EDO Principal Correspondence Control

FROM: DUE: 05/18/12 EDO CONTROL: G20120281
DOC DT: 04/12/12
FINAL REPLY:

Anthony R. Pietrangelo
Nuclear Energy Institute (NEI)

TO:

Virgilio, DEDR/OEDO

FOR SIGNATURE OF : ** GRN ** CRC NO:

DEDR/OEDO

DESC:

Degraded Grid Voltage Protection Design and Configuration (EDATS: OEDO-2012-0240)

ROUTING:

Borchardt
Weber
Virgilio
Ash
Mamish
OGC/GC
Bowman, OEDO

DATE: 04/27/12

ASSIGNED TO: CONTACT:

NRR Leeds

SPECIAL INSTRUCTIONS OR REMARKS:

Template: EDO-001 E-RIDS: EDO-01

EDATS

Electronic Document and Action Tracking System

EDATS Number: OEDO-2012-0240   Source: OEDO

General Information

Assigned To: NRR
OEDO Due Date: 5/18/2012 11:00 PM
Other Assignees:
SECY Due Date: NONE
Subject: Degraded Grid Voltage Protection Design and Configuration
Description:

CC Routing: NONE
ADAMS Accession Numbers - Incoming: NONE
Response/Package: NONE

Other Information

Cross Reference Number: G20120281
Staff Initiated: NO
Related Task:
Recurring Item: NO
File Routing: EDATS
Agency Lesson Learned: NO
OEDO Monthly Report Item: NO

Process Information

Action Type: Letter
Priority: Medium
Sensitivity: None
Signature Level: DEDR
Urgency: NO
Approval Level: No Approval Required
OEDO Concurrence: NO
OCM Concurrence: NO
OCA Concurrence: NO
Special Instructions:

Document Information

Originator Name: Anthony R. Pietrangelo
Date of Incoming: 4/12/2012
Originating Organization: NEI
Document Received by OEDO Date: 4/27/2012
Addressee: Martin J. Virgilio, DEDR/OEDO
Date Response Requested by Originator: NONE
Incoming Task Received: Letter

NUCLEAR ENERGY INSTITUTE

Anthony R. Pietrangelo
SENIOR VICE PRESIDENT AND
CHIEF NUCLEAR OFFICER

April 12, 2012

Mr. Martin J. Virgilio
Deputy Executive Director for Reactor and Preparedness Programs
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Degraded Grid Voltage (DGV) Protection Design and Configuration

Project Number: 689

Dear Mr. Virgilio:

Degraded grid voltage (DGV) protection design and configuration is a topic of discussion between NRC and industry that has been receiving increasing attention. These discussions initially focused on unresolved issues arising from Component Design Basis (CDB) inspections and more recently have focused on staff positions contained in a Regulatory Issue Summary finalized on December 29, 2011 (RIS 2011-12). Despite multiple attempts to bridge the perceived gaps in understanding between industry and NRC staff, we continue to be at an impasse on the operational impacts of the methods/expectations noted in the RIS. Recent correspondence between NEI and NRC regarding this matter is attached.

We believe that the methods and assumptions called for by the RIS are contrary, in many instances, to the methods and assumptions to which plants are licensed. We also believe that, if fully implemented, the RIS methods would lead to unacceptable setpoint values and plant operational performance. It is important that guidance for degraded voltage protection be developed and implemented in a manner that fully takes into account the impacts on operational and transient conditions.

The level of prescription in the RIS goes well beyond the general design criteria contained in GDC-17 and, as such, is more appropriate as regulatory guidance that would outline a set of methods and techniques that the NRC staff finds acceptable for meeting regulatory requirements. Alternative

EDO --G20120281

methods and solutions to meet GDC-17 requirements are possible and should be deemed acceptable if they provide a basis for compliance with applicable regulatory requirements.

We are seeking a consensus on the issues of concern and the determination of an appropriate path forward to address these issues. We would welcome the opportunity to meet to discuss possible means to move forward on this important issue. If you have any questions, please feel free to contact me at 202.739.8081; arp@nei.org.

