

Limerick Generating Station Digital Modernization Project LAR Technical Specifications Changes

NRC Pre-submittal Meeting
December 7, 2021



Agenda / Opening Remarks

- Introductions
- Current Limerick Technical Specifications (TS)
- Limerick Digital Upgrade Project
- Changes to Make the Limerick TS More Consistent with ITS
- Changes to the Limerick TS To Reflect the Upgraded Design
- TS Presentation in the LAR
- Next Steps

Introductions – Exelon Project Team

- Licensing
 - Darani Reddick, Licensing Director
 - Dave Helker, Licensing Manager
 - Frank Mascitelli, Licensing Lead
 - George Budock, LGS Regulatory Assurance
 - Pareez Golub, Digital Licensing SME
 - Brian Mann, Technical Specifications SME
- Engineering
 - John Connelly, Central Design Organization (CDO) Manager
 - Mark Samselski, CDO - Lead Responsible Engineer
 - George Bonanni, CDO - Senior Staff Engineer
 - Mike Foote, CDO - Senior Staff Engineer
 - Scott Schumacher, Systems Engineering

(continued)

Introductions – Exelon Project Team

- Project Management
 - Steve Hesse, Project Director
 - Dave Molteni, Senior Manager and Station Lead
 - Jerry Segner, Principal Project Manager
 - Kayla Marriner, Project Manager
- Operations
 - Paul Krueger, Operations

(continued)

Introductions – Westinghouse Project Team

- Project Management
 - Tom Pietryka, Program Manager
- Engineering
 - Terry Tuite, PPS Lead – Engineering
 - Warren Odess-Gillett, Lead – Licensing
 - Cal Tang, BWR Technical Advisor

Current Limerick Technical Specifications (TS)

Limerick Existing TS Overview

- Limerick is a two-unit BWR/4 plant with TS based on NUREG-0123, “Standard Technical Specifications for General Electric Boiling Water Reactors.”
- Limerick has adopted a Surveillance Frequency Control Program and a Risk-Informed Completion Time Program
- Significant differences between the Limerick TS and BWR/4 TS based on the improved STS (NUREG-1433):
 - Limiting Safety System Setting (LSSS) Section in Chapter 2
 - Instrumentation TS include trip setpoints and response time limits
 - Instrumentation TS typically include four tables:
 - Table 1 – Function, Minimum Operable Channels per Trip System, Operational Condition, Actions
 - Table 2 – Trip Setpoint and Allowable Value
 - Table 3 – Response Time Limits
 - Table 4 – Surveillance Requirements
 - Tables have lists of Actions and make extensive use of footnotes

