

**Single Failure Proof Crane Design Topical Report – Post-submittal Meeting
Presentation**

**on
February 19, 2014**

(Non-Proprietary)

EDR-1: Topical Report Single Failure Proof Crane Design NRC Post-Submittal Meeting Jason Schulz, Crane Product Manager, WEC



Background

- In January 1980, NRC issued their acceptance letter and safety evaluation report for Generic Licensing Topical Report EDR-1 (REV 1).
 - NRC acceptance confirmed X-SAM System meets the guidelines in NUREG 0554 for Single failure proof cranes
- In 1983 the NRC completed their second review of EDR-1 (REV 3) and reconfirmed compliance again to NUREG - 0554
- Westinghouse proposes another minor revision to update the *Generic Licensing* Topical Report.



EDR-1 Revision Objectives

- Retain the protective functionality and features of the X-SAM system previously accepted
- Update NDE acceptance criteria where applicable
- Provide closer alignment with current Industry technology & Standards, Including ASME NOG-1
- Consistency in examples of component design
- Establishment of 'Critical Items' in lieu of the prior terminology designation 'Nuclear Safety Related'



Protective Functionality & Features of X-SAM System

- No safety system design features have been changed or modified from EDR-1 Rev 3 report
 - Compliance with NUREG 0554
- Quality Assurance of manufactured components will still be maintained thru Westinghouse's NQA-1 and 10CFR50 Appendix B Quality Program



Update of NDE Acceptance Criteria

- ASTMs that have been retracted will be replaced with current industry accepted standards
- Alignment to NOG-1 2010 where practical
 - Section 7000 'Inspection and Testing'
 - Required Inspections or Tests – Type I (Table 7210-1)



NDE Acceptance Criteria Update

Notes

1. Nil Ductility Transition Testing of rolled structural materials shall be performed in accordance with NUREG 0554 Section 2.4. Actual testing of materials for listed item is performed only if material thickness is such that testing is required by the Regulatory Guide.
2. MT or PT inspect the welds, in the listed structure, whose failure could result in loss of the load per AWS D1.1. Acceptance Criteria: AWS D 1.1, 2010.
3. Deleted.
4. Post weld heat treatment per AWS D1.1, 2010, is normally provided for welded gear cases. Depending upon the detailed design parameters, i.e., material thickness and weld sizes, additional post weld heat treatment of other weldments is also provided.
5. UT inspect material after rough machining per ASTM A-388, 2011. The acceptance standard, using straight beam, is as follows: One or more reflectors which produce complete loss of back reflection, not attributable to geometric configuration, are unacceptable. Complete loss of back reflection is assumed when back reflection falls below 5 percent of full calibration.
6. MP inspect per ASTM E-709, 2008. Acceptance Standard: Cracks, forging laps, or linear indications open to the surface are not allowed. For forged hooks MP inspect per ASTM A 275, 2008. Acceptance Criteria: Same as above plus linear subsurface indications more than $\frac{1}{16}$ " long are unacceptable (DC current required).
7. UT inspect hooks per ASTM A-388, 2011 or EN 10228-3, 1998. Acceptance Standard for UT of hooks using straight beam, is as follows: One or more reflectors which produce complete loss of back reflection, not attributable to geometric configuration, are unacceptable. Complete loss of back reflection is assumed when back reflection falls below 5 percent of full calibration.
 - A. For custom fabricated hooks, perform the UT examination of billet prior to flame cutting.
 - B. After forging and before machining, hooks shall be ultrasonic tested using flat-bottomed hole reference standards and distance-amplitude correction curves. Discontinuity indications in excess of the response from a $\frac{1}{8}$ " (3mm per EN 10228-3) flat bottomed hole at the estimated discontinuity depth shall be unacceptable.
 - C. Because standard catalogue hooks must be inspected in a semi-finished condition, only about 90% of their surfaces are suitable for UT examination.
8. Following load test.
9. RT or UT & MT or PT inspect all full penetration butt welds present, if any, in listed item. Acceptance Criteria: AWS D 1.1, 2010.
10. UT inspect:
 - A. The area within five inches of both longitudinal edges for the entire length of the plates.
 - B. The area within 12 inches of both transverse edges for the entire width of the plates.
11. Deleted.
12. MT or PT inspect the lateral welds between the flange and web plates on the girders. Acceptance Criteria: AWS D 1.1, 2010.
13. UT inspect the plates per ASTM A-578, 2012. Acceptance Standard: Level B.
14. Minimum BHN 321 in tread area.
15. LP inspect per ASTM E-165, 2012 Acceptance Standard: No cracks at points of high stress or at stress risers, with ASTM E-433, 2008 as a reference.

