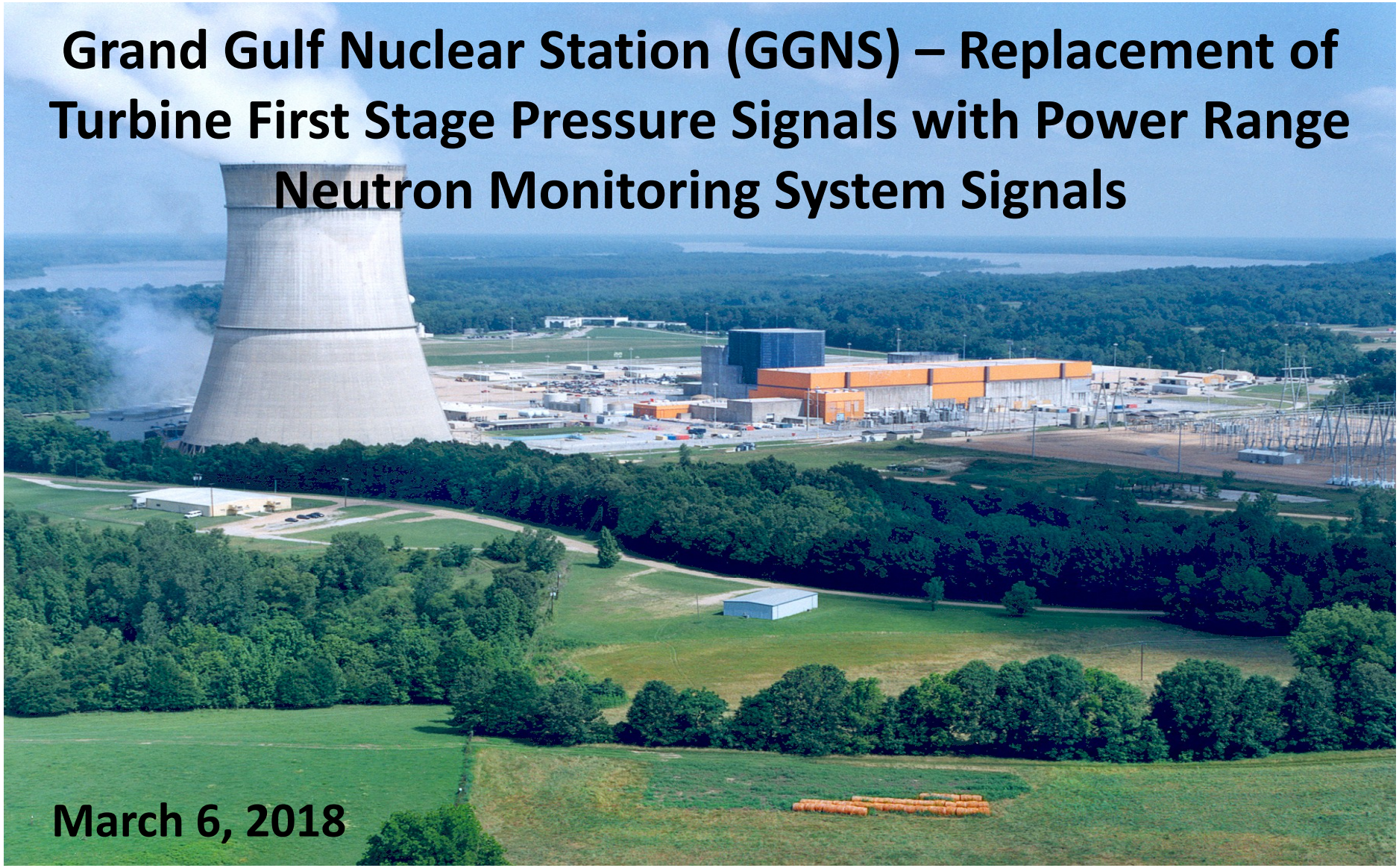
Grand Gulf Nuclear Station (GGNS) – Replacement of Turbine First Stage Pressure Signals with Power Range Neutron Monitoring System Signals



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Entergy

Introduction

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AGENDA

- Introductions
- Purpose
- System Description
- Background
- Modification EC 49880
- Schedule
- Questions

Introduction

GGNS Unit 1

- General Electric BWR 6
- Bechtel prime contractor
- Construction Permit issued September 4, 1974
- Operating License issued November 1, 1984
- Commercial operation began July 1, 1985
- License Renewal Approved December 1, 2016
- Period of Extended Operation begins November 2, 2024
- Renewed License expires November 1, 2044

PURPOSE

Introduce planned GGNS License Amendment Request for NRC approval to replace Turbine First Stage Pressure (TFSP) signals with the Power Range Neutron Monitoring System (PRNMS) signals for measuring reactor power

SYSTEM DESCRIPTION

- Turbine First Stage Pressure signal used as indirect measurement of reactor power
- 4 channels of Reactor Core power
- Safety Related Functions
  - Enable/bypass Turbine Stop Valve (TSV) closure and Turbine Control Valve (TCV) fast closure reactor scram
  - Enable/bypass End of Cycle (EOC) Recirculation Pump trip at low reactor power levels
  - Rod Control System Rod Blocks: Low Power Setpoint (LPSP), High Power Setpoint (HPSP), and Low Power Alarm Point (LPAP)

SYSTEM DESCRIPTION

- Non-safety Related Functions
  - Feedwater Low Power Set-Down
  - Hydrogen Water Chemistry Trips
  - Main and Reheat Steam Systems

- Average Power Range Monitoring (APRM) Subsystem Functions
  - Neutron Flux - High, Setdown
  - Fixed Neutron Flux - High
  - APRM - lnop
  - Flow Biased Simulated Thermal Power- High

