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

September 30, 1982

Mr. A. Schwencer, Chief
Licensing Branch #2
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: LaSalle County Station, Units 1 & 2
Modification of Automatic
Depressurization System Logic
NRC Docket Nos. 50-373 and 50-374

Reference: (a): License NPF-11 dated April 17, 1982
Condition 2.c.(30).(1).(a),
Modification of Automatic
Depressurization System Logic -
Feasibility for Increased Diversity
for some Event Sequences.

Dear Mr. Schwencer:

Reference (a) states, in part, that

"By October 1, 1982, the licensee shall evaluate the alternative design modifications of the BWR Owners Group relative to the logic for the automatic depressurization system, submit such evaluation, and propose modification to NRC for review and approval."

This submittal completes this requirement.

Attached is Commonwealth Edison Company's evaluation of the alternative design modifications as described in the Draft BWR Owners' Group report which was edited for applicability to LaSalle County Station. This is the third submittal on this topic; see FSAR Appendix L.62 (Amendment 56 which has been transmitted and amendment 61 which will be submitted in October, 1982). This third submittal augments the earlier versions by addressing the effects of ADS design options on future ATWS considerations and on present BWR Emergency Procedure Guidelines. The final recommendation is to incorporate a manual ADS inhibit switch coupled with a timer to bypass the existing high drywell pressure signal (for a predetermined interval). This modification extends the ADS logic coverage to the situations covered in the Emergency Procedure Guidelines and it is compatible with certain ATWS modifications contemplated for LaSalle.

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Enclosed for your use are one (1) signed original and thirty-nine (39) copies of this letter.

If there are any further questions in this matter, please contact this office.

Very truly yours,

CW Schroeder 9/30/82

C. W. Schroeder
Nuclear Licensing Administrator

lm

cc: Resident Inspector - LSCS
File - LSCS Operating License

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PART C: THIRD SUBMITTAL

Edison was a member of the BWR Owners' Group which sponsored this study to determine the feasibility, benefits and drawbacks of extending automatic initiation of the BWR Automatic Depressurization System (ADS). Options were considered to extend ADS operation to transient events which do not result in a release of steam to the drywell but which may require depressurization of the reactor pressure vessel (RPV) to maintain adequate core cooling. Eight different modifications or options, including retaining the current design, were compared.

The present design, given implementation of the BWR Emergency Procedure Guidelines (Revision 2), is adequate for all design basis events which require RPV depressurization to maintain adequate core cooling. However, ADS modifications which incorporate a manual ADS inhibit switch coupled with an interval timer could improve ADS operation for certain events and, simultaneously, better conform the ADS initiation logic to that employed in the Emergency Procedure Guidelines and to certain future ATWS modifications.

1. Introduction

This report supplements the previous feasibility study (NEDO-24951, Section 7) undertaken by the BWR Owners' Group to address NUREG-0737, Item II.K.3.18. That study identified two preferred ADS logic design modifications but did not consider the effects of those modifications on proposed designs for ATWS mitigation and on execution of procedures developed from the BWR Emergency Procedure Guidelines (EPGs). This study addresses these issues. The automatic depressurization system, through selected safety/relief valves, functions as a backup to the operation of the high pressure injection systems: feedwater, High Pressure Core Spray (HPCS), and Reactor Core Isolation Cooling (RCIC) for protection against excessive fuel cladding heatup upon loss of coolant over a range of steam or liquid line breaks inside the drywell. The ADS depressurizes the vessel, permitting the operation of the low pressure injection systems: condensate, Low Pressure Coolant Injection (LPCI), and Low Pressure Core Spray (LPCS). The ADS is currently activated automatically upon coincident signals of low water level in the RPV, high drywell pressure, and a low pressure ECCS pump running. A time delay of approximately 2 minutes after receipt of the signals allows the operator to reset the logic and prevent an automatic blowdown if the RPV water level is being restored or if the signals are erroneous. The ADS can be manually initiated as well.

For those transient and accident events which do not directly produce a high drywell pressure signal and are degraded by a loss of all high pressure injection systems, adequate core cooling is assured by manual depressurization of the reactor vessel followed by injection from the low pressure systems. Events which may require manual depressurization can be grouped into two classes: 1) reactor isolations (including breaks outside the drywell) with loss of high pressure makeup systems, and 2) reactor isolations with loss of high pressure make-up systems and coincident stuck-open relief valves (SORV). Both classes of events were considered in the development of possible changes to the ADS initiation logic even though the second class is beyond the current system design basis (which assumes a single failure). For transients that do not result in vessel isolation, the main condenser is available for depressurization and ADS operation is not required. Therefore such events are not included in this study.

