Attachment
August 2, 2011

Draft Guidance for Ex-Vessel Severe Accident (EVSA) Change Process

Per 10 CFR 52.47(a)(23), design certification applications must include descriptions and analyses of design features for preventing and mitigating severe accidents. In particular, design certification information should address challenges to containment integrity caused by:

- core-concrete interaction,
- steam explosions,
- high pressure core melt ejection, and
- hydrogen combustion.

Each design certification rule appendix contains criteria in Section VIII.B.5.c for determining whether a license amendment is required to depart from Tier 2 information that affects resolution of ex-vessel severe accident (EVSA) design features. In the Statements of Consideration for Part 52 (72 FR 49394), the NRC explained that the Section VIII.B.5.c criteria should be used for severe accident design features where the intended function of the design feature is relied upon to resolve postulated accidents when the reactor core has melted and exited the reactor vessel and the containment is being challenged.

Severe accident mitigation features are design specific and are discussed primarily in the Chapter 19 of the Design Control Document (DCD). However, EVSA features may be described elsewhere in the DCD, and the location of the EVSA design information in the DCD is not important to application of the Section VIII.B.5.c criteria (i.e., the information does not need to be located in Chapter 19 of the DCD).

Examples of EVSA design features used in various new plant designs include but are not limited to:

- Cavity flooding to promote in-vessel cooling and retention of core debris
- Reactor vessel depressurization to promote in-vessel cooling and retention of core debris
- Reactor vessel depressurization to prevent high pressure melt ejection
- Cavity flooding to provide ex-vessel cooling of core debris
- Cavity design to enhance core debris spreading and coolability
- Containment overpressure protection
- Combustible gas control
- Containment sprays and heat removal

The following performance characteristics could impact the ability of such features to prevent or mitigate an EVSA:

- Capacity (e.g., flow rate, battery life)
- Type
- Number
- Configuration
- Power source
- Active or passive nature
- Need for operator action
- Ability to function in harsh environment

Applicability of Section VIII.B.5.c Criteria

The Section VIII.B.5.c criteria are applicable to proposed departures affecting design features described in a referenced standard design certification that are relied upon to resolve postulated accidents when the reactor core has melted and exited the reactor (ex-vessel severe accidents) and the containment is challenged. If a proposed departure does not affect or involve an EVSA design feature or function, the Section VIII.B.5.c criteria do not need to be considered.

Screening

Once it has been determined that a proposed departure is within the scope of the referenced design certification rule and the Section VIII.B.5.c criteria are applicable, screening is performed to determine if the departure should be evaluated against the criteria in Section VIII.B.5.c.

Section VIII.B.5.c evaluations are required for departures that adversely affect EVSA functions, including methods used to perform or control EVSA functions.

EVSA design features may have preventive as well as mitigative functions. For example, design features that ensure in-vessel retention of core debris are considered EVSA design features because they prevent a severe accident from becoming an EVSA.

Some design features may have multiple purposes (i.e., they may be used to perform EVSA functions as well as design functions as defined in Section 3.3). If a design feature has both EVSA functions and design functions, the Section VIII.B.5.c criteria are used to evaluate departures related to the EVSA functions, and the Section VIII.B.5.b criteria are used to evaluate departures related to design functions.

Departures are "screened in" (i.e., require a Section VIII.B.5.c evaluation) if they adversely affect EVSA functions or how EVSA functions are performed or controlled (including changes to equipment, procedures, assumed operator actions, and response times). For purposes of Section VIII.B.5.c screening, departures that remove or fundamentally alter the existing means of performing or controlling EVSA functions should be conservatively treated as adverse and screened in. Such departures include but are not limited to replacement of automatic action by manual action (or vice versa), changes to the human-machine interface, and changing a valve from "locked closed" to "administratively closed." Departures that are determined to have a positive or no effect on EVSA functions and how those functions are performed or controlled may be "screened out" (i.e., do not require a Section VIII.B.5.c evaluation).

If a departure has both positive and adverse effects on EVSA functions, the departure should be screened in. The Section VIII.B.5.c evaluation should focus on the adverse effects.

Evaluation

For proposed departures that screen in, Section VIII.B.5.c requires prior NRC approval if:

1. There is a substantial increase in the probability of an EVSA such that a particular EVSA previously reviewed and determined to be not credible could become credible; or
2. There is a substantial increase in the consequences to the public of a particular EVSA previously reviewed.

