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TO: D. B. Vassallo

FROM: Toledo Edison
Toledo, Ohio 43652
Lowell E. Roe

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8p

ENCLOSURE: Consists of drawing entitled "Composite Of Grounding System...

1p

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ACKNOWLEDGED

PLANT NAME: DAVIS-BESSE UNIT # 1
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TOLEDO EDISON

LOWELL E. ROE
Vice President
Facilities Development
(419) 259-5242

Docket No. 50-346

File Cy.

Regulatory

August 30, 1977

Serial No. 376

Mr. D. B. Vassallo, Assistant Director
for Light Water Reactors
Division of Project Management
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Vassallo:

On August 17 and 25, 1977, we met in your offices to discuss the instrument and station ground systems that are installed at Davis-Besse Unit No. 1. At these meetings were members of my staff, Bechtel, B&W, and the appropriate representatives of the NRC.

During these meetings we reviewed our design criteria for the instrument ground system and its relationship and tie to the station ground system, and the results of testing that has shown that there may be inadvertent ties between these systems at other than the designed common tie point. We also presented the results of our analysis of the potential effect of these possible inadvertent ties on the safety instrumentation systems under the worst possible electrical fault in the station that would introduce ground currents into the station grounding grid. A summary of our analysis is attached to this letter. The systems that may have the station ground and instrument grounds connected include the Reactor Protection System - Nuclear Instrumentation, Non-Nuclear Instrumentation, Station Computer, Integrated Control System, and the non-essential Miscellaneous Electric Control System. Our analysis showed that the safety systems will perform as intended under this worst possible station electrical fault condition.

The Davis-Besse Unit 1 instrumentation and control systems have been functioning for a number of months during the pre-operational testing period, including hot functional testing prior to issuance of the operating license, and for four months following fuel loading, testing, criticality, and zero power physics testing. During this time, these systems have functioned in the proper manner with no abnormalities encountered.

Further, we have not identified any inadvertent ties between the Safety Features Actuation System instrument ground and the station ground so that one cannot postulate station electrical faults that would adversely affect the engineered safety features of the facility.

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We conclude that the likelihood of degrading conditions and spurious operation that could adversely effect the health and safety of the public as a result of the presence of any remaining inadvertent connections between the instrument and station ground grids is acceptably small.

We will continue to analyze and test our instrumentation systems to identify and eliminate any inadvertent connections between the instrument ground grid and the station ground grid so that the installation fully meets the design criteria. By the end of the first extended shutdown and no later than the end of the first scheduled refueling outage, we will provide to the NRC the results of our analysis, testing and corrective actions that have been implemented for assuring that the installation meets the design criteria.

In addition, we will carefully monitor the instrumentation systems for any degrading conditions requiring corrections and spurious operation. Normal instrumentation monitoring will be in accordance with the definitions of a channel check (every 12 hours), channel functional test (every 30 days), and we will also conduct daily heat balance checks as specified in the facility technical specifications for instrumentation systems. We will keep a record of our monitoring of these systems and will report in a timely manner any abnormalities to NRC (I&E Region 3).

Yours truly,

Lowell E Roe

Lowell E. Roe
Vice President
Facilities Development

LER.r

Enclosure: Safety Evaluation by Toledo Edison Company
as presented at August 25, 1977 meeting with NRC

Attachment to TECo Letter Serial No. 376
Dated August 30, 1977

DAVIS-BESSE UNIT 1
STATION
AND
INSTRUMENT GROUNDING SYSTEMS

SYSTEM DESIGN CRITERIA

The station ground grid system at Davis-Besse is a three dimensional grid in the turbine and auxiliary building that consists of 4/0 and 500 MCM bare copper conductor. The vertical risers are installed at a minimum of every other building column. Horizontal conductors are installed as needed to tie equipment to the station ground grid (20' to 70' horizontally). The station ground grid vertical risers are tied to the building steel at each floor as a minimum and the horizontal conductors are tied to the building steel at every other building column as a minimum. Drawing E-470, Rev. A shows some typical equipment that is tied to the station ground grid. This drawing was left with the NRC during our meeting on August 25, 1977 and a copy is attached.

The instrument grounding system has been installed as shown on drawing E-470, Rev. A. The instrumentation common signal and analog signal cable shields for the following major systems are tied to the instrument ground bus:

1. Reactor Protection System (RPS).
2. Integrated Control System (ICS).
3. Non-Nuclear Instrumentation (NNI).
4. Computer processing unit, local and remote multiplexers, typers, line printer, paper tape punch/reader, card reader, cathode ray tubes and operator keyboards.
5. Miscellaneous electronic control system.

The analog signal cable shields for the following major systems are tied to the instrument ground bus:

1. Safety Features Acutation System (SFAS)
2. Steam and Feedwater Rupture Control System (SFRCS)
3. Steam generator level

The station and instrument grounding systems have been installed in accordance with the Davis-Besse Unit 1 design criteria and as shown on drawing E-470, Rev. A. During the testing on these systems, the following has been found:

1. RPS, ICS and NNI; the instrument ground buses in these systems are intentionally tied together as shown on drawing E-470, Rev. A. There may be an inadvertent tie between this group of instrument ground buses and either the station ground system or the instrument ground bus in the computer or the miscellaneous electronic control system.