It was shown in NEDO -24708A, "Additional Information Required for NRC Staff Generic Report on Boiling Water Reactors", Section 3.5.2.1, that the operator has at least 30 to 40 minutes to initiate the ADS and prevent excessive fuel cladding heatup for both of the previously described classes of events. This minimum time represents a "worst case" situation starting from full power with equilibrium core exposure and complete failure of all the high pressure makeup systems. Lower initial core power, low fuel exposure, control rod drive leakage flow, or partial operation of the high pressure systems would significantly increase the time available for operator action.

The intent of NUREG-0737 Item II.K.3.18 is to provide additional assurance of adequate core cooling for transient events which do not directly produce a high drywell pressure signal. This study evaluates the feasibility and desirability of various logic modifications or options which further automate RPV depressurization for these events.

The intent of NUREG-0737, Item II.K.3.18 may be satisfied in two ways: the ADS logic can be modified to cover specific ATWS transients as well as other events requiring core cooling, and the operator can be given specific guidance and trained to perform manual actions under these conditions. Following the accident at Three Mile Island, the second course of action was undertaken, resulting in the development of symptom-oriented EPGs for BWR's. Implementation of the EPGs improves the operator response to degraded transients by giving him explicit guidance for these conditions. The EPGs also provide him with greater awareness of the plant's response to transients as a result of improved training. BWR events in each of the previously described classes are slow, well behaved, well understood transients which allow the operator sufficient time to actuate ADS if it is needed. The symptom oriented procedures lead the operator through conditions of increasing levels of degradation (system failures) and provide specific guidance on when initiation of ADS is required. Thus with the implementation of the new emergency procedures, the operator can more reliably utilize ADS equipment to assure core cooling for a wide range of transient and accident conditions.

Anticipated transient without scram (ATWS) events were the primary focus in the development of proposed modifications to the ADS initiation logic. For certain ATWS events, it is necessary to inhibit ADS initiation and the accompanying water makeup to the vessel once boron injection has been initiated because boron concentration in the core can be diluted beyond effectiveness. Seven ADS logic modifications were considered, and the present logic is reviewed using the same basis used for evaluating the modifications. These eight options were evaluated as to transient response, compatibility with emergency procedures, reliability, and feasibility of implementation.

This study was an evaluation of conceptual feasibility as opposed to a detailed design assessment. The goal was to determine, using simple concepts and arguments, whether or not ADS needs further automation to be compatable to ATWS challenges and to be consistent with EPG's developed for the BWR.

2. ADS Logic Modification Options Considered

Eight ADS logic options are considered: the present design and seven logic modifications. The seven logic modifications considered combinations of the following five design features:

a. Elimination of the high drywell pressure trip portion of the existing logic,
b. Addition of a timer that bypasses the existing high drywell pressure trip logic when reactor water level is low for a sustained period of time,
c. Addition of a suppression pool temperature trip in parallel with the existing high drywell pressure trip logic,
d. Addition of a manual inhibit switch, and
e. Changing the low reactor water level trip setpoint to the top of the active fuel (TAF).

The first three features respond to Item II.K.3.18 while the last two respond more to ATWS and EPG concerns.

Elimination of the high drywell pressure trip will cause the ADS logic to actuate on a low reactor water level signal only. Addition of a bypass timer or a suppression pool high temperature trip in parallel with the existing high drywell pressure logic leaves the automatic initiation of ADS in response to a LOCA unchanged, but provides for automatic ADS actuation when required for transient events which do not directly pressurize the drywell.

For an ATWS event in which ADS actuation is not desired, addition of a manual inhibit switch makes it easier for the operator to prevent ADS actuation. Operation of the manual inhibit switch would prevent automatic initiation of ADS only.

Lowering of the low reactor water level trip elevation to TAF makes the automatic ADS logic consistent with most operator actions called for in the EPGs. However, for many plants this change is impractical since it would require installation of additional water level instrumentation. It is also inconsistent with present auto actuation of ECCS's at higher levels which provide a timing margin for subsequent manual operator actuation prior to core uncovery.

The eight logic options considered in this report are defined below; each is treated in subsequent sections; see Table L62-2 also:

Option 1. The present ADS logic design.

