Enclosure 4

DAR-PAR-15-008-NP, Proposed Clarifications to EDR-1, "eXtra Safety And Monitoring (X-SAM®) Single Failure Proof Cranes", Revision 6 (Non-Proprietary)

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Subject: Proposed Clarifications to EDR-1, "eXtra Safety And Monitoring (X-SAM®) Single Failure Proof Cranes," Revision 6 (Non-Proprietary)

1. **Purpose:**

This letter details the proposed clarifications to EDR-1, "eXtra Safety And Monitoring (X-SAM®) Single Failure Proof Cranes," Revision 6. The clarifications detailed in this letter will be incorporated into EDR-1, "eXtra Safety And Monitoring (X-SAM®) Single Failure Proof Cranes," Revision 7. Revision 6 of EDR-1 was an interim revision to the EDR-1 document and will not be used or referenced. During a review of EDR-1 Revision 6, it was discovered that several clarifications can be made to the document. These clarifications will be submitted as part of EDR-1 Revision 7.

2. **Background:**

Westinghouse was in the process of developing the critical characteristics for the equalizer cylinder on the AP1000 polar crane main hoist and the engineering study targeted the internals of the hydraulic cylinder to address the failure modes analysis that was conducted. [a,c]. In a proactive measure, Westinghouse further examined topical report EDR-1, "eXtra Safety And Monitoring (X-SAM®) Single Failure Proof Cranes", which is currently under review by the NRC to identify if there were any associated design requirements that would require alterations or clarifications. While no issues were identified within the content of EDR-1 as it corresponds to the requirements described in NUREG-0554, it was determined that a further clarification of the Equalizer Arrangements in Figure III.D.5 would be useful to convey more comprehensive configurations of the equalizer cylinder applications. In addition, corresponding markups to the text in the "Hydraulic Load Equalization System" section of the report will be made that describe the clarifications made to Figure III.D.5. As a final clarification, a definition of the word "typical" as it is used in EDR-1 will be provided in the abstract section of the report.

Attachment 1

Proposed Markups to EDR-1

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NOTICE

This report was prepared by Ederer Incorporated (Ederer), with assistance from Holloran & Associates, for the use of Ederer. Its use by others is permitted only on the understanding that there are no representations or warranties, express or implied, as to the validity of the information or conclusions contained herein.

Revision 4 was prepared by PaR Nuclear, a Westinghouse Electric Company, current owners of the X-SAM® single failure proof technology and sole proprietor of EDR-1 Revision 4, Generic Licensing Topical Report. For historical references, actions referred to within this report prior to 2006, will collectively note Ederer Corporation (Ederer) as the responsible legal entity who performed those actions.

Revision 5 was prepared by Westinghouse Electric Company, current owners of the X-SAM® single failure proof technology and sole proprietor of EDR-1 Revision 5, Generic Licensing Topical Report. All figures and diagrams contained within this revision are intended to supersede their previously accepted version found in EDR-1 REV 3. Clarifying information was added to identify items and components referenced more clearly. Notes were added to select figures to reflect these as representative of typical X-SAM and X-SAM system designs. Non-Destructive Acceptance (NDA) techniques and practices were revised to allow for modern alternatives that will achieve the same level in of inspection and qualification integrity in a cost effective manner.

Revision 6 was prepared by Westinghouse Electric Company, current owners of the X-SAM® single failure proof technology and sole proprietor of EDR-1 Revision 5, Generic Licensing Topical Report. All figures and diagrams contained within this revision are intended to supersede their previously accepted version found in EDR-1 REV 3. Errata were corrected and the company name Ederer was replaced with Westinghouse where information didn't reflect historical accounts or actions.

Revision 7 was prepared by Westinghouse Electric Company, current owners of the X-SAM® single failure proof technology and sole proprietor of EDR-1 Revision 6, Generic Licensing Topical Report. All figures and diagrams contained within this revision are intended to supersede their previously accepted version found in EDR-1 REV 3. Clarifications to the hydraulic equalization systems were incorporated to provide a more comprehensive and representative configuration of the hydraulic equalizer schematics and arrangements.

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ABSTRACT

Westinghouse's eXtra-Safety And Monitoring (X-SAM) Cranes and Compact Hoists are designed for a wide range of single-failure-proof overhead handling equipment applications in nuclear power plants. This report provides generic descriptions of the safety systems and components of X-SAM Cranes and Compact Hoists that are utilized to meet the guidance originally promulgated in Regulatory Guide 1.104, "Single-Failure-Proof Overhead Crane Handling Systems for Nuclear Power Plants" and more recently in NUREG 0554 "Single-Failure-Proof Cranes for Nuclear Power Plants."

