Dominion Energy Kewaunee, Inc.
5000 Dominion Boulevard, Glen Allen, VA 23060

Dominion®

January 18, 2011

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No. 10-063A
LIC/JG/R0
Docket No. 50-305
License No. DPR-43

DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION
SUPPLEMENT AND RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION: LICENSE AMENDMENT REQUEST 236, AUTOMATIC OPERATION OF TRANSFORMER LOAD TAP CHANGERS (TAC NO. ME4011)

By application dated June 1, 2010 (reference 1), Dominion Energy Kewaunee, Inc. (DEK), requested an amendment to Facility Operating License Number DPR-43 for Kewaunee Power Station (KPS). The proposed amendment would revise the KPS current licensing basis (CLB) to allow the use of new automatic load tap changers (LTCs) on new transformers that provide offsite power to KPS.

Subsequently, the Nuclear Regulatory Commission (NRC) transmitted a request for additional information (RAI) regarding the proposed amendment (reference 2). The RAI questions and associated DEK responses are provided in Attachment 4 to this letter. Additionally, as discussed during a telephone conference with NRC staff on November 3, 2010, DEK identified imprecision in the proposed amendment that required clarification. This supplement to the originally proposed request incorporates the necessary clarifications. To facilitate ease of NRC review, this supplement replaces reference 1 in its entirety.

The LTCs are subcomponents of two new transformers; one that has been and one that will be installed at KPS. The LTC's are designed to compensate for potential offsite power voltage variations and will provide added assurance that acceptable voltage is maintained for safety-related equipment.

The proposed amendment requests NRC approval to operate the LTCs in the automatic mode. Operation of the LTCs in automatic mode requires NRC approval in accordance with 10 CFR 50.59 because automatic LTC operation creates a possibility for a malfunction of a structure, system, or component important to safety with a different result than any previously evaluated in the Updated Safety Analysis Report (USAR). There are no changes to the TS associated with this request. Approval of the proposed amendment to allow operation of the LTCs in automatic mode will necessitate a change to the USAR and Technical Specification (TS) Bases. Pending approval of the changes requested herein, the LTCs will be operated in the manual mode only, which does not require prior NRC approval in accordance with 10 CFR 50.59.

Attachment 1 to this letter contains a description, technical analysis, significant hazards determination, and environmental considerations evaluation for the proposed amendment. Attachment 2 contains the marked up TS Bases pages. Attachment 3 contains marked up USAR pages. Attachments 2 and 3 are provided for information to facilitate the NRC staff's understanding of this design basis change. Also enclosed are selected USAR figures to facilitate NRC staff review.

The KPS Facility Safety Review Committee has approved the proposed amendment and a copy of this submittal has been provided to the State of Wisconsin in accordance with 10 CFR 50.91(b).

DEK requests approval of the proposed amendment by June 1, 2011. One of the new transformers was installed during the previous refueling outage. The other transformer installation and associated design changes are currently planned for completion during the next refueling outage scheduled to begin in February 2011. Approval of the amendment will allow for testing of the automatic load tap changing features of the two new transformers during the subsequent refueling outage. This testing cannot be completed while the unit is online. Once approved, the amendment shall be implemented within 60 days.

If you have any questions or require additional information, please contact Mr. Jack Gadzala at 920-388-8604.

Sincerely,

Leslie N. Hartz
Vice President – Nuclear Support Services

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz, who is Vice President – Nuclear Support Services of Dominion Energy Kewaunee, Inc. She has affirmed before me that she is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of her knowledge and belief.

Acknowledged before me this 18th day of January, 2011.

My Commission Expires: 4/30/13.

Notary Public

I was commissioned a notary public as Ginger L. Alligood.

GINGER LYNN MELTON
Notary Public
Commonwealth of Virginia
310847
My Commission Expires Apr 30, 2013

Attachments:

1. Discussion of Change, Technical Analysis, Significant Hazards Determination and Environmental Considerations
2. Marked up Technical Specifications Bases Pages
3. Marked up Updated Safety Analysis Report Pages
4. Response to Request for Additional Information Regarding Kewaunee License Amendment Request 236

Enclosure:

Selected Kewaunee Power Station USAR Figures

Commitments made in this letter: None

References:

1. Letter from L. N. Hartz (DEK) to Document Control Desk (NRC), "License Amendment Request 236, Automatic Operation of Transformer Load Tap Changers," dated June 1, 2010.
2. Email from Karl D. Feintuch (NRC) to Jack Gadzala (DEK), Craig Sly (DEK), Gurcharan Matharu (NRC), and Prem Sahay (NRC), "ME4011 Request for Additional Information (RAI)," dated October 5, 2010.

cc: Regional Administrator, Region III
U. S. Nuclear Regulatory Commission
2443 Warrenville Road
Suite 210
Lisle, IL 60532-4352

Mr. K. D. Feintuch
Project Manager
U.S. Nuclear Regulatory Commission
One White Flint North, Mail Stop O8-H4A
11555 Rockville Pike
Rockville, MD 20852-2738

NRC Senior Resident Inspector
Kewaunee Power Station

Public Service Commission of Wisconsin
Electric Division
P.O. Box 7854
Madison, WI 53707

ATTACHMENT 1

SUPPLEMENT TO LICENSE AMENDMENT REQUEST 236
AUTOMATIC OPERATION OF TRANSFORMER LOAD TAP CHANGERS

DISCUSSION OF CHANGE, TECHNICAL ANALYSIS, SIGNIFICANT HAZARDS DETERMINATION, AND ENVIRONMENTAL CONSIDERATIONS

KEWAUNEE POWER STATION

DOMINION ENERGY KEWAUNEE, INC.

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AUTOMATIC OPERATION OF TRANSFORMER LOAD TAP CHANGERS

DISCUSSION OF CHANGE, TECHNICAL ANALYSIS, SIGNIFICANT HAZARDS DETERMINATION AND ENVIRONMENTAL CONSIDERATIONS

1.0 DESCRIPTION

Pursuant to 10 CFR 50.90, Dominion Energy Kewaunee, Inc. (DEK) requests an amendment to Facility Operating License Number DPR-43 for Kewaunee Power Station (KPS). The proposed amendment would revise the KPS current licensing basis (CLB) to allow the use of new automatic load tap changers (LTCs) on new transformers that provide offsite power to KPS.

The LTCs are subcomponents of two new transformers; one that has been installed and one that will be installed at KPS. The LTC's are designed to compensate for potential offsite power voltage variations and will provide added assurance that acceptable voltage is maintained for safety-related equipment.

The proposed amendment requests NRC approval to operate the LTCs in the automatic mode. Operation of the LTCs in automatic mode requires NRC approval in accordance with 10 CFR 50.59 because automatic LTC operation creates a possibility for a malfunction of a structure, system, or component important to safety with a different result than any previously evaluated in the Updated Safety Analysis Report (USAR). Approval of the proposed amendment to allow operation of the LTCs in automatic mode will necessitate a change to the USAR and Technical Specification (TS) Bases. There are no changes to the TS associated with this request. Pending approval of this license amendment, the LTCs will be operated in the manual mode only, which does not require prior NRC approval in accordance with 10 CFR 50.59.

2.0 PROPOSED CHANGE

The proposed amendment would modify the KPS current licensing basis to allow operation of the LTCs in automatic mode. Operation in the automatic mode requires changes to the TS Bases and USAR.

2.1 ITS Bases 3.8 Revision

The changes to the TS Bases originally provided with LAR 236 applied to KPS Custom TS (CTS). A corresponding revision to Improved Technical Specification (ITS) Bases Sections B 3.8.1, "AC Sources – Operating", and B 3.8.2, "AC Sources – Shutdown" is needed to reflect implementation of the automatic operation mode of the LTCs.

Based on discussions with NRC staff, the NRC was in the final stages of approving License Amendment 207, which revises the KPS Custom TS (CTS) to Improved TS (ITS), consistent with the Improved Standard Technical Specifications (ISTS) described in NUREG 1431, "Standard Technical Specifications - Westinghouse Plants," Revision 3.0. The marked up ITS Bases page excerpts being provided herein for information are from the same Bases pages previously provided to NRC staff for the ITS conversion (LAR 249, as amended).

The associated changes to the new ITS Bases needed to implement this amendment are provided in Attachment 2 for information. The ITS Bases markups replace the CTS Bases markups that were originally provided in their entirety. Additional detail is being included in the Bases for TS 3.8.2 regarding operation of the third offsite electrical circuit (as discussed in the original submittal), which is only used with the reactor shutdown, to facilitate operator access to this information.

2.2 USAR 8.2.2 Revision

Revision to USAR Section 8.2.2 is needed to reflect implementation of the automatic operation mode of the LTCs into the KPS design. The associated marked-up USAR page is provided in Attachment 3 for information.

3.0 BACKGROUND

3.1 System Description

KPS is provided with independent alternate power systems with adequate capacity and testability to supply the required Engineered Safety Features (ESF) equipment and associated protection systems. The plant is supplied with normal, standby and emergency power sources as described below (refer to enclosed KPS USAR Figures 8.2-2 and 8.2-3).

The plant turbine-generator serves as the primary source of auxiliary electrical power during power operation. Electrical power is supplied via a 20 kV/4.16 kV, three-winding, Main Auxiliary Transformer (MAT), which is connected to the main leads from the turbine generator. After turbine-generator trip, the auxiliaries on the 4.16 kV buses fed by the MAT are transferred by a fast-bus transfer scheme using stored energy breakers to the reserve auxiliary transformer (RAT).

The primary sources of electrical power for the auxiliaries associated with engineered safety features are the RAT and the tertiary auxiliary transformer (TAT), which supply power as follows.

1. Auxiliary power is normally supplied to one 4160 Volt ESF bus (Bus 1-6) through the 138 kV/4.16 kV, three-winding RAT which is connected to the 138 kV portion of the KPS substation.
2. Auxiliary power is normally supplied to the second 4160 Volt ESF bus (Bus 1-5) through the 13.2 kV/4.16 kV, two-winding TAT which is connected by an underground line to the 138 kV/13.8 kV tertiary supply transformer (TST) in the KPS substation and ultimately to a 138 kV portion of the KPS substation (different from the RAT supply).
3. A third offsite circuit available for connection to the 4160 Volt ESF buses consists of the 20 kV/4.16 kV MAT, powered by the 345 kV portion of the Kewaunee substation through the 345 kV/20 kV Main Transformers. This third circuit is available for connecting offsite power to the ESF buses when the reactor is shutdown and the main generator links are removed. It is normally not relied on except when one or both of the other circuits are unavailable. To ensure circuit reliability and prevent unnecessary opening of the main generator output breaker, protective trips associated with main generator operation are disabled when supplying offsite power through this circuit.

Auxiliary power required during plant startup, shutdown and after a reactor trip is supplied from the American Transmission Company's (ATC's) 138kV and 345kV transmission systems, through the 13.8 kV/138 kV/345 kV KPS substation, and via the reserve auxiliary and tertiary auxiliary transformers. The RAT and the TAT can both be powered from either transmission system through the interconnecting auto-transformer.

Either off-site power source (reserve or tertiary auxiliary transformer) can be manually aligned to either or both of the engineered safety features 4.16 kV buses. However, each transformer is only allowed to be aligned to a single bus when engineered safety features are required to be operable.

A load tap changer (LTC) can be used in the TST to adjust the voltage to the TAT as necessary. The maximum and minimum range of the LTC is ±10% of the nominal secondary voltage of the TST. The LTC includes 33 taps to adjust the voltage (nominal; 16 taps each 5/8% to lower and raise voltage). The LTC can be adjusted manually at the TST control panel in the KPS substation. Automatic functioning of the LTC is currently disabled.

Two emergency diesel generators (EDGs) are connected to the 4160V ESF buses (1-5 and 1-6) to supply emergency shutdown power in the event of loss of all other AC auxiliary power.

The 4160V system is divided into six buses, as shown in KPS USAR Figure 8.2-3 (enclosed). Buses 1-1 and 1-2 are connected via bus main breakers to the MAT and RAT. These buses supply power to the reactor coolant pumps and the feedwater pumps.

Buses 1-3 and 1-4 are also connected via bus main breakers to the MAT and RAT. These buses supply power to the normal balance-of-plant auxiliaries, and each bus supplies power to three 4160/480V station service transformers. A fourth transformer connected to Bus 1-4 supplies power to the Technical Support Center. In addition, the circulating water pumps, condensate pumps and the heater drain pumps are directly connected to Buses 1-3 and 1-4.

Buses 1-5 and 1-6 are connected via bus main breakers to the main auxiliary, reserve auxiliary, and tertiary auxiliary transformers. In addition, each bus is directly fed via a main breaker by a diesel generator. The two buses can be tied together via two bus tie breakers in series, one on each bus. Each bus supplies two of the four 4160/480V station service transformers for the plant's 480V engineered safety features equipment. In addition, the service water pumps, auxiliary feedwater pumps, safety injection pumps and the residual heat removal pumps are directly connected to Buses 1-5 and 1-6.

As described above, Bus 1-5 is normally supplied from the TAT and Bus 1-6 is normally supplied from the RAT. Thus, no transfer is required for the engineered safety features in the event of an incident.

The bus tie breakers between Bus 1-5 and Bus 1-6 can only be manually closed, but are interlocked so that the diesel generators cannot be operated in parallel.

Emergency power for vital instruments and for control is supplied from two safeguard 125-V DC station batteries and two non-safeguard 125-V DC station batteries. Emergency power for selected turbine and generator backup pumps is supplied from a non-safeguard 250-V DC station battery.

3.2 KPS Degraded Grid Voltage Scheme

The degraded voltage relay (DVR) protection scheme at KPS is designed to protect each of the two 4160V ESF buses (1-5 and 1-6) by providing one channel of protection per bus. Each channel consists of two DVRs, with integral adjustable time delay, connected in series. The present setpoint of the DVR relays is 93.6% (plus or minus 0.9%) of nominal bus voltage (4160 V). Actuation of any one DVR in either channel will activate its associated timer having a time delay of ≤ 7.4 seconds. After the time delay, the relay will annunciate an alarm to notify the operator of the degraded voltage condition on the affected bus. The relay also initiates one of the two series relay contacts, which taken together on each bus, will cause separation of the safety bus from the offsite power source, load shedding of equipment powered by the bus, EDG starting, and load sequencing. Should the bus voltage recover before the time delay expires, the DVR circuitry resets.

The DVR trip setpoint (93.6% ± 0.9% nominal bus voltage) is designed to protect against prolonged operation below 90% of nameplate voltage of safeguard motors. The time delay of ≤ 7.4 seconds ensures that ESF equipment operates within the time delay assumptions of the accident analyses. The time delay will prevent blown ESF control fuses in 480 V MCCs. The 480 V MCC control fuses are the limiting components for long-term low voltage operation. The time delay is long enough to prevent inadvertent actuation of the second level UV relays (DVRs) from voltage dips due to large motor starts (except when a reactor coolant pump motor starts with an ESF bus below 3980 volts; such starts are controlled administratively). Up to 7.4 seconds of operation of ESF motors between 80% and 90% of nameplate voltage is acceptable due to the service factor and conservative insulation designed into the motors.

3.3 Revised System Description

A substantial modification of the KPS switchyard is currently underway which will add greater flexibility in maintaining offsite sources available to KPS. A series of design changes will upgrade the substation 345kV, 138kV, and 13.8kV electrical distribution systems. These design changes are intended to improve the reliability of the off-site power supply to the station and to allow greater flexibility in removing switchyard equipment for maintenance without requiring the plant to enter a TS action statement. Some of the changes were implemented during the fall 2009 refueling outage. The remaining changes are expected to be implemented during the spring 2011 refueling outage.

This design changes include the following:

- TAT replacement and interface – Replacement of the current TAT with an upgraded transformer capable of handling higher loads (completed fall 2009).
- RAT replacement and interface – Replacement of the current RAT with an upgraded transformer capable of handling higher loads (planned spring 2011).
- TST installation and 138 kV Switchyard Work – A new transformer called the TAT Supply Transformer (TST) has been installed between the TAT and the 138 kV switchyard buses. The TST is currently equipped with an automatic load tap changer that is operated in manual mode only (completed fall 2009).
- RST installation and 138 kV Switchyard Work – A new transformer called the RAT Supply Transformer (RST) will be installed between the RAT and the 138 kV switchyard buses. The RST will be equipped with an automatic load tap changer (planned spring 2011).
- New 345 kV Mini-Substation and New G-1 Breaker – A new 345 kV substation to enhance flexibility for accessing offsite sources. The coupling capacitor voltage transformers (CCVTs) were replaced. The KPS Generator output breaker (G-1) was replaced with a new breaker (completed fall 2009).
- ATC Switchyard Work – The two offsite line / four 345 kV breaker arrangement will be modified into a two offsite line / six 345 kV double-bus/double-breaker arrangement. The existing four 345 kV breakers will be replaced with new

breakers. In addition, a redundant interface auto-transformer (T20) between the 345 kV and 138 kV systems will be added (planned for fall 2010, completion of remaining activity during spring 2011 outage).

- Switchyard 138 kV Bus Modifications – A double-bus double-breaker configuration on the 138 kV bus will be created. Of the original six breakers, one was replaced and a new 138 kV breaker was added to support the installation of the TST. Two new 138 kV breakers were added to achieve the required bus configuration (completed fall 2009). Two of the original breakers will be replaced to support the installation of the RST, and one new breaker will be added to support the new bus configuration (to be completed during spring 2011 outage).

