NRC FORM 195
(2-76)

U.S. NUCLEAR REGULATORY COMMISSION

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DOCKET NUMBER: 50-261

FILE NUMBER:

TO: Mr Reid

FROM: Carolina Pwr & Light Co
Raleigh, NC
J A Jones

DATE OF DOCUMENT: 10-12-76

DATE RECEIVED: 10-14-76

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DESCRIPTION:

Ltr re our 8-12-76 ltr....w/attch......furnishing info concerning effects of degraded grid voltage on unit operation.......

DO NOT REMOVE

PLANT NAME:
Robinson #2

ENCLOSURE:

ACKNOWLEDGED

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NRC FORM 195 (2-76)

CP&L

Carolina Power & Light Company

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October 12, 1976

REGULATORY DOCKET FILE COPY

FILE: NG-3514(R)

SERIAL: NG-76-1360

Director of Nuclear Reactor Regulation
ATTN: Robert W. Reid, Chief
Operating Reactors Branch No. 4
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

H. B. ROBINSON UNIT NO. 2
LICENSE NO. DPR-23
DOCKET NO. 50-261
EFFECTS OF DEGRADED GRID VOLTAGE ON UNIT OPERATION

Dear Mr. Reid:

We are in receipt of your letter of August 12, 1976, in which you requested us to investigate the vulnerability of the H. B. Robinson Unit No. 2 facility to degraded grid voltage conditions of a similar nature to the ones experienced on Millstone Unit 2. We have reviewed the information that exists for the Robinson Plant and have determined that it is not adequate to provide a complete response to the information requested in your Enclosure 2, Request for Information, which you forwarded with your letter. As a result, we have contracted with Ebasco Services, Inc., to provide a voltage drop analysis, which should allow a complete response to your concerns. We expect this analysis to be completed by November 1, 1976, and available for submittal soon thereafter. However, recognizing that the basic concern you express is related to voltage levels that could exist in the plant and for which full capability for starting and running emergency equipment does not exist, we have gathered available information and have formulated some interim procedures which we will institute and will modify as necessary when the final analysis is received from Ebasco. The available information and our interim procedures to avoid incidents similar to the one at Millstone are presented below.

In the normal electrical lineup (when the plant is operating above 5% rated power), three of the four 4160 volt busses, three of the four 480 volt nonsafety busses, and one of the two 480 volt emergency busses are supplied through the Unit Auxiliary Transformer (UAT) with the other 4160 volt, 480 volt nonsafety and 480 volt emergency busses being supplied by the Start-up Transformer (SAT). The UAT is supplied from the main station generator, while the SAT is supplied by the 115 KV switchyard. When plant output is below 5% rated power, all busses are supplied by the SAT. This condition exists approximately 5% of the time during normal plant operation between refueling outages, excluding major outages which require the plant to be placed in a cold shutdown condition,

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and is a result of plant trips or minor maintenance outages during which the plant is kept at hot standby or hot shutdown conditions. Refer to Section 8 of the Robinson FSAR for a description of the facility electrical system.

The nominal switchyard voltages for the Robinson Plant are 115 KV and 230 KV. A voltage schedule supplied by the Systems Control Center calls for voltages to be maintained between 97% and 101% of the nominal voltage on the 115 KV bus. A review of the recording voltmeter traces during 1976 shows that at no time has the voltage on the 115 KV bus fallen below 97%, even during an unscheduled outage of the Robinson No. 2 Unit.

Because of the close proximity of the Darlington County Internal Combustion Turbine Plant (eleven units) and the Robinson No. 1 Unit, the strong 230 and 115 KV transmission system connecting the area to the rest of the CP&L system and the location of capacitor banks throughout the system, a voltage variation at the Robinson Plant below the scheduled level is very unlikely. Should the system voltage begin to drop for any reason, capacitor banks in the affected area that are on voltage control will automatically come on line to correct the situation. Also, the system dispatcher is constantly monitoring the grid voltages and voltage distributions. Should additional action be required, he can bring into operation generating units in the troubled area that are on spinning reserve. In the unlikely event of the simultaneous failure of several system components causing the voltage to suddenly drop, the dispatcher is immediately notified by an alarm system that is set to go off should the voltage fall below 96% of the nominal level.

The effect of degraded grid voltages on the in-plant busses remain to be determined by detailed studies; however, it is expected that these studies will establish the minimum voltages at the generator bus or the startup transformer under normal operation and upset conditions. Based on these values, corrective actions can be specified which will maintain the capability of the plant to handle safety system initiation.

The undervoltage trip devices for the plant are located on each of the emergency busses and the 4160 V busses. An undervoltage condition of 75% of nominal voltage will trip the reactor coolant pumps on the 4160 busses. If an undervoltage condition of 68.3% of nominal bus voltage (480 V) is detected on the emergency bus, the bus will automatically be isolated, the diesel-generator for that bus will be started, and power will be supplied to the bus once the voltage and frequency reaches the proper values. One consideration for the setting of this undervoltage trip is to avoid inadvertent tripping of the bus and subsequent load shedding during transient loading of the bus. Additional bases for this trip are being investigated. Controls for all the breakers on the emergency busses are energized by direct current supplied from the station battery system and thus are not affected by variations in AC power.

Voltages are monitored in the control room for the following locations:

1. The 230 KV Switchyard
2. The 115 KV Switchyard
3. Four 4160 Volt Busses

There are no alarms on these voltages to indicate high or low voltages. An alarm is provided for generator output voltage to indicate to the operator that the voltage is either too high or too low and to alert him to the need for change of generator output to bring the voltage back within the operating range of 21 to

23 KV. The need for additional alarms or monitors in other locations will be investigated based on the results of the Ebasco study.

The load shedding feature of the emergency busses operates as follows. On loss of voltage the undervoltage trip device on the emergency bus actuates to isolate the bus, start the diesel generator, and shed all loads on the emergency bus except for the safety-related motor control center. When the diesel generator voltage rises to its rated value, its breaker is closed to supply power to the emergency bus. The blackout loads are automatically time sequenced onto the bus so that the generator's load carrying capabilities are not exceeded.

If the sequence has started and power on the emergency bus is interrupted, all breakers will be tripped and the sequencing (timing) relays will be deenergized by the undervoltage relay contacts. The timing relays reset instantaneously. When power is restored, the undervoltage relays energize the sequencing circuit and the sequence is reinitiated. Load shedding is required upon loss of voltage to allow the diesel generator to again accept the load gradually so that its load carrying capabilities are not exceeded. Refer to Section 8 of the H. B. Robinson FSAR for additional details of the load sequencing.

CP&L has also investigated the unit's operating limits with respect to voltage, frequency, and real and reactive power. No grid stability analyses were provided in the Robinson FSAR, and there are no grid requirements on the plant as dictated by system operations other than the voltage schedules discussed above. However, plant operating limits exist, as discussed below.

The operating limits on real and reactive power of the turbine generator are expressed by the attached figure of megawatts vs. megavars as a function of power factor. As voltage of the generator is raised or lowered to adjust power factor, the operator must ensure that the operating envelope for the appropriate hydrogen pressure is not exceeded. Although generator voltage affects the ratio of megawatts to megavars, operation of the generator is not limited by voltage limitation setpoints.

When load is greater than available generation, system frequency will sag. Grid stability depends on maintaining proper frequency. If the plant is operating below its maximum output capability, the generating capacity can be increased to aid in maintaining system frequency. However, this is limited by the consideration of real vs. reactive power as expressed above. Thus, if frequency continues to sag, operating procedures require separation from the system at 58.5 hertz. This will prevent tripping off the reactor coolant pumps at 58.2 hertz which would instigate a reactor and a turbine trip.

Based on Carolina Power & Light Company's investigations to date, it is highly unlikely that a situation would exist where grid voltage would fall to a value where safety-related functions could not be accomplished if required. However, it is possible that a voltage below 95% of nominal on the 115 KV bus could create such a problem, as is evident from the Millstone experience. An appropriate lower limit will be defined by the Ebasco study. In the interim, we intend to institute a procedure as described below, which will provide for operator action if the grid voltage falls too low. This procedure will be in effect whenever the plant is off-line and in a hot shutdown, hot standby, or lower power condition.

During the plant conditions outlined above, the plant operator will monitor the 115 KV bus voltage and assure that it remains above 95% of nominal voltage. A firm basis does not exist for this lower limit, but it is

consistent with the results of voltage drop studies on other units. Also, preliminary calculations indicate that the emergency bus voltage is adequate for sustained loads that are expected under this low voltage condition.

