BellBendCOLPEm Resource

From: Bhatia, Bhupendra
Sent: Tuesday, March 16, 2010 12:32 PM
To: BellBendCOL Resource
Cc: Johnson, Robert; Kang, Peter
Subject: FW: NUMARK Documents for the NRC Hearing File for TO #49, Bell Bend, Chapter #8 -NON PUBLIC
Attachments: Draft BBNPP 8.2 Final w Confirmatory Open Items and RAIs[1].doc

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From: Shaareem Wall [mailto:SWall@numarkassoc.com]
Sent: Monday, March 15, 2010 10:16 AM
To: Bhatia, Bhupendra
Subject: NUMARK Documents for the NRC Hearing File for TO #49, Bell Bend, Chapter #8

From: Hearing File
Sent: Thursday, March 04, 2010 11:05 AM
To: 'bhupendra.bhatia@nrc.gov'; 'peter.kang@nrc.gov'
Cc: 'sally.adams@nrc.gov'
Subject: Numark Documents for the NRC Hearing File for TO #49, Bell Bend, Chapter #8

The attached information is being provided to you from Numark Associates, Inc pursuant to 10 CFR 2.1203(b) for inclusion in the NRC Hearing File.

Please contact Ms Karen Hall if you have any questions.

Shaareem Wall, Administrative Assistant
Numark Associates, Inc.
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From: Marty Bowling
Sent: Thursday, January 28, 2010 7:13 PM
To: Hearing File
Subject: TO 49: BBNPP CH 8

----- Original Message -----
From: George Morris
To: Marty Bowling

Cc: Stan Kobylarz
Sent: Thursday, January 28, 2010 12:53 PM
Subject: RE: BBNPP CH 8

Marty,

Attached is a redhighlighted markup of the edited Sections 8.1, 8.3 and 8.2. I start out with a summary of my comments which I have also reviewed with Stan.

Also attached is Section 8.2 which completes the effort for Chapter 8.

Note I have not sent this transmittal to the Hearing File.

George

From: mbowling@numarkassoc.com
To: gwm2@msn.com
CC: beechwood00@gmail.com
Subject: BBNPP CH 8
Date: Wed, 27 Jan 2010 17:54:44 -0500

George

I have edited and compiled Sections 8.1, 8.3, and 8.4. Please take a look at and make sure that any of my edits did not change the meaning. For example in Section 8.4 you used RG 1.9 as part of the Regulatory Basis but you never referred to it in the Tech Eval or Conclusion section so I deleted it. I did not use track changes so you will have to review the entire attachment again which is probably a good idea anyway. Then provide me any changes you feel necessary. Please use track changes.

When should expect Section 8.2?

Marty

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Numark Associates, Inc.
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Hearing Identifier: BellBend_COL_Public
Email Number: 507

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Subject: FW: NUMARK Documents for the NRC Hearing File for TO #49, Bell Bend, Chapter #8 -NON PUBLIC
Sent Date: 3/16/2010 12:31:48 PM
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From: Bhatia, Bhupendra

Created By: bhfysp.bhfysp@nrc.gov

Recipients:
"Johnson, Robert" <Robert.Johnson@nrc.gov>
Tracking Status: None
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MESSAGE	3566	3/16/2010 12:31:49 PM	
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Options
Priority: Standard
Return Notification: No
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8.2 Offsite Power System

8.2.1 Introduction

The offsite power system supplies sufficient and reliable alternating current (AC) power from the transmission system to the onsite power plant distribution system to provide for safe shutdown of the reactor. The offsite power system provides the preferred power to the Class 1E emergency power supply system (EPSS) via the emergency auxiliary transformers (EAT) and offsite power to the normal power supply system (NPSS) via the normal auxiliary transformers (NAT) during normal and abnormal operation.

8.2.2 Summary of Application

Section 8.2 of the BBNPP FSAR incorporates by reference Section 8.2 of the U.S. EPR FSAR.

Interface Requirements

U.S. EPR Application Tier 1, Section 2.5.5, contains information related to the following plant interfaces that are required to be addressed in the COL designs as identified in U.S EPR Application Tier 2, Table 1.8-1:

Item 8-1 Off-site AC power transmission system connections to the switchyard and the connection to the plant power distribution system

Item 8-3 Auxiliary power and generator transformer areas

The BBNPP FSAR Section 8.2 addresses the transmission system, switchyard design and the auxiliary power and generator transformer areas as noted below.

In addition, in FSAR Sections 8.2.1.1, 8.2.1.2, 8.2.2.4, 8.2.2.5, and 8.2.2.7, the applicant provided the following:

Combined License Information Items

The applicant provided additional information in Section 8.2.1.1 to address COL Information Item 8.2-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide site specific information regarding the offsite transmission system and their connections to the station switchyard.

The applicant provided additional information in Section 8.2.1.2 to address COL Information Item 8.2-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide site-specific information for the switchyard layout design.

The applicant provided additional information in Section 8.2.2.7 to address COL Information Item 8.2-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide site-specific information that identifies actions necessary to restore offsite power and use available nearby power sources when offsite power is unavailable.

The applicant provided additional information in Section 8.2.2.4 to address COL Information Item 8.2-4 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide a site-specific grid stability analysis.

The applicant provided additional information in Section 8.2.1.2 to address COL Information Item 8.2-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide site-specific information for the protective devices that control the switchyard breakers and other switchyard relay devices.

The applicant provided additional information in Section 8.2.2.5 to address COL Information Item 8.2-6 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide site-specific information for the station switchyard equipment inspection and testing plan.