Other changes are being made in conjunction with the above including a new switchyard control house, new and replaced cabling, revised relaying of the switchyard, and new protection schemes. Addition of controls and indication for the new LTCs in the main control room will occur during the spring 2011 refueling outage. New protective zones are being added based on the addition of new equipment and revised equipment configurations.

3.4 Revised Offsite Power Supply with Automatic Load Tap Changers

DEK is implementing a series of modifications at KPS to install automatic load tap changers (LTCs) on the new RAT supply transformer (RST) and TAT supply transformer (TST). The purpose of the automatic LTCs is to compensate for potential offsite power voltage variations so as to ensure that acceptable voltage is maintained for safety-related equipment (above degraded voltage relay setpoints).

The tap changer mechanism for each transformer's LTC is located in a separate enclosure attached to each transformer. Each LTC has two modes of operation, automatic and manual. A drive motor rotates the tap changer to increase or decrease the number of transformer windings in service. When operating in the automatic mode, the LTC microcontroller raises and lowers voltage by operating the drive motor. The tap changer mechanism can also be operated in manual control mode, which can either use the drive motor to rotate the tap changer, or use a hand crank (if the transformer is de-energized) when no control power is available.

The LTCs will provide a range of -10% to +10% of the rated secondary voltage in 32 steps (plus the nominal tap position), each step being 0.625 %. By providing automatic adjustment of the voltage to the auxiliary power system from the offsite 138 kV system, the TST and RST LTCs can compensate for a wider range of 138 kV system operating voltages.

In automatic mode, the primary microcontroller monitors load voltages to create a signal based on the sensed secondary voltage of its associated TAT or RAT. The RAT has two output windings, designated the "X" and "Y" winding. The "X" winding provides power to the ESF buses; therefore, the microcontroller senses the

"X" winding voltage. The primary microcontroller sends the signal to the LTC mechanism, which changes the tap setting, when required, so that voltage is controlled to within the desired range. The primary microcontroller also has programmable overvoltage detection and undervoltage blocking settings available.

For added reliability, a backup microcontroller (which provides a limited supervisory function) is installed that prevents a defective primary LTC tap changer microcontroller from adjusting the voltage outside established upper and lower limits. The backup microcontroller also has the capability to send a high speed return signal to the primary microcontroller if the regulated voltage goes outside the voltage limit band.

3.5 Grid Management

The KPS substation is a joint use facility, in that it contains equipment owned by Dominion and equipment owned by ATC. The majority of transmission equipment in the switchyard is owned by ATC and a smaller percentage owned by Dominion. ATC is therefore the owner-operator of part of the KPS substation and is a transmission operator in cooperation with the Midwest Independent Transmission System Operator (MISO).

MISO is responsible for analyzing the transmission system from a regional perspective. The regional perspective includes analyzing the effects of system contingencies of any transmission operator within the MISO reliability footprint on the operation of any other transmission operator's system within the MISO reliability footprint. In addition, MISO will analyze the effects of contingencies external to the MISO reliability footprint on the operation of any transmission operator's system within the MISO reliability footprint.

MISO is also responsible for communicating to the transmission operator (ATC) when the transmission system is outside of the operating criteria for pre- and post-contingent conditions. MISO will differentiate the communication necessary for off-site power reliability. MISO and ATC will communicate to KPS whenever transmission system operating criteria is not met and corrections to the system cannot be implemented in a timely manner (within 30 minutes).

ATC, the transmission operator, is responsible for maintaining transmission system voltage. ATC will provide voltage and reactive schedules, which generator operators (e.g. KPS) shall follow to provide proper voltage support to the transmission system. ATC, in conjunction with KPS, specifies the NORMAL VOLTAGE at the bus to which a generator (345 kV) is connected and what voltage range is required to support plant loads fed from the substation 138 kV system. Under current normal conditions, the KPS substation 138 kV bus voltage is currently maintained in the range of 140 kV-143 kV.

4.0 TECHNICAL ANALYSIS

4.1 Evaluation of the Load Tap Changer

The new TST (12 MVA ONAN, 138kV/13.8kV) and replacement TAT (8 MVA ONAN, 13.2 kV/4.16kV) were installed during the fall 2009 outage. The new RST (30 MVA ONAN, 138 kV/21 kV) and replacement RAT (30 MVA ONAN, 20 kV/4.16 kV) will be installed during the next refueling outage planned for spring 2011. The new RST and TST are provided with LTCs that can regulate the output voltage of the RAT and the TAT to the respective 4.16 kV safety-related buses while in manual or automatic operating mode. Operation of the TST LTC in the manual mode has been evaluated in accordance with 10 CFR 50.59 and determined to not require NRC approval. Operation of the RST LTC in the manual mode will be similarly evaluated prior to operating the RST LTC in the manual mode. The analysis that follows focuses on the proposed RST LTC and TST LTC operation in automatic operating mode.

LTC operation is based on the three typical voltage bands shown in Figure 1 below. Explanation of these voltage bands is provided in the subsequent descriptions of LTC operation.

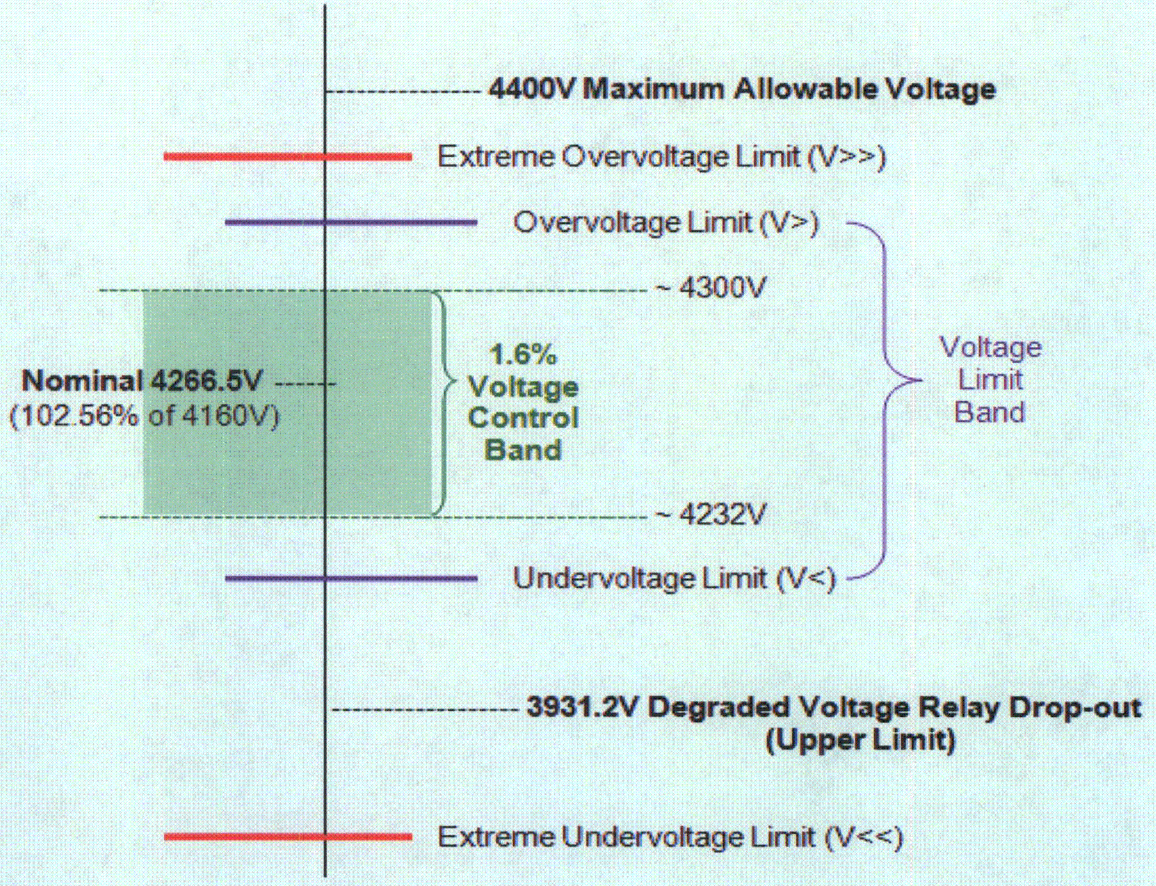


Figure 1 Typical Voltage Control and Limit Bands

The tap changer mechanism for each LTC is located in a separate enclosure attached to the transformer. A drive motor rotates the tap changer to increase or decrease the number of transformer windings in service. By operating the drive motor, which changes the tap settings, the transformer output voltage is raised or lowered. The tap changer mechanism can be operated in a manual control mode. In the manual control mode, the tap changer can be operated by the drive motor, or operated with a hand crank (if the transformer is de-energized) when no control power is available. Any alarm condition associated with the LTC mechanism or loss of control supply power will cause the pilot light ALARM condition to illuminate locally at the LTC and in the Control Room. Additionally, any single or combination of alarm conditions will result in blocking of the raise/lower switch while bringing the LTC back to the most recent step position (if the mechanism was in a mid-step condition).

The tap changer mechanism can also be operated in the automatic control mode when connected to primary and backup LTC microcontrollers. At KPS, a primary Tapcon 240 microcontroller and a backup Tapcon 240-LV microcontroller, separate from the transformer and the LTC mechanism, will be used to control the LTC mechanism. When operating in automatic mode, the primary microcontroller monitors load and source voltages to create a signal based on sensed secondary voltage of the associated TAT or RAT. The primary microcontroller then sends the signal to the LTC mechanism, which changes the tap setting as required so that voltage is controlled to within the desired range. The primary microcontroller also has programmable overvoltage detection and undervoltage blocking settings available. Should the primary Tapcon 240 microcontroller fail, the backup Tapcon 240-LV microcontroller is designed to prevent improper operation outside the voltage limit band.

The LTC will provide a range of -10% to +10% of the rated secondary voltage in 32 step increments, each step being 0.625% of rated secondary voltage. By providing automatic adjustment of the voltage to the auxiliary power system from the offsite 138 kV system, the TST and RST LTCs will compensate for a wide range of 138 kV system operating voltages.

The voltage decay that occurs following generator trip, which was determined by the transmission company (ATC), has been validated to be bounded by the response time of the LTCs when operating in automatic mode.

The primary LTC microcontroller is set with an initial time delay of 30 seconds during normal operation. Therefore, the voltage must be out of band for 30 seconds before the controls initiate a tap change. In the event of a voltage dip with an accident signal (train associated safety injection signal), the initial primary LTC microcontroller time delay of 30 seconds is bypassed. Upon receipt of a signal to change taps (in automatic mode), the tap changer will complete a tap change in approximately two seconds.

In the event of a voltage dip either with or without an accident signal present, the degraded voltage relay (DVR) scheme at the safety-related 4.16 kV buses includes a minimum six second time delay to allow voltage to recover before the safety-related buses are disconnected from offsite power (this time delay is not allowed to exceed a maximum of 7.4 seconds by TS).

To prevent unnecessary disconnection of the safety-related buses from offsite power, analyses have determined the maximum permissible voltage decay that can occur following generator trip without actuating the DVR scheme. With the LTC in automatic mode, the analytical maximum allowable generator trip voltage decay value will then be compared to real time anticipated voltage decay analyses results provided by the transmission company (ATC). The LTC will be capable of fulfilling its function if the real time contingency analysis predicts voltage decay less than the maximum analyzed permissible voltage decay. Similar to existing operation in fixed tap (manual) mode, when the real time analysis program shows an unacceptable situation, ATC will correct the situation or notify KPS within 30 minutes.

Proper operation of each transformer is verified following installation. This includes verification of LTC operation over the full range of tap positions. Testing on the primary and backup LTC microcontrollers includes confirmation, using a simulated voltage input, that the LTC regulating relay provides the correct raise/lower response. Testing on the backup LTC microcontroller also ensures that it provides the proper blocking function in the event of a primary LTC microcontroller failure.

4.2 LTC Automatic Operation Failure Modes Evaluation

DEK has evaluated the potential failure modes of the LTC and its control system. The evaluation results are discussed below and summarized in Table 1. Use of the LTC in automatic mode creates the possibility for a malfunction of the LTC mechanism or the LTC microcontroller that raises or lowers the voltage provided to the 4.16 kV safety-related buses. The condition created when the LTC microcontroller or the LTC mechanism automatically lowers the voltage provided to the safety-related buses was previously evaluated and is conservatively enveloped by evaluations previously performed in the USAR for the loss of voltage and degraded voltage instrumentation.

However, the condition created when the LTC microcontroller automatically raises the voltage provided to the 4.16 kV safety-related buses has not been previously evaluated in the KPS USAR. As a result, in accordance with 10 CFR 50.59, the use of the LTC in the automatic mode requires NRC approval, since this potential malfunction of the LTC creates a possibility for a malfunction of a structure, system, or component important to safety with a different result than any previously evaluated in the USAR. As discussed below, this potential malfunction is unlikely and operator action can be taken to prevent a sustained high voltage condition.

The most severe potential malfunction would be a failure of the primary LTC microcontroller or LTC mechanism causing the transformer output voltage to rapidly increase or decrease. The LTC mechanism is equipped with system monitoring functions that generate alarms in case of malfunctions and block the raise/lower switch while bringing the LTC back to the most recent step position (if the mechanism was in a mid-step position). The primary LTC microcontroller logic and settings also have the following capability to prevent misoperation of a defective LTC mechanism. The primary LTC microcontroller prevents voltage from dropping below the established lower limit by blocking the raise and lower logic of the tap changer. It prevents voltage from rising above the upper limit by causing a high speed lowering return to the control band. However, this design function is not currently planned to be used due to the addition of the backup microcontroller, which has an enhanced capability.

The backup microcontroller prevents a defective primary LTC microcontroller from adjusting voltage outside the established undervoltage and overvoltage limits (voltage limit band – symbolized on Figure 1 as "V<" and "V>" respectively) by initiating alarms, blocking the raise or lower logic of the primary microcontroller (i.e., block raise logic on overvoltage; block lower logic on undervoltage), and attempting to return the voltage to the control band with a high speed return control action. If the voltage still remains outside the limit band, then the LTC failure alarm is actuated and the backup microcontroller will send an emergency off signal to the motor drive control circuit. If the regulated voltage goes above the extreme upper voltage limit (symbolized "V>>" on Figure 1) for a set period of time, an additional alarm is actuated and the backup microcontroller will stop the voltage regulator at that position. If the regulated voltage goes below the extreme lower voltage limit, an additional alarm is actuated but no further action is taken by the backup microcontroller (i.e., all actions associated with the undervoltage limit are suppressed). Severe undervoltage is addressed by the degraded voltage relaying. The design also allows operators to override both LTC microcontrollers and take manual control, if necessary.

The failure or possible misoperation of the LTC mechanism is unlikely to significantly affect output voltage for a significant length of time since the LTC mechanism is monitored by the LTC mechanism monitoring system, the primary LTC microcontroller, and the backup LTC microcontroller. Simultaneous failure of the LTC mechanism monitoring system, the primary LTC microcontroller, and the backup LTC microcontroller is unlikely. Therefore, a failure of the LTC mechanism should be detected and quickly offset by the monitoring system, the primary microcontroller or the backup microcontroller.

Based on predicted mean time between failure data provided by the manufacturer, the predicted mean time between failures is 110 years for the primary microcontroller and 110 years for the backup microcontroller. The predicted failure rates are based on data current as of December 2009. Thus, the simultaneous failure of both microcontrollers is unlikely. Furthermore, simultaneous failure of both the RST and TST microcontrollers, resulting in loss of both safety-related trains at the same time, is even more unlikely.

Microcontroller maintenance and testing activities provide reasonable assurance that these mean time failure rates will be maintained.

Separately, it is noted that operating an emergency diesel generator (EDG) in parallel with offsite power (e.g., during EDG testing), with the RST or TST LTC in automatic mode, could cause the LTC to automatically change taps. This could result in possible damage to the EDG. To prevent such a condition, administrative controls will ensure that the associated LTC will only be operated in manual mode when operating an EDG connected with offsite power.

Failure Modes that Increase Voltage

In the unlikely event of a failure of both primary and backup LTC microcontrollers that results in increasing voltage, operators can take manual action from the control room or the RST and TST control cabinets to prevent damage to safety-related equipment. The 4.16 kV safety-related buses are equipped with a process computer alarm that indicates an overvoltage condition has occurred. The control room computer alarm setpoint is 4400 V, which is 110% of the voltage rating of the safety-related motors fed from the bus, consistent with ANSI/NEMA Standard MG-1-2003, "Motors and Generators." In addition, if a 480 V ESF bus voltage exceeds 509 volts, the operators receive a control room computer alarm. The 509-volt alarm setting slightly exceeds 110% of the voltage rating of the standard 460-volt motor. The 509-volt setting accounts for the voltage drop from the bus to the motor. Damage from an overvoltage condition is only expected if the condition is sustained for an extended period of time.

At voltages below 4400 V, there is no possibility of causing an overvoltage on 4000 V motors, since this is within the 110% NEMA criteria. However, at voltages below 4400 V on the 4.16 kV safety-related buses, there still is the possibility of creating an overvoltage condition on the 480 V safety-related buses because of the 460 V motors on these buses and because the 4160/480 V station service transformer taps are set at -2.5%. As load on the 480 V system increases, the actual voltage on the high side (4.16 kV) of the station service transformers will decrease; and with the impedance of the transformers, the overvoltage condition is minimized.

