FENOC
FirstEnergy Nuclear Operating Company

5501 North State Route 2
Oak Harbor, Ohio 43449

Mark B. Bezilla
Vice President - Nuclear

419-321-7676
Fax: 419-321-7582

Docket Number 50-346 10 CFR 50.90

License Number NPF-3

Serial Number 3100

January 17, 2005

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Subject: Davis-Besse Nuclear Power Station
Supplemental Information Regarding License Amendment Application to Revise Technical Specification (TS) 3/4.3.2.1, Safety Features Actuation System Instrumentation Setpoints and Surveillance Testing Requirements (License Amendment Request (LAR) 03-0014) (TAC MC3084)

Ladies and Gentlemen:

This letter responds to an NRC request for additional information (RAI) regarding LAR 03-0014.

By letter dated May 5, 2004 (Serial Number 3009), the FirstEnergy Nuclear Operating Company (FENOC) submitted an application for amendment of the Operating License, Appendix A, Technical Specifications (TS) for the Davis-Besse Nuclear Power Station (DBNPS). The proposed amendment would revise Technical Specification (TS) Table 1.2, "Frequency Notation;" TS 3/4.3.2, "Safety System Instrumentation" – "Safety Features Actuation System Instrumentation;" TS 3/4.3.2.1 Table 3.3-3, "Safety Features Actuation System Instrumentation;" TS 3/4.3.2.1 Table 3.3-4, "Safety Features Actuation System Instrumentation Trip Setpoints;" and TS 3/4.3.2.1 Table 4.3-2, "Safety Features Actuation System Instrumentation Surveillance Requirements." The proposed changes would add a definition of "annual" frequency for use in the TS. The proposed changes also remove the "Trip Setpoint" values for Functional Unit Sequence Logic Channel "a", "Essential Bus Feeder Breaker Trip (90%)", and Functional Unit Sequence Logic Channel "b", "Diesel Generator Start, Load Shed on Essential Bus (59%)" and rename these trip relays to more accurately reflect their design function. The proposed amendment would also revise the "Allowable Values" entries and would establish annual calibration requirements for these same Functional Units, consistent with updated calculations and current setpoint methodology.

A001

By facsimile dated August 20, 2004, the NRC staff issued an RAI concerning LAR 03-0014. Information was requested regarding differences between the electromechanical Loss of Voltage Relays (LVR), which were previously removed by modification, and the replacement solid-state LVRs currently installed, and the potential effect on the overcurrent relay protection and the pump speed characteristics, considering any difference between the original relays and the new solid-state relays for both accident and non-accident conditions. Attachment 1 provides a comparison between the original General Electric NGV LVR relays and the solid state Asea Brown Boveri LVR relays currently installed.

The staff also expressed interest in reviewing the instrument setpoint calculation used to develop the changes proposed in LAR 03-0014. On October 12, 2004, FENOC representatives met with NRC staff at NRC Headquarters to discuss the NRC's RAI. The instrument setpoint calculation described above was reviewed, and the participants discussed the General Electric relay instruction leaflet for the removed LVRs.

The DBNPS was originally designed with only one level of 4160 Volt essential bus undervoltage protection. The original scheme opened the normal supply breakers when voltage dropped to 59% of the nominal value. This setting was predicated upon a total loss of offsite power, not upon sustained low voltage conditions. In a letter dated October 1, 1976[1], the NRC requested that Toledo Edison (predecessor to FENOC) analyze the DBNPS class 1E electrical distribution system to determine if the operability of safety-related equipment could be adversely affected by degradation in the grid system voltage within the range where the offsite power is counted on to supply important equipment. As a result of its review, Toledo Edison added a second level of undervoltage protection to the DBNPS 4160 Volt buses. The second level of protection results in separation of the 4160 Volt buses from their normal power sources during sustained degraded voltage conditions (less than 90% nominal voltage for several seconds).

The original LVR scheme consisted of four General Electric model 12NGV13B25A ("NGV") undervoltage relays per bus, sensing through potential transformers with a ratio of 35:1, and set at approximately 59% of nominal bus voltage. These undervoltage relays operated in tandem with Agastat model 7014PA or model E-7014PA electropneumatic time delay relays set at approximately 0.5 seconds. General Electric's setting band for the NGV relays was 70-100 Volts; however, the field setting band required to meet the Technical Specification was 65-69 Volts. Although this out-of-range setting could be achieved in the field, it invalidated the accuracy information provided by the manufacturer. In addition, the time delay settings were significantly affected by temperature variations. During the thirteenth refueling outage (13 RFO), FENOC eliminated these undesirable features by replacing the affected undervoltage and time delay relays with integrated solid-state time delay harmonic-compensated undervoltage

[1] USNRC-Toledo Edison Company, FENOC Letter Log Number 120, "Equipment Failures During A Degraded Grid Voltage Condition at Millstone, Unit 1," October 1, 1976.

units.[2] This change improved setting accuracy and stability, but the nominal setting values were maintained.

