Class 1 Pressure Boundary Compliance with GDC 4, GDC 14, GDC 15

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GDC 4 Compliance Summary

Requirement	ACR Response Primary System	ACR Response Fueling Machine
Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents.	The primary system is designed, fabricated, and erected in accordance with ASME Section III, Class 1. This ensures that conditions including normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents have been considered in the design. Primary system materials beyond the scope of ASME Section II will be considered via 50.55a(a)(3). These materials have been proven by testing and experience to be compatible and suitable for their environmental conditions.	The fueling machine is designed, fabricated, and erected in accordance with ASME Section III, Class 1. This ensures that conditions including normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents have been considered in the design.

GDC 4 Compliance Summary (cont.)

Requirement	ACR Response Primary System	ACR Response Fueling Machine
These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.	ACR design considers these dynamic effects by performing appropriate analyses and providing barriers and separations as necessary for the feeders and piping. The pressure tube is contained within a calandria tube so the effect of pressure tube rupture is not propagated to other pressure tubes.	The fueling machine is a robust piece of equipment and will not be affected by feeder ruptures. The design of feeders includes barriers, supports, etc. to preclude any damage.

GDC 4 Compliance Summary (cont.)

Requirement	ACR Response Primary System	ACR Response Fueling Machine
However, dynamic effects associated with postulated pipe ruptures in nuclear power units may be excluded from the design basis when analyses reviewed and approved by the Commission demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design basis for the piping.	The use of leak-before-before break on portions of the primary system will be the subject of separate discussions. The ACR reactor assembly is designed for dynamic effects of a pressure tube and feeder ruptures.	The analysis of the end fittings, the only high-energy component in the fueling machine vicinity, is performed to the relevant level D conditions and it shows a significant margin from the allowable. Therefore the effects on fueling machine of end fitting failures are not included.

GDC 14 Compliance Summary

Requirement	ACR Response Primary System	ACR Response Fueling Machine
The reactor coolant pressure boundary shall be designed, fabricated, erected…	The primary system is designed, fabricated, and erected in accordance with ASME Section III, Class 1. Primary system materials beyond the scope of ASME Section II will be considered via 50.55a(a)(3).	The fueling machine pressure boundary is designed, fabricated, and erected in accordance with ASME Section III, Class 1.

GDC 14 Compliance Summary (cont.)

Requirement	ACR Response Primary System	ACR Response Fueling Machine
…,and tested…	Components are designed for accessibility. Preservice inspection and testing will be in accordance with ASME Section XI. For in-service inspection, a risk-informed inspection program similar to that in ASME Code Case N-577-1 will be proposed for the feeder tubes. A sampling program based on Canadian experience with monitoring of pressure tube performance will be proposed.	Components are designed for accessibility. Preservice inspection and testing will be in accordance with ASME Section XI. In-service inspection will follow the ASME Section XI rules for Section III vessels.

GDC 14 Compliance Summary (cont.)

Requirement	ACR Response Primary System	ACR Response Fueling Machine
…so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.	Canadian pressure tube experience has documented two pressure tube ruptures in 400 reactor-years of operation. Corrective actions have been taken. Continuous monitoring of the annulus gas system for humidity ensures that ruptures can be mitigated before they occur. 100% volumetric examination of pressure tubes prior to service. In-service monitoring to detect potential generic degradation. No pressure tube leaks since 1986 using improved manufacturing and inspection processes.	Fueling machine (FM) includes safety lock to prevent unintentional release from fuel channel. FM design has two independent and diverse interlocks to prevent the FM from accidentally unclamping from the fuel channel. One of the interlocks is a mechanical device actuated by reactor pressure. Non-ASME components present small cross-sectional areas that have very large margins of safety and would not result in challenges to ECI (10 CFR 50.55a(c)(2)(i)).

GDC 15 Compliance Summary

Requirement	ACR Response Primary System	ACR Response Fueling Machine
The reactor coolant system … shall be designed with sufficient margin to assure that the design conditions of the reactor coolant pressure boundary are not exceeded during any condition of normal operation, including anticipated operational occurrences.	The primary system is designed, fabricated, and erected in accordance with ASME Section III, Class 1. Primary system materials beyond the scope of ASME Section II will be considered via 50.55a(a)(3). The properties of these materials, which are certified by testing, are used to derive conservative allowable stress and load combinations according to ASME Section III rules. The resultant design ensures that the RCS pressure boundary design conditions are never exceeded for any anticipated operational occurrence.	The fueling machine pressure boundary is designed, fabricated, and erected in accordance with ASME Section III, Class 1. The design of the FM includes an analysis of all credible operating occurrences to confirm a low probability of failure of the RCS pressure boundary within the fueling machine and that the design conditions are not exceeded.

GDC 15 Compliance Summary (cont.)

Requirement	ACR Response Primary System	ACR Response Fueling Machine
…and associated auxiliary, control, and protection systems…	Design criteria for these systems to be addressed in other discussions.	Design criteria for these systems to be addressed in other discussions.


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