SYSTEM DESCRIPTION

Power Range Neutron Monitoring System/APRM Subsystem

- APRM subsystem provides primary indication of reactor core neutron flux
- Responds almost instantaneously to neutron flux increases
- License Amendment No. 188 approved replacement of APRM subsystem with digital General Electric Hitachi Nuclear Measurement Analysis and Control (NUMAC) PRNMS.
- EC 21999 “GGNS EPU Power Range Neutron Monitoring System NUMAC Upgrade,” installed during Refueling Outage 18 (Spring 2012)

BACKGROUND

TFSP Operating Experience - between 1995 and 2014 GGNS experienced numerous failures of the TFSP sensing lines/instrumentation

- Power operation (1995), isolation valve to TFSP transmitter leaked
- Refueling Outage (RO) 8 startup (1996), weld attaching TFSP sensing line to main steam line developed leak
- RO 9 startup (1998), weld repair of TFSP sensing line separated from main steam line; several compression fitting repairs conducted
- RO 10 startup (12/12/99), TFSP sensing line separated at the tube fitting on main steam line side of pressure transmitter isolation valve

BACKGROUND

TFSP Operating Experience (cont)

- RO 14 startup (10/19/2005), TFSP sensing line for division 2 failed
- RO 16 (10/27/08), flexible hoses installed in division 1 and 2, main steam line “A” and main steam line “B,” TFSP sensing lines
- Power ~~O~~operation (3/20/10), approximately one month before RO 17, division 1 main steam line “B” flexible hose failed
- Power ~~O~~operation (6/7/10), approximately two months after RO 17 startup, TFSP sensing line for division 2 failed. T-mod installed.

BACKGROUND

TFSP Operating Experience (cont)

- RO 18 (4/15/11), engineering change maintained the TFSP transmitters tap location, but relocated the branch connections to reduce the fatigue stresses
- Extended Power Uprate (EPU) Amendment Issued (7/18/12)
- RO 19 startup (3/17/14), manual reactor scram due to failed TFSP sensing line steam leak; caused failure of main steam line four inch drain line.
- EC 49880 implemented (June 2014), replaced TFSP signals with PRNMS signals
- November 2016 NRC Inspection: Evaluations of Changes, Tests, and Experiments and Permanent Plant Modifications (2016007) (ML 16348A222)" Severity Level IV NCV for failure to obtain prior NRC approval for EC49880

MODIFICATION EC 49880

- Replaced TFSP measurement with direct neutron flux measurement from the APRMs
  - Setpoints did not change for
    - Enable/bypass TSV closure, TCV fast closure scram
    - EOC Recirculation Pump trip
    - Rod Control System blocks
      - LPSP
      - HPSP
      - LPAP

MODIFICATION EC 49880

- Replaces TFSP measurement with a direct neutron flux power measurement from the APRMs (cont.)
  - Each APRM sends a 0 - 10 volt signal proportional to 0 – 125% reactor power to a voltage-to-current converter (4 to 20 mA) current similar to TFSP transmitters
  - Signals sent to existing Master/Slave Trip unit for the RCIS, RPS and RPT systems
  - APRMs are calibrated against reactor thermal heat balance per TS SR 3.3.1.1.2
  - Installation of new qualified signal converters
  - The modification has been designed in accordance with the applicable channel redundancy, independence, and separation criteria

MODIFICATION EC 49880

- Diversity (TFSP vs. APRM)
  - NEDC-31336P-A, “General Electric Instrument Setpoint Methodology,” September 1996 is included in the GGNS Licensing Basis by reference from EPU Submittals and Amendment
  - NEDC -31336P-A, Section 3.25, states, in part: TFSP has been historically used as the parameter to approximate reactor power and effect the actual trip bypass. The RPS design purposely chooses this parameter, as opposed to the more direct measurement of power such as neutron flux, in order to assure diversity between the TSV closure and TCV scram functions and the neutron flux scram function.

MODIFICATION EC 49880

- Diversity (TFSP vs. APRM) (cont.)
  - NEDC -31336P-A, Section 3.25 not completely applicable to GGNS
  - GGNS UFSAR credits reactor vessel high-pressure trip signal not neutron flux for TSV closure and TCV fast closure scrams
  - GGNSS UFSAR identifies TSV closure and TCV-fast closure are anticipatory of reactor vessel high-pressure scram, but not anticipatory of neutron flux scram
  - Potential reduction in diversity is offset due to the reactor vessel high pressure scram.
  - Other information is available to plant operators to determine whether the scram bypass has been lifted at the correct power
    - APRM required calibration checks
    - Scram bypass power level is annunciated in the control room
    - Low-pressure alarm, is also annunciated

MODIFICATION EC 49880

- Branch Technical Position 7-19 Review
  - GGNS demonstrated that the modification to install the NUMAC PRNMS met the acceptance criteria in NRC BTP 7-19 during NRC review and accepted in Amendment No. 188

  - GGNS submitted an LAR for Maximum Extended Load Line Limit Analysis Plus (MELLLA+). As part of that review process, content from the previously submitted RAI response associated with Amendment No. 188 was revisited in light of MELLLA+ operations. It was found that MELLLA+ did not alter the conclusions about diversity and defense-in-depth, and the MELLLA+ LAR was subsequently approved in Amendment No 205 .

  - GEH Nuclear Energy Report 004N6431 (included in LAR), performed similar review of the nine criteria in BTP 7-19 as it relates to the modification to replace the TFSP instrumentation with the APRMS. This review concluded that either the criterion was satisfied or not applicable to this modification.

SCHEDULE

- Pre-Submittal Meeting: March 6, 2018
- Planned Submittal Date: April 6, 2018
- Requested Approval Date: April 8, 2019

Questions?