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United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing

References: (a) Construction Permits CPPR-135 and CPPR-136, Docket Nos. 50-443 and 50-444
(b) PSNH Letter, dated January 28, 1983, "Single Failure Assumptions: (SRP 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5, 15.2.6; RAIs 440.64, 440.69, and 440.125; Reactor Systems Branch)," J. DeVincentis to G. W. Knighton

Subject: Open Item Response: (SRP 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5, 15.2.6; RAI 440.64, 440.69, and 440.125; Reactor Systems Branch)

Dear Sir:

In response to the open item regarding single failure assumptions for Condition II events, we have enclosed a response which supplements that submitted in Reference (b).

The enclosed response will be incorporated in OL Application Amendment 49.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

David A. Maidrand for

J. DeVincentis
Project Manager

ALL/fsf

cc: Atomic Safety and Licensing Board Service List

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The following is additional information with respect to the assumptions of the worst single failure for Condition II events (incidents of moderate frequency).

For each transient, its associated worst single failure within the protection system assumed in the FSAR analyses is given in Table 440.64-1. The protection system is defined as those safety functions required to mitigate the consequences of the event. This includes not only the Solid State Protection System (SSPS), but also the Engineered Safeguards Features (ESF) and pressurizer and steam generator safety valves.

For each event listed in Table 440.64-1, a brief discussion of the assumed single failure is provided below. The purpose of these discussions is to justify that the single failure assumed is indeed the worst single failure. These failures are failures at the system level and consider the failure of a protective function. The cause or mechanical nature of the failure which causes the system failure is not discussed, since these are addressed in the FMEA's of the SSPS and ESF and in Chapters 6, 7, and 9 of the FSAR. Therefore, further detail beyond the systems level single failure of loss of one protection train is not provided.

The steam generator safety valves may be required to prevent a pressurization of the secondary system. Except where it is already stated in the FSAR, the steam generator valves are not challenged or required to mitigate the consequences of the event. Failures of these valves are not considered since they are not active failures. These independent failures are not applicable. Therefore, failure of these valves is not discussed below unless they are actuated as stated in the FSAR.

Finally, a loss of offsite power is not considered as a single failure for these events. The SRP does not require consideration of a loss of offsite power for the accidents listed in Table 440.64-1 (loss of AC power, 15.2.6, is by definition an exception). Furthermore, no single active failure will cause a loss of offsite power to the emergency buses. Therefore, consideration of this failure is not applicable.

Feedwater Temperature Reduction (15.1.1)

As stated in 15.1.1.1, this event is similar to the effect of increasing steam flow. This is bounded by the events in 15.1.2 and 15.1.3, as stated in 15.1.1.4.

Excessive Feedwater Flow (15.1.2)

As seen in Figure 15.1-1, the pressurizer pressure decreases until the time of turbine trip. The pressure spike is caused by the conservative delay between turbine trip and reactor trip; however, the pressurizer PORV's and safety valves do not open. Since they are not required to mitigate the consequences of the event, a single failure in these valves is not applicable and has no impact. Failure of an FIV to close will have no impact since the DNBR is already increasing by the time the FIV closes (Table 15.1-1). The engineered safeguards features are not required for this event. Therefore, a single failure in the ESF is not applicable and has no impact. Therefore, the failure of one protection train as listed in Table 440.64-1 is the limiting single active failure.

Excessive Steam Flow (15.1.3)

As stated in 15.1.3.2.b, the plant reaches a stabilized condition. No reactor trip is required, no pressurizer relief valves are required to reduce pressure (Figures 15.1-3, 15.1-5, 15.1-7, 15.1-9), and no ESF actuation occurs. Since the protection system is not required to function for this event, a single failure does not apply and has no impact.

