



Browns Ferry Nuclear Plant
Extended Power Uprate License Amendment Request
Transmission System Update Supplements
NRC Public Meeting

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BFN EPU Transmission System Update Supplements – Agenda

Introductions

G Doyle

Background

A Michael

Supplement 36, Transmission System Updates
– Safety Aspects

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- Summary of Impacts
- Questions

Supplement 37, Transmission System Updates
– Environmental Aspects

D Green

- Discussion of Changes
- Summary of Impacts
- Questions

Questions/Comments

G Doyle

BFN EPU Transmission System Update Supplements – Introductions

Gerry Doyle – Director, EPU

Pete Donahue – EPU Engineering Manager

Dan Green – EPU Licensing Manager

Bill Baker – EPU Operations Support Manager

Ashley Michael – EPU Project Manager

Joe Bashore – EPU Engineer

Gordon Williams – Corporate Licensing Project Manager

BFN EPU Transmission System Update Supplements – Background

- Extended Power Uprate (EPU) License Amendment Request (LAR) Supplement 18
 - Interconnection System Impact Study (SIS), performed for Browns Ferry Nuclear Plant (BFN) at EPU conditions, determined that main generator stability issues exist for a three-phase fault on one of several BFN transmission lines coincident with certain transmission lines already out of service (N-1-1 event)
 - Existing generator excitation system could not raise field voltage fast enough and high enough to prevent main generator from becoming unstable
 - To address transient stability issue during N-1-1 event, BFN planned to install a new shunt-fed, static excitation system on each of the three BFN units
 - New excitation system would provide field current directly to brushes and collector rings eliminating need for rotating Alterrex exciter and stationary diodes
 - Additional computer simulations for interconnection SIS, with this new excitation system modeled, demonstrated main generators remain stable during N-1-1 event

BFN EPU Transmission System Update Supplements – Background

- Legacy error in generator field parameters used in development of Interconnection SIS was identified
 - Generator field parameter values provided after stator rewind in 2003
 - Condition entered into Tennessee Valley Authority (TVA) Corrective Action Program
 - Stability studies, at EPU power levels, with new generator field parameter values indicate more extensive compensatory measure needed for main generators to remain stable during N-1-1 event
 - As a result, previous N-1-1 event stability mitigation plan (addressed in BFN EPU LAR Supplement 18) no longer viable
 - At EPU power levels, these more extensive compensatory measures would require BFN units, even with proposed static excitation systems installed, to be de-rated, whenever an applicable transmission line, as specified in Interconnection SIS, was taken out of service

BFN EPU Transmission System Update Supplements – Background

- Previous N-1-1 Event Stability Mitigation Plan
 - Static exciter installed on each of the three BFN units
 - Shunt-fed, static excitation would provide field current directly to brushes and collector rings eliminating need for rotating Alterrex exciter and stationary diodes
- Updated N-1-1 Event Stability Mitigation Plan
 - For each BFN unit's generator, the following will be performed
 - Automatic voltage regulator will be modified
 - Alterrex system will be modified to be self-excited, with a shaft driven alternator
 - Static exciter will not be installed
 - Static Volt-Ampere Reactive (VAR) Compensator sized at +450 Mega Volt-Ampere Reactive (MVAR)/-400 MVAR will be installed at existing Limestone Substation (near BFN)
 - Combination of Static VAR Compensator and four Capacitor Banks will provide a minimum reactive compensation of 764 MVAR
 - Capacitor Banks at Wilson Substation will not be installed

BFN EPU Transmission System Update Supplement 36 – Safety Aspects

- LAR Supplement 36 – Safety Aspects (submitted 1/20/17)
- Enclosure 1 - Interconnection System Impact Study, Revision 3
 - Discussion of Changes
 - Updated, for each unit at EPU conditions, to include
 - Total Gross Capacity and New Net Expected Capacity for Summer, Winter, Spring/Fall
 - Updated cost estimate for replacement of breaker failure relays
 - Updated to reflect new proposed N-1-1 Event Stability Mitigation Plan
 - Summary of Impacts
 - Additional computer simulations of the N-1-1 event for Interconnection SIS, with the modified excitation system and the new Static VAR Compensator modeled, have shown that the main generators remain stable
 - Questions

BFN EPU Transmission System Update Supplement 36 – Safety Aspects

- Enclosure 2 - LAR Attachment 43, Transmission Stability Study (TSS), Revision 4
 - Discussion of Changes
 - Updated to reflect new proposed N-1-1 Event Stability Mitigation Plan
 - Summary of Impacts
 - Simulations of TSS events were performed with static VAR compensator modeled at Limestone Substation to evaluate the effect of the proposed transmission system upgrade on the TSS results
 - Static VAR compensator improves TSS results for 500 kilovolt (kV) and 161 kV offsite power systems
 - Questions

