REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

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UTLEY,E.E. Carolina Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
SCHWENCER,A. Operating Reactors Branch 1

SUBJECT: Responds to NRC 790808 ltr re specific actions to be taken by licensees as followup to IE Info Notice 79-04 re adequacy of station electric distribution sys voltages.Summary of degraded grid voltage study encl.

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Carolina Power & Light Company

October 5, 1979

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SERIAL NO.: GD-79-2502

Office of Nuclear Reactor Regulation
Attention: Mr. Albert Schwencer, Chief
Operating Reactors Branch No. 1
United Stated Nuclear Regulatory Commission
Washington, D.C. 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261
LICENSE NO. DPR-23
ADEQUACY OF STATION ELECTRIC DISTRIBUTION SYSTEM VOLTAGES

Dear Mr. Schwencer:

Your letter of August 8, 1979 identified specific actions to be taken by licensees as a followup of IE Information Notice 79-04. This letter documents Carolina Power & Light Company's (CP&L) response to those items.

The Degraded Grid Voltage Study by Ebasco Services Incorporated, dated October 15, 1976, for H. B. Robinson Unit No. 2 demonstrated that the off site grid and the on site electric distribution system are of sufficient capacity to automatically start as well as operate all required safety loads. A summary of the Degraded Grid voltage Study is provided as Enclosure 1.

The criteria of the test which you requested for verification of the validity of the Degraded Grid Voltage Study was discussed in a phone conversation between our staff and Mr. M. Thiramel of the NRC on September 11, 1979. This conversation resulted in the understanding that the NRC desired a test in which all normal running loads were being powered from the unit auxiliary transformer and a shift to the start up transformer is initiated simultaneously with the activation of all safety systems required for an accident. Conditions such as these are not consistent with the design at H. B. Robinson Unit No. 2.

The electric distribution system for H. B. Robinson Unit No. 2 is designed such that during power operations of 5% or greater, 4160 Bus Number 3, 480 Volt Bus 3, and Emergency Bus E2 are powered from the startup transformer with all other major buses being supplied by the unit auxiliary transformer. An engineered safeguards signal initiated at time Ø seconds would result in a reactor trip and an engineered safety feature (ESF) actuation sequence. With off site power available, the first ESF load would start on buses E1 and E2 at time 5 seconds. The last ESF load would start on buses E1 and E2 at time 40 seconds. At time 60 seconds, the turbine would trip with a resultant shift of unit auxiliary loads to the startup transformer.

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Since a test, which would initiate the sequence of events described above would provide the most meaningful results when conducted under actual operating conditions; and the acceptance criteria for such a test would be the successful starting and sustained operation of the required ESF loads, CP&L feels that a recent reactor trip at H. B. Robinson Unit No. 2 fulfills the requirements of such a test. This trip occurred on August 16, 1979 while the unit was operating at 100% power. This trip was initiated by a spurious safety injection signal, caused by the accidental jarring of a containment vessel pressure transmitter. During this event, the electric distribution system was aligned as described previously and all ESF loads were started on their designated transformers. The shift of auxiliary loads from the unit auxiliary transformer to the startup transformer occurred without incident and resulted in all site auxiliary and ESF loads being powered from the start up transformer.

H. B. Robinson Unit No. 2 was constructed prior to the issuance of General Design Criteria 17. Therefore, a single startup transformer connects the multiple sources of off site power to the on site electric distribution system. Should a failure of the startup transformer occur, an installed spare startup transformer could be jumpered into service. During the time that the startup transformer was out of service, the unit auxiliary transformer could supply power to the on site distribution system by back-feeding the main transformer from the 230 KV switchyard. Prior to back-feeding the main transformer from the 230 KV switchyard, the generator must be disconnected from the main transformer by removing the connecting straps.

If you have any questions on this subject, do not hesitate to call on my staff.

Yours very truly,

M. A. McDuffie

for E. E. Utley
Executive Vice President
Power Supply & Customer Services

EEU/jcb

Enclosure

DEGRADED GRID VOLTAGE STUDY SUMMARY

1.0 INTRODUCTION

The Degraded Grid Voltage Study for H. B. Robinson Unit No. 2 demonstrated that the H. B. Robinson off site grid and on site distribution system have the capability and capacity to supply auxiliary electric power throughout a specific range of grid voltages without violating equipment rating or operating ranges. This report summarizes the results of the studies which are pertinent to the Nuclear Regulatory Commission letter of August 8, 1979 concerning the adequacy of station electric distribution system voltages.

2.0 STEADY STATE CONDITIONS

The steady state voltage studies for H. B. Robinson Unit No. 2 were conducted to determine the minimum voltages which could be expected on the major on site electrical buses during steady state power operations as the grid voltage was varied from 0.95 pu to 1.06 pu of 115 KV. The following conditions were assumed to exist during the conduct of this study:

1. The plant is assumed to be operating at 100% power.

2. All electrical loads which are required to support power operations are being powered from the 115 KV grid via the startup transformer.

3. All electrical loads are assumed to be in continuous operation (i.e., no equipment starts or stops).

4. The power being drawn by each motor is assumed to be the brake horsepower rating. For those loads which a brake horsepower rating was not available, a brake horsepower rating was calculated from observed operating conditions.

Table 1 shows the calculated voltage for each of the major buses as grid voltage was varied from 0.95 pu to 1.06 pu of 115 KV. This table shows that all 4160 and 480 Volt buses are maintained above the minimum manufacturers' recommended voltage for continuous motor operation, 3600 Volts and 414 Volts respectively. It should also be noted that the undervoltage trip settings for the emergency busses, 328 Volts, is also exceeded. The maximum recommended voltage for continuous operation of the 4 KV and 480 Volt motors, 4400 Volts and 514 Volts respectively, is satisfied for all grid voltages except 1.06 pu, where the 4160 Volt busses are predicted to exceed the maximum recommended voltage by 1.0%. An over voltage condition such as this would only be incurred as a transient condition and would be quickly remedied by voltage regulation or removal of lightly loaded generating units from the grid.

3.0 TRANSIENT CONDITIONS

The transient voltage studies for H. B. Robinson Unit No. 2 were conducted to determine the minimum voltage which could be expected on the major on site electrical busses during the starting of large motors as grid voltage is varied from 0.95 pu to 1.06 pu of 115 KV. The following conditions were assumed to exist during the conduct of this study:

1. The plant is assumed to be operating at 100% power.

2. All electrical loads which are required to support power operations are operating with the exception of the motor being started.

3. All electrical loads are being powered from the 115 KV grid via the startup transformer.

4. The power being drawn by each motor is assumed to be the name plate rating.

Although it is unrealistic to be starting a reactor coolant pump at 100% power, this condition was allowed in the computer program to study the effect of starting the largest motor in the plant while the electric distribution system was fully loaded.

Table 2 lists the minimum calculated voltage for each of the major busses during the starting of large motors as grid voltage is varied from 0.95 pu to 1.06 pu of 115 KV. The minimum voltage required for the continued operation of the 4 KV and 480 volt motors are 2800 Volts and 312 Volts respectively. With the exception of buses E2 and MCC6, these minimum running voltages are always exceeded; for the case of buses E2 and MCC6, the minimum running voltage is just reached during the starting of a 6000 Hp motor at a degraded grid voltage of 0.95 pu.

Since the minimum voltage on buses E2 and MCC6 were approached in Table 2, the conditions under which these values were derived were reevaluated. Table 2 was developed using name plate horsepower ratings. Name plate ratings are normally indicative of design conditions and are more severe than normal operating conditions. As an example, the reactor coolant pump has a name plate rating of 6000 Hp but is observed to operate at 4700 Hp.

The use of name plate ratings results in a steady state voltage of 402 Volts on bus E2 at 0.95 pu; the use of brake horsepower ratings results in a steady state voltage of 427 Volts on bus E2 at 0.95 pu. With the analysis redone using the more realistic initial voltage of 427 Volts on bus E2, the minimum voltage calculated for bus E2 during the starting of a 6000 Hp motor at a grid voltage of 0.95 pu is 336 Volts. This voltage is well above both the minimum running voltage for 480 Volt motors and the under voltage trip setting for the emergency busses.

The minimum starting voltage for the 4 KV and 480 Volt motors are 3200 Volts and 345 Volts respectively. Table 2 shows that when starting the largest motor on any bus, the minimum starting voltage is always exceeded.

4.0 CONCLUSIONS

The steady state and transient studies show that the H. B. Robinson 115 KV grid and the on site electric distribution system are capable of starting and operating all loads which are required for normal power operations throughout a specific range of degraded grid voltages. The transient conditions following a reactor trip and the accident conditions following a LOCA are less limiting than power operations because of the decreased load on the electrical distribution system.

Following a reactor trip the main feed pumps see an immediate reduction in load as feed flow decreases. During this transient no loads other than those required for power operation are required. The loading on the grid and station electric distribution system is continuously decreased as the plant is brought to hot shutdown condition.

The sequence of events following a LOCA causes the immediate reduction of loads on the station electric distribution system. The safety injection signal which initiates the engineered safeguards actuation sequence also initiates a feedwater isolation signal. This causes the immediate tripping of the main feed pumps with a resulting decrease of 12,000 Hp on station loads. During the engineered safeguards actuation sequence the station electric distribution system is loaded with only an additional 2900 Hp resulting in an overall lower loading than that experienced at power operation.

TABLE 1

Calculated Bus Voltage During Steady State Operation

Pu	4160#1/2	4160#3/4	E1	E2	MCC5	MCC6
0.95	3913	3932	433	426	430	423
1.00	4147	4165	461	454	458	452
1.06	4425	4442	495	488	492	486

TABLE 2

Minimum Calculated Bus Voltage During Starting of Large Motors

2.a) Start of 6000 Hp Load on 4160 Bus 1 and 2

Pu	4160#1/2	4160#3/4	E1	E2	MCC5	MCC6
0.95	3245	3307	323	310	325	312
1.00	3452	3509	351	339	353	341
1.06	3696	3747	383	372	385	375

2.b) Start up of 150 Hp Load on 480V Bus 1 and 3

Pu	4160#1/2	4160#3/4	E1	E2	MCC5	MCC6
0.95	3786	3845	384	380	373	369
1.00	4029	4081	414	408	404	398
1.06	4315	4360	448	441	439	432

2.c) Start up of 350 Hp Load on 480V Bus E1 and E2

Pu	4160#1/2	4160#3/4	E1	E2	MCC5	MCC6
0.95	3776	3846	376	381	365	370
1.00	4017	4082	405	409	395	399
1.06	4302	4362	438	443	429	434

2.d) Start up of 150 Hp Load on 480V Bus Mcc5 and MCC6

Pu	4160#1/2	4160#3/4	E1	E2	MMC5	MMC6
0.95	3792	3862	388	392	361	359
1.00	4035	4099	418	422	390	387
1.06	4321	4379	453	457	423	420

Note: Each of the tables above was developed through the use of name plate horsepowers which gives the most conservative results.