In the October 12, 2004 meeting, the NRC staff requested that FENOC evaluate a hypothetical case during Technical Specification Mode 1 operation, in which bus voltage was maintained at just above the LVR (59%) setpoint for a time period up to the time delay of the Degraded Voltage Relays (DVR, 90%). Attachment 2 provides details of the degraded voltage evaluation. FENOC's evaluation of the above-mentioned hypothetical case did not identify any potential equipment damage, but did identify three cases with a potential for protective device actuation:

1. There is a potential that overcurrent relays will trip for the operating make-up pump motor. However, this trip would reset after the Make-Up pump motor breaker opened, so the motor could be restarted from the control room. During normal operation, one make-up pump is normally not running, and the non-running make-up pump would not be affected by this condition. This condition would not occur with 85% grid voltage, because the make-up pump motor would not stall.

2. There is a potential that the fuses in the control circuits of the containment recirculation fans will blow. However, the containment recirculation fans do not perform a safety-related function, and are not credited in any safety analysis. This condition would not occur with 85% grid voltage, because the associated contactors would not stall.

3. There is a potential that fuses in the control circuits of the Containment Air Coolers (CACs) will blow if the CACs are running in high speed. This is not an issue if the CACs are running in low speed. Note: If the low voltage condition is preceded by actuation of the Safety Features Actuation System (SFAS), the fuses will not blow, because SFAS switches the CACs to low speed. The low speed contactors are smaller and have insufficient current draw to blow a control circuit fuse. This condition would not occur with 85% grid voltage, because the associated contactors would not stall.

   The DBNPS has an installed spare CAC. In addition, the two credited CACs do not always run at high speed, and therefore may not be affected. However, should a sustained degraded voltage condition reduce the number of operable CACs, plant operators would act in accordance with TS 3.6.2.2, which requires two operable CACs in Modes 1, 2 and 3, and TS 3.6.1.5, which requires that containment average air temperature not exceed 120°F during Modes 1, 2, 3, and 4.

Although FENOC has provided the evaluation of the hypothetical case, the ability to operate at such a large degraded voltage is not discussed in any license condition, or credited in any licensee safety analysis. The event underlying the October 1, 1976 NRC letter was a grid disturbance at Millstone Unit Number 2 on July 5, 1976, which resulted

[2] DBNPS Engineering Change 02-0739

in a voltage reduction of approximately 5%. The proposed case goes beyond the Millstone event, involving a voltage reduction of up to approximately 50%[3]. FirstEnergy Service Company has determined that sustained voltages below 85% of nominal on the 345 kV transmission network at DBNPS and adjacent 345 kV buses is not a credible operating condition. At this level or below, the bulk transmission network would not be able to maintain voltage due to the loss of other generating plants. The transmission network would be expected to collapse quickly, within the time delay associated with the DVR setting.

No new regulatory commitments are included in this letter.

If you have any questions or require further information, please contact Mr. Henry A. Hegrat, Supervisor-Fleet Licensing, at (330) 315-6944.

The statements contained in this submittal, including its associated enclosures and attachments, are true and correct to the best of my knowledge and belief. I declare under penalty of perjury that I am authorized by the FirstEnergy Nuclear Operating Company to make this request and the foregoing is true and correct.

Executed on: January 17, 2005

By: [signature]
Mark B. Bezilla, Vice President-Nuclear

MSH

Attachment 1: Relay Comparison

Attachment 2: Degraded Voltage Evaluation

Attachment 3: Commitment List

[3] The low end of the Allowable Value band for the LVR voltage setting is 2071 Volts, which is approximately 50% of nominal.

cc: J. L. Caldwell, Regional Administrator, NRC Region III
J. B. Hopkins, DB-1 Senior NRC/NRR Project Manager
N. Dragani, Executive Director, Ohio Emergency Management Agency,
State of Ohio (NRC Liaison)
C. S. Thomas, DB-1 NRC Senior Resident Inspector
Utility Radiological Safety Board

RELAY COMPARISON FOR LAR 03-0014 RAI

Relay Comparison

The Loss of Voltage Relays (LVR, "59%") were replaced in 2003 by Engineering Change 02-0739. The original relays were General Electric model 12NGV13B25A. They were replaced by Asea Brown Boveri (ABB) model 411T6175-HF relays. These devices are described in General Electric instruction leaflet GEI-90805 and ABB instruction leaflet 7.4.1.7-7.