The applicant provided additional information in Section 8.2.1.1 to address COL Information Item 8.2-7 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide site specific information regarding the communication agreements and protocols between the station and the transmission system operator, independent system operator, or reliability coordinator/authority. Additionally, the applicant will provide a description of the analysis tool used by the transmission system operator to determine, in real time, the impact that the loss or unavailability of various transmission system elements will have on the condition of the transmission system to provide post-trip voltages at the switchyard. The information provided will be consistent with information requested by the NRC in NRC generic letter 2006-02.

The applicant provided additional site-specific information in Section 8.2.1.2 to address COL Information Item 8.2-8 from U.S. EPR FSAR Tier 2, Table 1.8-2 as follows:

> A COL applicant that references the U.S. EPR design certification will provide site-specific information regarding indication and control of switchyard components.

Supplemental Information

The applicant provided the following supplemental information.

BBNPP performed a failure mode and effects analysis (FMEA) of the switchyard components to assess the possibility of simultaneous failure of both circuits for BBNPP as a result of single events. This FMEA supplements the FMEA described in U.S. EPR FSAR Section 8.2.2.4.

Technical Specifications

Site-specific technical specifications are addressed in Part 4 of the application. Refer to Chapter 16 subsection 3.8 of this DTER where these items are addressed.

ITAAC

Site-specific inspections, tests, analyses and acceptance criteria (ITAAC) are addressed in Part 10 of the application, Appendix B. The following ITAACs, listed in Tabular form in the application, are applicable to this section:

Table 2.4-24, Offsite Power
Table 2.4-25, Power Generation

8.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the U.S. EPR FSAR.

In addition, the relevant requirements of the Commission regulations for the supplemental information being reviewed and the associated acceptance criteria are given in Section 8.2 of NUREG-0800.

The applicable regulatory requirements for information being reviewed are as follows:

1. GDC 17 as it relates to the preferred power system's (i) capacity and capability to permit functioning of structures, systems, and components important to safety; (ii) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies; (iii) physical independence; (iv) and availability.

2. GDC 18 as it relates to the inspection and testing of the offsite electric power system.

3. 10 CFR 50.63 as it relates to an alternate AC (AAC) power source (as defined in 10 CFR 50.2) provided for safe shutdown in the event of a station blackout (non-design-basis accident (non-DBA)).

The related acceptance criteria are as follows:

1. RG 1.32 (see also IEEE Std 308) as related to the availability and number of immediate access circuits from the transmission network.

2. Acceptance is based on meeting the guidelines of RG 1.155 as they relate to the adequacy of the AAC source and the independence of the AAC power source from the

offsite and onsite power systems and sources. New applications must provide an adequate AAC source of diverse design (with respect to AC onsite emergency sources) that is consistent with the guidance in RG 1.155 and capable of powering at least one complete set of normal safe shutdown loads.

3. RG 1.206 as it relates to power system analytical studies and stability studies to verify the capability of the offsite power systems and their interfaces with the onsite power system.

8.2.4 Technical Evaluation

The NRC staff reviewed Section 8.2 of the BBNPP FSAR and checked the referenced U.S. EPR FSAR to ensure that the combination of the U.S. EPR FSAR and the information in the BBNPP FSAR represent the complete scope of information relating to this review topic. The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to this section. Section 8.2 of the U.S.EPR FSAR is being reviewed by the staff under docket number 52-020. The NRC staff's technical evaluation of the information incorporated by reference related to onsite power systems will be documented in the staff safety evaluation report on the design certification application for the U.S. EPR.

The staff reviewed the information contained in Sections 8.2.1.1, 8.2.1.2, 8.2.2.4, 8.2.2.5, and 8.2.2.7 of the BBNPP FSAR. With respect to the supplemental information contained in the BBNPP application, the staff determined:

Combined License Information Items

The NRC staff reviewed COL Information Item 8.2-1 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under Section 8.2.1.1 of the BBNPP FSAR. The staff review of BBNPP FSAR Section 8.2.1.1 found the applicant provided sufficient site specific information regarding the offsite transmission system and their connections to the station switchyard to demonstrate the independence of the transmission lines feeding the BBNPP switchyard.

FSAR Figures 8.2-1 and 8.2-1 show the new BBNPP switchyard is connected to BBNPP by means of six overhead lines. The BBNPP switchyard is connected to the PPL Electric Utilities Corporation (PPL EU) transmission system by two normally energized, physically independent, overhead 500 kV transmission lines.

FSAR Table 8.2-1 shows the 500 kV transmission lines are single circuits, each circuit having a thermal rating of 4260 MVA. One transmission line connects the BBNPP site to an expansion of the existing Susquehanna 500 kV Yard and the other transmission line connects the BBNPP site to the new Susquehanna 500 kV Yard 2. This arrangement provides two preferred sources of power for the reactor protection system and engineered safety features (ESFs) during normal, abnormal, and accident conditions.

The two transmission lines and their associated structures interconnecting the BBNPP switchyard and the transmission system are designed and located to successfully withstand the loading requirements for postulated environmental conditions and for

postulated line breaking and tower failures to minimize the possibility of their simultaneous failure.

The NRC staff reviewed COL Information Item 8.2-2 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under Section 8.2.1.2 of the BBNPP FSAR. The staff review of BBNPP FSAR Section 8.2.1.2 found the applicant provided sufficient site-specific information for the switchyard layout design to demonstrate the independence of the offsite power connection from the BBNPP switchyard to the BBNPP auxiliary transformers.