Revision 5

A-2

August 2013

Revision 5

A-3

August 2013



Alignment with Section 7100 NOG-1 2010

Typical NDE Alignment Changes

NDE Testing alignment (RT) Terminology Alignment (MS)

Revision 3 10/8/82

APPENDIX A

SAMPLE CRITICAL ITEMS LIST
FOR EDERER'S NUCLEAR SAFETY RELATED X-SAM CRANES

Critical Item Number	Figure Number	Description (1)	Material Test Reports (2)	Non Destructive Examinations (3)	Miscellaneous Inspections, Tests, and Certifications (4)
<u>BRIDGE</u>		(Complete Cranes Only)			
B.1	III.C.1.d.2	<u>Girder Structure</u>	—	—	—
B.1.1	III.C.1.d.2	Top Plate	MS NDTT (5) UT (17,14)	RT (13)	NSR (7)
B.1.2	III.C.1.d.2	Bottom Plate	MS NDTT (5) UT (17,14)	RT (13)	NSR (7)
B.1.3	III.C.1.d.2	Web Plates	MS NDTT (5) UT (17,14)	RT (13) MT (16)	NSR (7)
B.2	III.A	Motors	NA	NA	RMTR
B.3	Similar to T.4	Seismic Restraints	MS	MT (6)	NSR (7)
B.4		Wheels	MS HP (19)	NA	NA
B.5		Rails	MS	NA	NA
B.6		Axles	MS HP	NA	NA

RT only to:
UT & MT
or RT

MS to CMTR
(Certified
Material Test
Reports)



A.11

Consistency in Component “CI” Design

- Provide clarification in diagrams or to CI specifying terminology throughout EDR-1 Topical Report

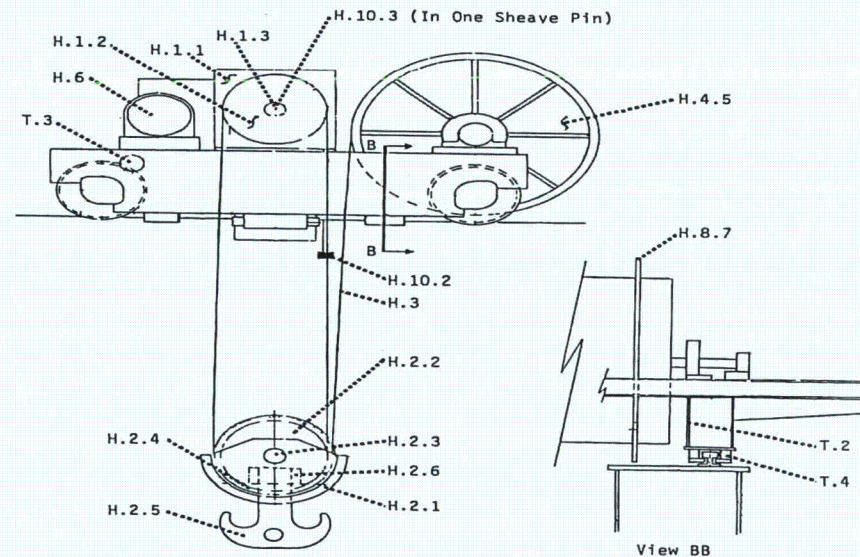


Figure III.D.6
Depiction of Typical Critical Items (See Appendix A for Explanation of Items)