2. Deletion of the high drywell pressure trip portion of the existing ADS logic plus addition of a manual ADS inhibit switch,

3. Deletion of the high drywell pressure trip portion of the existing ADS logic plus changing the low reactor water level trip setpoint to the top of the active fuel,
4. Addition of a timer that bypasses the existing high drywell pressure trip logic when reactor water level is low for a sustained period of time plus addition of a manual ADS inhibit switch,
5. Addition of a timer that bypasses the existing high drywell pressure trip logic when reactor water level is low for a sustained period of time plus changing the low reactor water level trip setpoint for ADS to the top of the active level,
6. Addition of a suppression pool temperature trip in parallel with the existing high drywell pressure trip logic plus addition of a manual ADS inhibit switch,
7. Addition of a suppression pool temperature trip in parallel with the existing high drywell pressure trip logic plus changing the low reactor water level trip setpoint for ADS to the top of the active fuel, and
8. Addition of a manual ADS inhibit switch to the present logic.

2.1 Present ADS Logic Design (Option 1)

The first option considered was the present ADS logic design. With the implementation of the symptom oriented EPGs, the current logic satisfies the intent of NUREG-0737 Item II.K.3.18 in that additional guidance for use of ADS is provided beyond that which was previously available. It is not obvious that the advantages of further automation outweigh its disadvantages. The current design is thus a viable option in its own right because an adequate time interval is available for the LaSalle operators to respond to EPG's with manual ADS operation when needed.

The design requires a loss-of-coolant accident (LOCA) signal consisting of concurrent high drywell pressure and low reactor water level signals in order to actuate the ADS. Satisfying the actuation logic requires receipt of the high drywell pressure (2 psig) signal. Once this signal is received, it is sealed into the initiation sequence and does not reset even if the high drywell pressure condition subsequently clears. The other portion of the LOCA signal is low reactor water Level 1 where low pressure ECCS's are actuated. When both of the LOCA signals are satisfied, the ADS initiation logic confirms that reactor water level is indeed below the RPV scram water level setpoint (to prevent spurious actuations) and starts a 120 second* delay timer. Once started the timer is automatically reset if the reactor water level is restored above Level 1 before the timer times out. The timer also allows the operator time to reset the logic and thus prevent automatic blowdown if RPV water level is being restored or if the signals were erroneous. To complete the ADS initiation logic sequence, the running status of the low pressure ECCS pumps is automatically checked. This is done to provide some assurance

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*Typical value; the time interval of 120 seconds is applicable for LaSalle.

that makeup water is available for injection to the reactor vessel once it is depressurized below the low pressure interlock (500 psi) at which LPCS and LPCI can automatically inject.

Drywell cooling is lost in some older plants when the reactor water level decreases to Level 1; this is not the situation at LaSalle, however, the loss of drywell cooling results in drywell isolation and subsequent heatup of the drywell air space. This results in pressurization of the drywell above the pressure setpoint for ADS actuation. Thus in plants where drywell cooling is lost on low reactor water level, the present logic will act as a satisfactory backup to manual action for the events considered.

The symptom oriented EPGs are written assuming no modifications to the present ADS logic. The events considered are slow, well behaved, well understood transients which allow the operator sufficient time to actuate ADS if needed. The operator is provided explicit instructions in the EPGs on when to manually depressurize the reactor vessel if the high pressure makeup systems cannot maintain reactor vessel water level. These instructions are based primarily on the status of reactor vessel pressure and RPV water level, and secondarily upon the availability of high and low pressure injection systems. Thus, with the implementation of the new emergency procedures, the operator has improved instructions on the use of the ADS and can more reliably perform the actions necessary to respond to a wide range of transient and accident conditions.

2.2 Eliminate High Drywell Pressure Trip and Add Manual Inhibit Switch (Option 2)

The second option eliminates the high drywell pressure trip from the present ADS logic sequence and adds a manual switch which allows the operator to prevent (inhibit) automatic ADS initiation. The ADS sequence would then be activated on low reactor water Level 1 only. The remainder of the logic sequence remains unchanged from the present design. The effect of high drywell pressure on the operation of other safety systems, such as reactor scram and the ECCS that initiate on high drywell pressure, is unaffected.