The new 500 kV Gas Insulated Switchyard (GIS) for BBNPP has been designed to accommodate the output of BBNPP. The switchyard is located on the BBNPP site approximately 150 ft east of BBNPP. The BBNPP switchyard includes six bays in a breaker-and-a-half / double breaker configuration.

The BBNPP switchyard circuit breakers and disconnect switches are sized in accordance with IEEE Standard C37.06 and the breakers are equipped with dual trip coils. The 500 kV circuit breakers in the switchyard are rated according to the following criteria.

- Circuit breaker continuous current ratings are chosen such that no single contingency in the switchyard (e.g., a breaker being out for maintenance) will result in a load exceeding 100% of the nameplate continuous current rating of the breaker.

- Interrupting duties are specified such that no fault occurring on the system, operating in steady-state conditions will exceed the breaker's nameplate interrupting capability.

- Momentary ratings are specified such that no fault occurring on the system, operating in steady-state conditions will exceed the breaker's nameplate momentary rating

- Voltage ratings are specified to be greater than the maximum expected operating voltage.

The NRC staff reviewed COL Information Item 8.2-3 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under Section 8.2.2.7 of the BBNPP FSAR. The staff review of BBNPP FSAR Section 8.2.2.7 found the applicant sufficient provided site-specific information for responding to a loss of offsite power.

The staff found that BBNPP includes two redundant SBO diesel generators designed in accordance with 10 CFR 50.63 and Regulatory Guide 1.155. The staff agreed that reliance on additional off-site power sources as an alternate AC source was not required. The staff found that BBNPP identifies the actions necessary to restore offsite power in procedures and training provided to plant operators as described in FSAR Section 8.4.2.6.4. The staff addressed 10 CFR 50.63 as it relates to an alternate AC (AAC) power source as part of their review of BBNPP FSAR Section 8.4.

The NRC staff reviewed COL Information Item 8.2-4 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under Section 8.2.2.4 of the BBNPP FSAR. The staff review of BBNPP FSAR Section 8.2.2.4 found the applicant provided sufficient site-specific information regarding grid stability analysis.

Two PJM studies are relevant for BBNPP: The preliminary Susquehanna 1600 MW R01-R02 Impact Study Re-study (SIS) and the PJM Preliminary Stability Study for R01-R02, Bell Bend 500KV-1800MW (PSS). The SIS projects the impact that BBNPP will have on the network and the PSS shows that PJM Generator Interconnection for Bell Bend is stable for all tested conditions. The PSS analyzed transient stability for the addition of BBNPP, and was prepared using PJM's planning criteria against the 2012 summer peak conditions load and identified design requirements necessary to maintain the reliability of the transmission system. The criteria are based on PJM planning procedures, NERC Planning Standards, and RFC Regional Reliability Council planning criteria. For the stability analysis, light loading (50% of peak loading) is utilized with maximum generation.

The computer analysis was performed using the Siemens Power Technology International Software PSS/E. The analysis examined conditions involving loss of the largest generating unit, loss of the most critical transmission line, and multiple facility contingencies.

The results of the study conclude that with the additional generating capacity of BBNPP the transmission system remains stable under the analyzed conditions, preserving the grid connection, and supporting the normal and shutdown requirements of BBNPP.

The U.S. EPR FSAR states that the plant will operate with a transmission system operating voltage range of ±10%. However, based on the above site specific voltage study BBNPP may be designed to operate with a -5%, +10% transmission system operating voltage range. A PJM System Voltage Study, using PSS/E software for load flow, was performed to determine the maximum and minimum voltage that the switchyard can maintain without any reactive support from BBNPP. The study used the same reliability planning criteria as was used on the SIS. Based on the results of the System Voltage Study, the grid will not be lost due to the loss of the largest generating unit (i.e., BBNPP), the loss of the most critical transmission line, or the loss of the largest load on the grid. The design of the on-load tap changers for each Emergency Auxiliary Transformer (EAT) ensures that the downstream EPSS 6.9 kV buses have sufficient voltage to preclude the degraded voltage protection scheme from separating the buses from the preferred power source. A site specific system calculation will be performed to confirm the design and the Chapter 16, Technical Specifications, Section 3.3.1, site-specific degraded grid voltage protection settings.

Grid availability in the region over the past 26 years was examined and it was confirmed that the system has been highly reliable with minimal forced outages. During these component outage occurrences, the transmission grid as a whole has remained available for 99.65% of the time, with a total of 47 forced outages in the 26 year period.

The PJM grid is maintained at 60Hz. During a system underfrequency condition, the Mid-Atlantic region of PJM utilizes an automatic load shedding scheme which will drop load by 30% in 10% increments at 59.3 Hz, 58.9 Hz & 58.5 Hz. A review of the grid frequency data for the last five years (including the Northeast Blackout of 2003) indicates

that the frequency decay rate during disturbances on the Eastern Interconnection (which includes the PJM Territory) was much less than 3.5 Hz/sec. The worst decay rate during this time period occurred on August 4, 2007 and was due to a 4400 MW generation loss event (largest disturbance on the grid since August 2003 blackout) which resulted in a sustained decay rate of 0.015 Hz/sec. As such, the reactor coolant pumps are not expected to be subject to sustained frequency decay greater than 3.5 Hz/sec.