Revision 4

13

November 2012



Improve Application of Report

Sample Critical Items List For Ederer's X-SAM Cranes

Critical Item Number	Figure Number	Description (1)	Material Test Reports (2)	Non Destructive Examinations (3)	Other/Additional Inspections, Tests, and Certifications (3)
Trolley					
T.1	III.C.1.d.1	Load Girts	MTR NDTT (1)	MT (2)	
T.2	III.C.1.d.1 III.D.6	Truck Structure (Inside Plates)	MTR NDTT (1)	N/A	
T.3	III.D.6	Motors	N/A	N/A	RMTR
T.4	III.D.6	Seismic Restraints	MTR	MT (2)	
T.5	III.D.4	Drum Safety Support	MTR NDTT (1)	MT (2)	
T.6	Not Shown	Drum Brake Mounting Base	MTR NDTT (1)	MT (2)	

Matrix Tabular Formatting in Appendices A, B, & C



Consistency and Economics in Component Design

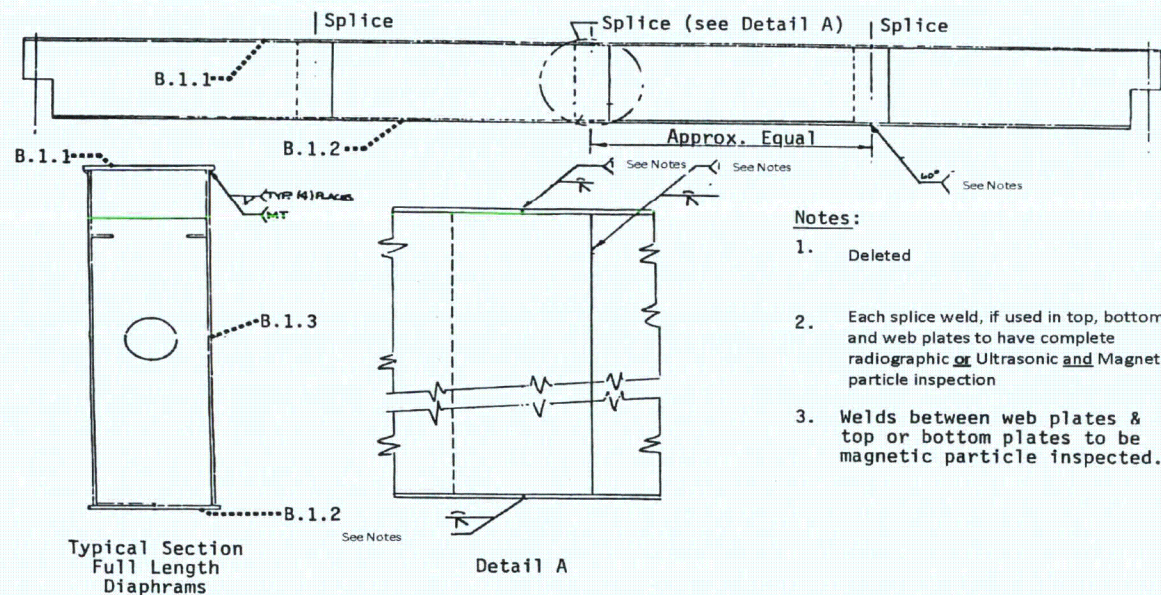


Figure III.C.1.d.2
Typical Girder Structural Welds

Allowances for continuous web plates design and for the application of alternative NDE practices

Revision 5

29

August 2013

Example Represents a "Typical" Girder design.



Incorporation of Modern Terminology and Technology

Table III.F.1
Typical Characteristics of Four Different Capacity X-SAM Hoists of the Reference Designs (cont.)