Operators will respond under the guidance of abnormal operating procedures upon receipt of a 4.16 kV or 480V safety-related bus overvoltage alarm. The procedural guidance will direct operators to take manual control of the LTC, if necessary. The tap setting can then be manually lowered to correct bus voltage. Additionally, plant conditions requiring the unnecessary running of safety-related loads can be avoided in order to minimize degradation of the equipment. Also, as plant conditions permit, non-safety-related loads can be added to help lower bus voltage.

As such, the existing overvoltage alarm, in conjunction with the procedurally controlled operator actions to promptly correct the condition, are considered sufficient protection against microcontroller (primary and backup) and LTC mechanism failures that could result in increasing voltage. These alarms and controls will also limit the duration of any overvoltage condition.

Failure Modes that Decrease Voltage

A failure that results in decreasing voltage could initiate the timers on the 4.16 kV bus degraded voltage relays if voltage decreases to the current TS setpoint (93.6% ± 0.9%). Failure to restore the bus voltage within 7.4 seconds would cause the power source for these buses to transfer to the emergency diesel generators. A loss of offsite power is analyzed in the USAR. The presence of the primary microcontroller blocking setting and the backup microcontroller makes this failure mode extremely unlikely. In addition, a low voltage alarm at approximately 4000 V (approximately 96.2%) alerts operators to take procedurally-guided action prior to reaching the degraded voltage relay setpoint.

Other Failure Modes

LTC failure modes or malfunctions that could lead to an overvoltage or undervoltage condition as a result of the tap changer failing to change the tap setting when required (i.e., the tap setting remains "as is") are identified in Table 1. These failure modes or malfunctions can result from:

- Failure of a microcontroller when the LTC is operating in automatic mode;
- Failure of the LTC drive motor (including a loss of power to the drive motor) when the LTC is operating in either the automatic or manual mode; or,
- Interruption in RAT or TAT secondary potential transformer (PT) voltage sensor signal (e.g. blown fuse, open circuit).

Failure of the tap changer to change the tap setting when required could create an overvoltage or undervoltage condition if transmission system voltage changed by a sufficiently large amount subsequent to the malfunction. For example, if the failure occurred when high summer load demand existed, a high tap setting could lead to a high voltage condition at a later time (due to failure of the tap changer to reduce the tap setting) when system load demand diminishes and grid voltage increases.

Failure of the tap changer to change settings when demanded (i.e., passive failure) is less severe than active failures of the LTC. This is because the overvoltage or undervoltage condition would typically evolve relatively slowly and the magnitude of the resultant change in voltage would be limited to the effect of the change in grid voltage. As noted previously, there are alarms that alert the operator to high and low voltage conditions on the 4.16 kV and 480 V safety-related buses. Implementing procedures will instruct operators to take action to mitigate or correct the condition after the new LTCs are installed and before automatic operation is enabled.

Under established KPS procedures, the first action is to contact the transmission system operator (ATC) and request that the voltage be increased or decreased as needed. Further actions include either securing/preventing the start of loads, or adding additional load depending on the condition. Additionally, for the TST and RST (upon RST installation), operators have the option to manually operate the tap changer and change the tap setting if required (assuming the operating mechanism did not fail and can be operated via the drive motor or the hand crank if there is no load on the transformer).

Similar LTC transformers are in use at other NRC-licensed facilities. DEK performed an operating experience (OPEX) review that focused on load tap changer issues at nuclear power plants. This review identified only three instances of an LTC microcontroller spuriously running voltage towards the transformer's upper limit. Reported instances of the tap changer failing as-is were infrequent. There were no documented instances of equipment failures resulting from LTC failure. Since transformers with load tap changers are widely used and have a long service history at nuclear facilities, it is reasonable to conclude that the low number of issues identified in the OPEX search indicate the LTCs in service at nuclear facilities have been reliable.

4.3 Evaluation of Offsite Circuit Operability with Non-Functional LTCs

Implementation of automatic operation of the LTCs will allow them to automatically compensate for variations in switchyard voltage that could otherwise render the offsite circuits inoperable. In the event an LTC is unable to automatically compensate for switchyard voltage variations, offsite circuit operability will be determined based on whether the actual and predicted post-trip voltage and actual tap position are adequate to prevent an inadvertent degraded voltage instrument transfer of the affected ESF bus source to the associated EDG.

4.4 Conclusion

Implementation of automatic LTC operation will provide additional assurance that the voltage provided by the transmission system is adequate to maintain operability of the offsite power sources for KPS for the expected range of switchyard voltages. LTCs have been shown to be reliable, and the likelihood and consequences of each LTC failure mode has been evaluated and determined to be acceptable. Thus, the proposed changes will increase overall reliability of the offsite power sources at KPS.

4.5 Precedence

This submittal is similar to license amendments that were approved by the NRC for Dresden Units 2 and 3 on March 17, 2006 (reference 1), Quad Cities Units 1 and 2 on July 24, 2006 (reference 2), and Clinton Unit 1 on October 1, 1998 (reference 3).

The Dresden submittal requested changes to Technical Specification (TS) 3.3.8.1, "Loss of Power (LOP) Instrumentation," and to implement use of automatic load tap changers (LTCs) on transformers that provide offsite power to Dresden Nuclear Power

Station, Units 2 and 3. Part of the proposed change to Dresden's TS 3.3.8.1 was to revise the maximum and minimum allowable values for the degraded voltage function of the 4160-volt essential service system bus under-voltage instrumentation. DEK is not requesting a change to the degraded grid voltage function in this amendment request. Therefore this part of the Dresden application is not applicable to the DEK request. The LTC portion of the request is similar, except that the transformers are of different sizes and one of the Dresden transformers includes a de-energized tap changer on the primary winding.

The Quad Cities submittal requested a change to implement the use of automatic load tap changers (LTCs) on transformers that provide offsite power to Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. The Quad Cities amendment request is similar to the DEK request.

The Clinton submittal requested a change to implement the use of automatic load tap changers (LTCs) on transformers that provide offsite power to Clinton Power Station, Unit 1. The Clinton amendment request is similar to the DEK request.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Consideration

Pursuant to 10 CFR 50.90, Dominion Energy Kewaunee, Inc. (DEK) requests an amendment to Facility Operating License Number DPR-43 for Kewaunee Power Station (KPS). The proposed amendment would revise the current KPS current licensing basis to implement use of new automatic load tap changers (LTCs) on new transformers that provide offsite power to KPS.

DEK has evaluated the proposed amendment to determine if a significant hazards consideration is involved by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of Amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No

The proposed amendment will allow operation of the LTCs in automatic mode. The only accident previously evaluated where the probability of an accident is potentially affected by the change is the loss of offsite power (LOOP) accident. Failure of an LTC while in the automatic mode of operation that results in decreased voltage to the engineered safety features (ESF) buses could cause a LOOP if voltage decreased below the degraded voltage relay (DVR) setpoint. The two postulated failure scenarios are: 1) failure of an LTC microcontroller that results in rapidly decreasing voltage supplied to the ESF buses and; 2) failure of an LTC microcontroller to respond to decreasing grid voltage. For the first scenario, a backup microcontroller is provided for each LTC, which makes this failure unlikely. For the second scenario, since grid voltage changes typically occur relatively slowly and the magnitude of the resulting change would be limited to the effect of the change in grid voltage, operators would have ample time to address the condition utilizing identified procedures. In addition, the frequency of occurrence of these failure modes is small, based on the operating history of similar equipment at other plants. Furthermore, in both of the above potential failure modes, operators can take manual control of the LTC to mitigate the effects of the failure. Thus, the probability of a LOOP will not be significantly increased by operation of the LTC's in the automatic mode.

The proposed amendment has no effect on the consequences of a LOOP, since the emergency diesel generators (EDGs) provide power to safety-related equipment following a LOOP. The design and function of the EDGs are not affected by the proposed change.

The probability of other previously evaluated accidents is not affected, since the proposed amendment does not affect the way plant equipment is operated and thus does not contribute to the initiation of any of the previously evaluated accidents.

The LTC is equipped with a backup microcontroller, which inhibits gross improper action of the LTC in the event of primary microcontroller failure. Additionally, the operator has procedurally identified actions available to prevent a sustained high voltage condition from occurring. Damage due to overvoltage is time-dependent, requiring a sustained high voltage condition. Therefore, damage to safety-related equipment is unlikely, and the consequences of previously evaluated accidents are not significantly increased.

Therefore, this proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No

The proposed amendment involves electrical transformers that provide offsite power to safety-related equipment for accident mitigation. The proposed change does not alter the design, physical configuration, or mode of operation of any other plant structure, system, or component. No physical changes are being made to any other portion of the plant, so no new accident causal mechanisms are being introduced. Although the proposed change potentially affects the consequences of previously evaluated accidents (as discussed in the response to Question 1), it does not result in any new mechanisms that could initiate damage to the reactor or its principal safety barriers (i.e., fuel cladding, reactor coolant system, or primary containment).

Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any previously evaluated.

3. **Does the proposed amendment involve a significant reduction in a margin of safety?**

Response: No

The proposed amendment does not affect the inputs or assumptions of any of the analyses that demonstrate the integrity of the fuel cladding, reactor coolant system, or containment during accident conditions. The allowable values for the degraded voltage protection function are unchanged and will continue to ensure that the degraded voltage protection function actuates when required, but does not actuate prematurely to unnecessarily transfer safety-related loads from offsite power to the emergency diesel generators. Automatic operation of the LTCs increases the margin of safety by reducing the potential for transferring loads to the EDGs during an undervoltage or overvoltage event on the offsite power sources.

Therefore, the proposed amendment to the KPS design basis does not involve a significant reduction in a margin of safety.

Based on the above, Dominion Energy Kewaunee, Inc. concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

The US Atomic Energy Commission (AEC) issued their Safety Evaluation (SE) of the Kewaunee Power Station (KPS) on July 24, 1972 with supplements dated December 18, 1972 and May 10, 1973. The SE, Section 3.1, "Conformance with AEC General Design Criteria," described the conclusions the AEC reached associated with the General Design Criteria in effect at the time. The AEC stated:

"The Kewaunee plant was designed and constructed to meet the intent of the AEC's General Design Criteria, as originally proposed in July 1967. Construction of the plant was about 50% complete and the Final Safety Analysis Report (Amendment No. 7) had been filed with the Commission before publication of the revised General Design Criteria in February 1971 and the

present version of the criteria in July 1971. As a result, we did not require the applicant to reanalyze the plant or resubmit the FSAR. However, our technical review did assess the plant against the General Design Criteria now in effect and we are satisfied that the plant design generally conforms to the intent of these criteria."

As such, the appropriate General Design Criteria (GDC), from the Final Safety Analysis (Amendment 7), as updated and included in the KPS USAR, is excerpted below.

Criterion 39 – Emergency Power

An emergency power source shall be provided and designed with adequate independency, redundancy, capacity, and testability to permit the functioning of the engineered safety features and protection systems required to avoid undue risk to the health and safety of the public. This power source shall provide this capacity assuming a failure of a single active component.

The above Criterion 39 is as suggested by AIF (Atomic Industrial Forum) in its October 2, 1967 comments on the then-proposed AEC Criteria. The design also met Wisconsin Public Service Company's (then Licensee) understanding of the intent of the Criteria as originally proposed by AEC in July, 1967. In the case of Criterion 39, where a difference existed, the more stringent AEC criterion was followed. As a result, in our opinion the emergency power systems as designed also met the intent of the GDC 17, adopted February 20, 1971, as amended July 7, 1971.

The current General Design Criteria in 10 CFR 50, Appendix A states the following:

Criterion 17 - Electric Power Systems

"An onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that:

1. Specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences; and,

2. The core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.

The on-site electric power supplies, including the batteries, and the on-site electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure.

Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights-of-way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. A switchyard common to both circuits is acceptable. Each of these circuits shall be designed to be available in sufficient time following a loss of all on-site alternating current power supplies and the other off-site electric power circuit, to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded. One of these circuits shall be designed to be available within a few seconds following a loss-of-coolant accident to assure that core cooling, containment integrity, and other vital safety functions are maintained.

Provisions shall be included 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 on-site electric power supplies.

Independent alternate power systems are provided with adequate capacity and testability to supply the required engineered safety features and protection systems."

Conclusion

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7.0 REFERENCES

1. Letter from Maitri Banerjee (NRC) to Christopher M. Crane (Exelon Generation Company, LLC), "Subject: Dresden Nuclear Power Station, Units 2 and 3 - Issuance of Amendments Regarding Offsite Power Instrumentation and Voltage Control (TAC Nos. MC6712 and MC6713)," dated March 17, 2006. [ADAMS Accession No. ML060520208]

2. Letter from Maitri Banerjee (NRC) to Christopher M. Crane (Exelon Generation Company, LLC), "Subject: Quad Cities Nuclear Power Station, Units 1 and 2 - Issuance of Amendments Re: Automatic Operation of Load Tap Changers (TAC Nos. MC9664 and MC9665)," dated July 24, 2006. [ADAMS Accession No. ML061770520]

3. Letter from Jon B. Hopkins (NRC) to Joseph V. Sipek (Illinois Power Company), "Subject: Issuance of Amendment No. 116 to Facility Operating License No. NPF-62 – Clinton Power Station, Unit 1 (TAC Nos. MA1925)," dated October 1, 1998 [ADAMS Accession No. ML020990669]

Table 1

Load Tap Changer (LTC) Failure Modes and Effects

LTC Automatic Operation Potential Failure Mode	Impact	Response
LTC mechanism or microcontroller attempts to raise tap setting when not needed.	Could cause over-voltage condition	The backup LTC microcontroller maintains acceptable tap position (at or just above the overvoltage limit) by blocking the raise signal. Additionally, alarm on overvoltage will initiate operator action to place LTC in manual mode.
LTC mechanism or microcontroller attempts to lower tap setting when not needed.	Could cause under-voltage condition	The backup LTC microcontroller maintains acceptable tap position (at or just below the undervoltage limit) by blocking the lower signal. Additionally, alarm on low voltage will initiate operator action to place LTC in manual mode. In extreme case, results in a loss of offsite power, which has been evaluated as part of plant design basis.
LTC mechanism or microcontroller malfunction fails to change taps, causing tap setting to remain as is.	Could result in over-voltage (or under-voltage) if grid voltage changes following failure	Operator action to monitor voltage and respond by placing LTC in manual mode and raising or lowering voltage as desired.
LTC drive motor fails to change taps (e.g., power to motor is lost), causing tap setting to remain as is.	Could result in over-voltage (or under-voltage) if grid voltage changes following failure	Operator action to monitor voltage and respond by raising or lowering voltage as desired by the transmission operator and/or adjusting on-site loads.

ATTACHMENT 2

SUPPLEMENT TO LICENSE AMENDMENT REQUEST 236
AUTOMATIC OPERATION OF TRANSFORMER LOAD TAP CHANGERS

MARKED UP TECHNICAL SPECIFICATIONS BASES PAGES
(FOR INFORMATION)

MARKED UP TS BASES PAGES:

TS B 3.8.1
TS B 3.8.2
(EXCERPTS)

KEWAUNEE POWER STATION

DOMINION ENERGY KEWAUNEE, INC.

BASES

LCO (continued)

Each offsite circuit must be capable of maintaining rated frequency and voltage, and accepting required loads during an accident, while connected to the ESF buses.

One qualified offsite circuit consists of the 138/21 kV Reserve Auxiliary Transformer (RAT) Supply Transformer, powered by the 138 kV portion of the substation, to the 20/4.16 kV RAT and normally supplying power to Bus 1-6. The other qualified offsite circuit consists of the 138/13.8 kV TAT Supply Transformer, powered by the 138 kV portion of the substation, to the 13.2/4.16 kV Tertiary Auxiliary Transformer (TAT) and normally supplying power to Bus 1-5. The substation transformers that supply the reserve and tertiary auxiliary transformers are each provided with a load tap changer. These load tap changers provide voltage regulation in the event of changing transmission system voltage. The load tap changers can be operated in manual or automatic mode.

The 138 kV and 345 kV portions of the substation are interconnected by two 345/138 kV Auto Transformers. The offsite circuits also include the supply breakers to buses 1-5 and 1-6. While each circuit has connections to each 4.16 kV ESF bus, each offsite circuit is only required to be capable of supplying one of the 4.16 kV ESF buses at a time.

[NOTE: For purposes of brevity, the remaining Bases are not reproduced here as they are neither germane to nor altered by this submittal.]

BASES

LCO

One offsite circuit capable of supplying the onsite Class 1E power distribution subsystem(s) of LCO 3.8.10, "Distribution Systems - Shutdown," ensures that all required loads are powered from offsite power. An OPERABLE DG, associated with a distribution system train required to be OPERABLE by LCO 3.8.10, ensures a diverse power source is available to provide electrical power support, assuming a loss of the offsite circuit. Together, OPERABILITY of the required offsite circuit and DG ensures the availability of sufficient AC sources to operate the unit in a safe manner and to mitigate the consequences of postulated events during shutdown (e.g., fuel handling accidents).

The qualified offsite circuit must be capable of maintaining rated frequency and voltage, and accepting required loads during an accident, while connected to the Engineered Safety Feature (ESF) bus(es).