Limerick Digital Modernization Project

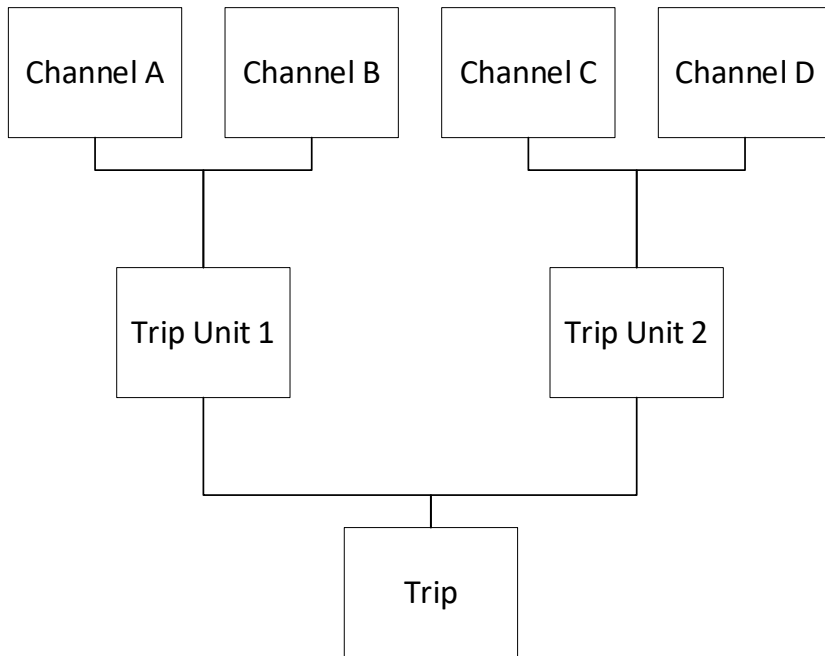
Project Overview

- The Limerick project is a pilot for future digital modernization projects at other Exelon sites and for other plants.
- An integrated digital Plant Protection System (PPS) replaces the analog systems that provide:
 - Reactor Protection System (RPS) instrumentation
 - Nuclear Steam Supply Shutoff System (NSSSS) (isolation) instrumentation
 - Emergency Core Cooling System (ECCS) instrumentation
 - Reactor Core Isolation Cooling System (RCIC) instrumentation
 - End-of-Cycle Recirculation Pump Trip (EOC RPT) instrumentation
- Upgrades analog Redundant Reactivity Control System (RRCS) to digital (ATWS).
- Most logic changed from typical BWR one-out-of-two-taken-twice to two-out-of-four.

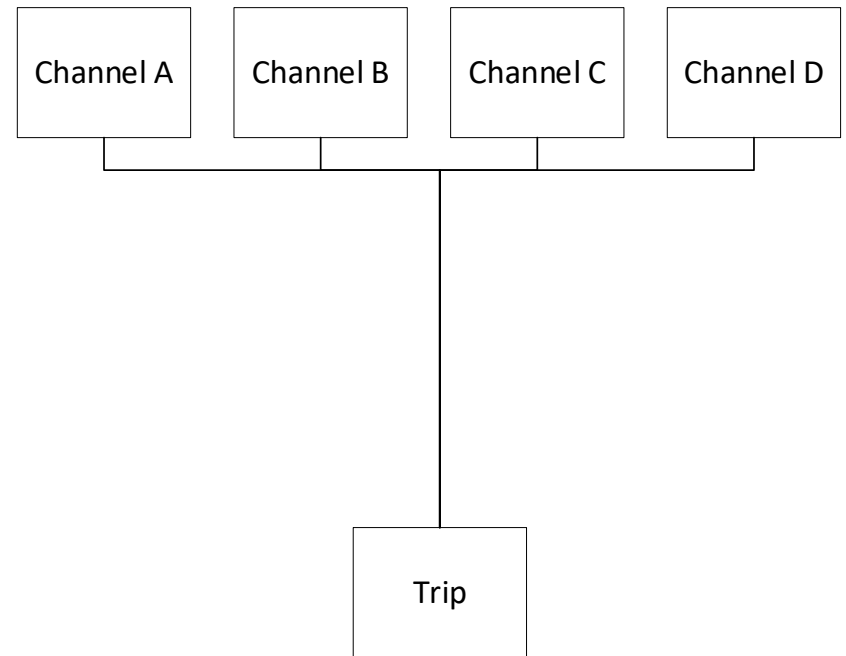
Trip Logic

TRIP LOGIC

One-Out-Of-Two-Taken-Twice



Two-Out-Of-Four



Changes to Make the Limerick TS More Consistent with ITS

Move LSSS Table to Instrumentation Chapter

- The BWR ITS removed the LSSS section and moved the instrument functions to TS 3.3.1, “Reactor Protection System Instrumentation.”
- The existing Limerick LSSS section contains a table of functions but references TS 3.3.1 for Actions and Surveillances.
- The LAR will retain the Limerick LSSS section, but the table of function will be moved to the instrumentation section.
 - Consistent with ITS.
 - Supports other project changes to the TS.
 - Improves useability of TS.
 - Provides better model TS for future digital upgrades.

Relocate Trip Setpoints to Licensee Control

- The BWR STS (NUREG-1433) only contains Allowable Values. Trip setpoints were relocated to licensee control.
- The Limerick TS contain both Trip Setpoints and Allowable Values.
 - The exception is Reactor Pressure Vessel Water Inventory Control (RPV WIC) Instrumentation, which contains only Allowable Values.
- The LAR will relocate trip setpoints to licensee control.
- The LAR will either reference previous amendments in which the NRC approved the application of the trip setpoint methodology or will describe the applicable trip setpoint methodology.
- Change is:
 - Consistent with ITS.
 - Supports other project changes to the TS.
 - Provides better model TS for future digital upgrades.