The applicant also indicated that following recommended modifications to the renamed Susquehanna-Lackawanna 500 kV line the local transmission system would remain stable. Upon completion of these modifications and verification of the updated analysis following those modifications, the staff believes BBNPP will satisfy the requirements of GDC 17, Section i and iv. **(RAI 8.2-1)**

The NRC staff reviewed COL Information Item 8.2-5 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under Section 8.2.1.2 of the BBNPP FSAR. The staff review of BBNPP FSAR Section 8.2.1.2 found the applicant provided adequate site-specific information for the protective devices that control the BBNPP switchyard breakers and other switchyard relay devices.

Electrical protection of circuits from the BBNPP switchyard is provided by a primary and secondary relaying scheme and a breaker failure scheme. The current input for the protective relaying schemes come from separate sets of circuit breaker bushing current transformers. Also, the control power for all primary and secondary relaying schemes is supplied from two switchyard 125 VDC battery systems located in the BBNPP 500 kV switchyard control house, separate from the battery systems within the BBNPP, which support the physical independence of the offsite power transmission sources required by GDC-17, Section iii.

The NRC staff reviewed COL Information Item 8.2-6 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under Section 8.2.2.5 of the BBNPP FSAR. The staff review of BBNPP FSAR Section 8.2.2.5 found the applicant provided adequate site-specific information for the station switchyard equipment inspection and testing plan.

The applicant referred to a future interface agreement between BBNPP and PPL EU that would define the necessary requirements for maintenance, calibration, testing and modification of the transmission components of the offsite power system. The applicant indicated that PPL EU follows its own field test manuals, vendor manuals and drawings, and industry maintenance practices for performance of maintenance, calibration and inspection and conforms to Federal Energy Regulatory Commission (FERC) requirements. **This is Confirmatory Item 08.02-5**

The NRC staff reviewed COL Information Item 8.2-7 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under Section 8.2.1.1 of the BBNPP FSAR. The staff review of BBNPP FSAR Section 8.2.1.1 found the applicant provided sufficient site-specific information regarding future communication agreements and protocols between the station and the transmission system operator, independent system operator, or reliability coordinator/authority.

In FSAR Section 8.2.1.1, the applicant stated PJM, PPL EU and the BBNPP operator would have formal agreements and protocols in place to provide safe and reliable operation of the transmission system and equipment at BBNPP. These agreements

would ensure Nuclear Plant Licensing Requirements will be monitored and maintained to ensure compliance with GDC 17 and GDC 18. **This is Confirmatory Item 08.02-6.**

The applicant indicated in FSAR Section 8.2.1.1 that during plant operation, BBNPP would rely on PPL EU and PJM (through PJM's Energy Management System (EMS) program) to continuously monitor real-time power flows and assesses contingency impacts. Operational planning studies would also be performed using offline power flow study tools to assess near term operating conditions under varying load, generation, and transmission topology patterns to ensure compliance with GDC 17. **This is Confirmatory Item 08.02-7**

The BBNPP FSAR did not address the North American Electric Reliability Corporation reliability standard NUC-001, Nuclear Plant Interface, which formalizes agreements between the nuclear plant operator and the transmission entities for the purpose of ensuring nuclear plant safe operation and shutdown. **(RAI 8.2-2)**

The NRC staff reviewed COL Information Item 8.2-8 from U.S. EPR FSAR Tier 2, Table 1.8-2 included under Section 8.2.1.2 of the BBNPP FSAR. The staff review of BBNPP FSAR Section 8.2.1.2 found the applicant provided adequate site-specific information regarding indication and control of switchyard components.

Control power for switchyard breakers required for BBNPP offsite power from the transmission system is provided by a dual set of batteries located inside the switchyard control house in the switchyard. A switchyard DC system undervoltage condition is alarmed in the main control room.

Administrative control of switchyard breakers is shared between BBNPP and PJM. The switchyard breakers connecting the Main Step-Up transformers and the auxiliary transformers are controlled by BBNPP and the breakers associated with the offsite connecting transmission lines is delegated to the transmission system owner (PPL EU). Local tripping control is also provided at the circuit breakers. Disconnect switches are provided to individually isolate each circuit breaker from the switchyard bus and associated lines. This ensures compliance to GDC-17 Section iii.

Supplemental Information

The staff found the applicant performed a failure mode and effects analysis (FMEA) of the switchyard components to assess the possibility of simultaneous failure of both circuits for BBNPP as a result of single events. This FMEA supplements the FMEA described in U.S. EPR FSAR Section 8.2.2.4. The events considered include a breaker not operating during fault conditions, a spurious relay trip, a loss of a control circuit power supply, and a fault in a switchyard bus or transformer. The components evaluated include the transmission system, transmission line towers, transmission line conductors, switchyard, circuit breakers and disconnect switches. The FEMA analysis finding is that there are no single failures which would cause the simultaneous failure of both preferred sources of offsite power. The staff found the applicant FMEA analysis finding acceptable.