One qualified offsite circuit consists of the 138/21 kV Reserve Auxiliary Transformer (RAT) Supply Transformer, powered by the 138 kV portion of the substation, to the 20/4.16 kV RAT and normally supplying power to Bus 1-6. The other qualified offsite circuit consists of the <u>138/13.8 kV TAT Supply Transformer</u>, powered by the 138 kV portion of the substation, to the 13.2/4.16 kV Tertiary Auxiliary Transformer (TAT) and normally supplying power to Bus 1-5. The substation transformers that supply the reserve and tertiary auxiliary transformers are each provided with a load tap changer. These load tap changers provide voltage regulation in the event of changing transmission system voltage. The load tap changers can be operated in manual or automatic mode.

<u>A third qualified offsite circuit available for connection to the ESF buses consists of the 20/4.16 kV Main Auxiliary Transformer, powered by the 345 kV portion of the Kewaunee Substation through the 345/20 kV Main Transformers. This third circuit is available for connecting offsite power to the ESF buses when the reactor is shutdown and the main generator links are removed. It is normally not relied on except when one or both of the other circuits are unavailable. To ensure circuit reliability and prevent unnecessary opening of the main generator output breaker, protective trips associated with main generator operation are disabled when supplying offsite power through this circuit.</u>

<u>The 138 kV and 345 kV portions of the substation are interconnected by two 345/138 kV Auto Transformers.</u> The offsite circuits also include the supply breakers to buses 1-5 and 1-6. While each circuit has connections to each 4.16 kV bus, each circuit is only required to be capable of supplying one of the 4.16 kV buses at a time. However, if only one offsite circuit is used to meet the LCO requirement, then it must be supplying both buses 1-5 and 1-6.

[NOTE: For purposes of brevity, the remaining Bases are not reproduced here as they are neither germane to nor altered by this submittal.]

ATTACHMENT 3

SUPPLEMENT TO LICENSE AMENDMENT REQUEST 236
AUTOMATIC OPERATION OF TRANSFORMER LOAD TAP CHANGERS

MARKED UP USAR PAGES
(FOR INFORMATION)

AFFECTED USAR PAGE:

Page 8.2-4
(EXCERPT – expanded to 2 pages)

KEWAUNEE POWER STATION

DOMINION ENERGY KEWAUNEE, INC.

[NOTE: For purposes of brevity, the information from this USAR page that precedes Section 8.2.2 is not reproduced here as it is neither germane to nor altered by this submittal.]

8.2.2 Plant Distribution System

The Auxiliary Electrical System is designed to provide a simple arrangement of buses requiring the minimum of switching to restore power to a bus in the event that the normal supply to that bus is lost.

8.2.2.1 **Single Line Diagrams**

The basic components of the plant electrical system are shown on the Single Line or Circuit Diagrams, Figure 8.2-3 and Figure 8.2-5. These figures show the 20 kV, 4160V, 480V and instrument bus ac systems and the 125V and 250V dc systems. In addition, Figure 8.2-1, Figure 8.2-3 and Figure 8.2-5 show the basic elements of the 13.8 kV, 138 kV and 345 kV substation systems.

8.2.2.2 **Main Auxiliary, Reserve Auxiliary and Tertiary Auxiliary Transformers**

The plant turbine-generator serves as the primary source of auxiliary electrical power during “on-the-line” operation. Power is supplied via a 20–4.16 kV, three-winding, Main Auxiliary Transformer, which is connected to the main leads from the turbine generator.

The primary sources of electrical power for the auxiliaries associated with engineered safety features during “on-the-line” operation of the plant are the Reserve Auxiliary Transformer and the Tertiary Auxiliary Transformer. Power is normally supplied to one bus (Bus 1-6) through the 20~~138~~-4.16 kV, three-winding Reserve Auxiliary Transformer (RAT), which is connected to the 138 kV/21 kV RAT Supply Transformer (RST) in the substation, and ultimately to a 138 kV portion of the ~~Kewaunee S~~substation. Power is normally supplied to the second bus (Bus 1-5) through the 13.2-4.16 kV, two-winding Tertiary Auxiliary Transformer (TAT), which is connected by an underground line, to the 138/13.8 kV Tertiary Supply Transformer (TST) in the ~~Kewaunee S~~substation and ultimately to a 138kV portion of the ~~Kewaunee S~~substation (different from the RST/RAT supply). A Load Tap Changer (LTC) is used on both ~~in~~ the RST and TST to adjust the voltage to the RAT and TAT as necessary. The maximum and minimum range of each ~~the~~ LTC is ±10% of the nominal secondary voltage of the RST and TST and includes 33 taps (nominal, 16 taps each to lower and raise voltage) to adjust the voltage. The LTCs can be adjusted manually ~~locally~~ at the respective RST and TST local control panel and from the control room. ~~Automatic functioning of the LTC is disabled~~

The LTCs can also be operated in automatic mode. In automatic mode, each LTC relies on both a primary and backup microcontroller. The backup microcontroller prevents the primary microcontroller from adjusting secondary side voltage outside established upper and lower limits in the event of a primary microcontroller failure.

Automatic operation of the LTCs, including their potential failure modes, has been evaluated. This evaluation determined that the simultaneous failure of both microcontrollers on one LTC is unlikely. Simultaneous failure of both the RST and TST microcontrollers, resulting in loss of both safety related trains at the same time, is even more unlikely. Microcontroller maintenance and testing activities provide reasonable assurance that failure rates remain low. A failure in which the LTC rapidly increases or decreases transformer output voltage is unlikely since both the primary and backup microcontrollers would have to fail. A failure of the LTC to respond to changing transmission system voltage generally occurs slowly and can be mitigated by operator action. A failure of the voltage sensor results in the affected LTC ceasing to operate in automatic mode and could result in the tap changer failing to change the tap setting when required (i.e., the tap setting remains "as is"). Failure of the tap changer to change settings when demanded (i.e., passive failure) is less severe than active failures of the LTC. This is because the overvoltage or undervoltage condition would typically evolve relatively slowly and the magnitude of the resultant change in voltage would be limited to the effect of the change in grid voltage. Alarms alert the operator to high/low voltage conditions on the 4.16 kV and 480 V safety-related buses.

ATTACHMENT 4

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION:
LICENSE AMENDMENT REQUEST 236
AUTOMATIC OPERATION OF TRANSFORMER LOAD TAP CHANGERS

KEWAUNEE POWER STATION

DOMINION ENERGY KEWAUNEE, INC.

**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION:
LICENSE AMENDMENT REQUEST 236
AUTOMATIC OPERATION OF TRANSFORMER LOAD TAP CHANGERS**

By application dated June 1, 2010 (reference 1), Dominion Energy Kewaunee, Inc. (DEK), requested an amendment to Facility Operating License Number DPR-43 for Kewaunee Power Station (KPS). The proposed amendment would revise the KPS current licensing basis (CLB) to allow the use of new automatic load tap changers (LTCs) on new transformers that provide offsite power to KPS.

Subsequently, the Nuclear Regulatory Commission (NRC) transmitted a request for additional information (RAI) regarding the proposed amendment (reference 2). The RAI questions and associated DEK responses are provided below.

NRC Question 1

The License Amendment Request (LAR) states that the auxiliary power required during plant startup, shutdown and after a reactor trip is supplied from the American Transmission Company's 138 kilovolt (kV) and 345kV transmission systems, through the 13.8 kV/138 kV/345 kV Kewaunee Power Station (KPS) substation, and via the reserve auxiliary transformer (RAT) and tertiary auxiliary transformers (TAT). The RAT and the TAT can both be powered from either transmission system through the interconnecting auto-transformer. Either offsite power source (reserve or tertiary auxiliary transformer) can be manually aligned to either or both of the engineered safety features 4.16 kV buses. The two buses can be tied together via two bus-tie breakers in series, one on each bus. The design and licensing basis of the plant states that upon loss of the normal source of offsite power to the 4.16 kV safety-related bus, a fast bus transfer to the second qualified source of offsite power will occur. Provide a detailed evaluation of the safety bus voltages when a loss of one offsite source results in transfer of safety bus to the second source during a design basis event and automatic tap changer(s) on RAT and TAT respond to voltage perturbations.

Response:

USAR, Revision 22, Section 8.2.2.2, Main Auxiliary, Reserve Auxiliary and Tertiary Auxiliary Transformers, states: "While either offsite power source (Reserve or Tertiary Auxiliary Transformer) can be manually aligned to either or both of the engineered safety features 4.16 kV buses, they each are operationally limited to be aligned to a single bus when engineered safety features are required."

Additionally, the description of undervoltage occurrences on 4160V Bus 1-5, contained in USAR Section 8.2.3.2, states the following: "Note: Above 200°F, the automatic loading of both safeguards Buses 1-5 and 1-6 on to the Reserve Auxiliary Transformer is prevented by procedural guidance. On Bus 1-5, Breaker 1-503 '43' switch is repositioned so that it does not have the ability to tie in onto the Reserve Auxiliary Transformer automatically." Therefore, automatic transfer of bus 1-5 to the RAT during an undervoltage condition is prevented. Consequently, the RAT will not automatically power both 4.16kV safeguards buses, simultaneously.

The above description in the USAR was implemented in December 2007 following a change to the manner in which the KPS electrical system is operated. This change, which resulted in positioning the control switch ('43' switch) for Breaker 1-503 to 'Manual', was part of the corrective action for deficiencies identified during an NRC Component Design Basis Inspection (CDBI) during 2007 and a subsequent NRC inspection in 2009. Specific details are contained in NRC Inspection Report 05000305/2007006 (Unresolved Item (URI) 2007-006-03) and NRC Inspection Report 05000305/2009004 (Non-Cited Violation (NCV) 2009-004-03).

The USAR Section 8.2.3.2 description of undervoltage occurrences on 4160V Bus 1-6, includes a sequencing step to close tertiary auxiliary source breaker (BKR611) if voltage is present and BKR501 is tripped. This step attempts to automatically place Bus 1-6 onto the TAT, which would be prevented if the TAT is already supplying Bus 1-5, which it normally does. Therefore, this interlock prevents the TAT from powering both 4.16kV safeguards buses simultaneously.

In summary, the fast bus transfer to the second qualified source of offsite power is prevented by the operational control of transfer for Bus 1-5 and the interlock configuration for Bus 1-6. Thus, when a loss of one offsite source occurs, a fast bus transfer to the second qualified source of offsite power will not occur, even during design basis events. Circuit design is such that a bus that experiences an undervoltage condition will be energized by its respective emergency diesel generator.

Based on analyses of bus voltage control and bus fast transfer capability (discussed above), DEK determined that use of the fast transfer capabilities of the 4160V system is not acceptable for maintaining operability of the offsite power sources. Thus, the fast transfer capability of the offsite supply breakers to the two safeguard buses has been disabled by placing the remaining '43' switches (for breakers 1-501 [TAT to Bus 5], 1-601 [RAT to Bus 6], and 1-611 [TAT to bus 6]) in 'Manual'. This prevents automatic fast transfer of Buses 5 and 6 to their alternate offsite power source under the conditions of an actuated loss of voltage or degraded voltage condition. Transfer will instead be to an operating emergency diesel generator.

NRC Question 2

Bus 1-5 is normally supplied from the TAT and Bus 1-6 is normally supplied-from the RAT. Thus, no bus transfer is required for the engineered safety features in the event of a unit trip. The plant was designed with an automatic bus transfer feature. Verify that a single failure of the bus transfer scheme will not result in transfer of the Busses 1-5 and 1-6 to a single source of offsite source during a design basis event.

Response:

KPS accident analyses were established under two postulated conditions regarding offsite power. The analyses postulate that either all offsite power would be available or no offsite power would be available.

Under a design basis accident with offsite power available, a single failure of the bus transfer scheme could cause the circuitry of one electrical train to detect an undervoltage condition when no such condition exists. With the existing switch and circuitry alignment, such an event would result in the associated safeguard bus being deenergized and its subsequent transfer to the associated energized emergency diesel generator (EDG). The final result would be one electrical train energized from an offsite source and one electrical train energized from an EDG.

Under a design basis accident with no offsite power available, a single failure of the bus transfer scheme could cause the circuitry of one electrical train to detect that one of the offsite sources is always available (even though it is deenergized). Thus, the bus transfer circuit would continually attempt to restore power to the deenergized bus from a deenergized offsite source. The final result would be one electrical train energized from an EDG and one train remaining deenergized. Such a condition is within the design and licensing basis of KPS.

Although not part of the KPS licensing basis, additional analyses were performed to evaluate the capability of both safety-related buses to be supplied from the same offsite source. This enhanced capability is expected to be in place subsequent to completion of modifications planned for the 2011 refueling outage and the implementation of automatic LTC operation.

ETAP runs were performed to verify the initial tap position (post event) based on the pre-event tap position (prior to generator trip and SI sequence initiation); and, to establish that the degraded voltage relaying (DVR) would not actuate. Based on analyses performed by American Transmission Company (ATC – transmission operator for KPS), if KPS loses both of its 345kV lines or both T10 and T20 345/138kV transformers (related to the two 345kV switchyard lines); or, if both Point Beach Nuclear Power (PBNP) units are unavailable; or, if Q303 (345kV) and F84 (138kV) transmission lines are both out of service, then it is possible that the maximum change in switchyard voltage due to a KPS unit trip would be from 1.82% to 2.76%. Therefore, for the above listed transmission system conditions, it is possible that a KPS unit trip would cause, at most, a drop in 138kV switchyard voltage of 1.82% to 2.76%. This could potentially cause actuation of the DVR and disconnection from the offsite power system (only on the RAT supply).

Absence of these worst case conditions would result in a much smaller resultant voltage change. The ATC analyses show that other possible limiting switchyard configurations would result in a maximum voltage drop of 1.465% or less. DEK plans to request that ATC provide a programmed load/voltage forecast warning indication to KPS upon the system forecasting a 1.46% or larger drop in voltage at KPS (due to KPS unit trip). In the event that a larger than 1.46% drop in voltage is forecasted, KPS operators have the capability to manually transfer Buses 1-3 and/or 1-4 to the RAT. This anticipatory transfer would cause the upstream RAT supply transformer (RST) LTC to raise taps and account for the additional Bus 1-3 and/or Bus 1-4 load prior to the trip and thereby decrease the 4kV voltage drop associated with the non-safety related bus transfer at the time of a unit trip. Thus, DVR actuation would not be expected to occur, and the offsite power source (RAT supply) would be maintained.

The TAT supply voltage does not actuate the DVR under any analyzed switchyard scenarios, thus the offsite power source via the TAT supply would be maintained.

Voltage profile graphs of the associated ETAP analyses results are provided (for information) in Figures 1 through 7 below. These graphs show that voltage does not decrease below 95% of nominal bus voltage for more than 6 seconds. Although the DVRs themselves actuate, their associated time delay relays do not time out. Thus, no bus stripping signal is initiated and offsite power remains available.

Figure 1

CS-SI-5R6R-6-ICS-0- (Bus Voltages)

Voltage profile for safety related Buses 1-5 and 1-6 during a worst case SI sequence start (motor start times are based on limiting SI relay times) with only the Reserve Auxiliary Transformer available (TAT is assumed to be out of service). The initial RST tap position is set at 1.875% (Tap 3R) and the 138kV switchyard voltage is set at 95%.