The following is a discussion of some of the differences between the relays.

1. The General Electric relays were electro-mechanical devices. The ABB relays are solid-state devices. The ABB relays have no microprocessor and are not "digital" devices.

2. The GEI-90805 document for the General Electric relays did not include uncertainties such as accuracy and temperature effects that should be accounted for in a calculated trip setpoint. Previously, drift for the General Electric relays was calculated using field data. The ABB instruction leaflet provides specifications for these uncertainties.

3. The General Electric relays had no adjustable time delay; therefore, the design included an Agastat time delay relay in series with the undervoltage relay. The General Electric relays had an inherent time response, and this, included in series with the time delay of the Agastat relays, provided the overall time response. The time delay relays were electropneumatic Agastat model 7014PA or model E-7014PA with a range of 0.2 to 2.0 seconds and a repeatability of ±10% of setting. The ABB undervoltage relays have an adjustable time delay included in the solid-state design, thus allowing FENOC to eliminate the separate time delay relay. The ABB relays also have a smaller time range of 0.1 to 1.0 seconds with an accuracy of ±10% of the dial setting. The dial settings available are 0.1, 0.2, 0.3, 0.5, 0.7, and 1.0 seconds. In addition to the dial setting, a potentiometer allows for fine-tuning of the setting. Repeatability observed in the field is better than that specified for the Agastat relays.

4. General Electric's setting band for the NGV relays was 70-100 Volts; however, the field setting band required to meet the Technical Specification was 65-69 Volts. Although this out-of-range setting could be achieved in the field, it invalidated the accuracy information provided by the manufacturer. The ABB relays can be set within their published operating band.

Design Bases Review

As noted in DBNPS LAR 03-0014, the 4160 Volt Essential Bus undervoltage protection is described in USAR Section 8.3.1.1.3, "4160 Volt Auxiliary System." Each 4160 Volt Essential Bus is provided with two levels of voltage protection. Four relays per bus at each voltage level (two per functional unit) operate with coincidental logic to preclude spurious trips of the offsite source. The undervoltage trip setpoints and associated time delays are provided in Technical Specification Table 3.3-4, "Safety Features Actuation System Trip Setpoints." The time delays associated with the relays are chosen to minimize the possibility that short duration disturbances will unnecessarily reduce the availability of the offsite source, to ensure that the time duration of a degraded voltage condition will not cause failure of a safety system or component, and to ensure that the equipment starting times in the accident analysis are not exceeded. The Degraded Voltage Relays (DVRs, "90%") automatically disconnect the off-site source whenever the bus voltage drops below the relay setpoint for a period longer than allowed by the relay time delay setpoint. Disconnecting the off-site source will cause the LVRs to actuate. A degraded voltage condition below approximately 59% for greater than approximately one-half second will also cause the LVRs to actuate. The LVRs disconnect the off-site source, load-shed the bus, and start the associated Emergency Diesel Generator.

As discussed in Toledo Edison's letter to the NRC dated January 4, 1977 (Toledo Edison Serial Number 179), the original proposed LVR time delay was 1.0 seconds. This was reduced to 0.5 seconds to reduce the extent to which a degraded voltage could delay the Emergency Core Cooling System (ECCS) equipment start time, given the unlikely event of a simultaneous degraded voltage condition combined with Safety Features Actuation System (SFAS) actuation. The original Technical Specifications provided a Degraded Voltage actuation time Allowable Value of 10.0 ± 1.5 seconds. LAR 03-0014 proposes an upper limit on the actuation time Allowable Value of 7.9 seconds, which represents a reduction of 3.6 seconds as compared to the original Allowable Value.

Toledo Edison's January 4, 1977 letter also addressed addition of a one second "dead bus timer" time delay associated with the diesel generator output breaker closure circuits. This has since been reduced from 1.0 seconds to 0.5 seconds, improving the total time response of the degraded voltage logic. With the Allowable Values proposed in LAR 03-0014, the total time response of the degraded voltage logic will be no more than the 10 second Emergency Diesel Generator start time assumed in the DBNPS Updated Safety Analysis Report.