In RAI No. 36, Question 08.02-1, the staff requested the applicant show in one-line diagrams the existing Susquehanna 500 kV switchyard and the new Susquehanna 500

kV Yard 2, for the connection interface with the BBNPP 500 kV switchyard, including interconnections and modifications to the existing switchyards. On December 9, 2009, the applicant responded with the requested drawings Susquehanna 500/230 kV Overview, Susquehanna 500 kV Yard and Susquehanna 500 kV Yard 2, that FSAR Figures 8.2-3 and -4 will be added, and FSAR Sections 8.2.1.1 and 8.2.2.4 will be updated accordingly. The staff finds the applicant adequately addressed the requested confirmation. **This is Confirmatory Item 08.02-1.**

In RAI No. 36, Question 08.02-2, the staff requested the applicant confirm the 500 kV gas insulated switchyard (GIS) design in accordance with applicable Institute of Electrical and Electronics Engineers (IEEE) standards, the site-specific interconnection provisions between the GIS and transformers, the insulation coordination and basic impulse level (BIL) for switchyard equipment, and the basis for selecting 40 kA as the interrupting rating of the 500 kV switchyard equipment. On December 9, 2009, the applicant responded with a list on applicable standards, a conceptual description and drawings of the GIS components/equipment for the interconnections between the GIS and transformers, the basis for the BIL level for the switchyard, the basis for the switchyard fault current rating, and that FSAR Sections 8.2.1.2 and 8.2.3 will be updated accordingly. The staff found the applicant response acceptable. **This is Confirmatory Item 08.02-2.**

In RAI No. 36, Question 08.02-3, the staff requested the applicant provide a summary of the Susquehanna 1600 MW R01-R02 Impact Study Re-Study (system impact study), and the PJM Preliminary Stability Study for R01-R02, Bell Bend 500KV-1800MW (PSS) (grid stability study), along with the assumptions made and the acceptable criteria for the case(s) analyzed. The staff also requested the applicant provide a summary of the grid stability steady-state and transient analysis results, in order to demonstrate compliance with GDC 17, with assumptions made and the acceptable criteria for the case(s) analyzed. The staff also requested the applicant provide an explanation for using the PJM planning criteria for the 2012 summer (peak) loading and why the winter loading cases are not considered in the system impact study. On December 9, 2009, the applicant responded with the requested summary information, assumptions, and acceptable criteria for cases considered, based on existing analyses. The applicant stated that based on preliminary load flow studies BBNPP can maintain the required voltage regulation at the Bell Bend 500 kV bus based on its given electrical characteristics. A voltage schedule 1.05 or higher may be specified by PJM at the Bell Bend 500 kV bus. The applicant stated that PJM and PPL EU will jointly review and potentially revise the voltage schedule after future studies are completed. No COLA changes were identified by the applicant. The staff found the applicant response acceptable.

In RAI No. 36, Question 08.02-5, the staff requested the applicant describe the details of the programs for reliability assessment and maintenance rule program implementation for offsite power system/ switchyard equipment. On December 9, 2009, the applicant stated that BBNPP FSAR Section 17.7.1.5 specifically addresses the offsite power system equipment, and that the MR (maintenance rule) program and procedures reflect, as appropriate, consideration of issues associated with grid/offsite power reliability as identified in NRC Generic Letter 2006-02, Items 5 and 6. The applicant also stated the reliability assurance program is addressed in BBNPP FSAR Section 17.4. The applicant stated that the BBNPP FSAR 17.7 will be updated for the Maintenance Rule Program description included in NEI 07-02A, “Generic FSAR Template Guidance for Maintenance

Rule Program Description for Plants Licensed Under 10CFR Part 52," Revision 0, dated March 2008, which is incorporated by reference, as a supplement to the U.S. EPR FSAR. The staff found the applicant response acceptable. **This is Confirmatory Item 08.02-3**

In RAI No. 36, Question 08.02-6, the staff requested the applicant describe site-specific raceway and cable routing for GIS equipment, wetting conditions or submergence for underground cables connecting offsite sources to safety buses, and how the proposed design for cable routing/layout/monitoring is to be implemented to prevent gradual degradation, as addressed in NRC Generic Letter 2007-01. On December 9, 2009, the applicant responded with a description of the raceway and cable routing design, the design features to address draining water from manholes, and the capability to perform periodic tests and to detect insulation degradations in underground cables, whether in duct banks, directly buried, or in a conduit, that meets the requirements of NRC Generic Letter 2007-01. No COLA changes were identified by the applicant. The staff found the applicant response acceptable.

In RAI No. 36, Question 08.02-7, the staff requested the applicant provide the basis for selecting the thermal rating of the transmission lines (4260 MVA for each line) and the switchyard equipment continuous ratings. On December 9, 2009, the applicant responded that the 4260 MVA rated 500 kV transmission line is PPL EU's standard design, and the continuous rating is based on IEEE Std 738-1993, as incorporated in PJM TSDS Report of November, 2000, "Bare Overhead Transmission Conductor Ratings." The applicant further stated that the continuous thermal ratings of the switchyard equipment are based on ANSI Std C37.010 for circuit breakers, IEEE Std C37.30 for switches, and IEEE Std 605-1998 for bus conductor ratings, in accordance with PJM Transmission and Substation Design Committee Reports and PPL EU Engineering Instructions. No COLA changes were identified by the applicant. The staff found the applicant response acceptable.

