of three hours, depth of water would be approximately five inches. There are no safety related components less than twelve inches above the floor.

Engineering Calculation MN(Q)-3-6 evaluated FHB +1 floor for moderate energy line break and concluded that more than 30 minutes are required to flood this area to a depth of one foot. Since equipment affecting common mode failure of SUPS are located above this water depth, flooding will not affect the common mode failure of affected SUPS.

Jet and pipe whip due to moderate energy line break is not a design basis for Waterford 3 and this section is not applicable for SUPS common mode failure assessment.

Therefore, flooding, EQ, jet and pipe whip in the FHB due to moderate energy line break is not a concern for the SUPS common mode failure.

b. Compensatory actions.

None required.

c. Corrective Actions.

Non-applicable.

d. Schedule For Completion of Action.

Non-applicable.

e. Why it's acceptable to change modes/startup prior to completing corrective actions.

There are no credible potential for SUPS common mode failures due to flooding, HELB, or MELB.

VI. Potential For Common Mode Failure Due To Tornado Missiles:

a. Description of all known and suspected areas of concern.

Plant areas housing cables that are connected to the safety related SUPS units in the RAB, FHB, and Containment Building are protected by concrete walls which act as tornado missile barriers as described in General Design Criteria (GDC) 4, except for the 'Q' deck area. Therefore, only the 'Q' deck area is considered in this review for cables vulnerable to tornado damage that could possibly result in common mode failure of the safety related SUPS units.

Conduits 35066-SA-4 and 36936-SB-4 have been identified (as a result of this review) to fit the criteria of being a potential target in the 'Q' deck area that could be damaged by a tornado missile and result in the loss of both the SA and SB SUPS units. Assuming a worst case condition wherein both conduits 35066-SA-4 and 36936-SB-4 are damaged resulting in cables faulting; or one conduit is damaged by the tornado and a single failure occurs concurrently on the other, both SUPS units SA and SB could conceivably momentarily shut down or go into current limiting mode, assuming the SUPS units win the race between the SUPS units and the individual load breakers to clear the faults.

This condition was not recognized in the recent efforts to identify potential tornado vulnerability (letters W3F1-96-0188 and W3F1-96-0132) due to the recent recognition of the potential race between the SUPS units and the individual load breakers on the SUPS units. The conduits involved are not carrying cables that connect loads required for Safe Shutdown.

The affected conduits carry cables associated with four rad monitors and two dampers. These end devices are required whenever there is irradiated fuel in the Spent Fuel Pool.

Waterford 3 was evaluated for offsite hazards, which included tornado missiles from natural phenomena, on the basis of a commonly applied qualitative probability standard of 10^{-6} documented in Standard Review Plan (SRP) section 2.2.3. The qualitative probability standard specifically states that "...the expected rate of occurrence of potential exposures in excess of 10 CFR Part 100 guidelines of approximately 10^{-6} per year is acceptable if when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower." SRP 3.5.1.4 reinforced this standard by stating, "... The methodology of identification of appropriate design basis missiles generated by natural phenomena shall be consistent with the acceptance criteria [10^{-6} per year] defined for the evaluation of potential accidents from external sources in SRP 2.2.3." SER section 3.5.1.4 concluded that the missile spectrum and the identification of missiles generated from natural phenomena was acceptable and met the guidelines of Reg Guide 1.76. Reg Guide 1.117 was later promulgated by the NRC, and this regulatory guide defined a credible tornado strike as having a probability of occurrence of 10^{-7} per year. However, Waterford 3 is not committed to Regulatory Guide 1.117 in the FSAR. Although a reference to Reg Guide 1.117 is made in the SER in section 3.5.2, there is no mention made to the 10^{-7} per year criterion, nor does the SER cite any acceptance criteria in referencing Reg Guide 1.117.

Engineering has now completed preliminary calculations of the probability of tornado missile strike for the three conduits located in overhead space of the 'Q' deck between the FHB and RAB wing wall (between column line 'T' and 'P1' and '1M' and '2FH'). The calculation results demonstrate that the tornado generated missile strike probability for these conduits is very low and within acceptable limits. The total probability of tornado missiles

striking any of the targets considered in Rev.0 of calculation EC-C97-003 was calculated to be 1.64×10^{-7} without the three conduits mentioned above. When the conduits are included, the total probability becomes 1.76×10^{-7}. This probability meets the design and licensing basis criterion of low probability of damage and 10^{-6}.

b. Compensatory actions.

No compensatory actions are required for tornado missiles due to the low (1.76×10^{-7}) acceptable calculated overall probability of damage including these conduits located in the 'Q' deck area.

c. Corrective Actions.

No corrective action is required for tornado missile strike due to the low overall (1.76×10^{-7}) calculated probability of damage.

d. Schedule For Completion of Action

Non-Applicable.

e. Why it's acceptable to change modes/startup prior to completing corrective actions.

No corrective action is required for tornado missile strike considerations. Mode changes and plant startup should not be impacted by the above described condition since the calculated probability of tornado damage to the Waterford 3 plant is acceptably low.