Three conditions were evaluated with the 1977 degraded voltage logic changes:

1. The first condition was that if the SFAS signal occurs simultaneously with a loss of voltage, the dead bus timers must time out before the Emergency Diesel Generators are ready to accept load. Since the LVR delay and the dead bus timer delay, taken together, are approximately one second (as compared to several seconds to start the Emergency Diesel Generators), this condition is easily met.

2. The second condition was that if the Emergency Diesel Generator was running and ready to accept load, the dead bus timer time delay must be less than the diesel start time in the accident analysis, so that the ECCS equipment would be started within the analyzed required time. Since 1977, the dead bus timer delay has been cut in half, and the analyzed required ECCS equipment start time has been lengthened by ten seconds. Although neither of these times is affected by LAR 03-0014, it can be seen that this condition is met with greater margin following the proposed changes than in 1977.

3. The third condition considered was a Loss of Coolant Accident occurring simultaneously with a degraded voltage. In this event, the diesel generators would be started by the SFAS signal, so that the degraded voltage time delay would run coincidentally with the diesel start. However, due to the various delays introduced by the degraded voltage logic, the ECCS equipment would not have been powered immediately when the diesel was ready to accept load. This condition was considered acceptable, due to the improbability that these two conditions would occur simultaneously. By contrast, the time delays for LAR 03-0014 were chosen so that the total degraded voltage logic delay will be no more than the Emergency Diesel Generator start time assumed in the USAR. This leaves a margin between the ECCS equipment start time and the analyzed required ECCS equipment start time.

Summary

The replacement relays provide the same function as the original relays. The replacement relays are qualified for nuclear safety-related mild environment applications and are qualified for use in seismic installations. Therefore, the replacement did not affect the relays' design function. With respect to the capability of the relays to perform their function, the replacement relays provide a more accurate setpoint, a more accurate time delay, and a more comprehensively documented uncertainty basis. This allows for a more clearly defined basis for uncertainties associated with the total instrument uncertainties calculated for the Technical Specification Allowable Value and the instrument trip setpoint.

DEGRADED VOLTAGE EVALUATION FOR LAR 03-0014 RAI

A. INITIAL CONDITIONS AND ASSUMPTIONS

This attachment evaluates the case where voltage drops to just above the LVR trip setpoint and stays there until the Degraded Voltage Relays (DVRs) trip. The plant is assumed to be in Mode 1 at the start of the event. As noted in the cover letter, this case is for study purposes only, since the transmission system operator has determined that it is not possible to maintain a stable grid voltage below 85% of nominal.

The degraded voltage circuit actuation time is assumed to be 8.3 seconds for this evaluation. This is based on the sum of the Analytical Limit for the DVRs (8.1 seconds) plus the response time of the associated 27X-4/5 control circuit relays (0.033 seconds) plus the bus supply breaker (AC110, ABDC1, AD110, AACD1) opening time (0.083 seconds), which is 8.216 seconds; then rounded up to 8.3 seconds. Note that since each bus has four relays, there is additional margin in that it is unlikely that all of the relays will simultaneously be at the upper Analytical Limit.

The assumed bus voltage varies according to the load under consideration. The Technical Specification Allowable Value for the LVRs is a band from 2071 Volts to 2450 Volts. The medium and low voltage essential motors are capable of operating without stalling at 65 percent of their rated terminal voltage, which in some cases varies slightly from the associated nominal bus voltage. For the purposes of this review, conservative assumptions were made regarding the 4160 Volt bus voltage during the 8.3 seconds. Specifically, when evaluating the impact of motors drawing locked rotor current, it was assumed that the motor terminal voltage was 65 percent of the motor's rated terminal voltage (for example, 2600 Volts for a 4000 Volt motor and 299 Volts for a 460 Volt motor). This evaluation was based on the locked rotor current at 65% voltage. Locked rotor current from the site load flow calculation was reduced by 35%. In the typical case where locked rotor current is six times full load current (FLA), the adjusted locked rotor current would be (FLA) times (65%) times (6) or approximately 4 times FLA. Therefore, it was not necessary to evaluate the motors operating at reduced voltage as a constant KVA load because that would only be approximately

$$\frac{FLA}{2071/4160} \approx 2\ (\mathrm{FLA}).$$

Constant KVA loads such as contactors were evaluated using the low end of the LVR setpoint voltage band issued to the field.