Application	Compact Hoist	Medium Capacity Main Hoist	Fuel Cask Handling Crane	Containment Building Polar Crane
Hoist (cont.)				
Controller	Variable Frequency Flux Vector ⁽⁷⁾	Variable Frequency Flux Vector ⁽⁷⁾	Variable Frequency Flux Vector ⁽⁷⁾	Variable Frequency Flux Vector ⁽⁷⁾
Control Braking	Dynamic Lowering ⁽⁷⁾	Dynamic Lowering ⁽⁷⁾	Dynamic Lowering ⁽⁷⁾	Dynamic Lowering ⁽⁷⁾
Hook Design Load	10 Tons	50 Tons	130 Tons	250 Tons
Hook Load Test	20 Tons	100 Tons	260 Tons	500 Tons
Hoist Reeving System				
Rope Class	6 x 36 IWRC	6 x 36 IWRC	6 x 36 IWRC	6 x 36 IWRC
No. Parts Rope	2 x 4	2 x 4	2 x 8	2 x 8 or 4 x 4
Rope Diameter	½"	1 1/8"	1 ¼"	1 3/8"
Max. Rope Speed	60 fpm	16 fpm	36 fpm	16 fpm – 32 fpm
Exterior Fleet Angle	3.5 degrees	3.5 degrees	3.5 degrees	3.5 degrees
No. Reverse Bends	1	1	1	1
Hoist Safety Features				
No. Ropes	2	2	2	2 or 4
Hook Safety Factor (Minimum)	10 ⁽⁴⁾	10 ⁽⁴⁾	10 ⁽⁴⁾	10 ⁽⁴⁾
No. Load Cell Devices	1	1	1	1

Typical application of Flux Vector Drives, Dynamic Lowering, modern wire rope 6 x36 IWRC classification



Alignment of EDR-1 to NUREG 0554

- **Clarification for the use of the originally authored and coined terminology “Nuclear Safety Related” (NSR)**
 - Meant to indicate “important/critical to safety components” within the design and or safety system
 - Due to industry conservatism, over time the NSR designations has become conjoined with the singular synonymous meaning associated with “Safety-Related”
 - These items are now identified as Critical Items (CI)
 - Subject to the same augmented quality requirements, tests, and certifications contain originally within EDR-1.
 - Maintained under a 10CFR50 Appendix B quality program



Alignment of EDR-1 to NUREG 0554

- NSSS or Nuclear Power Plant designer owns the responsibility of the (SR) component designation
 - Crane manufacturer or accepted industry design specification should not be the governing document
- Related NRC accepted industry standards for Single Failure Proof crane design does not include the designation of ‘Safety Related’ components or items in the design specification
 - ASME, NOG-1, for type 1 cranes
 - Regulatory Issue Summary 2005 - 25



Reference: Safety Related Definition

- EPRI Guideline NP 5652: Safety Related definition

Safety-Related Component - A plant structure, system, component or part thereof, necessary to assure:

1. **The integrity of the reactor coolant pressure boundary,**
2. **The capability to shut down the reactor and maintain it in a safe shutdown condition, or**
3. **The capability to prevent or mitigate the consequences of accidents which could result in potential offsite radiation exposures comparable to those referred to in 10CFR Part 100.11 (definition also applies to a basic component per 10CFR21).**



Post Submittal Commentary



Preliminary NRC Staff Comments

- Comment 1:

TR does not clearly address the use of current NRC guidance for safety-related, single failure proof cranes. Instead, the TR focuses on demonstrating compliance with RG 1.104 criteria, which was withdrawn and replaced by NUREG-0554. The current AP1000 COL applicants do not reference nor commit to use of RG 1.104 criteria. This complicates the review in order to determine whether pertinent guidance of NUREG-0554, NUREG-0612 and NOG-1 have been addressed for the single failure proof design for use in new nuclear power plants. The staff expects that requests for additional information (RAIs) will be needed to develop a full understanding.