BFN EPU Transmission System Update

Supplement 36 – Safety Aspects

- Enclosure 3/4 – Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) EEEB-RAI 1 Response, Revision 2
 - Discussion of Changes
 - Updated to reflect new proposed N-1-1 Event Stability Mitigation Plan
 - Summary of Impacts
 - Static VAR Compensator significantly improves 500 kV offsite power system
 - Most critical line unchanged from previous EEEB-RAI 1 Response
 - Acceptance criteria continue to be satisfied
 - 161 kV offsite power system also benefits from Static VAR Compensator
 - However, due to Static VAR Compensator's location on 500 kV offsite power system, the benefit to 161 kV offsite power system is not as significant as the benefit to 500 kV offsite power system
 - Questions

BFN EPU Transmission System Update

Supplement 36 – Safety Aspects

- Enclosure 5 - LAR Attachment 44, Probabilistic Risk Assessment (PRA) Addendum (Revised)
 - Discussion of Changes
 - Impact of proposed exciter modification addressed
 - Existing Automatic Voltage Regulator (AVR) is being modified
 - Also includes modifying AVR to receive power from the exciter generator (self-excited) instead of an external power source (separately excited)
 - Reliability of proposed modified exciter can be compared with existing exciter to provide insights into expected change in equipment reliability
 - Significant difference between existing and proposed exciter systems is power supply arrangement for AVR
 - Current system uses external power supplied from redundant excitation transformers, while modified system will obtain power from output of exciter generator through redundant transformers
 - Removal of external power source reduces number of potential component failures which could lead to a consequential generator exciter failure that would result in a turbine trip
 - With proposed modification, AVR will receive power from exciter stator, which is already required for exciter to function
 - Modification to AVR itself is not expected to impact reliability of exciter

BFN EPU Transmission System Update Supplement 36 – Safety Aspects

- Enclosure 5 - LAR Attachment 44, PRA Addendum (Revised) (continued)
 - Summary of Impacts
 - Proposed modification to generator excitation system does not result in a baseline risk increase nor a change in risk from Current Licensed Thermal Power to EPU power
 - Modified generator excitation system is considered to be more reliable than current generator excitation system
 - Questions

BFN EPU Transmission System Update

Supplement 36 – Safety Aspects

- Enclosure 6 - Power Uprate Safety Analysis Report Section 2.5.1.2.2 Update
 - Discussion of Changes
 - Updated to reflect new proposed N-1-1 Event Stability Mitigation Plan
 - Summary of Impacts
 - Additional computer simulations of N-1-1 event for Interconnection SIS, with modified excitation system and the new Static VAR Compensator modeled, have shown that the main generators remain stable
 - Questions

BFN EPU Transmission System Update Supplement 36 – Safety Aspects

- Enclosure 7 - LAR Attachment 47, List and Status of Modifications, Revision 4
 - Discussion of Changes
 - Static exciters will not be installed
 - For each BFN unit's main generator, the following will be performed
 - AVR will be modified
 - Alterrex system will be modified to be self-excited, with a shaft driven alternator
 - Modifications to be implemented as follows
 - Unit 1 - Fall 2020
 - Unit 2 - Spring 2021
 - Unit 3 - Spring 2020
 - Summary of Impacts
 - Generator exciters modified to be consistent with Interconnection SIS and TSS
 - Questions

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- LAR Supplement 37 – Environmental Aspects (submitted 2/3/17)
- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4
 - Updated Response to RERP-GE-RAI 2
 - Discussion of Changes
 - Updated to reflect new proposed N-1-1 Event Stability Mitigation Plan
 - Wilson Substation deleted from environmental reviews
 - Environmental reviews and results are included in Attachment 1, except for Limestone Substation
 - Deleted previous Attachment 2, letter to Tennessee State Historic Preservation Office with Phase 1 Wilson Substation Cultural Resources Survey
 - New Attachment 2 includes Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction
 - Updated schedule for completion of modifications
 - Updated to include Attachment 4, letter to Alabama State Historic Preservation Office with Phase 1 Limestone Substation Cultural Resources Survey
 - Summary of Impacts
 - Addressed in Attachment 2
 - Questions

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 1, Supplemental Environmental Information for Transmission System and BFN Main Generator Upgrades (excluding Limestone Substation)
 - Discussion of Changes
 - Updated to reflect new proposed N-1-1 Event Stability Mitigation Plan
 - Environmental reviews and results included, except for Limestone Substation
 - Added reference to new Attachment 2 for Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction
 - Information related to environmental reviews for Wilson Substation deleted
 - New proposed N-1-1 Event Stability Mitigation Plan does not involve changes to Wilson Substation
 - Summary of Impacts
 - Review results/conclusions unchanged
 - Review did not identify moderate or large environmental impacts from installation of proposed upgrades
 - TVA anticipates that installation of proposed upgrades will not affect human health or environment
 - Questions