In RAI No. 36, Question 08.02-9, the staff requested the applicant expand FSAR Section 8.2.2.5 for compliance with GDC 18, for the testing and inspection of the offsite system for 500 kV switchyard grounding and lightning protection systems. On December 9, 2009, the applicant responded that the PPL EU ground grid design and testing are in accordance with IEEE Std 80-2000, that PPL EU's lightning protection design utilizes the IEEE 998-1996 rolling sphere method for protection, and that BBNPP FSAR Section 8.2.2.5 and Section 8.2.3 (for reference to IEEE, 2000c and IEEE, 1996b) will be updated accordingly. The staff found the applicant response acceptable. **This is Confirmatory Item 08.02-4.**

In RAI No. 36, Question 08.02-4, the staff requested details of entities responsible for switchyard and transmission maintenance, modification and operation as well as implementation of the site-specific station equipment inspection and testing plan. On December 9, 2009, the applicant stated that a response to Question 08.02-4 will be provided by June 1, 2010. **This is Confirmatory Item 08.02-8.**

In RAI No. 36, Question 08.02-8, the staff requested details of operational experience data, inspection, testing and maintenance procedures for GIS components. On December 9, 2009, the applicant stated that a response to Question 08.02-8 will be provided by June 1, 2010. **This is Confirmatory Item 08.02-9.**

ITAAC

The staff reviewed the following ITAACs, listed in Tabular form in the application, as applicable to this section:

The staff review of the site-specific ITAAC found adequate inspection, test and acceptance criteria are given in the BBNPP application Part 10, Appendix B, Tables 2.4-24 and -25 and found adequate commitments and ITAACs to address the capacity, capability, independence and availability of GDC 17 and the testing requirements of GDC 18.

The results of the following off-site power system inspections, tests, or analyses are required for post COL review:

- Verify the results of the as-built Load Flow and Voltage have been incorporated into the interface agreement. **(RAI 8.2-3)**

- Verify that modifications required to ensure the stability of the transmission system required by the PSS, and other modifications identified in subsequent studies. **(RAI 8.2-1)**

- Verify the conclusions of the Load Flow and Voltage Regulation studies (by measurement) to demonstrate transmission system capability to provide adequate voltage to the Class 1E loads during static and dynamic conditions. **(RAI 8.2-4)**

Technical Specifications

The staff reviewed the technical specifications applicable to this section during the review of Chapter 16 and Part 4, Section 3.8, Electrical Systems, of the BBNPP application. See the staff's comments in DTER Chapter 16 for Technical Specifications 3.8.

8.2.5 Post Combined License Activities

There are no post COL activities related to this section.

8.2.6 CONCLUSION

The NRC staff reviewed the application and checked the referenced U.S. EPR FSAR. The NRC staff's review confirmed that the applicant addressed the required information relating to offsite power systems and there is no outstanding information, except as noted below, that is expected to be addressed in the BBNPP FSAR related to this section.

The staff is reviewing the information for the U.S EPR on Docket No. 52-020. The results of the NRC staff's technical evaluation of the information related to this section to be incorporated by reference in the BBNPP FSAR will be documented in the staff's safety evaluation report on the design certification application for the U.S EPR. The SER for the U.S. EPR is not yet complete, and this is being tracked as part of Open Item

1-1. The staff will update Section 8.2 of this SER to reflect the final disposition of the design certification application for the U.S EPR.

As the bases for evaluating the adequacy of the design of the Offsite Power System to accomplish the plant's safety-related functions as presented in the U.S. EPR Design Control Document (DCD) Tier 2, Chapter 8, "Electric Power," the U.S. Nuclear Regulatory Commission (the staff) used the acceptance criteria and guidelines for electric power systems contained in Chapter 8, "Electric Power," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants—LWR Edition" (SRP); Regulatory Guide (RG) 1.153, "Criteria for Safety Systems"; RG 1.155, "Station Blackout"; and Section 50.63 of Title 10 of the Code of Federal Regulations (CFR), "Loss of All Alternating Current Power."

With respect to the supplemental information presented in the BBNPP application, the staff concluded that the supplemental information adequately addressed the acceptance criteria contained in the bases documents, with the exceptions noted below.

In conclusion, the applicant has provided sufficient information for satisfying the following applicable regulations except as noted below:

1 GDC 17, as it relates to the Offsite Power System, except as noted below, consistent with RG 1.32, as it relates to the availability and number of immediate access circuits from the transmission network

(i) capacity and capability to permit functioning of structures, systems, and components important to safety; **(RAI 8.2-1 through RAI 8.2-4)**
(ii) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or loss of power from the onsite electric power supplies;
(iii) physical independence; and
(iv) availability. **(RAI 8.2-2)**

2 GDC 18 Inspection and testing of the offsite power systems. **(RAI 8.2-2)**

3 10 CFR 50.63 An AAC power source provided for safe shutdown (non-design-basis accident) in the event of a station blackout. (See the staff review of FSAR Section 8.4)

4 10 CFR 50.65(a)(4) Assessment and management of the increase in risk that may result from proposed maintenance activities before performing the maintenance activities. These activities include, but are not limited to, surveillances, post-maintenance testing, and corrective and preventive maintenance. **(RAI 8.2-2)**

5 Regulatory Guide (RG) 1.155 Adequacy of the AAC source and the independence of the AAC power source from the offsite power system and onsite power system and sources. (See the staff review of FSAR Section 8.4)

As a result of RAIs 8.2-1 through 8.2-4, the staff is unable to finalize its conclusions on the capability and availability of the offsite power system in accordance with the requirements of the following NRC regulations:

1 GDC 17 as it relates to the Offsite Power System's capacity and capability to power the required BBNPP loads. **(RAI 8.2-1 through RAI 8.2-4)**

2 GDC 17 as it relates to the Offsite Power System's provisions to minimize the probability of losing electric power as a result of, or coincident with, the loss of power generated by the nuclear power unit; **(RAI 8.2-2)**

3 GDC 17 as it relates to the availability of the Offsite Power System and 10 CFR 50.65(a)(4) (and RG 1.160) as it relates to the assessment and management of the increase in risk that may result from maintenance activities on the transmission system affecting the nuclear unit; **(RAI 8.2-2)**