B. EVALUATION

Calculation C-EE-015.03-008[4] load flow run "Lf1a," was used to determine which loads would be energized for this evaluation. Lf1a models conditions with the plant operating at 100% power in Mode 1.

The evaluation looked for the following events:

- Damage to running or energized equipment due to high current flow during the 8.3 seconds of potentially higher current flow, and
- Actuation of overcurrent protective devices (relays, circuit breakers, and fuses) during the 8.3 seconds of higher current, which would prevent re-energization of the associated loads after the Emergency Diesel Generators reestablished power.

1. Potential Transformers (PTs)

   Potential transformer ratio and accuracy are related to two factors that are affected by voltage variations: flux density and excitation current. Flux density in a transformer is directly proportional to the Volts per Hertz ratio. At degraded voltage conditions, the Volts per Hertz ratio will be less than at nominal voltage, resulting in lower than normal flux density. Excitation current will also be lower at degraded voltage conditions because both flux density and the applied voltage will be lower than normal. Therefore, the PTs on the essential buses will not be adversely impacted due to degraded voltage.

2. Current Transformers (CTs)

   The reduced voltages will not affect CT ratio and accuracy, since CTs measure current only. Therefore the CTs on the essential buses will not be adversely impacted due to degraded voltage conditions.

3. Ground Fault Relays

   A number of 50GS ground fault relays are used in the 4160 Volt power system. No ground faults are postulated to occur as a result of the degraded voltage conditions. The 50GS relays function through current transformers such as those described in item 2; therefore, the degraded voltage will not be misinterpreted by the 50GS relays as ground faults. No inadvertent operations of the 50GS relays will occur.

[4] C-EE-015.03-008, AC Power System Analysis.

4. Heaters

As a constant impedance load, the current will decrease with the decrease in voltage. There will be no damage to the heater and there will be no related protective system actuations.

5. Battery Chargers

The safety-related battery chargers have a loss of voltage relay, which will open, protecting the charger. When voltage is restored, the battery charger will recover, closing this relay. During this time, the essential direct current panels will be supplied from the station batteries.

6. Rectifiers

The rectifiers are similar to the battery chargers. They will shut down with low input voltage, and the station batteries will supply the required direct current voltage during the interruption.

7. Steam and Feedwater Rupture Control System (SFRCS) Logic Cabinets C5761A and C5792A

The maximum SFRCS relay pickup voltage is 81% and the minimum dropout voltage is 10%. In the postulated event, pickup has already occurred. Although the specified dropout voltage is a minimum, the minimum dropout voltage is so much lower than the postulated event voltage that no impact is expected on the SFRCS relays.

The SFRCS power supplies are unregulated supplies; i.e., the voltage will float up and down based upon input voltage. The logic module regulates the voltage on the module circuit board. The regulated voltage is at 15 Volts direct current (Vdc) of the 28 Vdc input. The logic module uses voltage regulation chip 78HV15C. Although the specification sheet for a 78HV15C could not be found, specification sheets for several other 7815 chips were reviewed. Based on these specification sheets, the voltage regulator will still operate at a 15 Volt output with an 18 Volt input or 64% of the 28 Volt normal input. The voltage regulation chips have a dropout voltage of 2 Volts, which means that the chip will still provide an output voltage below the 18 Volt input voltage, down to as low as 2 Volts input. An input of 16.5 Volts is equivalent to 59% of the 28 Volt normal input. Although the output of the voltage regulator may not be linear when the input is below the specified minimum voltage, an input of 16.5 Volts would be expected to provide an output voltage of approximately 13.5 Volts based on a 3 Volt difference between the 18 Volt minimum input and the 15 Volt output. The family of logic gates used on the logic module has a recommended supply voltage of 3 to 18 Volts. Therefore, as the supply voltage is reduced to the logic module and the logic gates, the logic still will perform the same function down to as low as 3 Volts. This is well below the voltage that corresponds to the 4160 Volt essential bus being at its LVR trip setpoint. Therefore, the logic module would be able to withstand the postulated degraded voltage.