In the unlikely event that the 115 KV bus voltage should fall below 95% of nominal voltage due to system conditions, the operator will immediately start the diesel generator units. As soon as these units reach the then existing frequency and voltage conditions on the 480 volt emergency busses, the breakers connecting the units to the emergency busses will be closed and the breakers connecting the offsite system to the busses opened. The diesel units will then be brought up to rated frequency and voltage and the emergency bus loads supplied from this source. When the system voltage returns to normal levels, the procedure will be reversed, first closing the breakers connecting the system to the emergency busses and then separating the diesel generators from the busses.

This procedure provides the advantage of supplying the emergency busses with full voltage so that if a loss of coolant accident or other severe transient did occur, the emergency busses could adequately supply the safety-related loads. The time for switchover of the diesel generator power supply to the emergency bus under the above procedure is short with respect to the probability of a LOCA occurring. Based on past system operating experience, it is highly unlikely that this procedure will be involved.

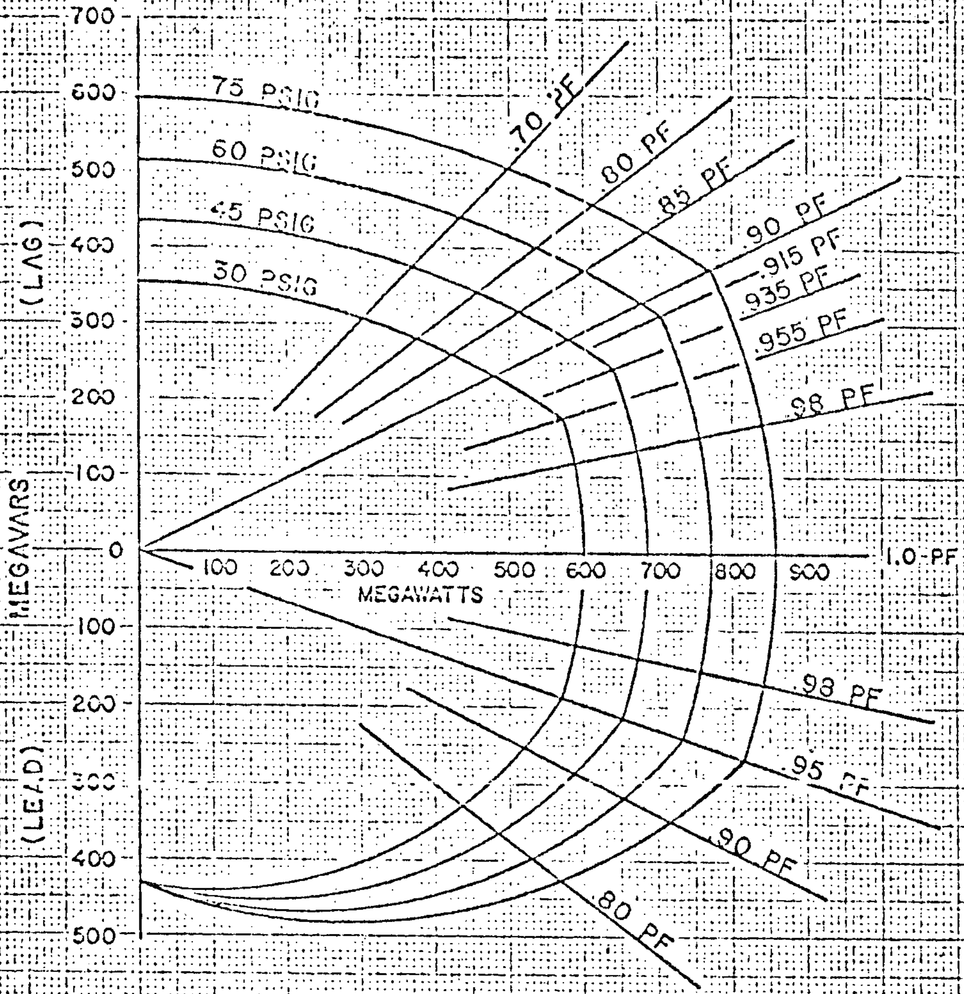
The study to be performed by Ebasco will define the lower voltage limit at which action must be initiated. We expect to have this information in the near future for submittal to you. Should you require additional information in the interim, please contact us.

Yours very truly,

J. A. Jones
Executive Vice President
Engineering, Construction & Operation

JAJ/kr

Attachment



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