A single-failure-analysis of the reference design X-SAM trolley for installation on an existing crane bridge is included. Typical design data is provided for cranes and hoists of the reference design that range in capacity from 10 Tons to 250 Tons. Throughout the EDR-1 document, 'typical' design data, figures, charts, tables, and the associated information contained within, are intended to convey the overarching design methodology, characteristics, elements, features, and or configurations applicable to an EDR-1 single failure proof crane. This 'typical' information is not intended to be interpreted as bounding or limited to the exact data, arrangements, or conditions shown, so as long as the same methodology, formulas, equations, features and functionality are maintained or exceeded by design. As EDR-1 is intended to be a generic licensing document, each particular application will be specifically tailored for that applicant's particular geometry or functional parameters using these basic design principles & concepts found within these associated 'typical' denotations. As individual application parameters change, component technology advances, and or OEM component sourcing changes, these conditions will still continue to reflect the 'typical' design methodology, characteristics, elements, features, and or configurations depicted. Compliance with the applicable Regulatory Guides and the provisions for operational testing of the hoist safety systems are also described.

Design of the girder structure is highly dependent upon site and plant specific seismic parameters. Therefore, girder design is dealt with in licensing documents for specific plants.

The original authored document of EDR-1, Ederer Cranes and their associated technical representatives responsible for the design of the X-SAM single failure proof system and generation of the generic licensing topical report to be within compliance of the requirements documented in NUREG 0554, coined the terminology 'Nuclear Safety Related' (NSR) within the Generic Licensing Topical Report. The intention of this NSR terminology and component/system designation was meant to identify the "important to safety" aspect of the component /system in the critical load handling environment at nuclear facilities. This designation would establish the system or component of the X-SAM design, as a Critical Item (CI), for an augmented quality classification with the single failure proof design. These components or systems would be then subject to the defined examinations and testing established within Appendix A of EDR-1 Generic Licensing Topical Report specifically to comply with NUREG 0554. Absent from NUREG 0554 are the design requirements or language that mandate the designation of particular items, components, or systems as safety-related or basic components. Ultimately, this functional definition and classification solely falls on the systems Architect/Engineer and or nuclear facilities licensee depending on that particular application.

Given the close representation of this coined phrase 'Nuclear Safety Related' (NSR) to the similarly expressed safety-related component/system (basic component) in the nuclear application environment, over the years an evolution of conservative nuclear culture had conflated these terms to form a singular synonymous meaning solely associated with a safety-related component/system. For this reason, the terminology 'Nuclear Safety Related' (NSR) has been removed from the EDR-1 topical report. The original use and identification of components within EDR-1 as NSR, was never meant to designate a component as a Safety-Related item in terms of a system, structure, component, and or control that is relied upon to remain functional during and following design-basis events. This would include any such identification, within the topical report itself for the application of a single failure proof crane within a nuclear facility, as having the function necessary to maintain the integrity of the reactor coolant pressure boundary, nor the capability to shut down the reactor and maintain it in a safe shutdown condition, nor have the capability to prevent or mitigate the consequences of accidents which could result in unacceptable offsite radiation exposures.

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5. Hydraulic Load Equalization System

Figure III.D.5 contains ~~is a~~ schematic diagrams of ~~a~~ typical Hydraulic Equalization Systems. The pressure relief and or flow control valves will protect~~s~~ the hydraulic system and the intact reeving from excessive stress. In the original hydraulic schematic design, ~~T~~the relief setting is at a pressure corresponding to 150% of the equilibrium tension in the intact wire rope. The hydraulic equalization arrangements will be designed to resist the maximum rope load from a broken rope, which is conservatively 3 times design single line pull. An independent hydraulic fluid flow control or a velocity fuse and/or an orifice are used to retard the motion of the ends of the reeving in the event of a single wire rope failure.

Alternatively, Figure III.D.5 also illustrates a more compact Hydraulic Equalization System that was developed initially for the Compact X-SAM Hoist. This system includes a shock absorber that limits the impact forces applied to the equalizer and crane structure as the equalizer rotates into contact with the structure following a wire rope failure. In the process a small additional amount of load motion occurs, as is calculated in accordance with Appendix I.

6. Lower Block and Hook

Figure III.C.3.a and III.D.6 depict typical lower blocks and hooks. The number of sheaves is adjusted to suit the hoist capacity.

7. Wire Rope Spooling Monitor

Figure III.A identifies the location of the wire rope spooling monitor. The wire rope spooling monitor consists of a rod positioned across the entire grooved area of the drum so that it is tripped by the wire rope if the wire rope crosses a groove in the drum or if the wire rope wraps over itself. During normal spooling the cylinder does not contact the wire rope or any moving parts of the drum. The electrical proximity switches are actuated by the motion of the rod that results from improper wire rope spooling.

b

Figure III.D.5
Typical ~~Schematic Diagram of the Alternate Design~~ Hydraulic ~~Load~~ Equalization ~~System~~Arrangements