Sincerely,

Anthony R. Pietrangelo

Attachments

1. Alexander Marion, NEI to Eric Leeds, NRC "Concerns Associated with NRC Release of Regulatory Issue Summary 2011-12, Revision 1, 'Adequacy of Station Electric Distribution System Voltages'," February 28, 2012 (ML120590853)
2. Eric Leeds, NRC to Alexander Marion, NEI, March 16, 2012 (ML12066A232)

NEI®
NUCLEAR ENERGY INSTITUTE

Alexander Marion
VICE PRESIDENT
NUCLEAR OPERATIONS
NUCLEAR GENERATION DIVISION

February 28, 2012

Mr. Eric J. Leeds
Director, Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Concerns Associated with NRC Release of Regulatory Issue Summary 2011-12, Revision 1, "Adequacy of Station Electric Distribution System Voltages"

Project Number: 689

Dear Mr. Leeds:

This letter outlines concerns the Nuclear Energy Institute (NEI)[1] has with the content and application of NRC Regulatory Issue Summary (RIS) 2011-12, Revision 1 (ML113050583). This RIS was issued on December 29, 2011, and is intended to clarify the NRC staff's technical positions on existing regulatory requirements specified in General Design Criteria (GDC) 17 to 10 CFR Part 50, Appendix A. Our concerns have been expressed previously on draft versions of the RIS through the public comment process and during public meetings. Review of the final RIS finds that many of industry stakeholder comments have not been adequately dispositioned. We believe that implementation of methods identified in the RIS can result in plant changes that are contrary to safety. The purpose of this letter is to communicate what continues to be the primary issues of concern and identify the steps necessary to resolve these concerns.

Implementation of RIS is Contrary to Operational Safety and Plant System Reliability
In our comments on a draft version of the RIS and through public meetings, we identified safety concerns with the implementation of certain RIS positions on degraded voltage protection. We noted that implementation will result in increased instances of separation from offsite power, unnecessarily stress the emergency diesel generators, and increase the likelihood of "double

[1] NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabricators, nuclear material licensees, and other organizations and individuals involved in the nuclear energy industry.

sequencing[2]." These concerns were generally dismissed by staff statements that "proper design of the plant electrical system...should provide more than adequate operating margin, preventing unnecessary separation from offsite power."[3] While this statement is valid, we believe that the methods called for by the RIS fail to recognize that proper design of electrical systems requires margin to be established for all facets of operation and that a balance must be maintained for often competing requirements.

To illustrate our concerns, an industry technical working group performed analyses for six different nuclear power stations using the methodology described in the RIS. These analyses, as documented in the attachment, were performed to determine the degraded voltage relay (DVR) setpoint necessary to support two key RIS positions: 1) DVR based on starting voltage requirements of safety related equipment and 2) initiation of an event at the DVR setpoint.

The analysis results demonstrate that setting the DVR on the basis of providing motor starting protection will likely result in increased DVR setpoints. Either method used to calculate available starting voltage is shown to potentially raise the DVR analytical limit, forcing an increase in the dropout setting and therefore the reset setting. This will reduce if not eliminate the margin between required switchyard operating voltage and anticipated post-accident voltage, increasing the probability of a LOOP from DVR timeout. In the case of one method, the results demonstrate a significantly higher DVR setting will be required along with potential elimination of switchyard operating voltage margin. Operating in such a manner would be unreliable and would not reflect actual system conditions expected during a response to a design basis event. The resulting minimum switchyard voltages required for DVR reset are unrealistic, if not unattainable, and would be counter to Transmission Operator criteria. Although analyzing motor starting voltage requirements based on the DVR setting is purported in the RIS to demonstrate that DVRs would provide protection against all eventualities regarding the voltage response of the non-Class 1E electrical system, it fails to do so. To the contrary, since a voltage relay only measures voltage (and not power system capacity), any proposed analytical technique must assume some level of power system capacity, thereby violating the stated purpose of the protective function, which is to provide protection against any conditions.

These analyses demonstrate that it is vital that guidance for degraded voltage protection be developed and implemented in a manner that fully takes into account the impacts on operational and transient conditions.