The field buffers and relay drivers have no regulation, which means that the circuit board will also float with the input voltage. The circuits for the upstream side (Light Emitting Diode (LED) side) is a simple voltage divider circuit which will bias the diode or will not bias depending on the input. For example, the field buffer will have open contacts or closed contacts as the input. If the contacts are closed, this provides a path to ground that will turn off the LED in the LED/photo-transistor isolation chip. Since the LED only requires a nominal 0.7 Vdc to be biased, it would not be affected by the postulated reduced voltage. If the contacts are open, the LED will be biased, which will saturate the photo-transistor. The photo-transistor side of the circuit is either in complete saturation or complete shutoff. Again, a reduced voltage will not affect the capability to put the transistors in saturation and bias the output devices. The only difference will be the output to the logic module from the field buffer and the output to the relays from the relay drivers will see a reduced voltage. However, this will not be a detrimental effect until well below the LVR setpoint.

8. Motors

DBNPS procurement specifications for small electric motors require that the motors be capable of producing full torque for 15 seconds at 65% voltage. Since the postulated case involves less than 65%, it is assumed that these motors stall. The stall current will exceed the running current for a constant KVA motor operating in this general voltage range. Therefore, the evaluation is performed using stall currents for the affected motors.

The 120 Volt motors are in hydro-motors, which control dampers. These loads use Size 1 Westinghouse starters, which are evaluated below. FENOC believes that its 120 Volt motors are comparable to motors addressed by Institute of Electrical and Electronics Engineers (IEEE) Standard 114-2001. Adequacy of these motors was determined by comparing the reduced voltage heating to the heating which would occur under testing described in section 9.3 of IEEE Standard 114-2001.[5]
IEEE 114-2001 states that the locked rotor test may be as long as five seconds. During locked rotor conditions, motors are constant-impedance devices, so the current at 65% voltage would be 65% of the locked rotor current at nominal voltage. Since winding heating is proportional to the square of the current (i.e., an I-squared-t relationship), heating at 65% voltage would be (65%) of (65%), or 42% of the heating at 100% voltage. Therefore, it is reasonable to conclude that the heating at 100%

[5] IEEE Std. 114-2001, "IEEE Standard Test Procedure for Single-Phase Induction Motors," Section 9.3.

voltage for 5 seconds would be more severe than the heating at 65% voltage for 8.3 seconds.

Guidance on 480/240 Volt motor tolerance to locked rotor current is provided in Section 9.14 of the National Electrical Manufacturers Association (NEMA) Standards Publication Guide, "Information Guide for General Purpose Industrial AC Small and Medium Squirrel-Cage Induction Motor Standards," which states:

> 9.14 Stall Time
>
> Polyphase motors having outputs not exceeding 500 horsepower and rated voltage not exceeding 1kV shall be capable of withstanding locked rotor current for not less than 12 seconds when the motor is initially at normal operating temperatures.[6]

The 12 seconds provided by NEMA exceeds the 8.3 seconds considered in this evaluation. Since current is reduced (see related discussion for 120 Volt motors), and since heating is an I-squared-t relationship, there is considerable margin to the motor damage curve. Also, the overload sizing criteria provided in Westinghouse Instruction Letter I.L. 14568-A indicates that a properly sized overload heater will nominally trip in ten seconds at six times the overload heater rating. Overload heater ratings at DBNPS are typically at least 115% of the highest full load current.

Worksheets were individually prepared for the 4160 Volt motors for Service Water pump motors 1 and 2, Component Cooling Water pump motors 1 and 2, and Make-Up pump motors 1 and 2. The results indicate that Service Water pump motors 1 and 2 and Component Cooling Water pump motors 1 and 2 will not trip the protective relays or be damaged by increased current. The overcurrent relay in the running Make-Up pump breaker circuit will trip in seven seconds at Locked Rotor Current at 65% voltage (at lower voltages, the current is less, and at higher voltages, the pump motor will not stall). The motor can withstand this current for 18 seconds. Since there is no seal in circuit for the trip, this non-essential motor can be restarted from the control room, or the non-running pump can be started.

---

[6] It is impractical to obtain and review the purchase specifications for all the motors on site to verify compliance with NEMA standards. However, FENOC believes that the affected motors were specified to comply with NEMA Standard MG-1, and that as motors specified to conform to the primary NEMA standard, these motors are subject to the quoted guidance. In addition, the Davis-Besse Design Criteria Manual section on Electrical Equipment specifies NEMA Standard MG-1 requirements for motors, motor enclosures, motor performance characteristics, and motor accessories. (reference: ANSI/NEMA Standard MG-1, Motors and Generators)

9. Contactors

Fuses in the circuits for the Size 3 and Size 5 contactors will interrupt the current before 8 seconds, but the Size 1 contactors would not be adversely affected. The inrush current for a Size 1 contactor is 1.8 Amperes. The fuse specified for this type of circuit is a Bussman FNM 2.5, which will not blow.