The advantage of adding a manual ADS inhibit switch is that it simplifies the execution of certain steps in the EPGs. This assumes of course that ADS is not the desired response, as would be the case for an ATWS transient. To inhibit the ADS with the current logic requires the operator to continuously reset the two-minute delay timer or to lock out all of the low pressure ECCS pumps. Thus, the addition of a manually-operated ADS inhibit switch enhances operator reliability under potentially stressful conditions. But, on the other hand, the genuine situation where ADS is the desired response, as is the case for LOCA, the addition of the manual ADS inhibit switch merely adds another possible error path should the operator not be able to distinguish LOCA from ATWS transients. Operator default in such a case produces the correct response fortuitously; an erroneous ADS inhibit with decreasing water level conditions can lead to a worse condition including core uncovery prior to possible low pressure ECCS injection.

2.3 Eliminate High Drywell Pressure Trip and change Low Reactor Water Level Trip Setpoint (Option 3)

The third option eliminates the high drywell pressure trip from the present ADS logic sequence and lowers the low reactor water level trip setpoint to the top of the active fuel. The ADS would then be activated on TAF reactor water level only. The remainder of the ADS logic sequence remains unchanged from the present design. The effect of high drywell pressure on the operation of other safety systems, such as reactor scram and the ECCS that initiate on high drywell pressure, is unaffected.

The advantage of lowering the low reactor water level trip setpoint to TAF is that it makes the automatic ADS logic consistent with most operator actions called for in the EPGs. The Emergency Procedure Guidelines currently require opening all the ADS valves when the water level outside the shroud cannot be maintained above TAF (provided that boron is not being injected and a low pressure injection system is lined up with at least one pump running). Again, the focus is on transients rather than accidents.

The disadvantage of TAF initiation of ADS is that actual vessel water level may be lower than the sensed water level thus eliminating any margin for measurement errors fed into ADS logic. This configuration with TAF initiation of ADS represents a last-ditch situation in the EPG's in that no other manual injection of low pressure ECCS's is possible before possible partial core uncovery. All available water level contingency was foregone by using TAF for the manual initiation level; however by design the LPCS/LPCI autoinitiation point (L1) was selected to permit water spray addition on to a covered core rather than to spray onto a partially uncovered core simply because ADS initiation was deferred. (It is the difference between prudent design and Emergency Procedures). The present design allows operator backup action for recovery with emergency procedures (EPG's). No meaningful operator backup exists if LPCS/LPCI initiate at TAF level; in other words, a prudent basis for design does not have to duplicate a prudent EPG sequence, nor vice-versa.

2.4 Bypass High Drywell Pressure Trip and Add Manual Inhibit Switch (Option 4)

The fourth option bypasses the high drywell pressure portion of the current logic after a specific settable time interval and adds a manual switch which allows the operator to prevent (inhibit) automatic ADS initiation. The high drywell pressure signal is bypassed by installing a second ("bypass") timer that is actuated on low reactor water Level 1. When this timer runs out, the high drywell pressure trip is bypassed and the ADS is initiated on a low reactor water Level 1 signal alone. A manual ADS inhibit switch is also provided to aid the operator in the execution of certain steps in the EPGs (as previously discussed in Section 2.2). The additional logic does not affect the drywell high pressure-reactor low water level initiation sequence for ECCS high pressure injection systems or RCIC responses to pipe breaks inside the drywell. Once the bypass timer runs out, this option becomes the same as that previously discussed in Section 2.2. The only difference here is that for events which do not produce a high drywell pressure signal, the bypass timer gives the operator additional time to prevent an unnecessary automatic blowdown if the RPV water level is being restored or if the signals were erroneous.

A time delay of approximately eight minutes for the high drywell pressure bypass logic was chosen for preliminary evaluations. Calculation of an exact delay setting for the bypass timer requires that a plant specific analysis be conducted. This analysis is based on (1) avoidance of excessive fuel cladding heatup using the realistic evaluation models of NEDO-24708A, and (2) providing sufficient time to allow recovery of reactor water level above Level 1 during an ATWS event.

Starting the bypass timer at low reactor water Level 1 allows the operator the greatest time interval to control the ADS system manually and still have automatic depressurization actuate in time to prevent excessive fuel heatup even under the worst case conditions described above. For BWR/2-3, the bypass timer would automatically reset if the reactor water level is restored above Level 1. For BWR/4-6, once the bypass timer times out, the bypassing of the high drywell pressure signal would be sealed in and the bypass timer would not automatically reset. This is required to prevent repeated partial core uncovery because of the lower reactor water level trip setpoint elevation for BWR/4-6 plants.