---

[2] Double sequencing refers to an unintended sequence of operations at a nuclear power plant during which safety and accident mitigation loads automatically start, shut down, and restart in rapid succession when called on to operate. This occurs when, for some combination of reasons, safety bus voltages fall below acceptable levels after the plant is shut down and mitigation loads are started. The buses must be isolated and then repowered from diesel generators or some alternate offsite source. Following this, shutdown and mitigation loads can be restarted.

[3] Response To Public Comments On Docket Id NRC-2011-0013 Proposed Generic Communications: Draft NRC Regulatory Issue Summary 2011-xx: "Adequacy of Station Electric Distribution System Voltage", ML113050588.

A Regulatory Guide is the appropriate vehicle for guidance contained in the RIS
The RIS states that it is intended to "clarify the NRC staff's technical position on existing regulatory requirements...specified in General Design Criteria (GDC) 17 to 10 CFR Part 50, Appendix A." The RIS goes on further to state that "This RIS does not transmit any new requirements or staff positions."

In our comments on the draft RIS, we questioned the appropriateness of issuing technical positions via a RIS instead of a regulatory guide. We noted that the level of prescription in the RIS far exceeds the general design criteria contained in GDC-17 and, as such, is more appropriate as regulatory guidance that would outline a set of methods and techniques that the NRC staff finds acceptable for meeting regulatory requirements, but not necessarily the only set.

Our comments also noted the regulatory evolution of degraded voltage protection that has resulted in protection being provided through a number of different approaches that were previously reviewed by NRC and found to comply with GDC-17. These different approaches are memorialized in the licensing bases of individual plants. Despite clear evidence of an evolution of regulatory guidance and clear differences between the RIS and previously issued guidance, the RIS maintains that it "does not transmit any new requirements or staff positions." Our comments, noting the differences between prior guidance and the staff positions contained in the RIS, were generally dismissed by a statement that the staff position is "consistent" with prior guidance. Consistency is not an appropriate test for determining if current staff positions have changed.

The RIS effectively bypasses the requirements of 10 CFR 50.109 by stating that NRC staff has maintained a single set of consistent positions that have remained unchanged and that these positions have been consistently applied in the reviews of plants licensed since the 1971 issuance of GDC-17. This has led to, and will continue to lead to, instances where the adequacy of previously approved licensing bases are challenged through the inspection process and licensees are forced to modify their previously approved designs to comply with the most recent interpretation of staff positions contained in the RIS with no measureable improvement in plant safety.

We believe that the RIS should be withdrawn and that a regulatory guide should be developed. This is necessary to make it clear that alternative methods and solutions to meet GDC-17 requirements are possible and will be deemed acceptable if they provide a basis for compliance with applicable regulatory requirements. Whether guidance is provided in a RIS or regulatory guide, we believe it is incumbent on NRC to provide a clear and coherent basis for technical positions, with a clear nexus to regulatory requirements and to provide justification for why alternative methods currently in use by licensees are not appropriate.

Working Group 4.7 of IEEE Subcommittee SC-4, "Auxiliary Power" is currently drafting a revision to Annex A of IEEE 741-1990, "IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations", to provide guidance on setting degraded and loss of voltage relays and their associated time delays. We believe that this effort provides the best

opportunity to develop durable guidance to support degraded grid voltage protection configurations that ensure adequate steady state voltages at the terminals of all equipment necessary for accident mitigation during both accident and non-accident conditions.

If you have any questions or wish to discuss this important topic further, please feel free to contact me or John Butler at 202.739.8108; jcb@nei.org.