For the first criterion, prior NRC approval is required for proposed departures that would result in a new, credible EVSA. To evaluate whether a proposed departure results in a new, credible EVSA, licensees should use criteria consistent with those used in the referenced DCD.

For the second criterion, an applicant or licensee may show that the departure will not result in a substantial increase in consequence to the public by demonstrating that the affected EVSA functions will still be successfully accomplished. Prior NRC approval is not required for departures that do not remove, defeat or significantly degrade an EVSA design feature such that functions of EVSA design features as described in the FSAR would not be accomplished.

For plants licensed or certified on the basis that there are no credible EVSAs (e.g., the design ensures in-vessel retention), criteria VIII.B.5.c.2 is not applicable. In this case, applicants and licensees may address the second EVSA criterion by stating that no credible EVSAs exist for the design, therefore no evaluation of consequences resulting from previously reviewed EVSAs is required.

Documentation and Reporting

Evaluations performed under Section VIII.B.5.c should be documented in accordance with the licensee's plant change process and reported to NRC in accordance with Section X of the referenced design certification rule.

Example 1

The licensee proposes to increase the starting time for the emergency diesel generators (EDGs). In the referenced DCD, the EDGs do not perform EVSA functions (i.e., they are not relied upon to prevent or mitigate an EVSA). Therefore, the change to the EDG starting time may be screened out and does not require evaluation under Section VIII.B.5.c of the design certification rule.

Example 2

The licensee of an AP1000 plant proposes to reduce the capacity of the In-containment Refueling Water Storage Tank (IRWST) by 10%. Per Appendix 19B of Tier 2 of the AP1000 DCD, the IRWST has an EVSA function of flooding the reactor cavity to submerge the outer surface of the reactor vessel to the reactor coolant loop nozzles. Therefore, this change cannot be screened out and must be evaluated under Section VIII.B.5.c of the design certification rule. The licensee performs a review of the existing analysis and determines that this small change in IRWST capacity would have a negligible effect on cooling the outer surface of the reactor vessel because the remaining capacity would be sufficient to submerge the outer surface of the reactor vessel to the reactor coolant loop nozzles. Therefore, the licensee concludes that the change does not require NRC approval.

Example 3

During construction, the licensee identifies a nonconformance in that the thickness of a portion of the reactor cavity floor concrete is 0.1 foot less than the minimum thickness specified in Tier 2 of the referenced DCD. The reactor cavity floor is an EVSA design feature; therefore, Section VIII.B.5.c of the design certification rule must be considered to determine whether NRC approval is needed to accept this nonconformance. Based on a comparison with the existing analysis, the licensee

determines that the reduction in thickness would have a negligible impact on the functional performance of the reactor cavity floor in the presence of core debris. Therefore, the licensee concludes that this nonconformance can be accepted as-is without NRC approval.

Example 4

The licensee considers reducing the capacity of the containment overpressure protection system (COPS) by 50%. The COPS is an EVSA design feature; therefore, this change cannot be screened out and must be evaluated under Section VIII.B.5.c of the design certification rule. The licensee performs a calculation and determines that a 50% reduction would significantly degrade the COPS function such that the containment may not be able to survive the pressures associated with the containment performance goals identified in SECY-93-087 and SECY-90-016, as approved by the associated Staff Requirements Memoranda, and described in NUREG-0800. As a result, the licensee concludes that there would be a substantial increase in the consequences of an EVSA previously evaluated, and this change would require NRC approval.

Example 5

A licensee proposes a departure to change the normal position of isolation MOVs on the lines connecting the IRWST to the spreading area for ex-vessel core debris quench. Tier 2 specifies that these flooding lines are isolated by a fuse valve (designed to open when the corium reaches the spreading area) and an MOV that is normally in the closed position. Changing the MOVs from a normally closed to a normally open position would be beneficial for an EVSA in that it would guarantee a passive flooding function upon opening of the fuse valve (i.e., flooding would not be impacted by mechanical or electrical failure of the MOV). On the other hand, changing the normal position of the MOV could increase the possibility of losing IRWST water inventory needed for emergency core cooling (due to a single failure if the fuse valve fails to remain closed). If the licensee determines that this departure would have no adverse effects on the EVSA flooding/core debris quenching function, then it would not need to be evaluated to the criteria in Section VIII.B.5.c. However, since the departure could have an adverse effect on a design basis function (ECCS), this change may need to be evaluated to other criteria in Section VIII of the referenced design certification rule.