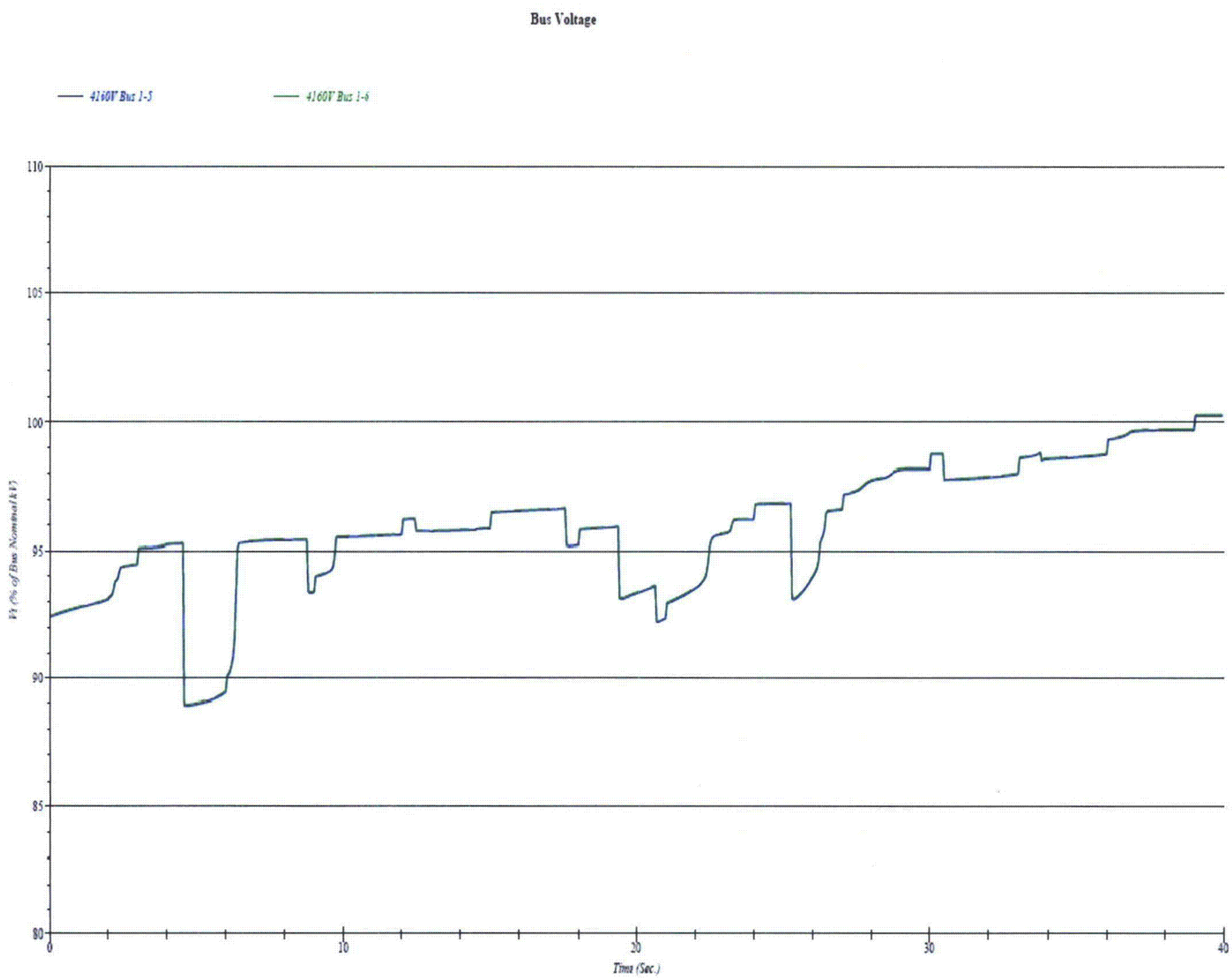


Figure 2

CS-SI-5R6R-6-ICS-0-2 (Bus Voltages)

Voltage profile for safety related Buses 1-5 and 1-6 during a worst case SI sequence start (motor start times are based on limiting SI relay times) with only the Reserve Auxiliary Transformer available (TAT is assumed to be out of service). Additionally, the first step in the sequence is staggered such that the train A loads start at minimum relay time while train B loads start at maximum relay time (in order to extend the undervoltage condition). The initial RST tap position is set at 1.875% (Tap 3R) and the 138kV switchyard voltage is set at 95%.

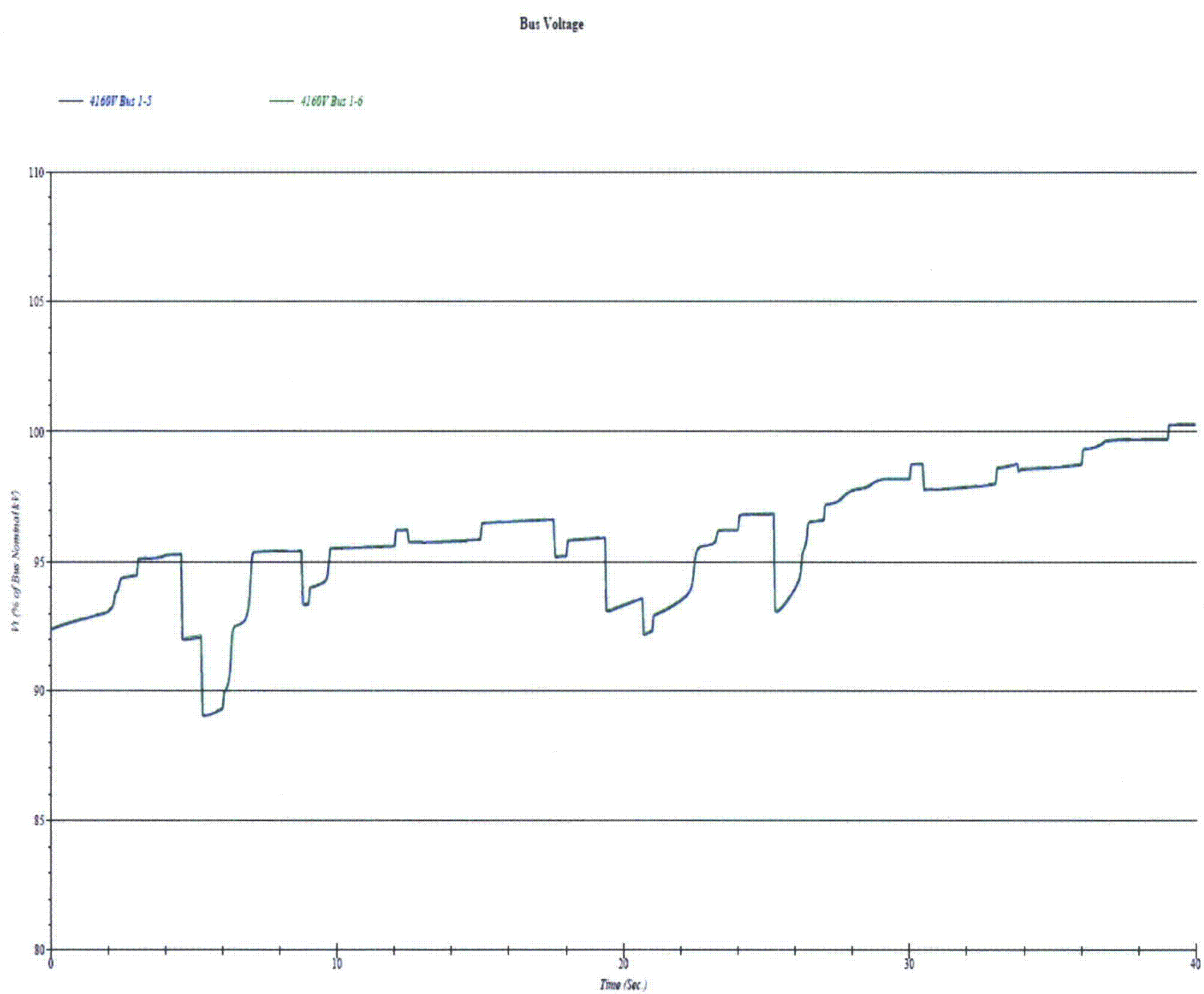


Figure 3

CS-SI-5T6T-6-ICS-0-2 (Bus Voltages)

Voltage profile for safety related Buses 1-5 and 1-6 during a worst case SI sequence start (motor start times are based on limiting SI relay times) with only the Tertiary Auxiliary Transformer available (RAT is assumed to be out of service). Additionally, the first step in the sequence is staggered such that the train A loads start at minimum relay time while train B loads start at maximum relay time (in order to extend the undervoltage condition). The initial TST tap position is set at 3.75% (Tap 6R) and the 138kV switchyard voltage is set at 95%.

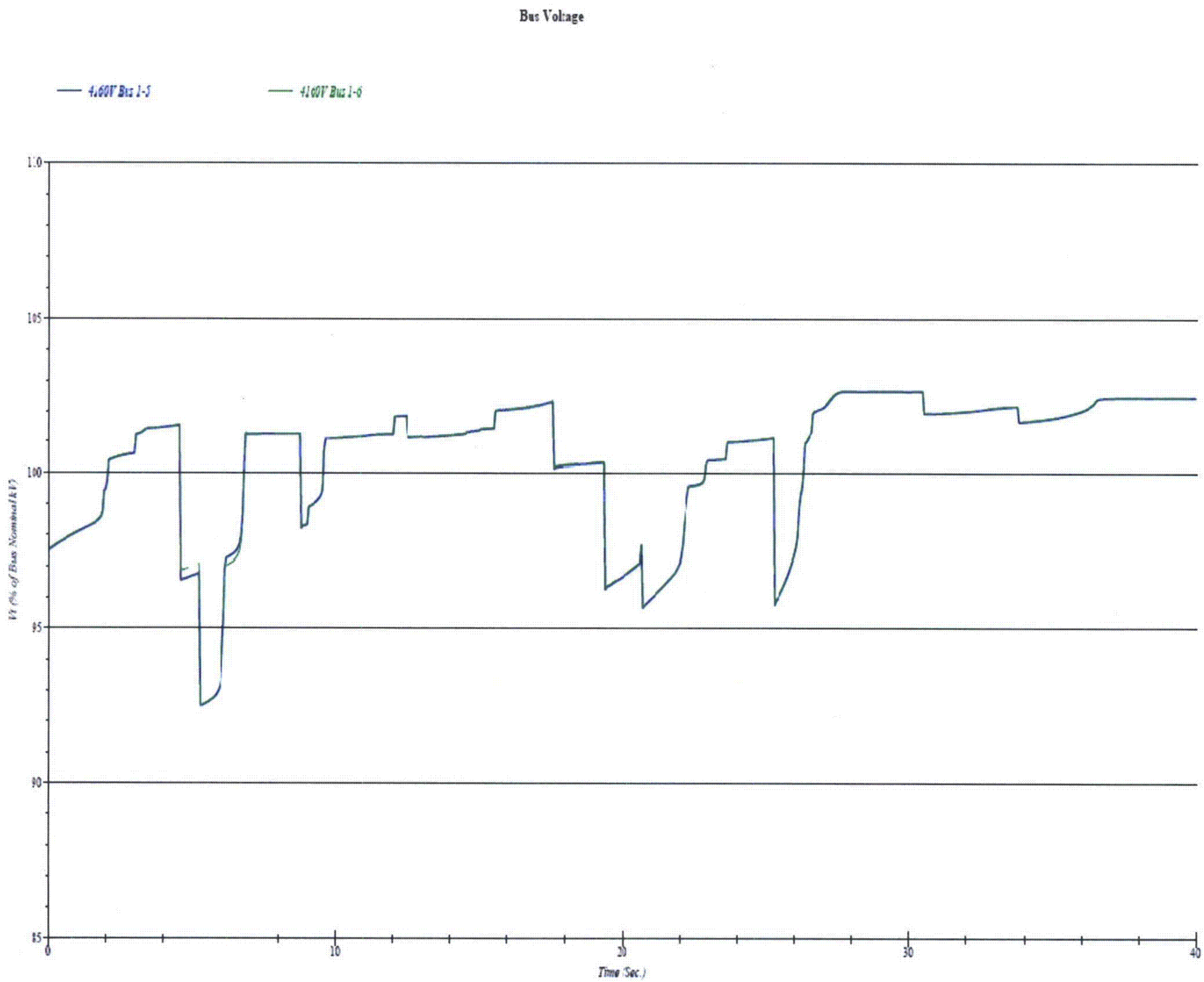


Figure 4

CS-SI-5R6R-6-ICS-0-2 (Bus Voltages at 6.875% Initial Tap Position)

Voltage profile for safety related Buses 1-5 and 1-6 during a worst case SI sequence start (motor start times are based on limiting SI relay times) with only the Reserve Auxiliary Transformer available (TAT is assumed to be out of service). Additionally, the first step in the sequence is staggered such that the Train A loads start at minimum relay time while train B loads start at maximum relay time (in order to extend the undervoltage condition). The initial RST tap position is set at +6.875% (Tap 11R) and the switchyard voltage is iterated to the minimum voltage level of 91.1%.

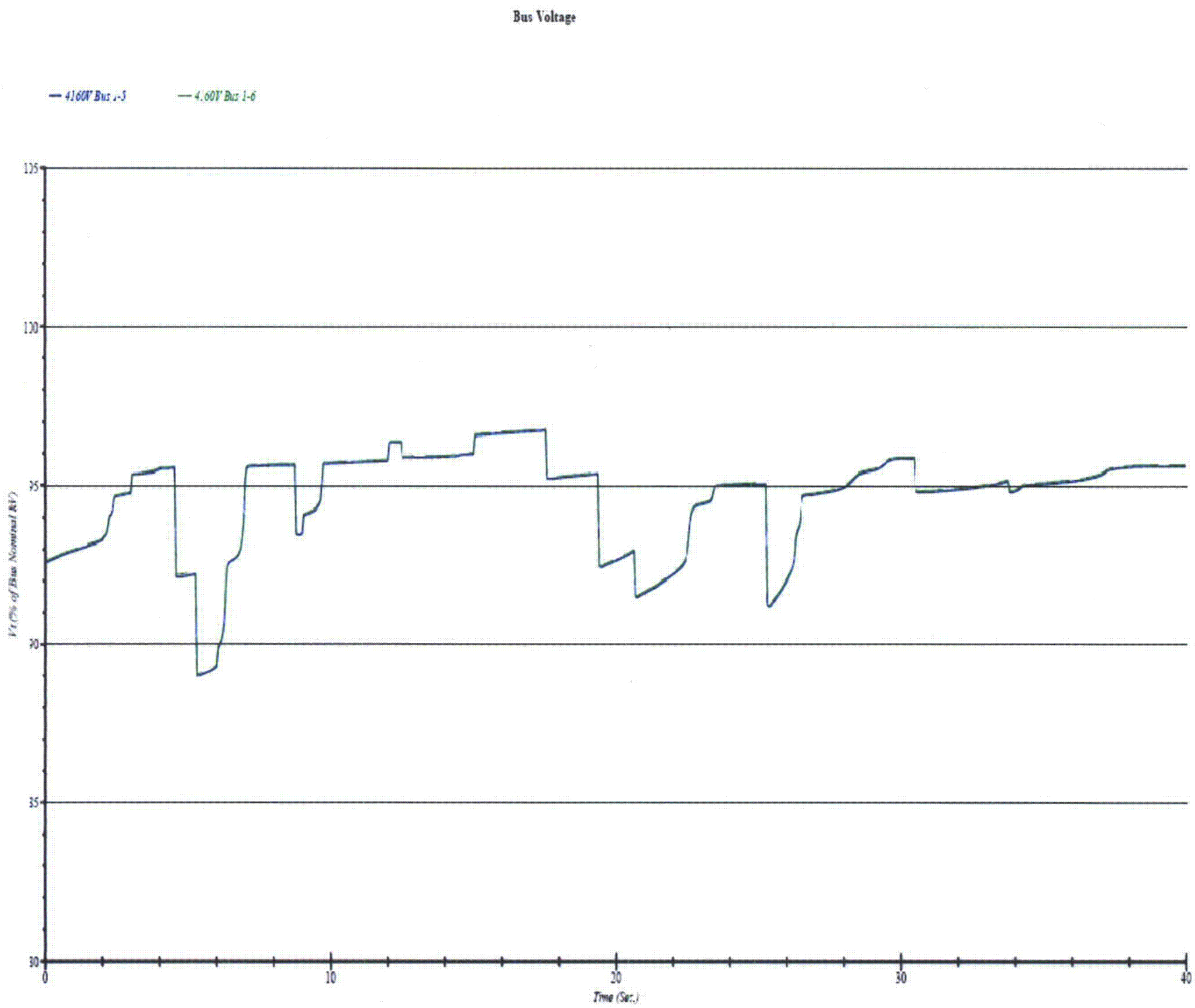


Figure 5

CS-SI-5R6R-6-ICS-0-2 (Bus Voltages Full Boost)

Voltage profile for safety related Buses 1-5 and 1-6 during a worst case SI sequence start (motor start times are based on limiting SI relay times) with only the Reserve Auxiliary Transformer available (TAT is assumed to be out of service). Additionally, the first step in the sequence is staggered such that the Train A loads start at minimum relay time, while train B loads start at maximum relay time (in order to extend the undervoltage condition). The initial RST tap position is set at the maximum of +10% and the switchyard voltage is iterated to the minimum voltage level of 91.1%.