Sincerely,

Alexander Marion

Alexander Marion

Attachment

c: Mr. Bruce A. Boger, NRR, NRC
Mr. Daniel H. Dorman, NRR, NRC
Mr. Patrick L. Hiland, NRR/DE, NRC
Mr. James W. Andersen, NRR/DE/EEEB, NRC

INDUSTRY REVIEW OF NRC PROPOSED DEGRADED VOLTAGE RELAY METHODOLOGY

NEI Task Force on Degraded Voltage Analysis

PURPOSE

The IEEE Nuclear Power Engineering Committee (NPEC) Working Group 4.7[1] and the Nuclear Energy Institute (NEI) have been working with the NRC staff to understand their current technical position related to degraded voltage relay (DVR) protection requirements for motor starting voltage as described in Regulatory Issue Summary 2011-12, "Adequacy of Station Electrical Distribution System Voltages". Specifically, there is an industry concern that the guidance in RIS 2011-12 is not being evaluated consistently at all Nuclear Power Generating Stations (NPGS) which could elevate the potential of a nuclear safety event such as a delayed loss of offsite power (LOOP) with double load sequencing effects as discussed in NRC GSI-171[2].

The purpose of this technical paper is to evaluate the technical merits of analytical methodologies proposed by the NRC regarding the starting voltage requirements of safety related equipment at the DVR setpoint.

Scope

The scope of this evaluation is to determine the potential impact of two NRC proposed methodologies on current NPGS DVR setpoints:

Method 1: Referred to as the "independent system method," determines the minimum voltage at the NPGS safety buses (i.e., "safety division") required to support both safety related equipment starting and running voltage limits. Safety related buses are not connected to the transmission system and do not credit the effects of the non-Class 1E system: such as upstream impedance, voltage control, load changes, etc. This results in a fixed voltage (i.e., infinite source bus) at the DVR-monitored buses during motor starting.

Method 2: Referred to as the "dependent system method," determines the minimum voltage that would be required at the NPGS safety buses prior to motor starting to support both safety related equipment starting and running voltage limits; thus accounting for the effects of the non-Class 1E system while connected to the transmission network. This results in a voltage at the DVR-monitored buses that dips during motor starting; however, for NPGS that utilize load sequencing, the pre-start bus voltage is readjusted between each load step to the original level.

In this evaluation, each of these methodologies is applied in actual power system analysis using the AC Auxiliary Power System model of several existing NPGS designs that are typical of the US nuclear industry. The impact on the DVR setpoints, as predicted by both these methodologies, is compared to existing setpoints.

It should be noted that neither method is capable of demonstrating voltage recovery above DVR reset in order to prevent transfer to the emergency onsite power source. In fact, voltage recovery must be shown to occur once loads have started and/or the transmission system has recovered using further analysis using the methodology presented in the "Offsite/Station Electrical Power System Design Calculation" section of RIS 2011-12 and IEEE Std 741-2007, Annex A.

It is not the intent of this paper to infer that degraded voltage protection is actually achieved during motor starting when the DVR minimum dropout voltage is set to correspond to the analytical value established by one or the other of these methodologies. In actuality, the very premise of using a voltage relay to protect a power system's capability (capacity) to start motors is technically inadequate. Since a voltage relay only measures voltage (and not power system capacity), any proposed analytical technique must assume some level of power system capacity, thereby violating the stated purpose of the protective function.

Background

The guidance for DVR protection has been developed through three primary NRC documents (1) NRC issued "Statement of Staff Positions Relative to Emergency Power Systems for Operating Reactors" - June 1977, (2) NUREG 0800 (Standard Review Plan) Appendix A, BTP PSB-1 Revision 0, "Adequacy of Station Electric Distribution System Voltages," dated July 1981, and (3) Generic Letter 79-36, August 8, 1979, "Adequacy of Station Electric Distribution Systems Voltages." NPGS have implemented specific designs and technical specifications to meet the intent of these NRC documents. In general, the NPGS licensing commitments are specific to the plant distribution system design and time frame in which the technical specifications were approved, based upon one or more of the three NRC documents listed above.

[1] Responsible for IEEE Std 741, "IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations"

[2] NRC Generic Safety Issue 171, "Engineered Safety Features Failure from Loss-of-Offsite-Power subsequent to a Loss-of-Coolant Accident"

The recent Component Design Basis Inspections (CDBI) have resulted in NRC inspection findings that are requiring plants to perform DVR analyses that are not consistent with the plants licensing basis. The evaluations result in scenarios that may potentially lead to double sequencing of the NPGS engineering safety system loads.

NPGS have implemented the NRC DVR requirements based on the steady state equipment ratings and not on the starting voltage requirements of equipment. The current NRC staff position that degraded voltage protection includes motor starting at the DVR analytical minimum dropout is inconsistent with current industry practice in two respects:

- First, many NPGS have addressed the transient period of motor starting by demonstrating that the DVR time delay is long enough to prevent spurious tripping during the voltage transients.

- Second, NPGS that account for starting voltage transients typically use the DVR relay maximum reset voltage value as an analytical ending condition and establish an initial condition that will ensure that this criterion will be met. This initial condition is often the subject of positive administrative controls, alarms, and Technical Specification LCO action statements. The reset value is used because any transient that causes a voltage dip below the dropout setpoint must recover to the reset value in order for the electrical distribution system to stay connected to the grid. All transients that start below the reset value initiate the DVR, and if they exceed the relay time delay, will result in separation from the offsite source of power. Hence, analyses below the reset value are moot unless they also address the delayed LOOP and double sequencing effects as discussed in NRC GSI-171.

Approach

As previously identified, there are two NRC proposed methods that will be evaluated to determine the effect on the NPGS DVR setpoint. These methodologies are being considered to determine the impact to the current NPGS DVR setpoints when considering starting voltage adequacy, not to suggest changes to DVR protection.

The following items were applicable for both methods:

1. Determined an analytical limit for DVR setpoint (dropout) at the safety division measurement point.

2. Utilized the existing electrical model (i.e., ETAP model) used in current DVR analysis at each NPGS.

3. Determined the most limiting motor (defined as the one which received the lowest required percent of starting voltage, down to the NPGS 480V MCC) for the worst case design basis event (e.g., LOCA, Safety Injection, Containment Isolation, Load Rejection). Other components, such as static loads and MCC contactors, were assumed to be bounded by the current calculation of record.

Method 1, independent system, determines the DVR setpoint minimum voltage (analytical limit) without crediting the effects of the non-Class 1E system: upstream impedance of the non-Class1E plant or offsite electrical network, voltage control, load changes, etc. The intent of the independent system method is to bound any postulated transient condition and assure required starting voltages. To accomplish this, voltage is fixed at the safety division measurement point prior to the start of any motor start sequence (sequenced loading or block loading). This represents the voltage seen at the safety division at the moment of a motor start sequence, regardless of the upstream voltage response. Utilizing the existing methodology and loading for each NPGS, the constant voltage source was adjusted and a motor starting analysis was performed until the most limiting component received sufficient starting voltage (terminal voltage). This method provides the base minimum voltage required at the DVR to support starting equipment limits. This method cannot predict the required voltage at the DVR prior to the motor start sequence, it can only determine voltage adequacy during the sequence.

Key assumptions of Method 1 include:

1. The non-Class 1E system will maintain the voltage throughout the sequence (i.e., infinite source capacity).

2. Nominal load sequencing times are used, as applicable.

Method 2, dependent system, determines the DVR setpoint minimum voltage by accounting for the effects of the non-Class 1E system (e.g. non-Class 1E distribution elements, offsite power grid, etc.) and non-Class 1E load change (addition or removal). The intent of the dependent system method is to present the least conservative transient condition (using operable grid capacity) which would assure required motor starting voltages, given that this method is dependent on upstream conditions. Other upstream conditions (e.g., degraded grid capacity, negative operation of system voltage compensating equipment, spurious operation of any non-Class 1E component) would produce an even higher analytical limit. Utilizing the existing methodology and loading for each NPGS, the Transmission voltage source was adjusted and a motor starting analysis was performed until the most limiting component received sufficient starting voltage (terminal voltage). To accomplish this, the transmission system voltage was adjusted until the voltage at the DVR (prior to the motor starting sequence) was at the analytical limit. This method

attempts to predict the minimum required voltage prior to the design basis event.