2.5 Bypass High Drywell Pressure Trip and Change Low Reactor Water Level Trip Setpoint to TAF (Option 5)

The fifth option bypasses the high drywell pressure portion of the present logic after a specific time interval and lowers the low reactor water level trip setpoint to the top of the active fuel. This option works the same way as that discussed in Section 2.4 except the low reactor water level initiation setpoint has been lowered to TAF. Once the bypass timer times out the bypassing of the high drywell pressure would be sealed in for all BWR's and the bypass timer would not automatically reset. The advantages and disadvantages of Section 2.3 apply here also.

2.6 Add Suppression Pool Temperature Trip and Manual Inhibit Switch (Option 6)

The sixth option utilizes a suppression pool high temperature trip in parallel with the high drywell pressure trip and adds a manual inhibit switch which allows the operator to prevent (inhibit) automatic ADS initiation. For this option, the ADS initiation sequence would be initiated by either high drywell pressure or an elevated suppression pool temperature in conjunction with a low reactor water level signal. The remainder of the logic remains unchanged from the present design except for the addition of a manual ADS inhibit switch. There are two conditions that could be used to initiate the suppression pool high temperature logic: when the pool temperature reaches a specified value, or when the pool heats up faster than a specified rate. The heatup rate trip would require a data processing system to record the present pool the intent of NUREG-0737 Item II.K.3.18 in that additions guidance for use of the ADS is provided beyond that which was previously available. With the ADS inhibit switch, the operator knows he is in control of timing for the ADS function. With adequate response time interval available and EPG's to focus on adequate core cooling, the operator can capitalize on both the adequate ECCS design features of the BWR as they exist, and the new EPG's as they exist to respond to accidents and transients.

3. Transient Response Assessment

Each of the options was analyzed (1) as to whether adequate core cooling is assured for isolations (including breaks outside the containment) with or without an SORV, (2) for its effect on LOCA analyses contained in Safety Analysis Reports, and (3) for its effect on ATWS mitigation (assuming Alternate 3A plant modifications).

3.1 Isolation Transients

Note: Although isolations events produce water level transients they are not in themselves a transient (frequency) event. By lowering the MSIV actuation level from Level 2 to Level 1 many isolation events can be avoided, containment and suppression pool loadings can be minimized, and core inventory control can be satisfied more easily.

For these analyses it is assumed that scram is successful but all high pressure injection systems fail to operate. For these events the ADS must function to depressurize the reactor vessel and allow the low pressure makeup systems to inject. The modeling used in these analyses is the same as that which was previously used in NEDO-24708A.

3.1.1 Present Design (Option 1)

The present logic does not automatically actuate the ADS specifically for transient events considered. However as stated earlier, the operator has 30 to 40 minutes to depressurize the vessel and prevent inadequate core cooling under these worst case conditions. This is sufficient time to assess the situation and manually take the necessary corrective actions. The present design uses a conservative approach such that level margin exists between level 1 (actuation of ADS) and TAF to provide a reserve for water level uncertainties, measurement errors, miscalibrations, etc., thus enabling a subsequent (manual operator) response with low pressure ECCS's following vessel depressurization but prior to serious core uncovery.

3.1.2 Eliminate High Drywell Pressure Trip and Add Manual Inhibit Switch (Option 2)

The addition of a manual inhibit switch to the ADS initiation logic for this option has no effect on the automatic ADS response to isolation events. In addition, the manual inhibit switch makes it easier for an operator to prevent an undesired ADS actuation for the situation described above.

3.1.3 Eliminate High Drywell Pressure Trip and Change Low Reactor Water Level Trip Setpoint (Option 3)

Elimination of the high drywell pressure trip for this option produces a reactor system response which is similar to Option 2 for the transients considered in this study. The only difference is that automatic ADS actuation will occur after the reactor level drops to TAF instead of Level 1.

3.1.4 Bypass High Drywell Pressure Trip and Manual Inhibit Switch (Option 4)

Addition of a timer bypassing the high drywell pressure portion of the current ADS logic will result in ADS actuation occurring approximately ten minutes after low water reactor level trip setpoint (Level 1) is reached. The analyses and conclusions presented in Section 3.1.1 are applicable here.

3.1.5 Bypass High Drywell Pressure Trip and Change Low Reactor Water Level Trip Setpoint (Option 5)

Bypassing the high drywell pressure trip for this option produces a reactor system response which is similar to Option 4 for the transients considered in this study. The only difference is that the bypass timer would begin running once the reactor water level drops to TAF.