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction
 - Discussion of Changes
 - Supplemental Environmental Information addresses the same topics as included in Attachment 1
 - Overview of Operations and Equipment Changes - Static VAR Compensator proposed to be installed at Limestone Substation
 - Requires expansion (approximately 25 acres of previously disturbed TVA property) of existing substation footprint with additional grading and clearing
 - Cost Benefit Analysis included in Attachment 1
 - Economic benefit is still highly positive
 - Phase 1 Cultural Resources Survey completed and results submitted to Alabama State Historic Preservation Office for concurrence (included in Attachment 4)

BFN EPU Transmission System Update

Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction
 - Discussion of Changes
 - Public drinking water is available to residents in the area, however, private wells are also used for drinking water
 - Mitigation measures include
 - Erosion control Best Management Practices (BMPs)
 - Use of fertilizers and herbicides in areas that flow to springs would be avoided or would be used sparingly
 - Endangered, Threatened, or Special Status Species – Aquatic
 - TVA Natural Heritage Database query identified 21 federally listed aquatic species within Limestone Creek Watershed
 - Field survey documented no intermittent or perennial streams and three wet weather conveyances (ephemeral streams)
 - Three ephemeral streams contain no suitable habitat for federally listed species
 - To eliminate potential impacts to sensitive aquatic life, ground disturbance will be minimized and all work conducted in accordance with BMPs

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction
 - Discussion of Changes
 - Endangered, Threatened, or Special Status Species – Terrestrial (Botany)
 - Field survey documented no impact to federally listed plant species or designated critical habitat
 - Neither exist within area that would be affected by proposed work
 - Field survey documented no rare plants or habitat capable of supporting state listed plant species occurs in the project area
 - Endangered, Threatened, or Special Status Species – Terrestrial (Zoology)
 - TVA Natural Heritage Database query indicated no state or federally listed species within three miles of project area
 - One federally protected species (bald eagle) and two federally listed species (gray bat and Indiana bat) are known from Limestone County, Alabama
 - United States Fish and Wildlife Service has determined that federally listed northern long-eared bat may occur in Limestone County, Alabama

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction
 - Discussion of Changes
 - Endangered, Threatened, or Special Status Species – Terrestrial (Zoology)
 - For the bald eagle
 - No suitable nesting or foraging habitat exists within project area
 - Bald eagle records are known approximately 9 to 17.5 miles from project footprint
 - No additional nests or individuals are known from project area and none observed during January 2017 field survey when active nesting behavior would have been apparent
 - No waterways or wetlands are present or would be affected by the proposed actions, thus bald eagle habitat not impacted

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction
 - Discussion of Changes
 - Endangered, Threatened, or Special Status Species – Terrestrial (Zoology)
 - For the gray, Indiana, and northern long-eared bats
 - No caves or other winter hibernacula exist in project footprint or would be impacted by proposed action
 - During January 2017 surveys, no suitable roost trees were identified within the forested habitat of area to be cleared
 - No wetlands or waterways are present within the proposed action area, thus foraging habitat for these bat species would not be affected

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction
 - Discussion of Changes
 - Review results for the following areas are the same as for other substation expansions
 - Socioeconomic and Environmental Justice Considerations
 - Land Use, Wetlands, and Natural Areas
 - Transmission Facilities, Electric Shock, and Electromagnetic Fields
 - Noise, Odor, Microbiological, and Visual Aesthetics
 - Air Impacts
 - Terrestrial Biota and Habitat
 - Non-radiological Waste Streams and Potential for Pollutant Generation
 - Geological Environment
 - Aquatic Resources - Rivers, Streams, and Reservoirs
 - Groundwater
 - Surface Water
 - Compliance, Permits, and Reporting
 - Applicable TVA BMPs and Environmental Quality Protection Specifications summarized

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 2, Supplemental Environmental Information for Limestone Substation Static VAR Compensator Construction
 - Summary of Impacts
 - Environmental review for Static VAR Compensator installation at Limestone substation did not identify moderate or large environmental impacts from installation of the Static VAR Compensator
 - TVA anticipates that installation of proposed Static VAR Compensator will not affect human health or environment
 - Questions

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 3, TVA letter to the Mississippi State Historic Preservation Office - TVA, Corinth and Holly Springs Substation Expansion Project, Phase 1 Cultural Resources Survey, Alcorn and Marshall Counties, Mississippi
 - Discussion of Changes
 - No changes
 - Summary of Impacts
 - No changes
 - Questions