Contactor circuits were discussed in Toledo Edison's letter to the NRC dated July 18, 1977, on pages 8 and 9.[7] The conditions were "Mode No. 3 , Subanalysis 1," which discussed the situation where the contactors are unable to pickup in which case they would be subject to inrush current for 9 seconds. That is similar to this situation, where the contactor drops out, but the inrush current at a low voltage continues. The only required action identified for that situation was to increase the fuse size to 2.5 Amperes. That action has been done. This was verified by reviewing the electrical drawings, where the fuse size is identified as 2.5 Amperes, and also in the fuse list, drawing E-2014. The conclusion was that these contactors are acceptable as-is.

Size 1 contactors were tested to determine minimum pickup voltage. Nineteen Size 1 contactors were tested at FENOC's Beta Laboratories. The testing involved setting a power supply to a low voltage and then attempting to pull the contactor in to ensure the lowest voltage was established. The test voltage was increased in small increments and another attempt was made were made to pull the contactor in. The testing involved pausing with inrush current flowing to see if the contactor would pull in. Once the minimum pull in voltage was established, the contactor was cycled five times at low voltage, allowed to cool and then cycled five more times. This process was originally done with no auxiliary contact blocks, then repeated with one contact block installed, repeated again with two contact blocks installed, and again with three contact blocks installed. There were no sample failures or apparent changes in electrical parameters due to this testing. This process exposed the contactor to extended inrush current a sufficient number of times to provide confidence that the contactor would still function after being exposed to inrush current for 8.3 seconds. This conclusion is in agreement with the information in DBNPS Serial Number 293 (footnote 7). Again referring to the section titled "Mode 3 Operation, Subanalysis 1," the letter considered the impact of operating at a voltage so low that the contactor would not pull in and was left at inrush current for nine seconds. The only alteration that was required to address this concern was to increase the fuse size. Therefore, exposing the contactor to inrush current for 8.3 seconds is not a concern.

To confirm the ability of the Size 1 contactor to remain undamaged during an exposure to inrush current at a voltage which causes dropout, an additional test was

[7] Toledo Edison (DBNPS) Serial Number 293, July 18, 1977.

performed. This testing involved extended exposures of 21 seconds at inrush current, followed shortly by another exposure of 35 seconds at inrush. This testing provided confidence in the discussion in Serial Number 293, which indicated that the only corrective action required for Size 1 contactor circuits was to increase the fuse size.

10. Breakers on Essential Load Center Transformers (XCE1-1 (XCE1-2) and XDF1-2 (XDF1-1))

The total current through the breakers was determined by adding all of the postulated locked rotor currents for the motors plus all of the static loads. The results at the 480 Volt level were 2146 Amperes through XCE1-1 and 2125 Amperes through XDF1-2. The worksheets for the 480 Volt breakers (BCE11 and BDF12) demonstrate that at these currents, the trip time for these breakers is greater than 80 seconds. The breakers on the 4160 Volt side (AC1CE11 and AD1DF12) will not trip at these currents.

11. 480 Volt Overcurrent Protective Devices

FENOC has evaluated the overcurrent device to the load and the overcurrent devices in the control circuits. The loads on the protective devices were determined by combining the currents of the downstream energized loads.

Static Loads

Static loads were evaluated as either constant current or constant impedance loads. In either case, full load current was conservatively used to determine loading on the upstream protective devices. Since the load (current) will not increase when voltage is reduced, the immediate upstream protective device was determined to be acceptable, without further evaluation.

Motor Loads

As noted above, motor loads were evaluated by correcting the locked rotor current at nominal voltage to a locked rotor current at 65% of nominal voltage. The molded case circuit breakers were reviewed to ensure that they would not trip during low voltage, high current situations. No problems were identified.

480 Volt Control Circuits

Latching Contactors

Safety-related circuits generally use latching contactors, which will not drop out, even at zero voltage. They draw no current after they have been "latched-in," so overcurrent devices will not actuate.

Size 1 Starters

The contactor was conservatively assumed to be drawing inrush current. The maximum inrush current for a Size 1 starter is 1.8 Amperes. Since the control circuit fuse is an FNM-2.5, which is rated for 2.5 Amperes, this inrush will not blow the fuse. The control power transformers have a turns ratio of 3.83 to 1, so one phase on the 480 Volt side will have 1.8/3.83 or 0.47 additional Amperes. Since this current is small compared to the motor inrush current and there are a small number (approximately 5 circuits on each train) of circuits, this contribution was ignored.

Size 3 Starters

Size 3 starters are used on the containment recirculating fan motors (MC56-1 and MC56-2). The inrush current for a Size 3 starter was determined to be 8.13 Amperes by testing. The fuse is a Bussman BAF-3. The fuse time-current curve indicates that the fuse may blow, however, the containment recirculating fans do not perform a safety function.

Size 5 Starters

Size 5 starters are used with the Containment Air Cooler motors. There are two high-speed starters per cooler, each drawing approximately 6 Amperes, which may blow the 6 Ampere KTK fuse in less than 8 seconds.

The control and power circuit for radiation monitor motors MP274-1, MP273-1, MP274-3, and MP273-3 is internal to each device. These are 1.5 horsepower motors that support the pumping system on Kaman Sciences Corporation radiation monitor skids used for containment and station vent stack monitoring. Plant experience has been that the associated pump motors can stall for 10 to 30 seconds without the thermal overloads tripping. Based on this information, it was concluded that the overloads would not trip during a reduced voltage event lasting 8.3 seconds.

The required equipment will start after the Emergency Diesel Generators restore power. Latching contactors are used on safety-related circuits, so that these contactors remain closed even when voltage is lost. 4160 Volt circuits such as the component cooling water and service water pump motors receive a start/breaker closure signal based on relay contacts. The previously running component cooling water pump motor will start immediately after its associated Emergency Diesel Generator output breaker closes. The control power for these functions is direct current, which will not be affected by low voltage, because it is battery-backed. Some equipment will get a start signal if a condition exists which requires the equipment to operate. For example, a temperature switch in the control circuit for the Emergency Diesel Generator immersion heaters will remain in the close/start state if there is a low oil temperature, through the low voltage/loss of voltage period so the fan will restart when power returns. Other equipment may need to be manually restarted. A control logic review indicated that the automatic start or manual start requirements of the equipment would not be affected by the postulated degraded voltage event.

C. CONCLUSIONS

Our review did not identify any potential equipment damage, but did identify three cases with a potential for protective device actuation:

1. There is a potential that overcurrent relays will trip for the operating Make-Up pump motor. However, this trip would reset after the Make-Up pump motor breaker opened, so the motor could be restarted from the control room. During normal operation, one make-up pump is normally not running, and the non-running make-up pump would not be affected by this condition. This condition would not occur with 85% grid voltage, because the associated make-up pump motors would not stall.

2. There is a potential that the fuses in the control circuits of the containment recirculation fan motors will blow. However, the containment recirculation fans do not perform a safety-related function, and are not credited in any safety analysis. This condition would not occur with 85% grid voltage, because the associated contactors would not stall.

3. There is a potential that fuses in the control circuits of the Containment Air Coolers (CACs) will blow if the CACs are running in high speed. This is not an issue if the CACs are running in low speed. Note: If the low voltage condition is preceded by actuation of the Safety Features Actuation System (SFAS), the fuses will not blow, because SFAS switches the CACs to low speed. The low speed contactors are smaller and have insufficient current draw to blow a control circuit fuse. This condition would not occur with 85% grid voltage, because the associated contactors would not stall.

   The DBNPS has an installed spare CAC. In addition, the two credited CACs do not always run at high speed, and therefore may not be affected. However, should a sustained degraded voltage condition reduce the number of operable CACs, plant operators would act in accordance with TS 3.6.2.2, which requires two operable CACs in Modes 1, 2 and 3, and TS 3.6.1.5, which requires that containment average air temperature not exceed 120°F during Modes 1, 2, 3, and 4.

Docket Number 50-346
License Number NPF-3
Serial Number 3100
Attachment 3

COMMITMENT LIST

The following list identifies those actions committed to by the Davis-Besse Nuclear Power Station, Unit Number 1, (DBNPS) in this document. Any other actions discussed in the submittal represent intended or planned actions by the DBNPS. They are described only for information and are not regulatory commitments. Please notify Henry L. Hegrat, Supervisor–Licensing (330-315-6944) of any questions regarding this document or associated regulatory commitments.

COMMITMENTS	DUE DATE
None	NA