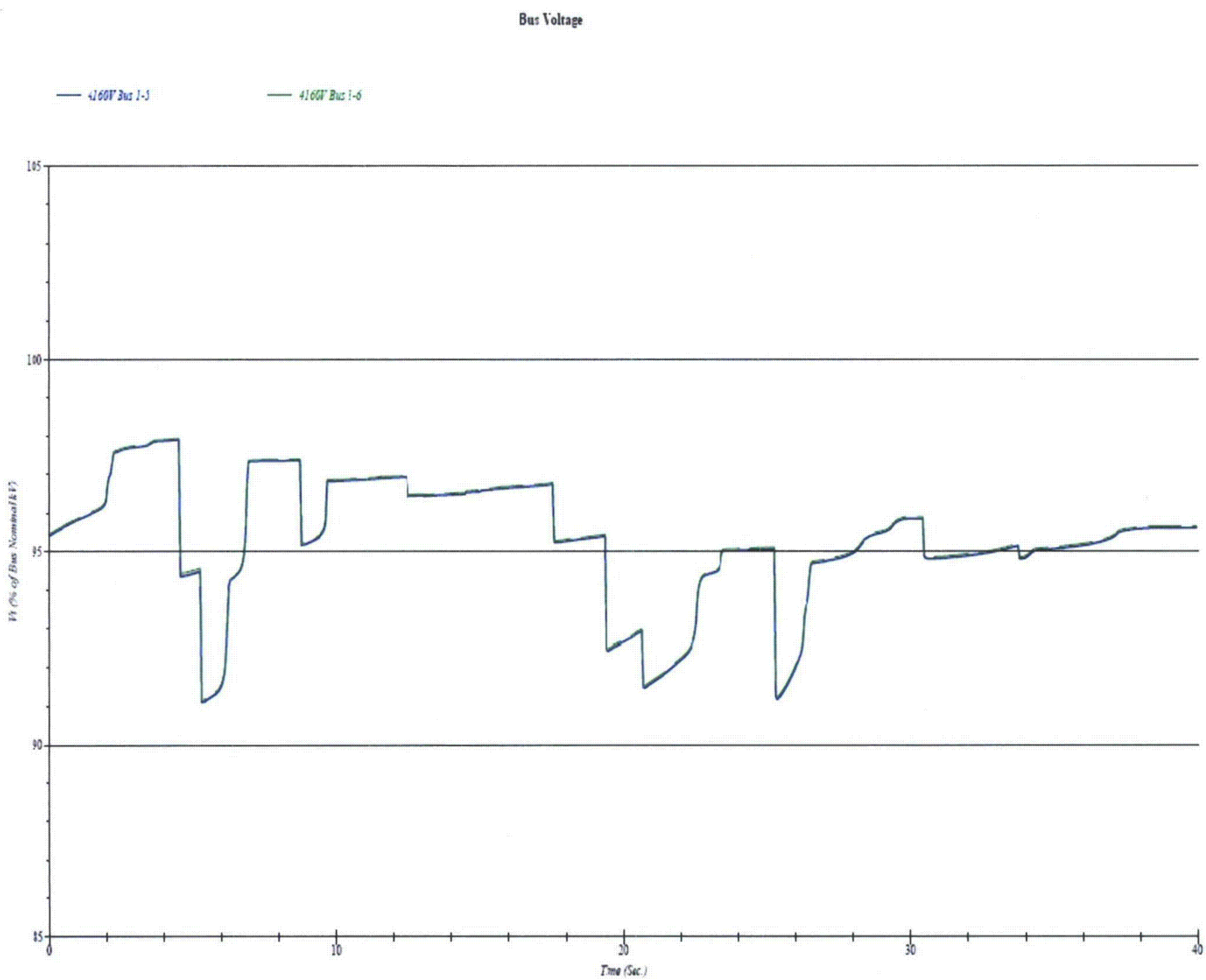


Figure 6

CS-SI-5T6T-6-ICS-0-2 (Bus Voltages Full Boost)

Voltage profile for safety related Buses 1-5 and 1-6 during a worst case SI sequence start (motor start times are based on limiting SI relay times) with only the Tertiary Auxiliary Transformer available (RAT is assumed to be out of service). Additionally, the first step in the sequence is staggered such that the Train A loads start at minimum relay time while train B loads start at maximum relay time (in order to extend the undervoltage condition). The initial TST tap position is set at the maximum of +10%. and the switchyard voltage is iterated to the minimum voltage level of 88.1%.

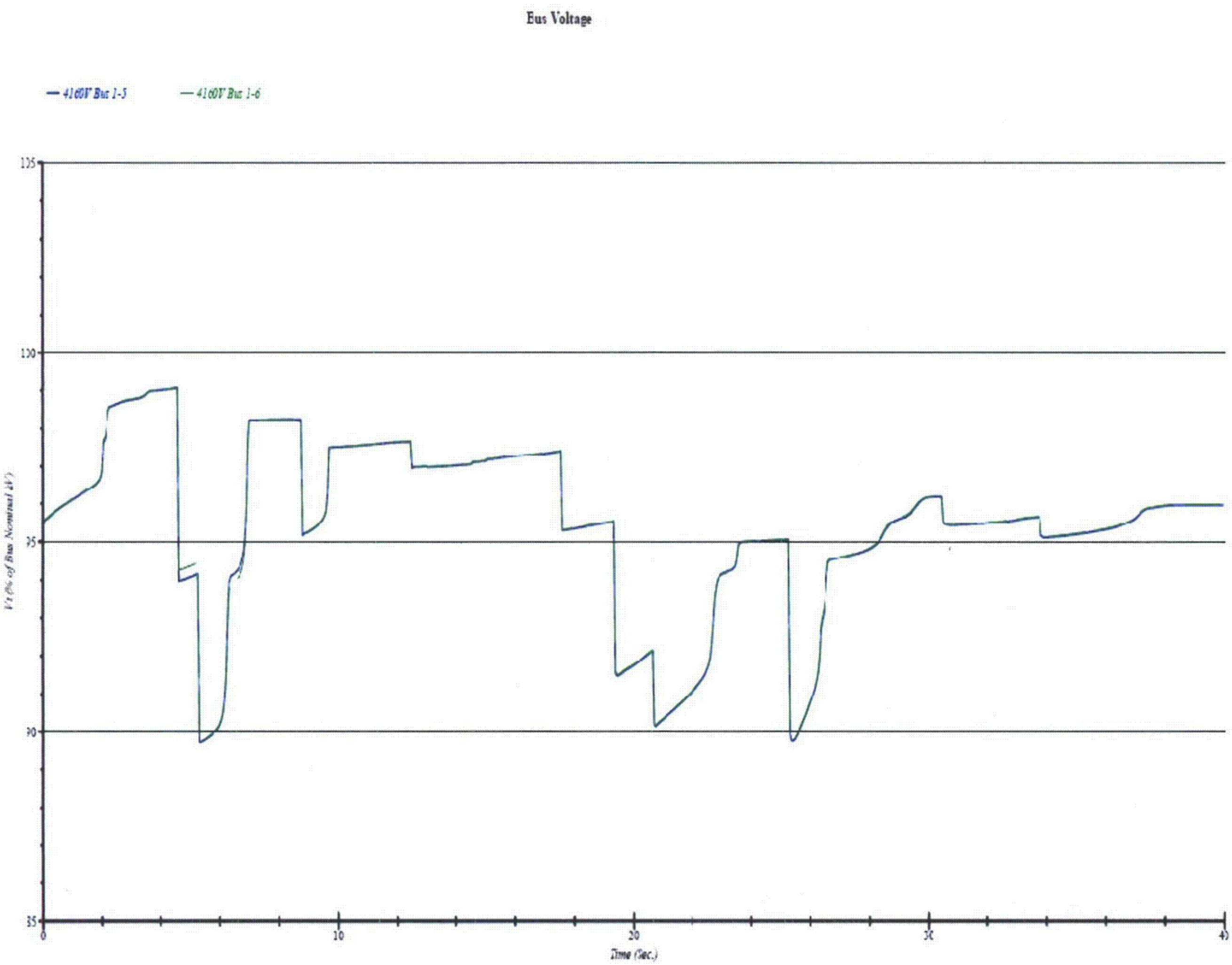
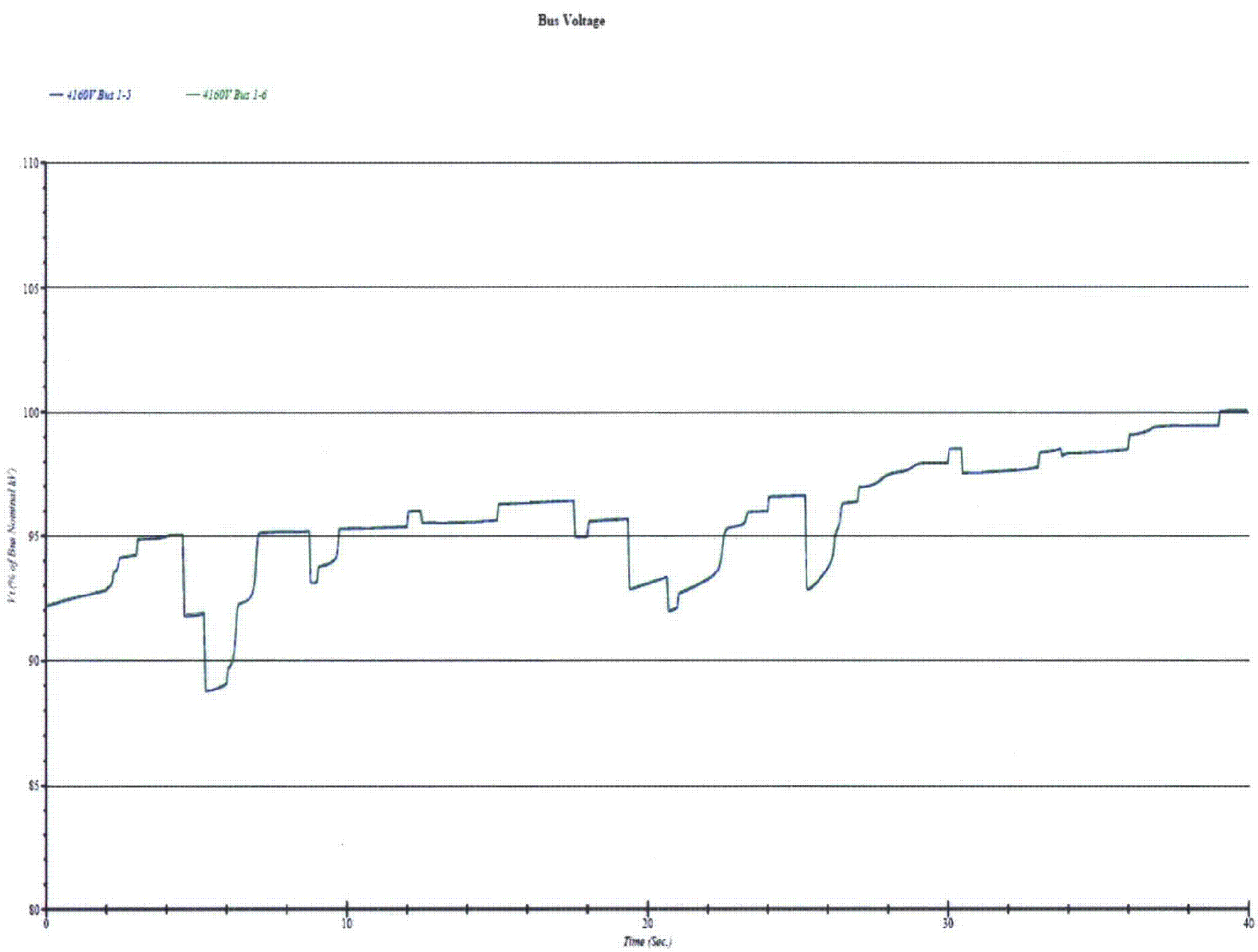


Figure 7

CS-SI-5R6R-6-ICS-0-2 (Bus Voltages TAP 3R)
Minimum Voltage for a 1.465% Pre-trip to Post Generator Trip Voltage Drop

Voltage profile for safety related Buses 1-5 and 1-6 during a worst case SI sequence start (motor start times are based on limiting SI relay times) with only the Reserve Auxiliary Transformer available (TAT is assumed to be out of service). Additionally, the first step in the sequence is staggered such that the Train A loads start at minimum relay time while train B loads start at maximum relay time (in order to extend the undervoltage condition). The initial RST tap position is set at +1.875% (3R). Bus voltages are iterated to the minimum level that allows the buses to continue to be supplied by offsite power (DVRs do not drop out).



NRC Question 3

The LAR also states that Buses 1-1 and 1-2 are connected via bus main breakers to the main auxiliary transformer (MAT) and RAT. Buses 1-3 and 1-4 are also connected via bus main breakers to the MAT and RAT. These buses supply power to the normal balance-of-plant auxiliaries. The Updated Final Safety Analysis Report figures in Chapter 8 indicate that the breakers connecting these busses to the RAT are normally open. The safety-related Bus 1-6 is normally connected to the 'X' winding of the same RAT and the Bus 1-5 is normally connected to TAT. The licensee has verbally indicated that the grid is not stable if the 138kV system degrades by 10 percent, the load tap changer (LTC) limit for voltage correction, and it is therefore unlikely that the plant will be operating with the LTCs at the upper limit. In the event of a safety injection signal resulting in plant trip and transfer of Busses 1-1 and 1-2 to the 'Y' winding and 1-3 and 1-4 to the 'X' winding of the RAT, provide a detailed analysis of the interaction of the automatic LTCs and the safety bus voltages with accident loads sequencing for the following conditions:

a) The 138kV system voltage at normal.

b) The high voltage side of the RAT supply transformer (RST) operating at grid stability limit with appropriately loaded RAT.

c) The high voltage side of the tertiary supply transformer (TST) operating at grid stability limit with appropriately loaded TAT.

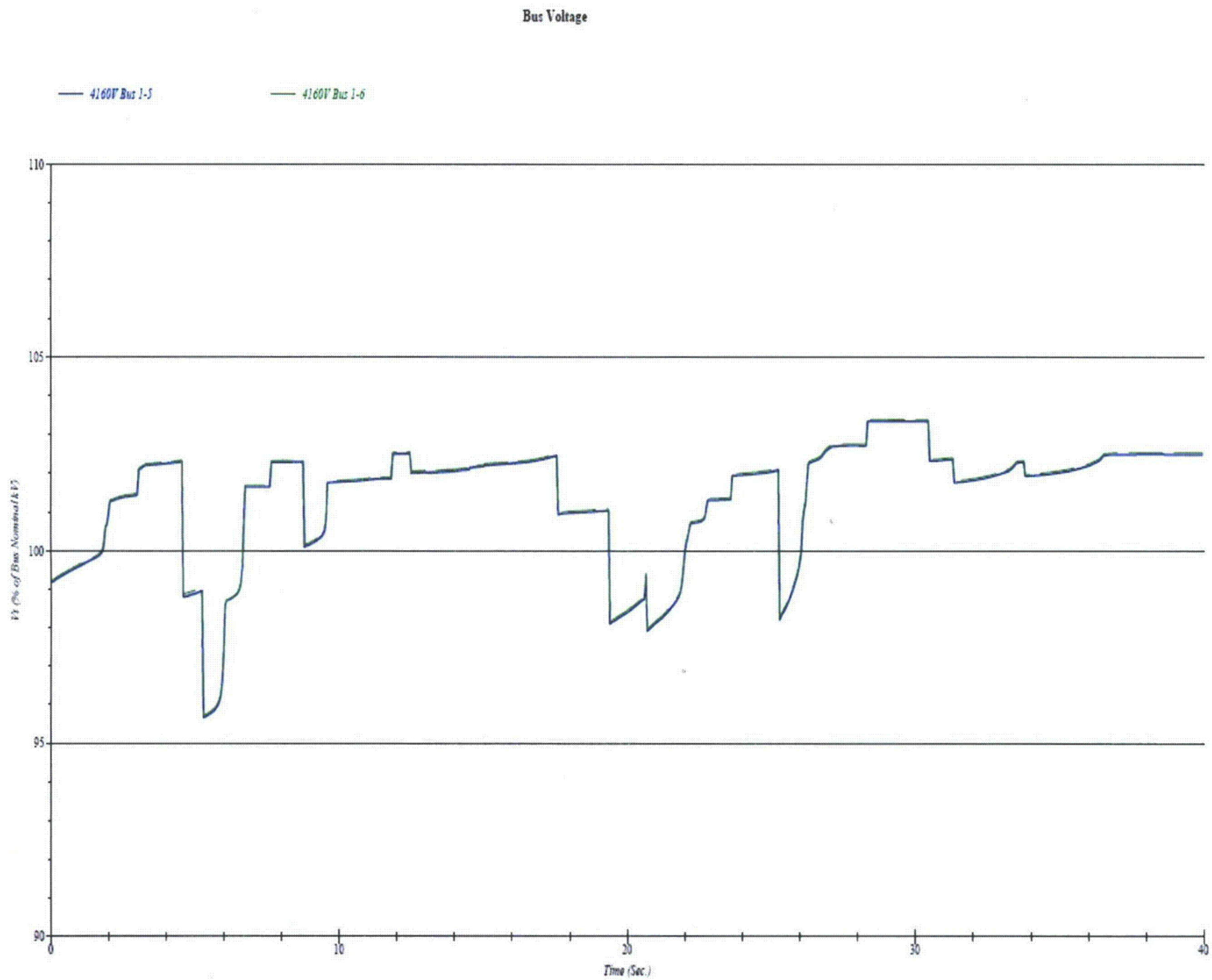
Response:

A voltage graph resulting from ETAP analysis runs based on the 138kV system voltages at normal is provided for information in Figure 8 below. Operation of the KPS electrical system is based on the FERC Category A grid limit. The analysis used the FERC limit of +/-5% voltage (Category A) as the grid limit. The ETAP runs that were generated for the response to RAI Question 2 are bounding (evaluated both safety buses being supplied by one source, which is conservative) and can be applied in the Question 3 request to illustrate the adequacy of safety-related bus voltages for -5% voltages. The near identical response of the normal (Figure 8 below) and extreme voltage cases (See Question 2, Figures 1 – 7) reflects the capability of the LTC to adjust to a wide range of grid conditions.

Figure 8

CS-SI-5R6R-6-ICS-0-2 (Bus Voltages at Normal)

Voltage profile for safety related Buses 1-5 and 1-6 during a worst case SI sequence start (motor start times are based on limiting SI relay times) with only the Reserve Auxiliary Transformer available (TAT is assumed to be out of service). Additionally, the first step in the sequence is staggered such that the Train A loads start at minimum relay time, while train B loads start at maximum relay time (in order to extend the undervoltage condition). The switchyard voltage is set at nominal level.



NRC Question 4

According to the LAR, the Degraded Voltage Relay (DVR) trip setpoint is 93.6 percent ± 0.9 percent of nominal bus voltage. Confirm that this setpoint ensures satisfactory operation of all safety related equipment and affords protection during prolonged operation under degraded voltage conditions independent of the operation of the automatic LTC.

Response:

The DVR trip setpoints were evaluated in KPS Calculation C11709. DEK evaluated the DVR trip setpoints within this calculation (in response to this question), in conjunction with additional voltage and coordination calculations. This evaluation confirmed satisfactory operation of applicable safety related equipment and that protection is afforded during prolonged operation under degraded voltage conditions. Since these calculations were developed independent of LTC operation, equipment operation remains satisfactory under degraded voltage conditions without LTC operation.