BFN EPU Transmission System Update

Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 4, TVA letter to the Alabama State Historic Preservation Office - TVA, Limestone Substation Static VAR Compensator Construction, Phase 1 Cultural Resources Survey, Limestone County, Alabama
 - Discussion of Changes
 - Documents results of Phase 1 Cultural Resources Survey and seeks Alabama State Historic Preservation Office concurrence with TVA findings
 - No new archaeological resources were documented within boundaries of the Area of Potential Effects
 - One farm complex was located within line of sight of project area
 - Includes four cinderblock residential houses, one cinderblock outbuilding, as well as several other wood and metal outbuildings.
 - Construction dates of complex structures range from 1944 to 1970
 - Property not identified as having been associated with any important event ,or significant people, nor does it display distinct characteristics of a type, period, or method of construction

BFN EPU Transmission System Update

Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 2, Attachment 4, TVA letter to the Alabama State Historic Preservation Office - TVA, Limestone Substation Static VAR Compensator Construction, Phase 1 Cultural Resources Survey, Limestone County, Alabama
 - Summary of Impacts
 - Based on results of Phase 1 Cultural Resources Survey and pending agreement by the Alabama State Historic Preservation Office, TVA finds that no historic properties listed or eligible for listing in the National Register of Historic Places would be affected by the proposed construction
 - Questions

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 3
 - Discussion of Changes
 - Updated to reflect new proposed N-1-1 Event Stability Mitigation Plan
 - Added Static VAR Compensator at Limestone Substation
 - Deleted Wilson Substation
 - Updated schedule for completion of modifications
 - Summary of Impacts
 - EPU schedule not impacted by changes
 - Questions

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 1 – Updated Responses to NRC RAIs RERP-GE-RAI 2, RERP-GE-RAI 3, and RERP-GE-RAI 4 (continued)
 - Updated Response to RERP-GE-RAI 4
 - Discussion of Changes
 - Updated to reflect new proposed N-1-1 Event Stability Mitigation Plan
 - Added Static VAR Compensator at Limestone Substation
 - Deleted Wilson Substation
 - Updated environmental review closure status/dates
 - Summary of Impacts
 - Addressed in new Attachment 2 of revised response to RERP-GE-RAI 2
 - Questions

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 2 - Supplemental Environmental Report, Revision 2
 - Discussion of Changes
 - Updated to reflect new proposed N-1-1 Event Stability Mitigation Plan
 - 1.0 Executive Summary
 - Reactive compensation
 - 2.2 Related Power Uprate Submittals and NEPA Documentation
 - Main generator excitation system modifications
 - 4.0 Overview of Operational and Equipment Changes
 - Reactive compensation
 - 6.0 Cost Benefit Analysis
 - Updated cost of new proposed N-1-1 Event Stability Mitigation Plan
 - 7.1.1 BFN Site and Surroundings
 - Static VAR Compensator at Limestone Substation
 - Capacitor Bank installation at four locations distant from BFN
 - 7.1.2 Transmission Facilities
 - Static VAR Compensator at Limestone Substation, requiring expansion of existing footprint
 - Four capacitor banks locations
 - Main generator excitation system modifications

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 2 - Supplemental Environmental Report, Revision 2
 - Discussion of Changes (continued)
 - Corrected typographical/mathematical errors
 - In Table 7.2-3 Summary of BFN Hydrothermal Impacts for Warm, Summer Meteorology, in column “Change 105%→120% OLTP”
 - “Diffuser Discharge Temperature, Flow-Weighted - 24-hr Avg Max”
 - “Hydrothermal Derate Operation - Max No. Hours of Derate for Summers with Derate”
 - Summary of Impacts
 - Addressed in new Attachment 2 of revised response to RERP-GE-RAI 2
 - Questions

BFN EPU Transmission System Update Supplement 37 – Environmental Aspects

- Enclosure 3 – Draft Environmental Assessment and Finding of No Significant Impact Change Markup
 - Discussion of Changes
 - Markup of proposed changes provided to reflect environmental review of modifications associated with new proposed N-1-1 Event Stability Mitigation Plan
 - Used information from revised Attachment 1, new Attachment 2, and new Attachment 4 of updated response to RERP-GE-RAI 2
 - Summary of Impacts
 - Based on information provided, it is expected that NRC will be able to update the draft Environmental Assessment and Finding of No Significant Impact and conclude that the proposed action, including changes associated with the proposed Transmission System update, would not have significant effects on quality of human environment
 - Questions

BFN EPU Transmission System Update Supplements – Acronym List

- AVR – Automatic Voltage Regulator
- BFN – Browns Ferry Nuclear Plant
- BMP – Best Management Practice
- EPU – Extended Power Uprate
- kV – kilovolt
- LAR – License Amendment Request
- MVAR – Mega Volt-Ampere Reactive
- NRC – Nuclear Regulatory Commission
- PRA – Probabilistic Risk Assessment
- RAI – Request for Additional Information
- SIS – System Impact Study
- TSS – Transmission Stability Study
- TVA – Tennessee Valley Authority
- VAR – Volt-Ampere Reactive

BFN EPU Transmission System Update Supplements – Questions/Comments