2. There is an inadvertent tie between the following instrument ground bus and either the station ground system or the instrument ground bus in another system:

   A. Computer.

   B. Miscellaneous electronic control system.

EQUIPMENT DESIGN CRITERIA

The RPS was designed and shipped to Davis-Besse with isolated instrument and station ground systems. The RPS has been used at all B&W units in operation with these two buses tied together in the cabinets and then connected to the station ground grid. The RPS is designed to operate within specifications when installed with a single grounding system or with separate station and instrument grounds as specified at Davis-Besse. The Davis-Besse grounding system meets the B&W balance-of-plant (BOP) requirements for this installation. The B&W BOP requirements stated in the 205 BSAR call for a grounding system similar to that employed at Davis-Besse.

The NNI and ICS were designed to have either single or separate instrument and station ground systems. All B&W units in operation have had the two ground buses in these systems tied together. The NNI and ICS cabinets and interconnecting cables to remote instruments were shipped to Davis-Besse with the two ground systems tied together. This required Toledo Edison to work closely with B&W and Bailey field representatives to modify the equipment to separate the ground buses in these systems.

The computer and miscellaneous electronic control system were designed and shipped with separate instrument and station ground systems.

The SFAS and SFRCS and steam generator level systems were designed and shipped with separate instrument and station ground systems. Only analog signal cable shields are connected to the instrument ground bus. Noise tests conducted by their manufacturer (Consolidated Controls Corporation) indicated that these shields could be connected to either the station or instrument ground system or they could be left ungrounded.

MAXIMUM GROUND FAULT CURRENTS

If a ground fault on any of the major electrical equipment, station power electrical buses or transformers should occur, this fault current would flow through the station ground system. The maximum ground fault current that could occur due to a fault on each electrical system on Davis-Besse Unit 1 is as follows:

1. 345 KV - 21,200, amps.
2. 25 KV Main Generator - 8 amps. Limited by ground resistor.
3. 13.8 KV Housepower buses - 400 amps. Limited by ground resistor.
4. 4.16 KV Housepower buses - 400 amps. Limited by ground resistor.
5. 480 Volt Housepower buses - 21,900 amps.
6. 250/125 Volt DC Housepower buses are ungrounded and no DC fault currents can flow in the station ground grid.

MAXIMUM GROUND CURRENT INDUCED VOLTAGES

If there is an inadvertent tie between the instrument ground system in the RPS and the station ground, loop fault current from an electrical fault could flow in the RPS instrument ground connection producing an induced voltage at the RPS system.

The largest ground currents that can flow thorough the station ground system in the Cable Spreading Room ceiling would be caused by an ground fault in the 480 V Motor Control Center (MCC) located directly above the Control/Cabinet Room at elevation 643'. The maximum ground fault current that can occur at this MCC is 12,600 amps assuming zero ohms station ground system impedance. The source of this ground fault current is a 1000 KVA transformer located on elevation 603' at the northside of the auxiliary building. This 1000 KVA transformer has a 6.75% impedance on 1 MVA base, 13.8 KVA to 480 V, (Delta : Y) transformer with a solidly grounded neutral. The 13.8 KVA bus is assumed to have zero impedance up to the 480 volt transformer.

In calculating this induced voltage that could be impressed on the RPS instrument ground bus, the following conservative assumptions were made:

1. Only 50% of the ground fault current would flow from the MCC to the 1000 KVA transformer on the ground cables installed in the conduits with the phase cables.

2. The station ground grid at elevation 643' is assumed connected to the 1000 KVA transformer by a single 500 MCM uninsulated copper cable which forms a 165' by 40' vertical boundary of the auxiliary building region involved. All the fault current which flows in the station ground is assumed to flow through the Cable Spreading Room ceiling in an East-West direction, and has been taken to be a single 500 MCM cable.

3. No ground fault current would be by-passed through building steel.

4. The location of the inadvertent tie between the instrument and station ground systems was picked in an attempt to maximize the loop currents flowing in the RPS instrument ground buses.

5. A zero voltage drop in the station ground system between the 1000 KVA transformer and the point where the 500 MCM insulated conductor from the instrument ground bus in the Cable Spreading Room connects to the station ground system. This assumption will further maximize the fault current in the instrument ground loop in the RPS cabinets.

Using the above conservative assumptions, the fault voltage that could be impressed on the instrument ground buses would be 1.2 volts, rms, 60 Hz. The ground fault current that caused this voltage would be interrupted within 3 cycles (50 ms.). This 1.2 volt difference between NI/RPS cabinets would cause 60 Hz current flow thorough the system's instrument ground. Normally, this kind of "noise" could enter the system through inductive or capacitive coupling between a ground lead carrying the noise and an analog signal lead. Since the degree of coupling is not known, one can assume an unlikely worst case in which there is direct coupling, with no attenuation, directly into any or all RPS 0 to 10 volt DC analog signals. The system is designed to reject such noise by a minimum of 34 db which translates to a 2500:1 power attenuation or a 50:1 voltage attenuation. With 34 db rejection, the worst effect on a trip set point will be to impose an error of less than 0.24% of the signal full range. However, when the noise is injected in such a way as to pass through one or more modules prior to the bi-stable set point module, additional attenuation occurs reducing the error to less than 0.06%. Considering the assumed direct coupling, the effect is extremely conservative. It is B&W's accessment that this is not a safety concern.

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