Relocate Response Time Limits to Licensee Control

- The BWR STS (NUREG-1433) requires response time testing, but the limits are relocated to licensee control.
- The Limerick TS contains response time limits.
- Response time limits will be relocated to licensee control following the guidance in Generic Letter 93-08, “Relocation of Technical Specification Tables of Instrument Response Time Limits.”
- Change is:
 - Consistent with ITS.
 - Supports other project changes to the TS.
 - Provides better model TS for future digital upgrades.

Create a Loss of Power TS

- The BWR STS (NUREG-1433) requirements on Loss of Power instrumentation (Degraded Voltage and Loss of Voltage) are in a separate specification.
- The Limerick TS 3.3.5, “ECCS Instrumentation,” contains functions for Degraded Voltage and Loss of Voltage.
- The LAR will move the Loss of Power requirements to a separate specifications, consistent with the ITS, without change except to relocate the trip setpoints to licensee control.
- Change is:
 - Consistent with ITS.
 - Supports other project changes to the TS.
 - Simplifies the PPS specifications.
 - Provides better model TS for future digital upgrades.

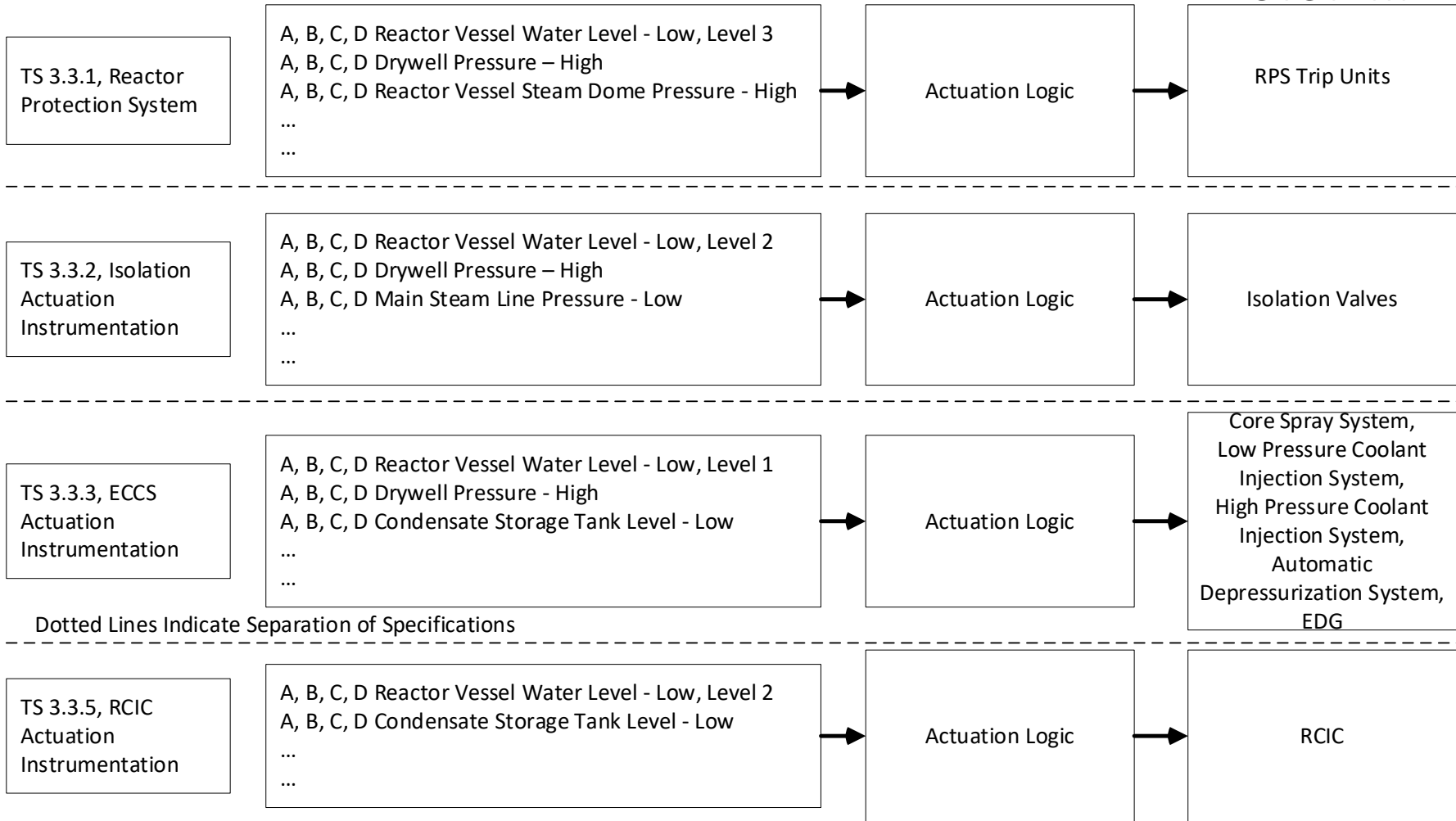
Changes to the Limerick TS To Reflect the Upgraded Design