Confirmatory Items:
08.02-1, Revisions to FSAR Sections 8.2.1.1 and 8.2.2.4; add FSAR Figures 8.2-3 and 8.2-4
08.02-2, Revisions to FSAR Sections 8.2.1.2 and 8.2.3
08-02-3, Revisions to FSAR Section 17.7
08.02-4, Revisions to FSAR Sections 8.2.2.5 and Section 8.2.3
08.02-5, Implement Interface Agreement between BBNPP and PPL EU
08.02-6, Implement Formal Agreements and Protocols to Provide Safe and Reliable Operation
08.02-7, Implement Formal Agreement between BBNPP and PJM and PPL EU
08.02-8, Entities Responsible for Switchyard and Transmission Maintenance, Modification and Operation
08.02-9, GIS Operational Experience Data, Inspection, Testing and Maintenance Procedures

Open Items:
RAI 8.2-1, Transmission System Modifications
RAI 8.2-2, Conformance to NERC Reliability Standards
RAI 8.2-3, Incorporate Results of Load Flow and Voltage Regulation Studies into Interface Agreement
RAI 8.2-4, Verify Results of Load Flow and Voltage Studies by Site-specific Field Measurements

Pending resolution of RAI 8.2-1 through RAI 8.2-4, which are being tracked as open items, no further conclusion can be rendered on this subsection.

Confirmatory Items Related to BBNPP Section 8.2

Confirmatory Item 08.02-1, Revisions to FSAR Sections 8.2.1.1 and 8.2.2.4; add FSAR Figures 8.2-3 and 8.2-4

In the response to RAI 36, Question 08.02-1, the applicant indicated they would revise the BBNPP FSAR Sections 8.2.1.1, Offsite Power, and Section 8.2.2.4, Compliance with GDC 17. The response also indicated Figures 8.2-3, Susquehanna 500 kV, Yard 2, and Figure 8.2-4, Susquehanna 500 kV Yard, would also be added to the FSAR as noted in the response.

Confirmatory Item 08.02-2, Revisions to FSAR Sections 8.2.1.2 and 8.2.3

In the response to RAI 36, Question 08.02-2, the applicant indicated they would revise the BBNPP FSAR Section 8.2.1.2, Station Switchyard, and Section 8.2.3, References as noted in the response.

Confirmatory Item 08-02-3, Revisions to FSAR Section 17.7

In the response to RAI 36, Question 08.02-5, the applicant indicated they would revise the BBNPP FSAR Section 17.7, Maintenance Rule Program as noted in the response.

Confirmatory Item 08.02-4, Revisions to FSAR Sections 8.2.2.5 and Section 8.2.3

In the response to RAI 36, Question 08.02-9, the applicant indicated they would revise the BBNPP FSAR Section 8.2.2.5, Compliance with GDC 18, and Section 8.2.3, References as noted in the response.

Confirmatory Item 08.02-5, Implement Interface Agreement between BBNPP and PPL EU

For COL Information Item 8.2-6, the staff review of BBNPP FSAR Section 8.2.2.5 found the applicant referred to a future interface agreement between BBNPP and PPL EU that would define the necessary requirements for maintenance, calibration, testing and modification of the transmission components of the offsite power system.

Confirmatory Item 08.02-6, Implement Formal Agreements and Protocols to Provide Safe and Reliable Operation

For COL Information Item 8.2-7, the staff review of BBNPP FSAR Section 8.2.1.1 found the applicant stated PJM, PPL EU and the BBNPP operator would have formal agreements and protocols in place to provide safe and reliable operation of the transmission system and equipment at BBNPP.

Confirmatory Item 08.02-7, Implement Formal Agreement between BBNPP and PJM and PPL EU

For COL Information Item 8.2-7, the staff review of BBNPP FSAR Section 8.2.1.1 found the applicant stated that during plant operation BBNPP would rely on PPL EU and PJM to continuously monitor real-time power flows and assesses contingency impacts and that operational planning studies would also be performed using offline power flow study

tools to assess near term operating conditions under varying load, generation, and transmission topology patterns to ensure compliance with GDC 17.

Confirmatory Item 08.02-8, Entities Responsible for Switchyard and Transmission Maintenance, Modification and Operation

In response to RAI 36, Question 08.02-4, the applicant stated that a response to Question 08.02-4 will be provided by June 1, 2010.

Confirmatory Item 08.02-9, GIS Operational Experience Data, Inspection, Testing and Maintenance Procedures

In response to RAI 36, Question 08.02-8, the applicant stated that a response to Question 08.02-8 will be provided by June 1, 2010.

RAIs Related to BBNPP Section 8.2

RAI 8.2-1 Transmission System Modifications

GDC 17 requires that the Offsite Power System have the capacity and capability to provide sufficient power to allow the safety-related loads to perform their safety function.

FSAR Section 8.2.1.1 and 8.2.2.4 indicate there are a number of modifications required to permit the Bell Bend plant to be connected to the transmission network. Verify that modifications to the breakers at both ends of the renamed Susquehanna-Lackawanna 500 kV transmission line, and other recommendations related to stability, have been completed prior to initial fuel loading. Add this verification to the FSAR as a Post COL Activity and/or as an ITAAC activity.

A response to this RAI is required to clarify how the interface agreements contribute to the assurance of the availability and capability of the offsite power system as required by GDC 17 and the testing requirements of GDC 18.

RAI 8.2-2 Conformance to NERC Reliability Standards

GDC 17 requires the preferred power system (i) have the capacity and capability to permit functioning of structures, systems, and components important to safety; (ii) have provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or loss of power from the onsite electric power supplies; (iii) be physically independent; (iv) have availability.