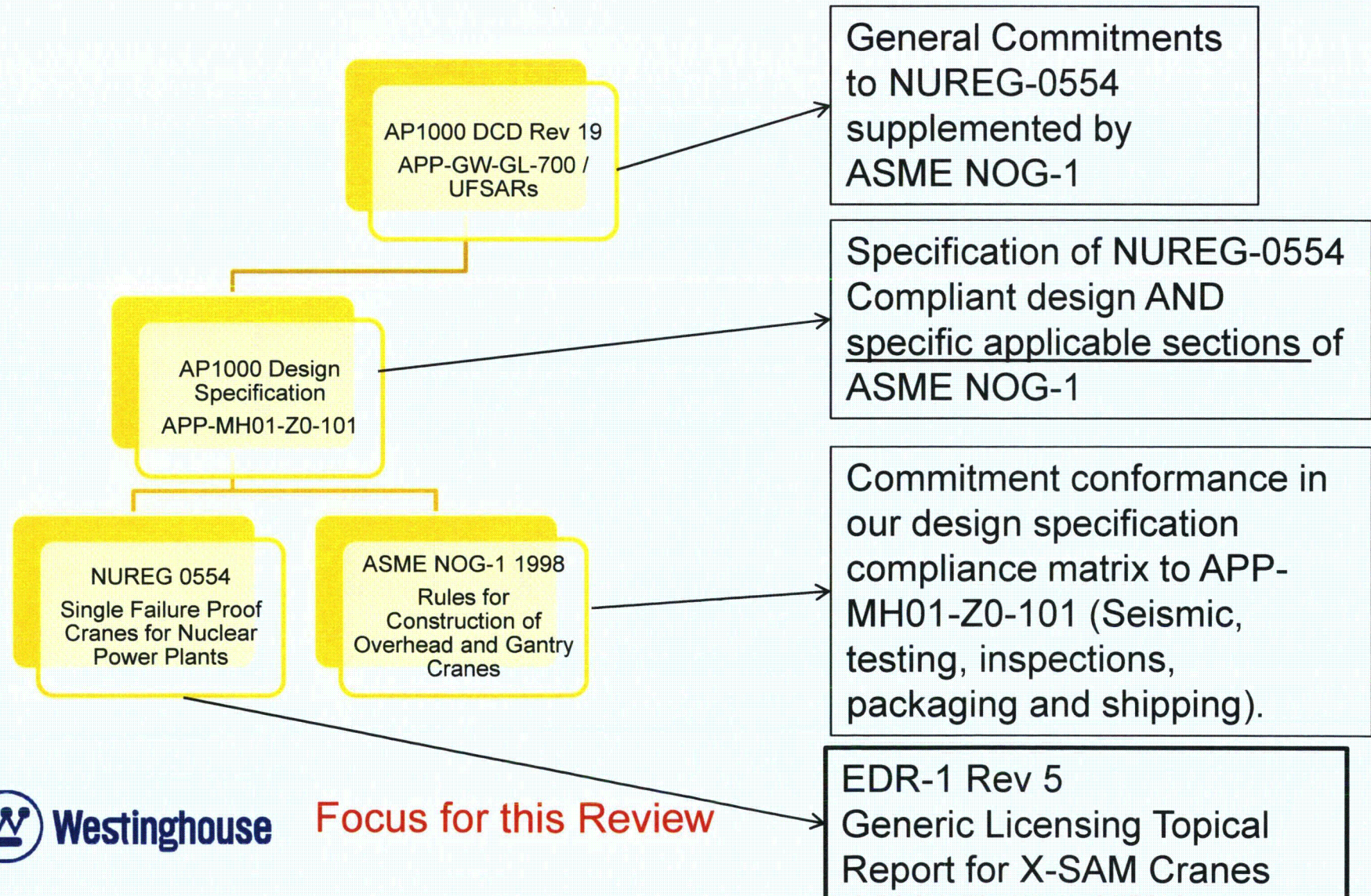
- Response:

Single failure proof cranes are not safety related by definition or application of NUREG 0554 and/or NOG-1 alone. The original basis for EDR-1 was RG1.104, however the applicability and relevance of EDR-1 has always been evaluated by the NRC against NUREG 0554. This can be found in the two prior acceptance letters by the NRC, one for REV 1 and one for REV 3. Compliance to NUREG 0554 is specifically stated throughout the document. References to RG1.104 in the TR exist and should primarily be viewed as historical markers to the origin of the initial design objectives for the single failure proof hoists only.