Key assumptions of Method 2 include:

1. Automatic On-Load Tap Changers did not actuate during the event (i.e. were locked in place).

2. The non-Class 1E systems were modeled per NPGS current analytical basis. Examples may include: the non-class 1E load shed schemes, bus transfers, load application, and all balance of plant automatic functions (including unit trip delay).

3. Typical transmission system impedance was not degraded below the operable impedance for the offsite transmission system. (Note: This is a non-conservative assumption with respect to capacity, since operable transmission system impedance doesn't represent a degraded grid.)

Utilizing the existing methodology and loading of each NPGS, the transmission system voltage source was adjusted and a motor starting analysis was performed until the most limiting component, down to the 480V MCC, received sufficient starting voltage (terminal voltage). Once sufficient starting voltage was achieved, the corresponding pre-event switchyard voltage was recorded. Once the analytical limits were established for each method, the required DVR settings were determined using tolerances and minimum ranges (between dropout and reset) applicable to the existing hardware for each NPGS. The resulting DVR dropout and reset settings for each NPGS are included in the results section for comparison to existing DVR settings.

Results

Impact on DVR Setpoints
Method 1 (Independent System)

Plant	NPGS 1	NPGS 2	NPGS 3	NPGS 4	NPGS 5	NPGS 6
ECCS Loading Type	Load Sequence	Block Start	Block Start	Block Start w/ Bus Xfer	Load Sequence	Load Sequence w/ Bus Xfer
DVR Dropout [1] (minimum)	91.4%	92.8%	91.9%	91.7%	88.7%	91.0%
DVR Reset [2] (maximum)	94.7%	95.0%	96.6%	94.2%	91.5%	93.6%
DVR Dropout [1] (minimum)	92.4%	93.8%	92.3%	91.7%	89.7%	91.7%
DVR Reset [2] (maximum)	95.7%	96.0%	97.0%	94.2%	92.5%	94.2%
DVR Setpoint [3] Change (+/-)	+1.0%	+1.0%	+0.4%	0.0%	+1.0%	+0.7%

Notes:

1) The DVR setpoint analytical limit that produces required voltage to all required loads. Actual DVR setpoint (dropout) will be slightly higher to account for tolerances.
2) The maximum DVR reset value, including tolerances.
3) The change in existing DVR dropout setpoint required to satisfy these criteria.

The independent system method shows an increase of the existing DVR setpoint from, 0.4% to 1.0% for five of the units while one plant showed no increase. Some of these NPGS may be successful in demonstrating reset of the relay, required for GDC-17 conformance (as historically interpreted); however, others may not have margin in the "Offsite/Station Electrical Power System Design Calculations" as discussed in the RIS. As a minimum, five of the NPGS would require licensing amendments to change the Technical Specifications, unless a more refined analysis can demonstrate lower motor starting voltage.

Impact on DVR Setpoints
Method 2 (Dependent System)

Plant	NPGS 1	NPGS 2	NPGS 3	NPGS 4	NPGS 5	NPGS 6
ECCS Loading Type	Load Sequence	Block Start	Block Start	Block Start w/ Bus Xfer	Load Sequence	Load Sequence w/ Bus Xfer
DVR Dropout [1] (minimum)	91.4%	92.8%	91.9%	91.7%	88.7%	91.0%
DVR Reset [2] (maximum)	94.7%	95.0%	96.6%	94.2%	91.5%	93.6%
DVR Dropout [1] (minimum)	98.7%	101.3%	102.5%	96.7%	92.7%	99.8%
DVR Reset [2] (maximum)	101.8%	103.9%	107.8%	101.4	95.5%	102.4%
DVR Setpoint [3] Change (+/-)	+7.3%	+8.5%	+10.6%	+5.0%	+4.0%	+8.8%
Switchyard [4] Voltage	104.0%	108.9%	104.9%	103.9%	104.8%	112.2%

Notes:

1) The DVR setpoint analytical limit that produces required voltage to all required loads. Actual DVR setpoint (dropout) will be slightly higher to account for tolerances.
2) The maximum DVR reset value, including tolerances.
3) The change in existing DVR dropout setpoint required to satisfy these criteria.
4) The switchyard voltage required to produce new DVR Reset (maximum).