3.1.6 Add Suppression Pool Temperature Trip and Add Manual Inhibit Switch (Option 6)

Because the suppression pool temperature trip can be used for the same function for isolation transients as the high drywell pressure trip provides for a LOCA, the discussion and conclusions presented in Section 3.1.1 are applicable for this option. The addition of a manual inhibit switch to the ADS initiation logic for this option has no effect on the automatic ADS response to isolation events. It also makes it easier for an operator to handle the situation described above if it produces a high suppression pool temperature signal.

3.1.7 Add Suppression Pool Temperature Trip and Change Low Reactor Water Level Trip Setpoint (Option 7)

The automatic ADS response for this option would be identical to Option 6 since the suppression pool high temperature trip is not expected to occur until after the water level drops below TAF.

3.1.8 Manual Inhibit Switch (Option 8)

With the implementation of the symptom oriented EPGs this option satisfies the intent of NURET-0737, Item II.K.3.18 and its incorporation in the BWR NSSS design meets all of the applicable design and licensing requirements. Addition of a manual inhibit switch to the current ADS logic has no effect on the automatic ADS response to isolation events. Consequently, the analyses and conclusions presented in Section 3.1.1 are applicable here.

3.2 LOCA Safety Analysis Report Calculations

Loss-of-coolant accident calculations performed to show compliance with 10CFR50.46 and Appendix K would be affected by ADS logic options which lower the water level trip to TAF (Options 3, 5 and 7). The effect of the lower reactor water level trip setpoint is pertinent to Appendix K LOCA calculations for breaks outside containment.

3.2.1 Large Breaks

For large breaks (greater than 1.0 ft^2) in the recirculation line or steamline, the reactor vessel depressurizes rapidly without ADS actuation. Consequently, lowering the ADS water level trip to TAF has a negligible effect on large break LOCA calculations.

3.2.2 Small and Intermediate Breaks

Small and intermediate size breaks (less than 1.0 ft^2) require ADS operation to depressurize the reactor vessel in the event of HPCI/HPCS failure. Lowering the water level setpoint for ADS trip results in a later ADS actuation and longer core coverage in the event. However, it also prevents the low pressure pumps from injecting water into the vessel for a longer period of time.

The low reactor water level ADS trip setpoint for BWR/4-6 plants is currently located approximately one foot above TAF. These plants typically have higher capacity ADS valves than earlier BWRs and employ a larger number of ADS valves. These features result in small break peak cladding temperatures which are several hundred degrees lower than the

PCT for the limiting break. Because the impact on small break PCT of lowering the ADS low reactor water level trip setpoint is small, the limiting break for BWR/4-6 plants will still be in the large break region of the break spectrum.

3.3 Anticipated Transients without Scram (ATWS)

During an ATWS event requiring the addition of boron to the core, it is advantageous to prevent ADS initiation unless the high pressure makeup systems (feedwater, HPCS and RCIC) fail to inject. The main reasons why an ADS actuation is undesirable during an ATWS are; (1) water flashing to steam due to rapid pressurization could interfere with the mixing of boron, and (2) rapid depressurization would allow the low pressure systems to inject a large volume of cold water into the core which would result in a core power increase (due to the effects of boron dilution/washout in the core, the negative temperature coefficient of reactivity and an increase in moderator density).

This section discusses the impact of the proposed logic modifications on ATWS design calculations for typical (generic) BWR plants. The plant specific analysis for LaSalle has not been completed; however, PRA results indicate no need for autoboron addition; suppression pool response indicates adequate time interval for manual control of boron injection equipment.

Note: Implicit in the assumption for all ATWS calculations is that the plant has been modified to Alternate 3A requirements of NUREG-0460, Volume 4 (Draft). If final resolution of the ATWS issue requires installation of something other than Alternate 3A, the conclusion that Options 1 through 3 are acceptable for some plants may no longer be valid. The acceptability of Options 4 and 5 is believed to be independent of final resolution of the ATWS issue because (1) no operator actions are required to prevent ADS actuation within 10 minutes of event initiation, and (2) the timer setting can be adjusted if necessary.

3.3.1 Current Design (Option 1)

During an ATWS the reactor water vessel level will drop until core power decreases and an equilibrium between boiloff and the high pressure systems makeup capability is sufficient to reverse the decreasing water level trend. For BWR/4-6 plants with HPCS operable, the current logic prevents an ADS actuation for all postulated design basis events. Manual operator actions may be used to inhibit or allow ADS actuation for some failure-to-scram scenarios.

