TOLEDO EDISON

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Docket No. 50-346

License No. NPF-3

Serial No. 812

May 12, 1982

Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4
Division of Licensing
United States Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Stolz:

This is in response to your letter of February 16, 1982 (Log No. 911) concerning Request for Additional Information on Adequacy of Station Electrical Distribution System Voltages. Your letter referenced Page 2, Paragraph 4 of NRC letter to All Power Reactor Licensees, dated August 8, 1979 (Log No. 416), as the related area of requested information. The attachment provides Toledo Edison response as it pertains to Davis-Besse Nuclear Power Station Unit No. 1.

Very truly yours,

RPC:GAB:lab

attachment

cc: DB-1 NRC Resident Inspector

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ANALYSES

OF

THE ADEQUACY

OF THE

DAVIS-BESSE NUCLEAR POWER STATION

ON-SITE ELECTRICAL

AUXILIARY DISTRIBUTION

POWER SYSTEM

VOLTAGES

Prepared
in
Response
to the
Nuclear Regulatory Commission
Request for Additional Information
of
February 16, 1982

TABLE OF CONTENTS

Responses	Informations requested by NRC Page 1 thru 9
Figure 1	Davis-Besse Nuclear Power Station Single Line Diagram - Page 10 (Revised 3-82)
References	Page 11

INFORMATIONS REQUESTED BY NRC

As referenced in the NRC letter of February 16, 1982; page 2, paragraph 4 of Reference (1), requested an analysis of the Davis-Besse Electrical Power Systems to determine if there are any events or conditions which could result in the simultaneous or consequential loss of both circuits to the off-site network (violation of GDC 17). The analysis in reference should have included, but not limited to, such events or conditions as possible equipment overloading, protective relaying actuation, short circuits, breaker failures, switch and battery failures, etc.

RESPONSE:

Previous Toledo Edison correspondence with the NRC (references 2, 3, 4 and 5) provided load and voltage drop analyses. Our present analysis consists of a review of the station electrical power system design and its behavior under various postulated events or conditions to determine whether simultaneous or consequential loss of both required circuits to the off-site network can occur.

The following conditions and events have been investigated:

I. Overloading of equipment or circuits caused by an event, under full load plant operation, shutdown or start-up condition, with applicable breaker positions.

II. The effect of a single short circuit in the electrical power system.

III. The consequence of a single failure or malfunction of an equipment or component of the electrical power system to clear a single fault on the electrical power system.

IV. Failure of a single 125V DC battery.

V. Failure of the power supply to transformer auxiliary equipment (i.e., forced cooling equipment).

ANALYSIS

I. Overloading

The thermal capability of the 345 KV bus and equipment will accommodate any possible switching arrangement without causing any overload.

The other possible overloading considered is that of a start-up or bus-tie transformer caused by a transfer of all plant load to one start-up and bus-tie transformer circuit. Three aspects of the overloading are considered:

1. Whether maximum stea. · state load or motor starting transient load causes a degraded voltage and actuation of degraded voltage protective relays.

2. Whether overcurrent relays are set properly to permit maximum possible steady state or transient load.

3. Whether maximum steady state load exceeds transformer rating.

(1) Degraded Voltage:

The concern is whether maximum steady state load or motor starting transient load causes a degraded voltage and actuation of degraded protective relays.

Voltage relaying on 4.16 KV buses (C1, D1) exist to separate the Class IE power system from the off-site source when the voltage degrades below acceptable limits. If the 4.16 KV bus voltage falls to 59 percent for 0.5 seconds or 90 percent for 7.5 seconds, separation of the Class IE buses (C1, D1) will occur.

In the detailed voltage analysis previously submitted (Ref. 5), we have already shown that no possible steady state load condition causes voltage on the 4.16 KV buses of 90 percent or less. This is also true for maximum plant operating load plus all SFAS loads running and only one start-up and one bus tie transformer available.

In our previous response (Ref. 5), the voltage analysis also showed that no motor starting transient conditions, except Reactor Coolant Pump (RCP) start, causes dips sufficient to actuate voltage relaying. The magnitude and duration of the voltage dip associated with a RCP start exceeds the 90 percent and 7.5 seconds setting of the degraded voltage relays, and therefore, bypass pushbuttons for the relays must be used during RCP start which is strictly a manual operation. This pushbutton bypass will require a change in Technical Specification and a request for allowing such a change is pending with NRC, per our letter to NRC dated March 23, 1979 (Serial No. 487).

The voltage analysis showed that starting the largest 4.16 KV motor (1500 HP condensate pump) with maximum plant operating loads on, does not cause voltages of 4.16 KV buses to drop as low as 59 percent for .5 seconds or 90 percent for 7.5 seconds. The analysis also showed that voltage available to the equipment during a transient will be sufficient to start all loads required for safe shutdown of the plant. The duration of transients due to starting of large motors is less than 7.5 seconds setting required for actuation of 90 percent relays. From the discussion, it is evident that no separation from off-site power supplies caused by under voltage relaying can occur with the exception of RCP as discussed earlier.

(2) Protective Relaying Actuation:

The concern is whether overcurrent relays are set properly to permit maximum possible steady state or transient load.

In our previous response (Ref. 5), we have verified that the timing of the protective relays will permit the highest expected steady state and transient load current flow through a single circuit without any actuation of overcurrent relays. The conditions considered were the worst case, described as follows: 1) RCP start with maximum plant operating load running and only one startup transformer available; 2) simultaneous starting of all SFAS loads with maximum plant operating load running and a single bus-tie transformer available; 3) maximum plant operating load running and a condensate pump start through a single bus tie transformer; 4) and maximum steady state load (operating loads plus SFAS loads) through a single circuit (one start-up and one bus tie transformer) with minimum grid system voltage.

In all transient cases analyzed, there is a margin between the duration of the transient and the time required for any relay to operate at the current level during the transient. In the steady state condition, all relays are set at values of current above the value which exists when full auxiliary load plus SFAS loads are carried by a single power supply circuit (i.e., one start-up and one bus-tie transformer).

The 345 KV switchyard buses and major equipments are protected and no blind spots exist.

(3) Exceeding the Transformer Rating

The concern is whether maximum steady state load exceeds the transformer rating. The total conservatively calculated plant auxiliary load with all SFAS loads and all operating loads running is 55 MVA. The startup transformer rating is 39/52/69 MVA, OA/FOA/FOA. The worst case plant load, therefore requires forced cooling of the startup transformers when only one start-up transformer is available. Loss of a start-up transformer or 13.8 KV bus cannot affect the power to the cooling equipment of the remaining start-up transformer.

The conservatively calculated total operating load plus SFAS load of both 4.16 KV buses is 10 MVA. A single bus-tie transformer has a rating of 12/16 MVA, OA/FA. Its self-cooled rating therefore exceeds by 20 percent the maximum total load carried when only one bus-tie transformer is available.

II. Short Circuits

Numerous cases were analyzed to evaluate the behavior of Davis-Besse Electrical Power System under the condition of a single fault in the system as follows. The cases included both full power operation and start-up condition of the plant with applicable breaker position.

A. Transmission Line Fault

On 345 KV Davis-Besse to Lemoyne, Bay Shore or Ohio Edison Company line.

B. Bus Fault

1. 345 KV J or K bus.
2. 13.8 KV bus A or B.
3. 4.16 KV bus C2 or D2.

C. Transformer Fault

1. Start-up transformer 01 or 02.
2. Bus-tie transformer AC or BD
3. Auxiliary transformer 11
4. Main transformer 1

D. Main Generator Fault

III. Consequential Loss

Cases in which a single failure of a breaker or a single protective relay which trips multiple breakers (spurious trip); to perform its intended function and thereby failing to clear a fault, were studied for the following:

A. Breaker Failure

1. 345 KV breakers 11, 12, 13, 31 or 33 (refer to Fig. No. 1 on page 10).

2. 13.8 KV breaker HX01A, HX01B, HX02A, HX02B, HX11A, HX11B, HAAC or HBBD.

3. 4.16 KV breaker AACC2, ABDD2, AC110, AD110, ABDC1 and AACD1.

B. Relay Failure

1. Differential relay for startup transformer 01 or 02.

2. Differential relay for generator.

3. Generator Overall differential relays for generator, No. 1 main transformer and No. 11 auxiliary transformer.

4. Single set of redundant 345 KV bus differential relays.

5. Single set of redundant line relays on 345 KV incoming transmission lines at Davis-Besse.

The case study including cases listed in II and III indicated that in all except one case, there will be no total loss of offsite power to the essential buses (C1, D1) due to a single fault or a single failure plus a fault as given in cases, listed.

The exception is a condition where the overall generator differential relay fails to operate and as a consequence fails to clear a fault on the 345 KV leads of No. 1 main transformer (refer to Fig. 1 on page 10). The fault on the leads will be first cleared by Zone 2 distance relays, on the remote end of 345 KV Lemoyne, Bay Shore and Ohio Edison transmission lines followed by operation of the generator overcurrent relays with voltage restraint which trips breakers 11 and 13 and drops both startup transformers 01 and 02.

Bay Shore and Ohio Edison lines to Davis-Besse will not reclose automatically, however, the Lemoyne to Davis-Besse line will reclose after a delay of 15 seconds. In the mean time, the essential buses will be isolated and supported by emergency diesel generators and restored to normal off-site power manually, after the reclosing of Lemoyne line.

IV. Battery Failure

The 125V DC power for 345 KV switchyard breaker control and protection is provided by two separate batteries dedicated to the 345 KV switchyard equipment only. Failure of a single battery will not eliminate the tripping functions of 345 KV breakers since each breaker has two trip coils, each powered from a separate battery.

Failure to close a single 345 KV switchyard breaker due to the loss of one battery is not considered as a problem since these breakers are normally operated in a ring bus arrangement.

Bus and line relays consist of two separate sets of relays, one being mechnical type and the other solid state.

Failure of a single battery will not jeopardize the function of redundant bus and line relays since each redundant set is powered from a separate battery. Also the differential relays are powered from batteries separate from the ones for backup relays installed at the station switchyard. Batteries for backup distance relays on Bay Shore, Lemoyne and Beaver lines are provided at the remote end.

In addition, the station has four 125V DC batteries feeding four essential and four non-essential distribution panels (see Table 1). The 125V DC power is used for protection and control of on-site AC electrical power distribution.

An inspection of Table 1, shows that the loss of a single battery will not result in loss of both circuits to offsite power.

V. Transformer Auxiliary Power Feeds

480V auxiliary power for the startup and bus-tie transformer cooling is provided from the motor control centers (MCC) listed below.

Transformer	Start-Up Transformer	Start-Up Transformer	Bus-Tie Transformer	Bus-Tie Transformer
	01	02	AC	BD
Primary MCC:	E31A	E22A	E31	F31A
Backup MCC:	F31A	F22	*	*

The startup transformers 01 and 02 have dual feeds via auto transfer to the transformer auxiliaries. The bus-tie transformers have only single feeds. All above listed MCCS have dual feeds from unit substations, and the substations themselves have dual feeds from the 13.8 KV buses A and B. Therefore the loss of one auxiliary feed to one transformer will in no case result in the loss of cooling power to the other transformer.

*No auxiliaries required for self cooled rating.

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TABLE 1

Distribution Panels:

Battery:	1P (1)	1N (3)	2P (2)	2N (4)
Ess. Pnl.	D1P (1)	D1N (3)	D2P (2)	D2N (4)
Non Ess. Pnl.	DAP (A)	DAN (A)	DBP (B)	DBN (B)

1. Start-Up Transformer		01	02
1.1 Protection		DAP (A)	DAN (A)
1.2 Protection, Back-Up		DBP (B)	DBN (B)
2. 13.8 KV Bus		A	B
2.1 Bus Relays & Incoming Bkrs.	Norm.	DAN (A)	DBN (B)
	Alt.	DAP (A)	DBP (B)
2.2 Feeder Bkrs.	Norm.	DAP (A)	DBP (B)
	Alt.	DAN (A)	DBN (B)
3. Bus-Tie Transformer		AC	BD
		DAP (A)	DBP (B)
		DAN (A)	DBN (B)
4. 4.16 KV Bus		C2	D2
		DAN (A)	DBN (B)
5. 4.16 KV Bus		C1	D1
	Norm.	D1P (1)	D2P (2)
	Alt.	D1N (3)	D2N (4)

Note: In parenthesis is listed the train association.

References:

(1) NRC letter To All Power Reactor Licensees, August 8, 1979

(2) Toledo Edison letter, October 9, 1979 (No. 543)

(3) Toledo Edison letter, December 7, 1979 (No. 562)

(4) Toledo Edison letter, January 2, 1981 (No. 673)

(5) Toledo Edison letter, June 16, 1981 (No. 722)

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