NRC Question 5

The licensee states that the time delay of DVR is long enough to prevent inadvertent actuation of the relays from voltage dips due to large motor starts except when a reactor coolant pump motor starts with an engineered safety feature (ESF) bus below 3980V and that such starts are controlled administratively. In automatic LTC mode, the primary microcontroller monitors load and source voltages to create a signal based on the sensed secondary voltage of its associated TAT or RAT. The "X" winding of the RAT provides power to the ESF buses; therefore, the microcontroller senses the "X" winding voltage. During grid perturbations lasting a few seconds, the nonsafety large motor loads on the "Y" winding will slow down and require inrush current during simultaneous reacceleration. Provide a summary of the analyses performed to demonstrate that the voltage drop on the plant buses will not result in an inadvertent trip of the offsite power to the ESF buses for a bounding case grid voltage perturbation that results in a plant trip.

Response:

KPS does not have a bounding case for grid voltage perturbation in the plant specific licensing basis. Rather, offsite power operability is assessed by analyzing anticipated events to show that trips of offsite power to the ESF buses would not occur. Voltage transient analyses of reactor coolant pump starts were previously developed based on a bus voltage of 3980V. Subsequent analyses have refined the earlier analyses and are based on anticipated bus voltages.

A conservative slow voltage recovery fault event was postulated based on ATC analysis. The ATC studies showed that a fault on the Q303 transmission line during light load conditions could cause the following voltage behavior.

- Near instantaneous voltage decay to about 25% voltage
- Recovery above 70% in about 0.21 seconds
- Subsequent recovery to 100% voltage in about 0.5 seconds

A transient stability ETAP run was performed with the plant at normal operating load, except with the RAT supporting all non-safety related buses and Bus 1-6. In the run, the voltage disturbance described above was conservatively modeled. Based on transient stability ETAP run results, the DVR will drop out, but will reset prior to the DVR timing out (recovers in less than 6 seconds above 95% voltage). The analysis showed that the 4kV voltage recovered above the reset setpoint without active LTCs during the analyzed event. Figures 9 – 12 below are provided for information. Additionally, since this event would result in voltage dropping below its extreme undervoltage limit setting, the LTC would not actuate under such a condition due to the event duration being shorter than 30 seconds.

Figure 9

Voltage Profile for Safety Related Bus 1-6 during an Offsite Voltage Disturbance that Requires Motor Restarts

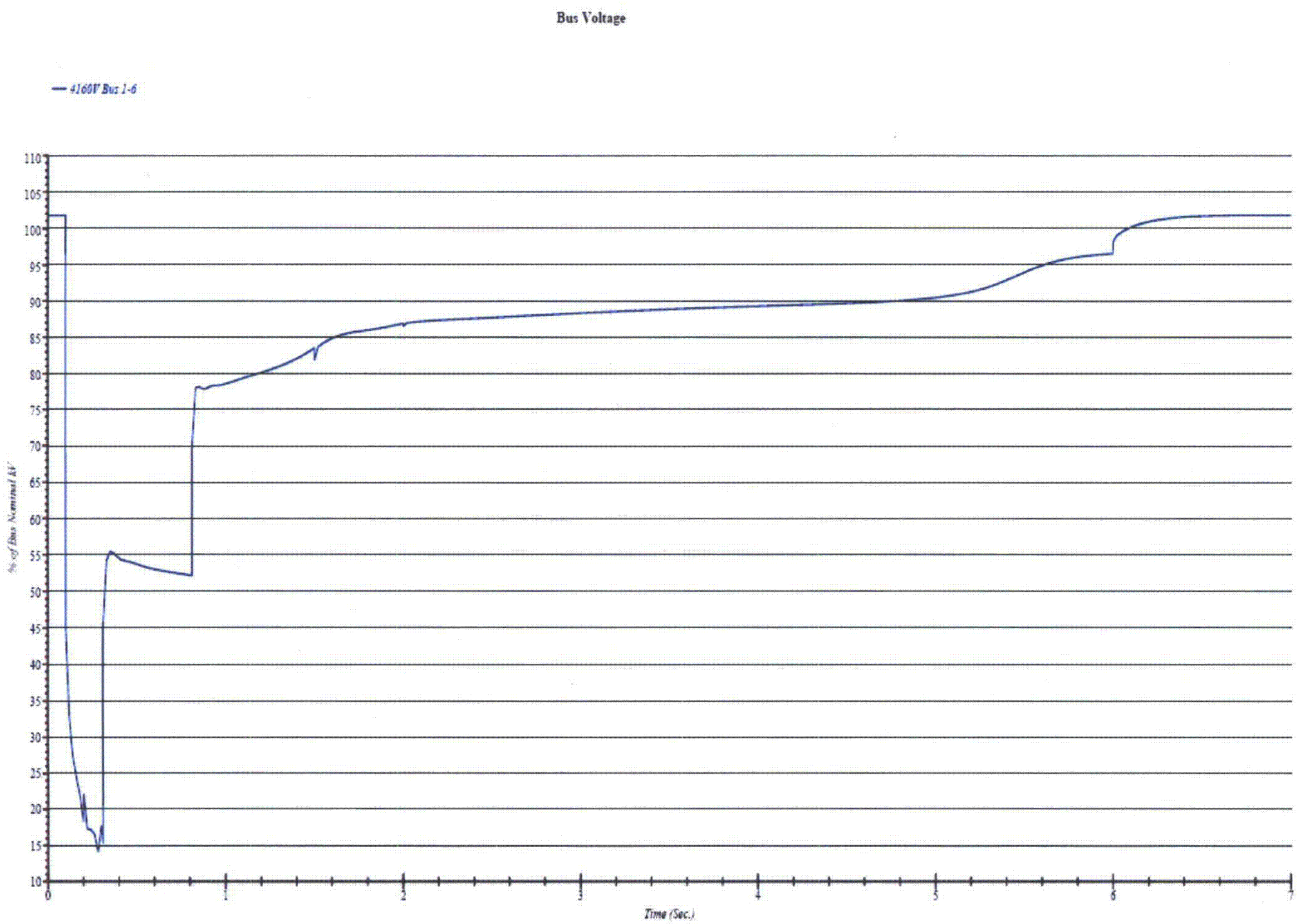


Figure 10

Motor Slip Profiles for Motor Restarts on Bus 1-6

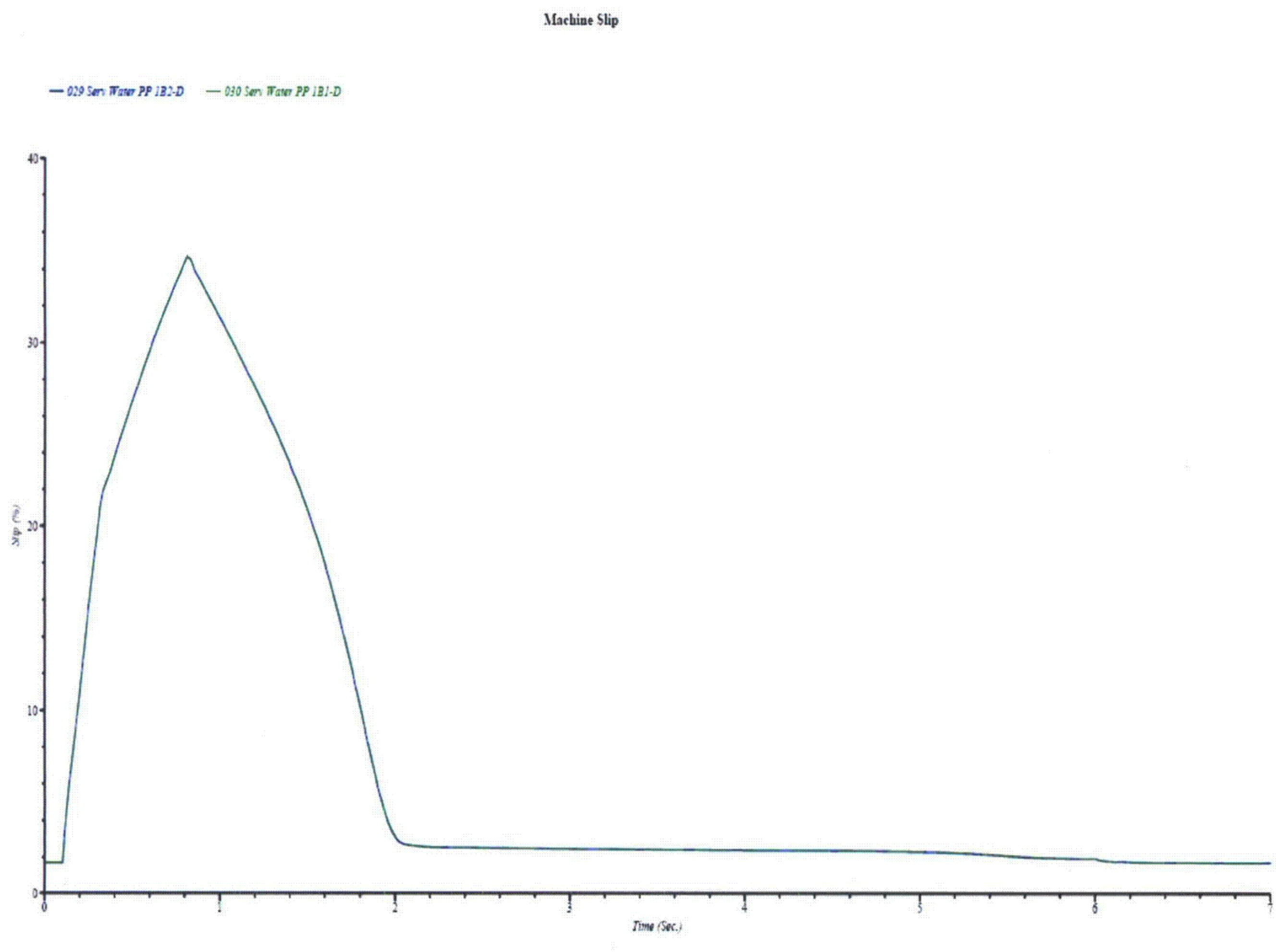


Figure 11

Motor Slip Profiles for Motor Restarts on Bus 1-3 and 1-4

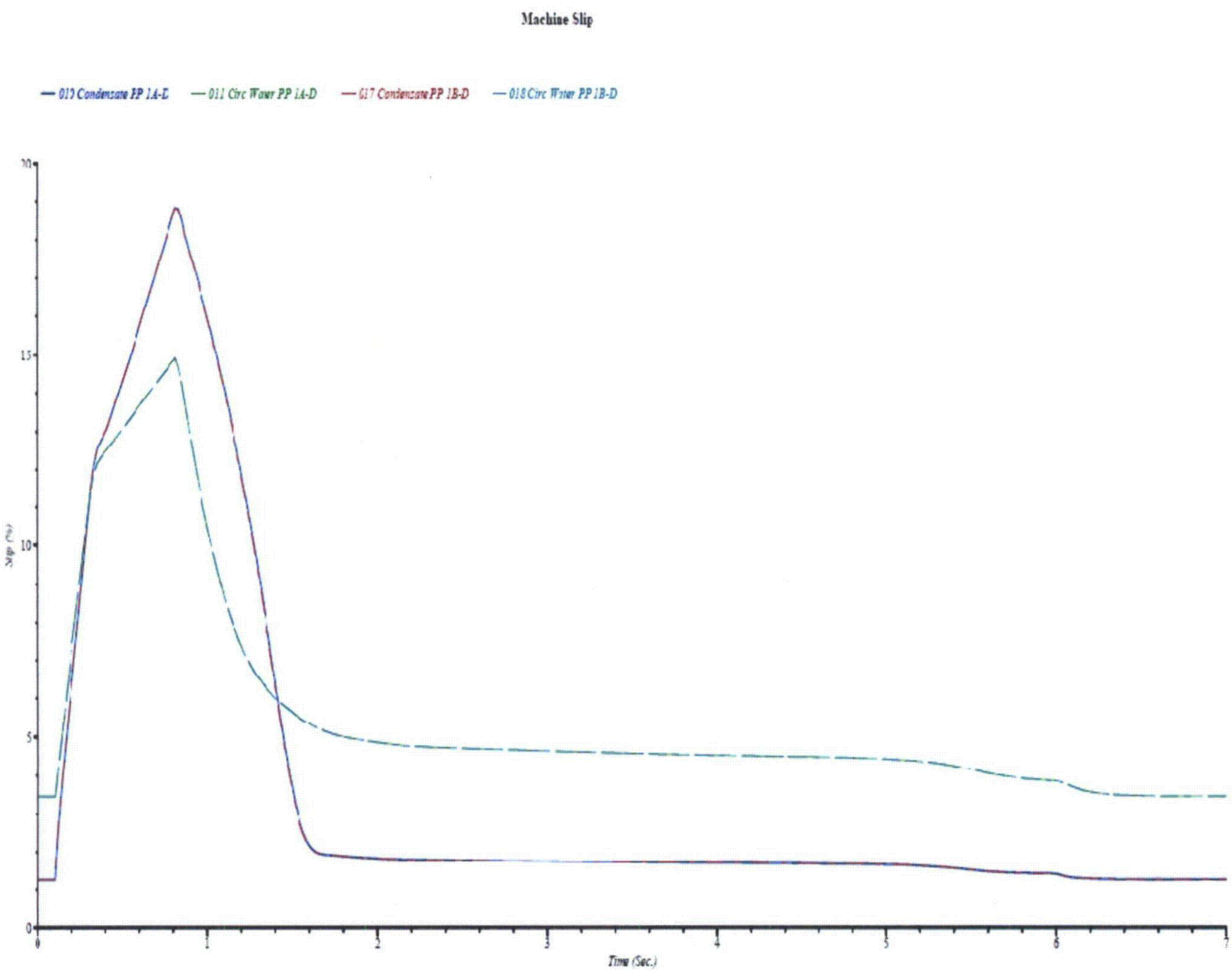
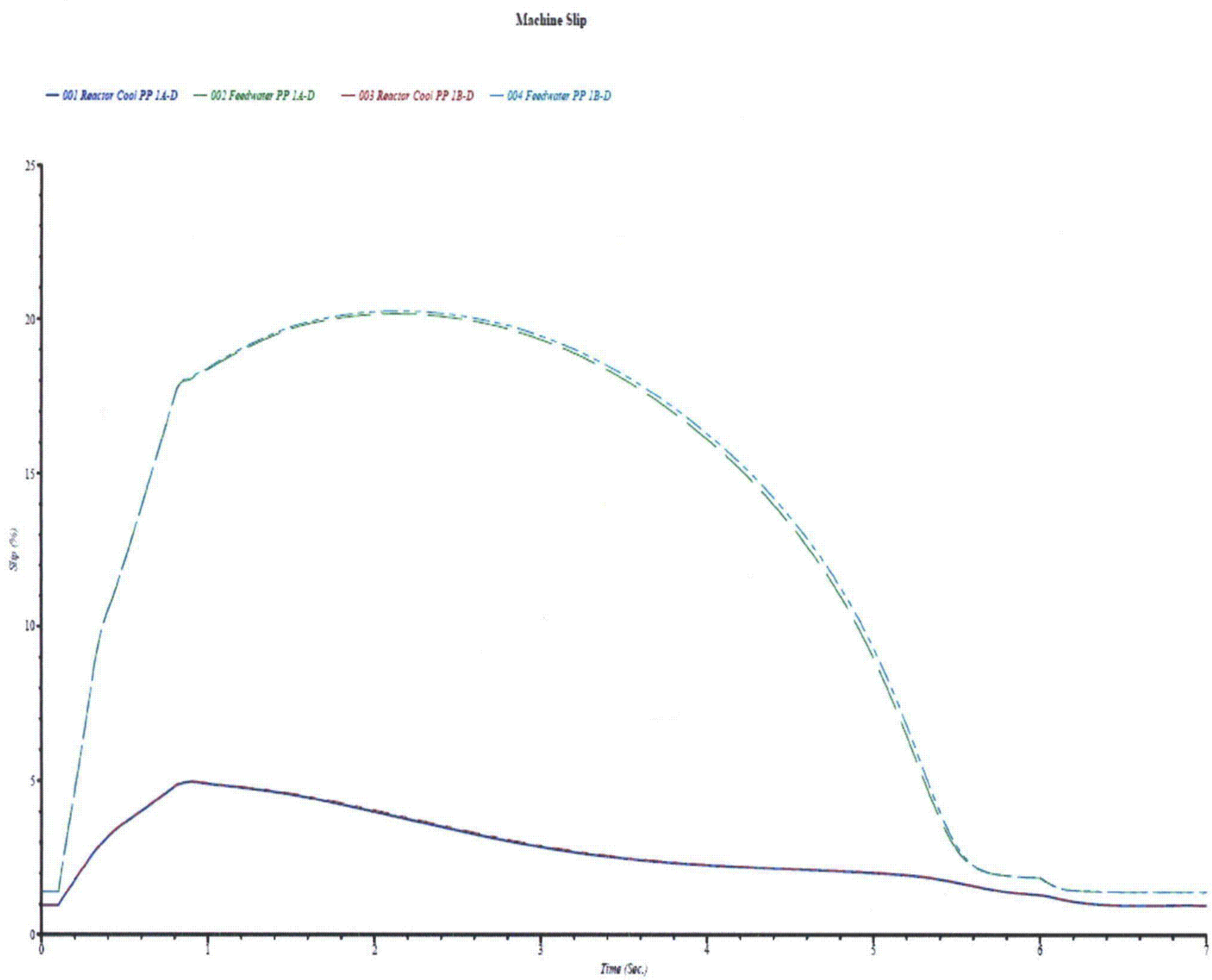


Figure 12

Motor Slip Profiles for Motor Restarts on Bus 1-1 and 1-2



NRC Question 6

The voltage decay that occurs following a generator trip was evaluated for response time of the LTCs. Provide a summary of the analyses performed for the bounding case with details on the maximum reactive power capability of the main generator and actual voltage values at the safety buses used in the analyses.