3.3.2 Eliminate High Drywell Pressure Trip and Add Manual Inhibit Switch (Option 2)

Eliminating the high drywell pressure trip from the ADS initiation logic requires reactor water level during a failure-to-scram event to recover above the low reactor water level trip elevation (Level 1) before the delay timer times out to prevent an automatic ADS actuation. ATWS design basis calculations performed for a BWR 5 typical plant show that maintenance of reactor water level above Level 1 is achievable.

3.3.3 Eliminate High Drywell Pressure Trip and Change Low Reactor Water Level Trip Setpoint (Option 3)

The automatic ADS response for this option is similar to Option 2 except that the reactor water level must recover above TAF before the delay timer times out to prevent an ADS actuation. ATWS design basis calculations show that this condition is met in the BWR 5 plants.

3.3.4 Bypass High Drywell Pressure Trip and Add Manual Inhibit Switch (Option 4)

Addition of a bypass timer to the ADS logic allows an ADS actuation to be automatically prevented for an ATWS event. This is accomplished by setting the timer so that it won't run out until after the reactor water level is restored above the low water level trip elevation. Plant dependent calculations are required to determine the minimum possible timer setting which accomplishes this. The maximum allowable timer setting is determined from LOC[illegible]nsiderations.

3.3.5 Bypass High Drywell Pressure Trip and Change Low Reactor Water Level Trip Setpoint (Option 5)

The automatic ADS response for this option is similar to Option 4 except that the minimum bypass timer setting would be based on the time required to restore the reactor water level above TAF.

3.3.6 Add High Suppression Pool Temperature Trip and Add Manual Inhibit Switch (Option 6)

Addition of a suppression pool high temperature trip bypassing the high drywell pressure crip portion of the current ADS logic can also prevent an ADS actuation during an ATWS. Plant specific pool responses are required to determine if an acceptable setpoint for the high suppression pool trip ex ts consistent with the SORV event timing needs (minimum temp) and the ATWS event timing needs (maximum temp.).

3.3.7 Add High Suppression Pool Temperature Trip and Change Low Reactor Water Level Trip Setpoint (Option 7)

The automatic ADS response for this option will be similar to Option 6 with timing initiated at TAF water level.

3.3.8 Manual Inhibit Switch (Option 8)

Addition of a manual inhibit switch to the present ADS logic does not affect the automatic reactor protection system (RPS) response during any failure-to-scram event. Consequently the discussion and conclusions presented for Option 1 above are applicable here.

3.4 Summary

The present ADS logic meets all of the applicable reactor system design and licensing requirements. In addition, the present ADS logic and normal operator response assures adequate core cooling for isolation and SORV events when drywell pressurization resulting from the loss of drywell cooling on low reactor water level is considered. ADS Options 2 through 7 can provide adequate core cooling by further automating reactor vessel depressurization for isolations and SORV events. Options which lower the ADS level trip to TAF (Options 3, 5 and 7) may adversely affect BWR/2-3 small break LOCA PCT calculations while elimination of the high drywell pressure trip may not satisfy some ATWS concerns in some plants. In the BWR-5 there is no incentive to lower ADS trip to TAF level.

The containment response is plant specific, of course, and unique determinations are necessary. The high suppression pool temperature trip (Options 2 and 3) and the high drywell pressure bypass timer (Options 4 and 5) require additional plant specific calculations to determine acceptable trip setpoints. Addition of a manual inhibit switch, (Options 2, 4, 6 and 8) when used consistently with the LOCA and ATWS EPGs, does not adversely affect automatic ADS system performance for design basis accidents and BWR transients.

4. Reliability Assessment

An assessment of each of the eight options described in Section 2 was made as to whether it reliably actuated the ADS for the events considered, and whether it increased the probability of spurious or inadvertent actuation. The conclusion is that each option reliably actuates the ADS when needed and that there is no significant difference in the probability of inadvertent ADS actuation.

5. Feasibility Assessment

A qualitative comparison of the feasibility of each of the design featu ، incorporated in the proposed ADS logic modifications is given below in terms of the practicality of each concept and the scale of resources required for implementation.

5.1 Eliminate high Drywell Pressure Trip (Option 1)

Implementation of this option requires simple wiring changes with no hardware additions. Maintenance and testing is somewhat easier in that the resultant logic design has fewer components than the current design.

5.2 Bypass High Drywell Pressure Trip (Option 2)

The cost of hardware to incorporate this option into the present ADS logic is relatively low compared to some of the other changes considered. Installation of the necessary hardware is straight forward. Maintenance and surveillance testing required for this additional feature would be minimal.

5.3 Add High Suppression Pool Temperature Trip (Option 3)

The hardware required for this option is complex. The suppression pool temperature monitoring and averaging equipment must be precise enough to measure a relatively slow suppression pool heatup in order to initiate the ADS consistent with the need to assure adequte core cooling.

Variations in suppression pool mixing (a function of SRV discharge locations and RHR operation) require installing a large number of temperature sensors and sophisticated averaging and recording equipment. Compared to other options, hardware costs are expensive; maintenance and surveillance testing would also be substantial.

The selection of an appropriate setpoint may not be feasible; extensive pool response analysis would have to be performed to determine whether an acceptable temperature or heatup rate exists and if so, what it is.

5.4 Bypass of High Drywell Pressure and a Manual ADS Inhibit Switch (Option 4)

Implementation of this modification requires minor hardware additions; the additional maintenance and surveillance testing required is minimal.

5.5 Bypass of High Drywell Pressure and Change Low Reactor Water Trip Setpoint to TAF (Option 5)

Implementation of this modification would be extremely expensive because installation of new water level instrumentation would be required for many plants. Many new safety analyses would be required to appraise design base accidents and transients. The required additional maintenance and surveillance testing would also be substantial.

5.6 Add High Suppression Pool Temperature Trip and Add Manual ADS Inhibit Switch (Option 6)

The feasibility discussions of paragraphs 5.3 and 5.4 are applicable for this combination making up Option 6.

5.7 Add High Suppression Pool Temperature Trip and Change ADS Low Level Trip to TAF (Option 7)

The feasibility discussions of paragraphs 5.3 and 5.5 are applicable for this combination making up Option 7.

5.8 Manual Inhibit Switch (Option 8)

The addition of this feature requires minimal logic additions. Validation of installed circuitry and controls is straight forward. Maintenance and surveillance testing would be minimal for this added manual feature.

6. Conclusions

The intent of NUREG-0737 Item II.K.3.18 was to investigate ADS logic modifications to assure adequate core cooling for certain transient events not associated with a high drywell pressure signal. For the BWR-5's at LaSalle, this intent is fully satisfied (1) by the present design of the ADS logic for design basis events and most transients, (2) by a future addition of an ADS bypass timer (bypasses the high drywell pressure signal) and a manual ADS inhibit switch (Option 8) for other ATWS transients, and (3) by the implementation of BWR Emergency Procedure Guidelines for extreme situations where lack of operational data could exist such that operator response is the only safety method.

Note: The design approach for LaSalle includes lowering the MSIV actuation level from Level 2 to Level 1 as it is in the BWR-6 to decrease the incidence of MSIV transients and to markedly decrease the thermal loading of the suppression pool by retaining the power conversion system heat sink (condenser) longer through the coast-down period after reactor scram. By this approach, both the event frequency and event severity are decreased and the time interval is extended for manual operator response (more than 30 or 40 minutes). The combination of the high drywell pressure bypass timer and the manual inhibit switch then provides the optimum capability to take care of all transients, including ATWS, as well as all design basis events.

As in the second submittal (to be included in Amendment 61), Edison's commitment for resolution of ATWS is approached in a larger context than these ADS logic modifications, however the results of this third appraisal are consistent with the results of the prior appraisals and they are also consistent with Edison's prior resolution of ATWS, therefore the addition of the bypass timer and the manual ADS inhibit switch in the ADS logic is endorsed for the LaSalle plant.

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TABLE L62-2

TABLE OF ADS LOGIC MODIFICATIONS CONSIDERED

OPTION	HIGH DRYWELL PRESSURE TRIP	TIMER TO BYPASS HIGH DRYWELL PRESSURE TRIP	HIGH SUPPRESSION POOL TEMPERATURE TRIP	WATER LEVEL TRIP SETPOINT	MANUAL INHIBIT SWITCH
1	Yes	No	No	Level 1	No
2	No	No	No	Level 1	Yes
3	No	No	No	TAF	No
4	Yes	Yes	No	Level 1	Yes
5	Yes	Yes	No	TAF	No
6	Yes	No	Yes	Level 1	Yes
7	Yes	No	Yes	TAF	No
8	Yes	No	No	Level 1	Yes