Inadvertent Secondary Depressurization (15.1.4)

As stated in 15.1.4.1, it is the failure (opening) of a steam dump, relief, or safety valve which initiates the transient. As seen in Figure 15.1-3, this is a depressurization event, therefore pressure relieving functions of the protection system are not challenged nor required to mitigate the consequences of the event. The only portion of the protection system required is the safety injection portion of the ESF. A single failure in a protection train of the

signals which actuate SI (15.1.4.1.a) will have no impact due to the redundancy, diversity and independence of the SI actuation signals. The failure of one SI train (listed in Table 440.64-1) is the limiting single failure since it reduces SI flow, delays the injection of boron to the core, and, consequently allows a "closer" return to criticality. This is the single failure assumed in the FSAR as stated in 15.1.4.2. For this event, the DNB design basis is met by demonstrating no return to criticality (15.1.4.4).

Loss of External Load (15.2.2)

This is bounded by the event described in 15.2.3, as stated in 15.2.2.4 and 15.2.3.1.

Turbine Trip (15.2.3)

Unlike a depressurization transient, for this analysis, the ability to maintain RCS pressure below 110 percent of design per the SRP criterion must be explicitly addressed. Since the DNBR increases with pressure (assuming all other variables are held constant), the event is analyzed with and without pressure control to address both peak pressure and DNBR concerns. As stated in 15.2.3.2.a Item 7, both the pressurizer and steam generator safety valves may be required to operate. Assumptions relative to their operation are described under Items 4 and 5 in the FSAR.

If the pressurizer relief/safety valves fail to close once the pressure has been reduced, there will be no impact on the minimum DNBR. This is because the valves are not required to close until after the time of reactor trip, at which point the DNBR is rising and is very high (see Figures 15.2-1 through 15.2-8). As stated in 15.2.3.2.a Item 4, steam relief is obtained by the steam generator safety valves. However, these or any other steam relief valves would not be required to close until after reactor trip, when both the RCS pressure and DNBR are past their maximum and minimum values respectively. Therefore, failure to close would have no impact. Although the ESF may be required to function to supply emergency feedwater, a failure in the ESF would have no impact since credit for emergency feedwater is not taken (15.2.3.2.a Item 6). Therefore, the limiting single failure is one protection train (Table 440.64-1).

Inadvertent Closure of MSIV (15.2.4)

This is bounded by 15.2.3 as stated in the FSAR.

Loss of Condenser Vacuum (15.2.5)

This is bounded by 15.2.3 as stated in the FSAR.

Loss of AC Power (15.2.6)

For this event, the ability of the protection system to provide long term cooling is verified. The loss of one emergency feedwater pump of the ESF is the limiting single failure, as stated in Table 440.64-1. A reduction of emergency feedwater capacity reduces the capability of the emergency feedwater to provide long term cooling. This results in a higher primary side heatup and pressure. The pressure transient of Figure 15.2-9 shows that the pressurizer safety valves are actuated for this event. Failure of the valves to close would have no impact since the emergency feedwater is adequately removing the decay heat by that time (Table 15.2-1 item b). For the case where the single active failure is the failure of the pressurizer PORV or safety valve to close, credit can be taken for complete emergency feedwater capability. This would reduce the peak pressure and cause the time at which decay heat equals heat removal capability to be sooner. As stated in 15.2.6.1.b and c, the steam generator safety and relief valves are used to dissipate decay heat during long term cooling. Since it is desirable to have these valves open, failure to close has no impact, especially since the emergency feedwater supplies sufficient heat removal capability. Single failures which result in loss of signals which actuate emergency feedwater, reactor trip, or valve openings have no impact due to their redundancy, diversity and independence. Therefore, the single failure listed in Table 440.64-1 is the limiting single failure.

Loss of Normal Feedwater (15.2.7)

As for the loss of power event, the primary concern for the loss of normal feedwater is long term cooling capability which is provided by the emergency feedwater system. Therefore, as for the loss of AC power, the single active

failure causing the loss of one emergency feedwater pump is the limiting single failure, as stated in 15.2.7.2.

Loss of Flow (15.3.1 and 2)

The protection for this event is discussed in Sections 15.3.1.2 and 15.3.2.2. A single failure in the ESF is not applicable since the ESF are not required to mitigate the consequences of the event. As can be seen in Figures 15.3-2 and 15.3-6, the pressurizer PORV's may open. However, failure to close will have no impact since the point of minimum DNBR is past and the DNBR is rising by the time the valves close (Figures 15.3-4 and 15.3-8). Therefore, the worst single failure is that of one protection train, as stated in Table 440.64-1.