All six NPGS show significant setpoint impact under the dependent system method (4 to 10.6% increases). All would require a minimum switchyard voltage greater than currently predicted by the transmission system provider and, in two cases, greater than the maximum voltage typically allowed by a transmission system (105%). The "Offsite/Station Electrical Power System Design Calculations" would not show acceptable results. Setpoints raised to these values would

require operating the plant distribution at higher voltage than presently allowed by operating procedures. As an example under light loading conditions, there would be a significant concern of overvoltage conditions. This could result in overexcitation in motors and transformers in addition to other potential concerns such as circuit breaker interrupting ratings as well as bus withstand (close and latch).

Conclusion

A review of the results demonstrates that setting the DVR on the basis of providing motor starting protection will likely result in increased DVR setpoints. Either method is shown to potentially raise the DVR analytical limit, forcing an increase in the dropout setting and therefore the reset setting. This will reduce if not eliminate the margin between required switchyard operating voltage and anticipated post-accident voltage, increasing the probability of a LOOP from DVR timeout.

In the case of Method 2, the results demonstrate a significantly higher DVR setting will be required along with potential elimination of switchyard operating voltage margin. Operating in such a manner would be unreliable and would not reflect actual system conditions expected during a response to a design basis event. The resulting minimum switchyard voltages required for DVR reset are unrealistic if not unattainable and would be counter to Transmission Operator criteria.

Although each evaluated methodology is purported to demonstrate that DVRs would provide protection against all eventualities regarding the voltage response of the non-Class 1E electrical system, it fails to do so. To the contrary, each method makes many assumptions about the non-Class 1E system voltage response in an attempt to quantify the magnitude of voltage dip on the Class 1E system during motor starting. Making these assumptions violates the intended purpose of the DVR to provide a Class 1E protective function against all conditions.

Resetting DVRs in an attempt to provide perceived motor starting protection has no practical benefit and would have significant negative consequences for the following reasons:

- Increased DVR settings would significantly increase the probability of spurious LOOP and delayed LOOP with double sequencing effects as discussed in NRC GSI-171.
- Increased DVR settings would reduce or eliminate switchyard voltage operating bands for NPGS. If based on Method 2, this may result in a minimum switchyard voltage so high that it would result in overvoltages to plant equipment during light loading conditions.
- Since the DVRs provide no protective function while they are timing out, their voltage setting is not a factor in the voltages to which the plant equipment may be exposed during that period and increasing their voltage setpoint would have no benefit during this period.
- Each evaluated methodology analyzes a scenario that would be incredible at most plants (significant voltage degradation at the same instant as an accident signal) and fails to consider the credible scenario of a voltage change later into the event when the main generator trips.
- NRC GSI-171 concluded that a LOCA with delayed LOOP was an improbable event. Raising the DVR setpoint will negate this conclusion, leading to greater possibility of a delayed LOOP with double sequencing effects.

A more realistic scenario is to set the DVR to protect accident mitigating equipment from damage during steady state conditions (not motor starting), which is the current licensing basis for most plants. NPGS typically use the DVR maximum reset voltage value or "minimum anticipated voltage" as described in IEEE Std 741, as an ending condition following automatic load sequencing or block loading of safety related loads and establish an initial switchyard voltage to avoid DVR actuation. This ensures the grid provides sufficient capacity for starting required loads and for resetting the DVR; thus, ensuring continuity of a qualified offsite power source.

Setting the DVR dropout to protect accident mitigating equipment from damage during steady state conditions will avoid the risk of early offsite power separation associated with higher DVR settings based solely upon motor starting voltage demands.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 16, 2012

Mr. Alexander Marion
Vice President, Nuclear Operations
Nuclear Energy Institute
1776 I Street, N.W., Suite 400
Washington, DC 20006 3708

Dear Mr. Marion:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your February 28, 2012, letter (Agencywide Documents Access and Management System (ADAMS) Accession Number ML12059A461) regarding concerns associated with the NRC's release of Regulatory Issue Summary (RIS) 2011-12, Revision 1, "Adequacy of Station Electric Distribution System Voltages," dated December 29, 2011.