GDC 18 requires the capability for inspection and testing of the offsite electric power system.

10 CFR 50.65(a)(4) requires the assessment and management of the increase in risk that may result from proposed maintenance activities before performing the maintenance activities. These activities include, but are not limited to, surveillances, post-maintenance testing, and corrective and preventive maintenance in the interface between the nuclear generator and the transmission entity.

FSAR Section 8.2.1.1 states the frequency and type of studies to be performed, as well as the required transmission system operation criteria are outlined in the agreements and are in accordance with Federal Energy Regulatory Commission (FERC) reliability standards, PJM and PPL EU standards, regional practices and the Bell Bend Transmission Owner Agreement. The applicant failed to mention the Reliability Standards of the North American Reliability Corporation (NERC), and in particular, NERC Reliability Standard NUC-001, Nuclear Plant Interface.

FSAR Sections 8.2.1.1 and 8.2.2.4 state a system impact study was performed for the addition of Bell Bend based upon Regional Reliability criteria. The applicant again failed to mention the Reliability Standards of the North American Reliability Corporation (NERC), and in particular, NERC Reliability Standard NUC-001, Nuclear Plant Interface.

FSAR Section 8.2.2.5 states maintenance, testing, calibration and inspection, PPL EU follows its own field test manuals, vendor manuals and drawings, industry's maintenance practices and observes (FERC) requirements. The applicant again failed to mention the Reliability Standards of the North American Reliability Corporation (NERC), and in particular, NERC Reliability Standard NUC-001, Nuclear Plant Interface.

FSAR Section 8.2.2.8 indicates no departures were taken from the U.S. EPR approach for 10 CFR 50.65 (a)(4) regarding assessment of risk.

FERC has endorsed the North American Reliability Corporation (NERC) Reliability Standard NUC-001, Nuclear Plant Interface. The interface between the generator and the transmission system should be governed by NERC Reliability Standard NUC-001. FSAR Section 8.2.1.1, 8.2.2.5, 8.2.2.7 and Section 8.2.2.8 failed to address this NERC reliability standard on Nuclear Plant Interface. This interface standard addresses communication protocols to assure the offsite power system has the capacity and capability to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or loss of power from the onsite electric power supplies.

NERC Reliability Standard NUC-001 interface requirements also address GDC 17, as it relates to the availability of the offsite power system and provisions to minimize the probability of losing electric power from the offsite power system upon loss of the generating unit, and 10 CFR 50.65(a)(4), as it relates to the assessment and management of the increase in risk that may result from proposed maintenance activities before performing the maintenance activities. Conformance to this reliability standard will increase the assurance that maintenance at either the nuclear generating unit or the transmission system is coordinated to reduce risk and control availability of the offsite power supply.

Confirm the interface agreements between the generator (BBNPP) and the transmission system entities (PJM and PPL EU) that are in place are governed by the North American Reliability Corporation, Reliability Standard NUC-001, Nuclear Plant Interface Coordination. This standard requires coordination between Nuclear Plant Generator Operators and Transmission Entities for the purpose of ensuring nuclear plant safe operation and shutdown.

A response to this RAI is required to assure the provisions are in place to (1) Minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or loss of power from the onsite electric power supplies as required by GDC 17; (2) assure communication protocols address GDC 18 and 10 CFR 50.65 as they relate to the maintenance and testing of interface components; and, (3) agreements are in place that address 10 CFR 50.65 as it relates to operating procedures between the transmission system entities and the nuclear unit to restore offsite power following a loss of offsite power.

RAI 8.2-3 Incorporate Results of Load Flow and Voltage Regulation Studies into Interface Agreement

GDC 17 as it relates to the preferred power system's (I) capacity and capability to permit functioning of structures, systems, and components important to safety; (ii) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or loss of power from the onsite electric power supplies; (iii) physical independence; and (iv) availability.

FSAR Section 8.2.2.4 describes the load flow and voltage studies that were performed as part of the PPL studies for the inclusion of the BBNPP onto the PPL EU system. These studies were performed to establish the minimum switchyard voltage that would result in adequate voltage at the Class 1E loads. Confirm (1) this information is included in the interface agreements with the transmission entities, and (2) confirm that the final studies will be performed with as-built data prior to fuel loading at BBNPP.

Include this commitment in the FSAR as a Post COL Activity and an ITAAC item, “Verify the as-built Load Flow and Voltage studies have been performed to establish the minimum voltage required at the switchyard to ensure adequate voltage at the Class 1E loads and the results have been transmitted to the transmission entities”.

RAI 8.2-4 Verify Results of Load Flow and Voltage Studies by Site-specific Field Measurements

GDC 17 as it relates to the preferred power system's (I) capacity and capability to permit functioning of structures, systems, and components important to safety; (ii) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or loss of power from the onsite electric power supplies; (iii) physical independence; and (iv) availability.

FSAR Section 8.2.2.4 describes the load flow and voltage studies that were performed as part of the PJM studies for the inclusion of the BBNPP onto the PPL EU system. Confirm the results of the load flow and voltage regulation studies will be verified by actual measurement at the BBNPP interface.

Include this commitment in the FSAR as a Post COL Activity and an ITAAC item, “Verify the conclusions of the Load Flow and Voltage studies (by measurement) to demonstrate transmission system capability to provide adequate voltage to the Class 1E loads during static and dynamic conditions following a BBNPP plant trip during startup testing”.