RCCA Bank Withdrawal from Subcritical (15.4.1)

Although the pressure transient is not shown for this transient, an increase in RCS pressure is expected due to the increase in heat flux and temperature. However, if the PORV's opened and failed to close, there would be no impact on the minimum DNBR since credit for the change (increase) in pressure is not taken in the DNBR analysis. The ESF are not required for this accident, therefore, a single failure in the ESF is not applicable. Therefore, a loss of one protection train is the limiting single failure.

RCCA Bank Withdrawal at Power (15.4.2)

This event is primarily a DNB event and demonstrates the adequacy of the overtemperature ΔT and high flux trips, as stated in 15.4.2.4. Typical transients for the RCCA bank withdrawal at power event are provided in Figures 15.4-4 through 15.4-9. Operation of pressure relieving valves would serve to reduce pressure and thus minimize the DNBR. (If no pressure control was available, the maximum pressure would be limited to that which results in a high pressurizer pressure trip. This is a less limiting pressure transient than those events discussed in 15.2.) Failure of valves to close would have no impact, since the point of minimum DNBR is past by the time the pressure begins to fall (after trip) as seen in the transient figures.

As discussed in 15.4.2.2.b, for some cases, the steam generator safety valves are opened. The result is to minimize the DNBR, as seen in Figures 15.4-11 and 15.4-12. However, failure to close has no impact since the point of minimum DNBR comes right after reactor trip. Failures in the ESF are not applicable since the ESF are not required. Therefore, the worst single failure is one protection train as stated in Table 440.64-1.

Dropped RCCA (15.4.3)

The worst single failure for this event is the failure of one HIS channel. This results in fewer dropped RCCA's being detected in order to initiate reactor trip via negative flux rate, but has no impact if no trip is generated (i.e., if credit for trip is not taken because of the failure.) As can be seen in Figures 15.4-13 through 15.4-15, the plant reaches a new equilibrium condition, and no further protective action is required. Therefore, consideration of other single failures within the protection system is not applicable.

Statically Misaligned RCCA (15.4.3)

As stated in Table 440.64-1, no transient analysis is required. Furthermore, no protective functions are required and single failures have no impact.

Single RCCA Withdrawal (15.4.3)

As stated in 15.4.3.1, this is a Condition III event. Since this is not a Condition II event (incident of moderate frequency) it is not within the scope of the question and should be deleted.

Inactive RC Pump Startup (15.4.4)

The pressure transient in Figure 15.4-19 shows that the pressurizer PORV's are not challenged for this event. In any case, failure to close would have no impact, since the point of minimum DNBR is past by the time the failure could

occur (Figure 15.4-20). Failures in the ESF are not applicable since the ESF is not required to mitigate the consequences of the event. Therefore, the limiting single failure is the failure of one protection train, as stated in 440.64-1.

Inadvertent Acutation of the ECCS (15.5.1)

As stated in 15.5.1.1, it is a failure in the ESF which initiates the event. As see in Figure 15.5-2, this is initially a depressurization event. The pressure then rises to the PORV setpoint. The PORV's are capable of maintaining system pressure below 110 percent of design. Failure of the PORV's to close would have no impact on the DNBR, since it is already high and never falls below the initial value (Figure 15.6.3). Therefore, the failure listed in Table 440.64-1 is the limiting single failure.

Increase in RCS Inventory (15.5.2)

As stated in the FSAR, this is bounded by 15.5.1.

Inadvertent RCS Depressurization (15.6.1)

As stated in 15.6.1.1, it is a single failure resulting in the opening of a pressurizer PORV or safety valve which initiates the transient. Although ESF features might be actuated, they are not required to mitigate the consequences of the event, since the DNBR rises after reactor trip. Therefore ESF failures are not applicable. Therefore, the worst single failure is failure of one protection train.

Failure of Small Lines (15.6.2)

No transient analysis is involved for this event. The protective system is not required to function, since operator action terminates this event as stated in 15.6.2.2.