Response:

The post generator trip voltage drop discussed in the response to RAI Question 2 is supported by ATC transmission system analyses and incorporates the reactive power flow capability for various transmission configurations, including the KPS main generator. Based on the ETAP runs associated with RAI Question 2, the plant buses will have adequate voltage and the DVRs will reset if the voltage drop resulting from a unit trip is 1.46% or less. Mitigating steps would be taken (as discussed in the response to RAI Question 2) to prepare for the possibility of a larger (albeit unlikely) pre- to post-generator voltage drop if such a possibility were to be forecasted.

NRC Question 7

Failure of a tap changer during high summer load with a high tap setting could lead to high voltage but is considered to be limited due to relatively slow change in voltage during evolving grid conditions. Provide details on the consequences of tripping the largest load on the grid resulting in sudden change in grid voltage during peak summer conditions with failure of the LTC motor at high setting.

Response:

This question addresses the potential condition of voltages rising to high levels on in-plant buses in conjunction with a failure of LTC stepping. Specifically, it concerns sudden load changes (under high load conditions) that would not be immediately addressed by other actions. ATC analyses indicate that such a condition would actually occur from tripping a large load in a light load condition (rather than during a heavy load condition). Existing ATC studies have examined this impact and conclude that the worst case is a step increase from 142.05kV to 143.20kV, which would result from opening the Granville end of the Granville-Sheboygan Energy Center transmission line. This 0.81% increase could occur if the LTC failed when it was at the high end of the control band (4300.6v), resulting in an increase to 4335.4 volts. This relatively small voltage increase would not be expected to generate a high voltage alarm. ATC has several options for bringing voltage back into the normal grid range, and KPS has the option of starting additional loads to alleviate high plant bus voltages.

NRC Question 8

Provide a summary of testing, monitoring and maintenance programs for the new automatic load tap changers. Confirm that the RAT, TAT, TST, RST and the associated LTCs are incorporated into the plant maintenance rule guidelines.

Response:

Testing and maintenance of the LTCs is planned as follows.

- Weekly, perform a functional test in manual to verify lower and raise stepping capability of the LTC (only required if no stepping occurred in prior week; auto stepping of the LTC satisfies this requirement).
- Quarterly, perform a functional test in both manual and automatic to verify stepping capability and automatic response of the LTC voltage regulator.
- Every refueling outage, perform a diagnostic maintenance calibration and test to verify settings and functionally check the Tapcon 240 and Tapcon 240-LV settings. This includes verification of the OLTC motor drive operation for both normal expected operation (voltage in and outside the normal control bandwidth) and abnormal operation (voltage outside the voltage limit band). Also, perform the recommended maintenance-free interval complementing checks of oil sampling, vacuum interrupter system test, motor drive condition checks, dehydrating breather checks, and checks for oil leaks. LTC cabinets are to be visually inspected to check for loose connections, damage, overheating, deterioration, and relay degradation.
- Every other refueling outage, perform a maintenance test procedure to check the internals of the OLTC cabinet, including vacuum interrupter, associated motor drive circuitry and equipment, and monitoring system. This inspection is performed per the vendor manual for Load Tap Changer Type RMV-II, which includes a vacuum interrupter examination for a mechanical test, contact erosion indicator check, and Hi-Pot test (if required); bypass switch check; and preparation of the LTC for service checks. Additionally, check for loose connections, damage and contact wear. The above tests and checks are to be completed in addition to those performed every refueling outage.

Monitoring of the LTCs is planned to be provided by local and remote alarms. Local alarms are to be available on both the Tapcon 240 and the Tapcon 240-LV at the transformers. Remote alarms are to be available in the Plant Process Computer System (PPCS) and will alarm Trouble Light Annunciator (TLA) windows for the RST and TST respectively. Some of the alarms are available in the PPCS for information only. Alarm Response Procedures (ARP) direct operator response to off-normal conditions. The transformer tap positions are planned to be made available in the PPCS and can be used for monitoring LTC operation. Also, digital voltmeters monitoring TAT and RAT output voltage are planned to be installed in the Control Room to provide operators an accurate bus voltage level when those transformers are connected to the safeguard buses.

TAT, RAT, and TST transformers are already within scope of the maintenance rule. The RAT supply transformer (RST) and the TST and RST load tap changers are being incorporated into the maintenance rule.

References

1. Letter from L. N. Hartz (DEK) to Document Control Desk (NRC), "License Amendment Request 236, Automatic Operation of Transformer Load Tap Changers," dated June 1, 2010.

2. Email from Karl D. Feintuch (NRC) to Jack Gadzala (DEK), Craig Sly (DEK), Gurcharan Matharu (NRC), and Prem Sahay (NRC), "ME4011 Request for Additional Information (RAI)," dated October 5, 2010.

ENCLOSURE

SUPPLEMENT TO LICENSE AMENDMENT REQUEST 236
Automatic Operation of Transformer Load Tap Changers

SELECTED KEWAUNEE POWER STATION USAR FIGURES

ENCLOSED CURRENT USAR FIGURES

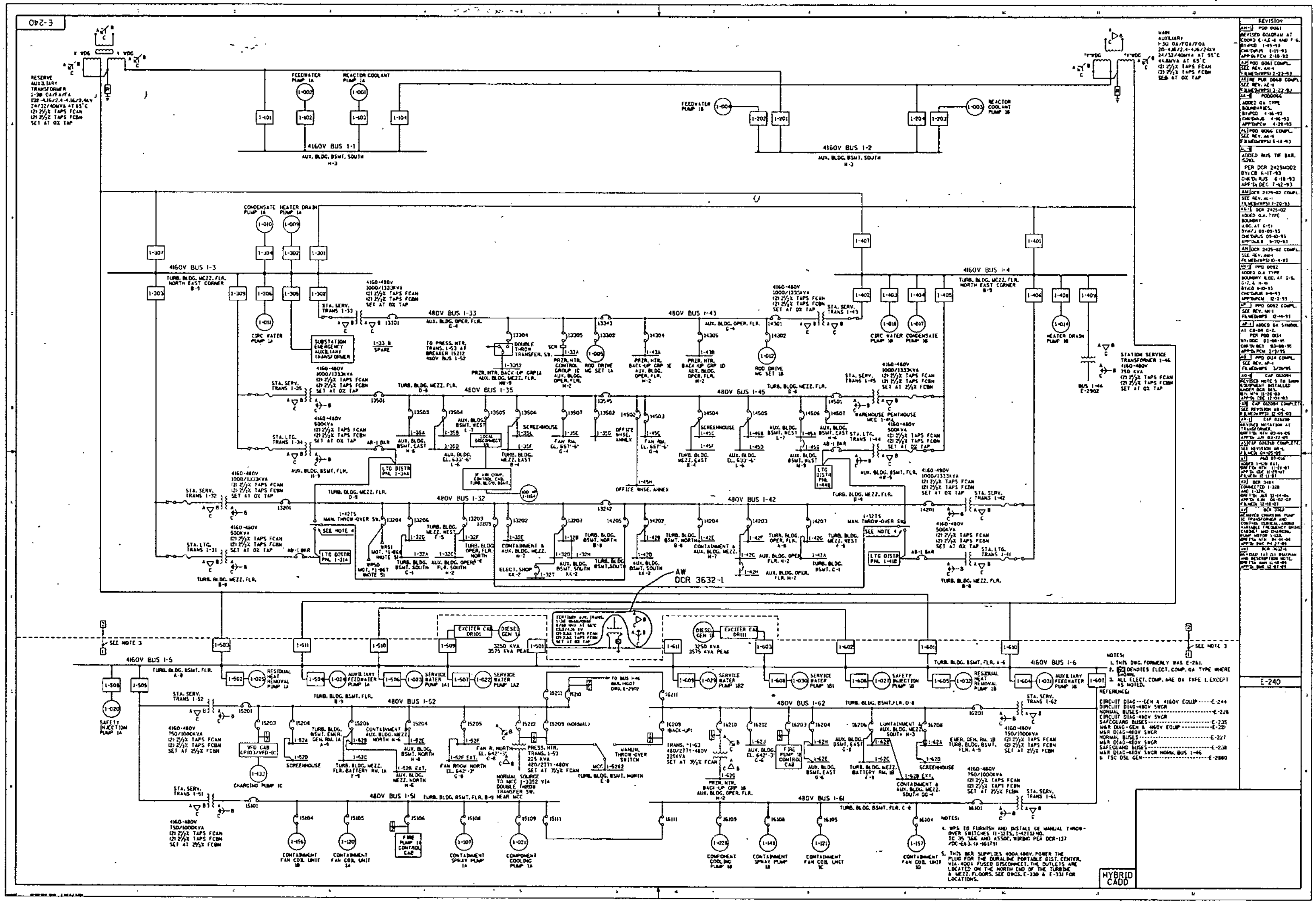
Figure 8.2-1, "System Interconnection"

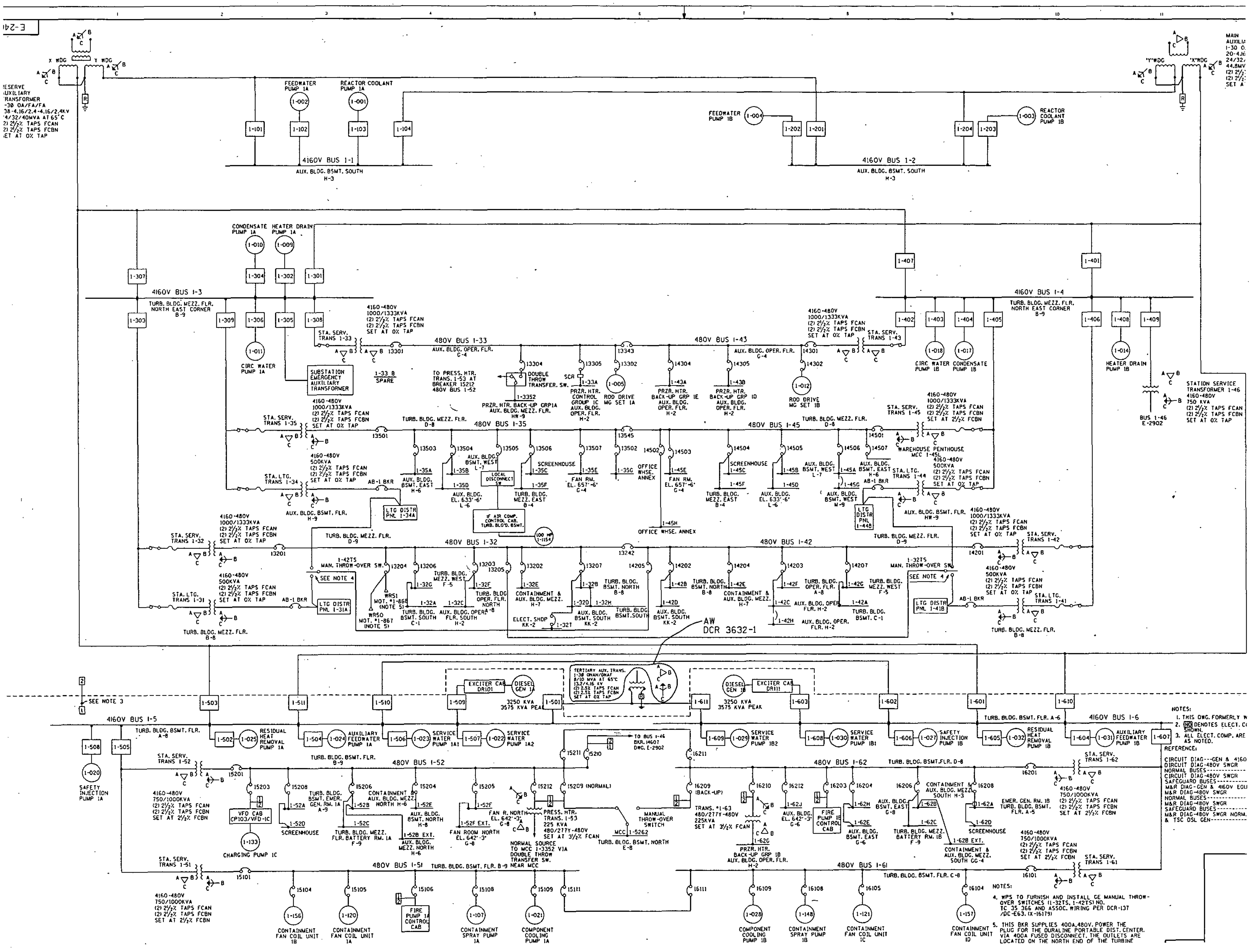
Figure 8.2-3, "Main 4160 and 480V Single-Line Diagram"

KEWAUNEE POWER STATION

DOMINION ENERGY KEWAUNEE, INC.

Figure 8.2-3 Main 4160 and 480V Single-Line Diagram





E-24
RESERVE AUXILIARY TRANSFORMER
X WDG
Y WDG
FEEDWATER PUMP 1A
REACTOR COOLANT PUMP 1A
4160V BUS 1-1
AUX. BLDG. BSMT. SOUTH H-3
FEEDWATER PUMP 1B
REACTOR COOLANT PUMP 1B
4160V BUS 1-2
AUX. BLDG. BSMT. SOUTH H-3
CONDENSATE PUMP 1A
HEATER DRAIN PUMP 1A
4160V BUS 1-3
TURB. BLDG. MEZZ. FLR. NORTH EAST CORNER B-9
4160V BUS 1-4
TURB. BLDG. MEZZ. FLR. NORTH EAST CORNER B-9
CIRC WATER PUMP 1A
SUBSTATION EMERGENCY AUXILIARY TRANSFORMER
480V BUS 1-33
480V BUS 1-43
CIRC WATER PUMP 1B
CONDENSATE PUMP 1B
HEATER DRAIN PUMP 1B
STATION SERVICE TRANSFORMER 1-46
ROD DRIVE MG SET 1A
ROD DRIVE MG SET 1B
DOUBLE THROW TRANSFER SW.
PRZR. HTR. BACK-UP GRP1A
480V BUS 1-35
480V BUS 1-45
OFFICE WHSE. ANNEX
WAREHOUSE PENTHOUSE MCC 1-45L
LTG DISTR PNL 1-34A
LTG DISTR PNL 1-44B
480V BUS 1-32
480V BUS 1-42
MAN. THROW-OVER SW.
SEE NOTE 4
LTG DISTR PNL 1-31A
LTG DISTR PNL 1-41B
AW
DCR 3632-1
EXCITER CAB DR101
DIESEL GEN 1A
3250 KVA 3575 KVA PEAK
EXCITER CAB DR111
DIESEL GEN 1B
3250 KVA 3575 KVA PEAK
SEE NOTE 3
4160V BUS 1-5
4160V BUS 1-6
SAFETY INJECTION PUMP 1A
RESIDUAL HEAT REMOVAL PUMP 1A
AUXILIARY FEEDWATER PUMP 1A
SERVICE WATER PUMP 1A1
SERVICE WATER PUMP 1A2
SERVICE WATER PUMP 1B2
SERVICE WATER PUMP 1B1
SAFETY INJECTION PUMP 1B
RESIDUAL HEAT REMOVAL PUMP 1B
AUXILIARY FEEDWATER PUMP 1B
480V BUS 1-52
480V BUS 1-62
VFD CAB CP103/VFD-1C
CHARGING PUMP 1C
MANUAL THROW-OVER SWITCH
FIRE PUMP 1B CONTROL CAB
480V BUS 1-51
480V BUS 1-61
CONTAINMENT FAN COIL UNIT 1B
CONTAINMENT FAN COIL UNIT 1A
FIRE PUMP 1A CONTROL CAB
CONTAINMENT SPRAY PUMP 1A
COMPONENT COOLING PUMP 1A
COMPONENT COOLING PUMP 1B
CONTAINMENT SPRAY PUMP 1B
CONTAINMENT FAN COIL UNIT 1C
CONTAINMENT FAN COIL UNIT 1D
NOTES:
4. WPS TO FURNISH AND INSTALL GE MANUAL THROW-OVER SWITCHES (1-32TS, 1-42TS) NO. TC 35 366 AND ASSOC. WIRING PER DCR-137 /DC-E63. (X-16179)
5. THIS BKR SUPPLIES 400A,480V. POWER THE PLUG FOR THE DURALINE PORTABLE DIST. CENTER. VIA 400A FUSED DISCONNECT. THE OUTLETS ARE LOCATED ON THE NORTH END OF THE TURBINE
NOTES:
1. THIS DWG. FORMERLY W
2. NO DENOTES ELECT. C SHOWN.
3. ALL ELECT. COMP. ARE AS NOTED.
REFERENCE: