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(2-76)

U.S. NUCLEAR REGULATORY COMMISSION

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TO: D.L. ZIEMANN

FROM: FLORDIA POWER & LIGHT CO.
MIAMI, FLORDIA
R.E. UHRIG

DATE OF DOCUMENT 9-22-76

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DESCRIPTION
LTR. RE. OUR 8-13-76 LTR...... TRANS THE FOLLOWING

PLANT NAME: ST. LUCIE # 1

ENCLOSURE
RESPONSE TO A REQUEST FOR INFORMATION CONCERNING THE GRID VOLTAGE CONDITIONS ....

(3 SIGNED CYS. RECEIVED)
(5 PAGES)

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ACKNOWLEDGED

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FOR ACTION/INFORMATION

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9703

NRC FORM 195 (2-76)

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SEP 27 1976
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FPL
FLORIDA POWER & LIGHT COMPANY

September 22, 1976
L-76-338

Regulatory File Cy.

RECEIVED
SEP 27 1976

Office of Nuclear Reactor Regulation
Attention: Mr. Dennis L. Ziemann, Chief
Operating Reactors Branch #2
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Ziemann:

Re: St. Lucie Unit 1
Docket No. 50-335
<u>Grid Voltage Conditions</u>

Your letter of August 13, 1976 contained a Request for Information concerning grid voltage conditions at St. Lucie Unit 1. Our response to your request is attached.

Very truly yours,

Robert E. Uhrig
Vice President

REU/MAS/cpc

Attachment

cc: Mr. Norman C. Moseley
Jack R. Newman, Esquire

9703

ATTACHMENT

ANALYSIS OF THE CONSEQUENCES OF UNDERVOLTAGE CONDITIONS AT THE TURKEY POINT AND ST. LUCIE PLANTS

Two sets of limiting parameters can be defined for the minimum and maximum voltage conditions of the auxiliary power system. The first condition is defined by the main generator terminal voltage excursions when the auxiliary power system is fed from the unit auxiliary transformer. Design limitations of the generator permit a maximum variation of ± 5% of the nominal generator terminal voltage of 22,000 volts. Since the primary of the auxiliary transformer is connected directly to the generator terminals, it can be seen that the primary voltage can vary only from 20,900 volts to 23,100 volts. Operation outside these limits is avoided in order not to damage the main generator.

The second condition that determines the auxiliary power system voltage is the expected range of the 240 KV switchyard voltage when the auxiliary power system is fed through the start-up transformer. Normal operating practice is to maintain 240 KV at the station switchyard. Normally this voltage varies between 238 and 242 KV. A review of operating experience has proven that the switchyard voltage may vary between 228 and 242 KV due to various system parameters such as reactive load on the generators, instantaneous power demand, outages, etc. At Turkey Point the auxiliary power system is estimated to be on the startup transformer less than 1% of the time during normal operating conditions. Even though there has been less than one year of operating experience at St. Lucie, the time on the startup transformer at St. Lucie is expected to be approximately the same as that of Turkey Point. In accordance with operating procedures, the plant auxiliary systems at both plants are supplied with offsite power via the startup transformer until the operating power level is above approximately 170 Mw at St. Lucie and 70 Mw at Turkey Point.

The minimum auxiliary bus voltages occur when the generator terminal voltage is 20.9 KV (auxiliary transformer) or if the auxiliary bus is being supplied by the grid (start-up transformer) when the start-up transformer primary voltage is 228 KV.

The voltage on the auxiliary busses corresponding to the minimum expected voltage conditions are presented herein. The listed busses are those which have the lowest voltage under maximum credible load. Voltage at all other busses are greater than the given values.

ST. LUCIE PLANT

Auxiliary bus voltages with loads being supplied by the auxiliary transformer with generator terminal voltage at 20.9 KV:

		NOMINAL VOLTAGE	ACTUAL VOLTAGE	% OF NOMINAL
4 KV bus	1A2-1A3	4160	4002	96%
480 V bus	1A2	480	441	92%
MCC bus	1A5-1A8	480	436	91%

Auxiliary bus voltages with loads being supplied by the start-up transformer with grid voltage at 228 KV:

		NOMINAL VOLTAGE	ACTUAL VOLTAGE	% OF NOMINAL
4 KV bus	1A2-1A3	4160	3935	95%
480 V bus	1A2	480	433	90%
MCC bus	1A5-1A8	480	429	89%

TURKEY POINT PLANT

Auxiliary bus voltages with loads being supplied by the auxiliary transformer with generator terminal voltage at 20.9 KV:

		NOMINAL VOLTAGE	ACTUAL VOLTAGE	% OF NOMINAL
4 KV bus	3B	4160	3959	95%
480 V bus	3D	480	434	90%

Auxiliary bus voltages with loads being supplied by the start-up transformer with grid voltage at 228 KV:

		NOMINAL VOLTAGE	ACTUAL VOLTAGE	% OF NOMINAL
4 KV bus	3B	4160	3854	93%
480 V bus	3D	480	422	88%

The minimum acceptable bus voltages are established by the design parameters of the various connected devices and equipment. The 4 KV motors are designed to operate at 86% of 4160 volts and the 460 volt motors have also been designed for operation at 86% of 480 volts. Relays, motor control center contactors, and other auxiliary devices are designed for a minimum of 85% of their nominal voltage and as such are not the limiting items.

Therefore, it is demonstrated that the minimum voltages on the auxiliary power system are well above the minimum necessary for proper operation of the various safety and non-safety related equipment.

In order to adequately protect against voltage excursions below the minimum required value for safe and reliable operation, it is necessary to consider many different parameters. Among the primary considerations are 1) to alarm on voltages below a predetermined setpoint, 2) to initiate necessary protective action below a second setpoint, and 3) to avoid unnecessary or false trips.

To satisfy the criteria described above, the St. Lucie Plant incorporates a Westinghouse type CV-2 undervoltage relay on each of the safety related 4.16 KV busses. These relays are used to initiate their respective diesel generator loading sequence. They are induction disc type units which inversely relate voltage to time, that is, the greater the drop in voltage below the setpoint the faster the response. In order to achieve the design criteria the relay tap was selected to be 105 volts. This corresponds to 88.34% of the 4.16 KV bus voltage.

This setting was selected in order to provide a high level of protection and, at the same time, avoid spurious and undesirable false trips due to transients from such causes as inrush currents from the starting of large motors, faults, etc.

Since Turkey Point does not currently have a similar type of undervoltage circuitry, plans are underway to develop a scheme similar to the one used at St. Lucie.

When the auxiliary loading is maximum and supplied through the station start-up transformer, the grid voltage which corresponds to the undervoltage relay setpoint is 224.6 KV at St. Lucie. It should be noted that this voltage is below the grid voltage range. When the auxiliary system is supplied through the unit auxiliary transformer, the range of voltages are determined exclusively by the generator terminal voltage. This cannot be below 20.9 KV without risking damage to the main generator. However, the undervoltage relay setpoint corresponds to 19.3 KV at St. Lucie on the generator terminals under maximum auxiliary load conditions. The setpoint is also below the operating range of the generator terminal voltage. Thus, in both cases, spurious trips, due to voltage supply conditions, can be avoided since the undervoltage setpoints are out of the range of operation.

At St. Lucie, with maximum load on the 480 volt transformer, the minimum 480 volt motor control center bus voltage corresponding to the undervoltage relay setpoint is 83% of 480 volts. A similar setpoint is being considered for Turkey Point. Such a setpoint will avoid spurious trips under the conditions previously described. It is improbable that the 480 volt bus voltage will remain between 83% and 86% for an extended period of time because only transients could cause the voltage to pass through this region. In the unlikely event that the voltage should pass through this region, voltage monitoring and alarm/annunciator equipment is provided at both St. Lucie and Turkey Point to alert the operators of the condition.

Diesel Generators (Turkey Point and St. Lucie)

The loss of offsite power undervoltage relays remain functional through the loading sequence and operation of the diesel generators. Proper design philosophy requires this in order to establish maximum reliability of the diesel generators to assume load. That is, it is considered more advantageous to strip the diesel generator loads and resequence the load than to risk stalling the diesel engine, possibly damaging equipment, and losing all capability of picking up load again on the given engine-generator.

Grid Stability Limits

The results of the stability study referenced in the St. Lucie Unit 1 FSAR imposed no limits on plant operation.

The Turkey Point FSAR did not address a stability analysis. Subsequent analyses and responses to bulk system disturbances have resulted in an extension of the Florida Power & Light Company Emergency Load Management Program and the addition of underfrequency tripping logic for generator protection. The Emergency Load Management Program and preventive maintenance programs for relay hardware assure that the facility is being operated within appropriate grid stability limits.

Proposed Followup Action

The St. Lucie bus voltage alarm setpoints will be revised to correspond to approximately 88% of the 480 volt bus voltage under full load conditions.

The advantages of the St. Lucie design are recognized, and a plan is being considered for utilizing the same principles at Turkey Point.