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**Bcc:** [Hernandez, Raul](#); [Wittick, Brian](#)  
**Subject:** RE: discussion refers to single failure proof polar crane  
**Date:** Wednesday, April 21, 2021 2:19:00 PM

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Dear Zhaoran,

I forwarded the question you sent on the single failure proof crane to NRC's technical staff. The following is their response/input:

Standard Review Plan (SRP) Section 9.1.5 (2007 Revision, ADAMS Accession No. ML070380201) Section I.4 states that the reviewer should verify that one of these three safety guidelines is followed:

- A. Movement of the OHLHS [overhead heavy load handling systems] is restricted by design or interlocks to areas away from stored fuel and equipment necessary for the safe shutdown of the reactor.
- B. The consequences of a load drop have been evaluated to ensure that it could neither damage stored irradiated fuel to the extent that a significant off-site release would occur nor preclude operation of sufficient equipment to achieve safe shutdown.
- C. The probability for a load drop is minimized by an overhead handling system designed to comply with the guidelines of NUREG-0554 and lifting devices that comply with American National Standards Institute (ANSI) N14.6 or an alternative based on American Society of Mechanical Engineers (ASME) B30.9. An overhead handling system that complies with ASME NOG-1 criteria for Type 1 cranes is an acceptable method for compliance with the NUREG-0554 guidelines.

[Note that later in SRP Section 9.1.5 in Section III.4.C the guidance specifically states that the likelihood of failure is extremely low due to a single failure-proof handling system and NUREG-0554, ASME B30.9, and ANSI 14.6 address the elements needed.]

In both designs (AP1000 and ESBWR), FSAR Section 9.1.5 discusses the designs respective load handling system and the staff concluded that the system designs conform with all the requirements of a single failure-proof system. In NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design" Volume 3 (Chapters 9 – 15), page 9-84 the staff discussed RAI 9.1-99 (quoted text below). In this RAI, the staff requested the applicant to address the lack of a drop analysis on structures, systems, and components (SSCs) that form a temporary reactor coolant boundary during shutdown activities. The applicant response indicated that the drop analysis is not needed because they credit the use of single failure-proof handling system and the staff found this response acceptable.

DCD Tier 2, Revision 5, Section 9.1.5, describes the applicant's heavy load drop analyses. In RAI 9.1-99, the staff asked the applicant to describe how the evaluations took into account the potential for the function of main steam line and isolation condenser nozzle plugs to be affected by heavy load drops. The RAI also asked the applicant to address the effect of heavy load drops on SSCs that form a

temporary reactor coolant boundary during shutdown activities. In response, the applicant stated that the RB overhead crane and associated lifting devices used for handling heavy loads are single-failure-proof, in accordance with NUREG-0554. Also, hoists, cranes, or other lifting devices that comply with the applicable guidance of NRC Bulletin 96-02, "Movement of Heavy Loads over Spent Fuel, over Fuel in the Reactor Core, or over Safety-Related Equipment," dated April 11, 1996, ANSI N14.6, ASME/ANSI B30.9, ASME/ANSI B30.10, and NUREG-0612. NUREG-0612 allows the use of the single-failure-proof equipment, pursuant to NUREG-0612, Section 5.1.6, or the effects of load drops can be analyzed. As stated in the RAI response, the applicant has chosen to have the heavy load handling equipment designed to comply with the single-failure-proof guidelines of NUREG-0612, Section 5.1.6, such that no single failure will result in the dropping of a load and affecting equipment such as main steam line and isolation condenser nozzle plugs, as well as other SSCs that form a temporary reactor coolant boundary during shutdown activities. The staff finds that the RAI response is acceptable since it clarified that the ESBWR design satisfies the single-failure-proof guidelines with respect to this equipment. Accordingly, based on the above and the applicant's response, RAI 9.1-99 is resolved.

SRP Section 15.7.5 (Rev.2, 1981, ADAMS Accession No. ML052350315) indicates that a **design basis radiological analysis is performed** if a cask drop exceeding the 30-foot drop height is exceeded. The chapter 15 RAI was focusing on the requirements of postulating a design basis radiological analysis, not on the requirements to do a drop analysis.

In the case of ESBWR, the design relies on single failure-proof handling systems that makes it highly unlikely to postulate a load drop. Since they don't postulate a drop of more than 30-feet, the applicant is not required to perform a design basis radiological analysis.

To answer your question at the end, the two conditions are not related. If they meet the single failure proof handling system, they do not need to do the drop analysis. With regard to a spent fuel cask drop in Chapter 15, if the drop is 30 feet or less, they do not need to do the design basis radiological analysis. I hope this answers your question. Please let me know if it does not.

Thank you and take care,

Jen

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**Subject:** [External\_Sender] discussion refers to single failure proof polar crane

Dear Don,

I hope this email finds you well.

The NNSA staff are studying the issue refers to the hypothesis of polar crane, cask handling crane, equipment hatch hoist that are designed to be single-failure-proof in NPP safety review. Can you please kindly discuss with NRC technical staff, and sharing more information such as background information, technical points and discussion.

The detailed understandings and questions from our technical staff are described as below:

*a) In AP1000 DCD R9 FSER, section 9.1.5.2.9 (ML112061231,page 9-121) :*

*“Based on its review, the staff finds acceptable the part of the applicant's response, that states that no heavy load drop analyses are required for the polar crane, cask handling crane, equipment hatch hoist, and maintenance hatch hoist because they are designed single-failure proof. ”*

*Our understanding is that the single-failure proof design is accordance with SRP Section 9.1.5, Section III.4.C, so it is acceptable.*

*b) In ESBWR FSER (NUREG-1966), section 9.1.5.2.1:*

*“The FB crane is designed to be single-failure-proof, in accordance with NUREG-0554, and to meet ASME Code NOG-1. ”*

*Meanwhile in section 15.4.1 (page 15-69) states the following :*

*“The staff finds that the cask drop distance is within the 9.2-m (30.2-ft) height limit specified in SRP Section 15.7.5. Therefore, neither the staff nor the applicant analyzed the radiological consequences for a spent fuel cask drop accident. Based on the applicant's response, RAI 15.4-5 is resolved.”*

*Therefore, shall the two conditions: 1) use a crane that meets single failure design and, 2) The drop height is less than 30.2ft, be satisfied at the same time in order that further analysis of the spent fuel cask drop is not necessary? Or only need to satisfy either 1) or 2).*

Best regards,

Zhaoran

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