For background, RG1.104 was more stringent than its predecessor NUREG 0554.



AP1000 Design Hierarchy



Preliminary NRC Staff Comments

- Comment 2:

The TR does not clearly address the basis regarding how NOG-1 supplements the single failure proof design. DCD Section 9.1.5.2 states, “The polar crane and cask handling crane are designed according to the requirements of NUREG-0554 supplemented by ASME NOG-1 for a Type I, single-failure-proof crane...” The staff expects additional information will be necessary to determine extent of ASME NOG-1 requirements applied.

- Response:

EDR-1 REV 5 is meant to be a “generic” TR and will be used to satisfy the requirements of NUREG-0554. It was not intended to meet both the application of NUREG 0554 combined with supplements of NOG-1. Therefore we are only requesting an evaluation against NUREG 0554.

For AP1000 plants, compliance matrices exist exclusively for the design requirements to the applicable sections of NOG-1 and the design requirements of EDR-1, Appendices B&C. Our intention, at the time of crane equipment licensing, is to apply these sets of documents towards the DCD requirements.

- EDR-1 Revision 5 is to meet the requirement for compliance to NUREG 0554.
- Design specification is compliant for the supplemental requirements of NOG-1.



Preliminary NRC Staff Comments

- Comment 3

TR specifies, "Typical design data is provided for cranes and hoists of the reference design that range in capacity from 10 Tons to 250 Tons." Table III.F.1 of TR further defines the typical cask handling and polar cranes having capacities of 130 ton and 250 tons, respectively. With the current Westinghouse DCD design capacities exceeding these values, additional analysis may be necessary to justify the applicability of the TR to larger crane capacity designs.

- Response:

The generic licensing TR should be viewed merely as an application of a design specification for an enhanced hoisting safety system in the prescribed heavy load or critical load lifting application.

At the time the report was written, the project that this report was first being utilized for had these specific capacity applications. The capacity ranges listed in the TR are meant only to denote typical crane capacities in certain classifications or crane types throughout the TR. They were not meant to represent a bounding capacity range for any particular crane classification or type.

In application for the AP1000, the MCL (maximum critical load- i.e. the load being lifted over fuel or safety related equipment) for the AP1000 polar crane is specified to 235 tons, this would be within the bounds of the TR if these values were taken to be a bounding range.



AP1000 Licensing Basis

- Maintain compliance to all licensing commitments made through the AP1000 DCD/UFSARs for single failure proof cranes and hoists
 - Compliance to NUREG 0554
 - Compliance to the supplemental requirements of ASME NOG-1 1998
 - The AP1000 Licensing Basis will not be impacted by EDR-1 Rev. 5.
- Meet the requirements of NUREG 0554 via EDR-1 Generic Topical Licensing Report Rev. 5
 - Retain the protective functionality and features of the X-SAM system that were previously accepted.
 - Retain all commitments for previously accepted testing requirements
 - Update NDE acceptance criteria and methodology where applicable
 - Quality Assurance of manufactured cranes and components will still be maintained through an approved 10CFR50 Appendix B Quality Program



Construction Need Date

Need Date to Support Construction: **6/9/2015**

- The approval of EDR-1 is tied to lifting and setting the trolley for the spent fuel cask handling crane at elevation 161'-6" – Areas 5 & 6 at V.C. Summer.
- The construction date for this activity is 6/10/15.



Questions