Consistent with the NRC's regulatory requirements and processes, the staff did review and consider the concerns raised in draft versions of the RIS through the public comment process and during public meetings. In addition, the NRC Committee to Review Generic Requirements and the Office of the General Counsel staff have reviewed this RIS and the comment/resolution document. With respect to the specific issues raised in your letter, the staff offers the following clarifications on key issues.

Although, the Nuclear Energy Institute letter did not discuss the purpose and role of the degraded voltage relays (DVR) in protecting the safety-related systems, the staff wants to emphasize its safety function. Specifically, the DVR monitors sustained degraded voltage conditions at the plant safety bus and automatically takes protective actions when a plant reaches unacceptable voltage conditions. This ensures that all safety-related equipment is protected from a potentially damaging degraded voltage condition. Since degraded voltages could potentially damage both trains of emergency core cooling systems, the DVR must automatically initiate isolation of the degraded offsite power source and transfer the safety buses to the emergency power source within the time period assumed in the accident analysis.

The staff does not agree that implementation of the RIS is contrary to operational safety and plant system reliability. Licensees established analytical limits and plant technical specifications (TS) requirements long before the RIS was issued to ensure that safety-related equipment can meet their intended functions. This means that all equipment can operate (start and run) in accordance with the design and licensing basis of the plant at any voltage at or above the minimum allowable values of the plant's TS. The licensees must maintain the design-basis analyses throughout the life of a plant to demonstrate that the trip setpoint adequately protects the Class 1E equipment from a potentially damaging degraded voltage condition. They must also show that the time delay to transfer from a degraded offsite source to the standby power source to support the emergency core cooling equipment operation is consistent with accident analysis time assumptions. The NRC issued the RIS to clarify the staff's position because

recent inspections have identified that some licensees have not implemented the degraded voltage protection for their plants in accordance with regulatory requirements and staff positions.

The potential for double sequencing is inherent in existing plant designs, regardless of the DVR setpoint, primarily because of the assumption that loss of offsite power and loss-of-coolant accident event occur simultaneously. Any stagger in the two events would result in double sequencing. However, it is important to note that the analytical limits and setpoints chosen for the degraded voltage protection scheme must be supported by the capacity and capability of the offsite power system and grid. If not, there is a potential for the separation of offsite power to occur prematurely, which is contrary to the requirements specified in General Design Criterion 17, "Electric Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10 of the *Code of Federal Regulations,* Part 50, "Domestic Licensing of Production and Utilization Facilities," or applicable principal plant design criteria.

Your letter stated that an industry technical working group performed analyses for six different nuclear power stations using the methodology described in the RIS, and that results of the analyses indicated that setting the DVR on the basis of providing motor starting protection would likely result in increased DVR setpoints and higher grid voltages. As stated before, the offsite power system must support the DVR analytical limits and setpoints that the licensee established. If these are existing plant conditions, they are not in compliance with NRC regulations. The staff also noted that the reset values (3 percent to 4 percent of dropout values) specified for six different nuclear power stations mentioned in the attachment of the letter may be incorrect because the reset values typically are a very small percentage change from the dropout values.

Your letter also stated that a regulatory guide would be the appropriate vehicle for guidance contained in the RIS; therefore, the RIS should be withdrawn and a regulatory guide developed. The staff does not plan to withdraw the RIS. As stated in the RIS, the staff technical positions outlined are consistent with the aforementioned regulations and generic communications, and provide more information on calculations needed. The NRC staff is working with the Institute of Electrical and Electronics Engineers (IEEE) Standard 741 working group (Working Group 4.7 of IEEE Subcommittee SC-4, "Auxiliary Power") to revise the existing guidance. If acceptable, the staff may endorse this guidance through a future regulatory guide.

Should you or your staff have any questions, please contact James Andersen at (301) 415-3565 or Roy Mathew at (301) 415-8324.

Sincerely,

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

cc: Anthony Pietrangelo, NEI
Martin Virgilio, NRC