CURRENT TS DESIGN

SPECIFICATION

SENSORS & LOGIC

ACTUATED SYSTEM



Each specification is independent, even though the specifications are based on many of the same parameters.

The Surveillances in each specification test from the sensor to the actuated system (Channel Calibration, Response Time Test, Logic System Functional Test).

The Actions in each specification are based on the ability of the operable sensors to initiate the one-out-of-two-taken-twice logic to initiate the supported system.

REVISED TS DESIGN

CHANNELS

A Drywell Pressure – High
 A Condenser Vacuum - Low
 A MSL Pressure – Low
 ...
 ...

B Drywell Pressure – High
 B Condenser Vacuum - Low
 B MSL Pressure – Low
 ...
 ...

C Drywell Pressure – High
 C Condenser Vacuum - Low
 C MSL Pressure – Low
 ...
 ...

D Drywell Pressure – High
 D Condenser Vacuum - Low
 D MSL Pressure – Low
 ...
 ...

Dotted Lines Indicate
 Separation of Specifications

A
 Comparators

B
 Comparators

C
 Comparators

D
 Comparators

All the Sensors in
 a Channel
 Communicate
 with that
 Channel's
 Comparators

All Comparators
 Communicate
 with All Divisions

DIVISIONS

Division 1
 Actuation Logic

Division 2
 Actuation Logic

Division 3
 Actuation Logic

Division 4
 Actuation Logic

Different
 Divisions
 Communicate
 with Different
 Devices

ACTUATED SYSTEMS

RPS Trip Units
 (Div 1 or 3 Half-Scram
 Div 2 or 4 Half-Scram)

HPCI
 (Div 2&4)

RCIC, ADS
 (Div 1&3)

LPCI, CS, EDG, Isolation
 Valves
 (Div 1, 2, 3, 4)

New TS Organization

- To reflect the new design, the Section 3.3 TS are reorganized:
 - 3.3.1 Plant Protection System Instrumentation Channels
 - ~~3.3.1 Reactor Protection System Instrumentation~~
 - 3.3.2 Plant Protection System Divisions
 - ~~3.3.2 Isolation Actuation Instrumentation~~
 - 3.3.3 Reactor Trip Units
 - ~~3.3.3 Emergency Core Cooling System Actuation Instrumentation~~
 - 3.3.3.A Reactor Pressure Vessel (RPV) Water Inventory Control (WIC) Instrumentation
 - 3.3.4.1 ATWS Recirculation Pump Trip System Instrumentation
 - ~~3.3.4.2 End-of-Cycle Recirculation Pump Trip System Instrumentation~~
 - 3.3.5 Loss of Power
 - ~~3.3.5 Reactor Core Isolation Cooling System Actuation Instrumentation~~
 - 3.3.6 Control Rod Block Instrumentation (Unchanged)
 - 3.3.7 Monitoring Instrumentation (unchanged)
 - 3.3.7.4 Remote Shutdown (Unchanged)
 - 3.3.7.5 Accident Monitoring Instrumentation (Unchanged)
 - 3.3.7.6 Source Range Monitors (Unchanged)
 - 3.3.9 Feedwater/Main Turbine Trip System Actuation Instrumentation (Unchanged)

TS 3.3.1, Plant Protection System Instrumentation Channels

- TS 3.3.1 is consistent with the IEEE-603 definition of a channel:
 - An arrangement of components and modules as required to generate a single protective action signal when required by a generating station condition. A channel loses its identity where single protective action signals are combined.
- The TS will contain a single table that lists the sensor function, applicable operational condition, minimum operable channels, and allowable value.
- Like the ITS, the specification will include the Actions and Surveillance Requirements instead of separate tables.
- Average Power Range Monitor (APRM), Intermediate Power Range Monitors (IRMs), and Oscillation Power Range Monitor (OPRM) inputs are treated as channel inputs.
- Only manual functions credited in the accident analysis (i.e., satisfying 10 CFR 50.36(c)(2)(ii) Criterion 2 or 3) are required.

TS 3.3.1, Plant Protection System Instrumentation Channels

Example Table (Format Only)

TABLE 3.3.1-1

PLANT PROTECTION SYSTEM INSTRUMENTATION CHANNELS				
	FUNCTIONAL UNIT	APPLICABLE OPERATIONAL CONDITIONS	MINIMUM OPERABLE CHANNELS	ALLOWABLE VALUE
<u>Neutron Flux</u>				
1.	Intermediate Range Monitors ^(a)			
	a. Neutron Flux - High	2, 3 ^(b) , 4 ^(b) , 5 ^(b)	3	≤ 122/125 divisions of full scale
	b. Inoperative	2, 3 ^(b) , 4 ^(b) , 5 ^(b)	3	N.A.
2.	Average Power Range Monitor ^(b)			
	a. Neutron Flux - Upscale (Setdown)	2	3	≤ 20.0% of RATED THERMAL POWER
	b. Simulated Thermal Power - Upscale			
	i. Two Recirculation Loop Operation	1	3	≤ 0.65 W + 62.2% and ≤ 117.0% of RATED THERMAL POWER
	ii. Single Recirculation Loop Operation ^(c)	1	3	≤ 0.65 (W-7.6%) + 62.0% and ≤ 117.0% of RATED THERMAL POWER
	c. Neutron Flux - Upscale	1	3	118.7% of RATED THERMAL POWER
	d. Inoperative	1,2	3	N.A.
	e. 2-Out-Of-4 Voter	1,2	4	N.A.
	f. OPRM Upscale	1 ^(c)	3 ^(d)	N.A.
<u>Reactor Vessel</u>				
3.	Reactor Vessel Steam Dome Pressure - High	1, 2 ^(b)	3	≤ 1103 psig
4.	Reactor Vessel Pressure - High (RHR Cut-in Permissive)	1,2,3	3	≤ 95 psig
5.	Reactor Vessel Pressure - Low (Permissive)	1,2,3	3	≥ 435 psig (decreasing)
6.	Reactor Vessel Water Level			
	a. Low, Low, Low Level 1	1,2,3	3	≥ - 136 inches
	b. Low, Low - Level 2	1,2,3	3	≥ - 45 inches*
	c. Low - Level 3	1,2,3	3	≥ 11.0 inches*
	d. Reactor Vessel Water Level - High, Level 8	1,2,3	3	≤ 60 inches
<u>Reactor Trip System</u>				
7.	Scram Discharge Volume Water Level - High			
	a. Level Transmitter	1,2,5 ^(f)	3	≤ 261' 5 5/8" elevation
	b. Float Switch	1,2,5 ^(f)	3	≤ 261' 5 5/8" elevation
8.	Reactor Mode Switch Position	1,2,3,4,5	3	N.A.
<u>Drywell</u>				
9.	Drywell Pressure - High	1,2,3	3	≤ 1.88 psig
<u>Emergency Core Cooling System</u>				
10.	Condensate Storage Tank Level - Low	1,2,3	2	≥ 164.3 inches
11.	Suppression Pool Water Level - High	1,2,3	2	≤ 24 feet 3 inches

(continued)

TS 3.3.1, Plant Protection System Instrumentation Channels

- The TS will require three sensor channels to be operable for most four channel functions.
- 10 CFR 50.36(c)(i) states, “Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility.”
- Most sensor channels provide input to all divisions.
- Only three channels are needed to meet all design requirements for voted channels.
- Consistent with the regulations and the plant design, the 3.3.1, PPS Channel Instrumentation, LCO will only require three sensor channels to be operable for most functions.
 - All four channels are maintained and tested by the PPS.
 - Under the new TS, one channel can be removed for testing or otherwise be inoperable without entering an Action.
 - Simplifies the current TS which contains Actions and SR Notes to facilitate removing a channel from service for testing.

(continued)

TS 3.3.1, Plant Protection System Instrumentation Channels

- The Actions will not be based on the actuated system.
- The typical Surveillance will be a calibration of the sensor to the input of the comparator.
 - The comparator is tested by the PPS self-test.

TS 3.3.2, Plant Protection System Divisions

- TS 3.3.1 is consistent with the IEEE-603 definition of a division:
 - The designation applied to a given system or set of components that enables the establishment and maintenance of physical, electrical, and functional independence from other redundant sets of components.
NOTE—A division can have one or more channels.
- The LCO will require all four divisions to be operable.
- Still under development.
 - May be an Allowable Value table for TS limits implemented in the division, such as timers.
 - The TS will recognize that different divisions may support different actuated components.

TS 3.3.2, Plant Protection System Divisions

- The LAR will include revisions to certain TS Surveillance Requirements by crediting self-diagnostics of the digital platform:
 - Will credit NRC-approved WCAP-18461-P-A, “Common Q Platform and Component Interface Module System Elimination of Technical Specification Surveillance Requirements”
 - Will include analysis providing a comparison between the Limerick-specific design and the WCAP-18461-P-A’s scope
 - Draft analysis shows:
 - Some SRs can be eliminated: Channel Checks, Channel Functional Tests, Logic System Functional Tests
 - May add a new SR to test new design
 - Reduce scope of response time testing

TS 3.3.3, Reactor Trip Units

- New specification will be created that provides requirements on the trip system from the division reactor trip matrix through the scram valves.
- Still under development

3.3.5, Loss of Power Instrumentation

- Degraded voltage and loss of voltage functions moved from existing ECCS Actuation Instrumentation TS to a separate TS.
 - Consistent with the ITS.
 - Trip setpoints and response time limits relocated to licensee control.
 - Do not anticipate changing other requirements.

Other Changes

- 3.3.3.A, Reactor Pressure Vessel (RPV) Water Inventory Control (WIC) Instrumentation
 - Isolation functions are part of the digital modernization project, but TS requirements not incorporated into PPS TS.
 - Trip logic is changed from one-out-of-two-taken-twice to two-out-of-four.
 - Actions revised to reflect the new design.
- 3.3.4.1, ATWS Recirculation Pump Trip System Instrumentation
 - The ATWS RPT system instrumentation is part of the digital modernization project but is not part of PPS.
 - Retained as a separate TS.
 - Trip logic is changed from one-out-of-two-taken-twice to two-out-of-four.
 - Actions revised to reflect the new design.
 - Trip setpoints and response time limits relocated to licensee control.
- There will be changes to the defined terms to reflect the other TS changes.

TS Presentation in the LAR

TS Markup

- The LAR TS markups will be similar to a TS conversion markup.
 - Current TS (CTS) markup showing disposition of requirements with numbered Discussions of Change (DOCs).
 - New TS markup showing origin of existing requirements and new requirements with numbered DOCs.

Next Steps

Next Steps

- Arrange a follow-up meeting in mid-January to receive any NRC staff feedback.

Discussion