Docket No. 50-261

DISTRIBUTION
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DEisenhut
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EJordan
ACRS (10)
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Mr. E. E. Utley, Executive Vice President
Power Supply and Engineering & Construction
Carolina Power and Light Company
Post Office Box 1551
Raleigh, North Carolina 27602

JAN 19 1984

Dear Mr. Utley:

SUBJECT: ADEQUACY OF STATION ELECTRIC DISTRIBUTION VOLTAGE

Carolina Power and Light (CP&L) was requested by NRC letter dated August 8, 1979 to review the subject matter. The review was to consist of:

a) Determining and analytically the capacity and capability of the offsite power system and onsite distribution system to automatically start, as well as operate, all required loads within their required voltage ratings in the event of 1) an anticipated transient, or 2) an accident (such as LOCA) without manual shedding of any electic loads.

b) Determining if there are any events or conditions which could result in the simultaneous or, consequential loss of both required circuits from the offsite network to the onsite electric distribution system and thus violating the requirements of GDC 17.

CP&L responded by letters dated October 5, 1979, July 23, 1980, October 14, 1982 and March 23, 1983. We have requested our contractor, Lawrence Livermore Laboratory (LLL) to review these submittals.

We concur with LLL findings that additional information is required before we can conclude that the electrical distribution systems at H. B. Robinson Unit No. 2 are adequate to maintain the voltage within the design limits of the required Class 1E equipment. Attached is a copy of our draft Safety Evaluation on this subject.

Please provide additional information as required to resolve the four open items identified on pages 5 and 6 of the draft Safety Evaluation within 45 days of the date of receipt of this letter, and a schedule for providing the verification testing data described in open item (4) page 6.
cc: See next page

The reporting and/or recordkeeping requirements contained in this letter affect fewer than ten respondents; therefore, OMB clearance is not required under P. L. 96-511.

ORIGINAL SIGNED BY

Steven A. Varga, Chief
Operating Reactors Branch #1
Division of Licensing

Enclosure:
As stated

cc: See next page

ORB#1:DL	ORB#5:DL	C-ORB#1:DL
GRequa:ps	RDudley	SVarga
1/19/84	1/19/84	1/19/84

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

Docket No. 50-261

January 19, 1984

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Power Supply and Engineering & Construction
Carolina Power and Light Company
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Division of Licensing

Enclosure:
As stated

cc: See next page

Mr. E. E. Utley
Carolina Power and Light Company

H. B. Robinson Steam Electric
Plant 2

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DRAFT

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

INTRODUCTION AND SUMMARY

Carolina Power and Light Company (CP&L) was requested by NRC letter dated August 8, 1979 to review the electric power system at H.B. Robinson, Unit No. 2. The review was to consist of:

a) Determining analytically the capacity and capability of the offsite power system and onsite distribution system to automatically start as well as operate all required loads within their required voltage ratings in the event of 1) an anticipated transient, or 2) an accident (such as LOCA) without manual shedding of any electrical loads.

b) Determining if there are any events or conditions which could result in the simultaneous or, consequential loss of both required circuits from the offsite network to the onsite electric distribution system and thus violating the requirements of GDC 17.

The August 8, 1979 letter included staff guidelines for performing the required voltage analysis and the licensee was further required to perform a test in order to verify the validity of the analytical results. CP&L responded by letters dated October 5, 1979, July 23, 1980, October 14, 1982 and March 23, 1983.

A detailed review and technical evaluation of the submittals was performed by LLL under contract to the NRC, with general supervision by NRC staff. This work is reported by LLL in Technical Evaluation Report (TER), "Adequacy of Station Electric Distribution System Voltages For The H.B. Robinson Steam

Electric Plant, Unit 2," dated July, 1983 (attached).

We have reviewed this report and concur in the conclusion that additional information is required to complete the evaluation of the adequacy of the station electric distribution systems to maintain the voltage within the design limits of the required Class 1E equipment for worst case station electric load and grid voltage.

EVALUATION CRITERIA

The criteria used by LLL in this technical evalution of the analysis includes GDC 13 ("Instrumentation and Control"), GDC 17 ("Electric Power Systems") of Appendix A to 10 CFR 50; IEEE Standard 308-1974 ("Class 1E Power Systems for Nuclear Power Generating Stations"), ANSI C84.1-1977 ("Voltage Ratings for Electric Power Systems and Equipment - 60 Hz"), and the staff positions and guidelines in NRC letter to CP&L dated August 8, 1979.

ANALYSIS AND TEST FEATURES

Initially CP&L analyzed the adequacy of the plant's onsite distribution based on the postulated extremes of grid voltage range from 0.95 pu to 1.06 pu. The initial results of the analysis showed that in most cases the worst case terminal voltages were within the equipment design ratings. However, the cases where the voltage was marginal were reanalyzed by using an actual grid voltage schedule (0.97 -1.01 pu) as maintained by the system control center. The following is a list of the major assumptions used for the analysis:

(1) Design brake horsepower (BHP) was used for the large and medium sized motors (approximately 10% greater than the recorded running load). The data is taken from the FSAR and manufacturer speed-torque curves.

(2) Nameplate horsepower, $Pf_{run} = 0.88$, $Pf_{start} = 0.20$, eff = 0.92 and LRA/FLA = 6.5 was used where actual data was not available.

(3) Motor cable feeder size and length used from breaker coordination study.

(4) Transformer nameplate data with assumed X/R ratios. The assumed ratios were based on NEMA and ANSI standards and actual compiled Westinghouse transformer data.

(5) MCC starter data from manufacturer.

(6) Safety injection loads per FSAR.

(7) Power factor used at BHP extrapolated from typical motor characteristic curves.

The worst case Class 1E equipment terminal voltages occur under the following conditions:

(1) The maximum steady-state voltage occurs when the offsite grid is at its maximum expected voltage of 1.06 pu of the 115 Kv nominal with the plant in a cold shutdown mode. All buses are lightly loaded.

(2) The minimum steady-state voltage shows when the plant is operating at 100% and a LOCA occurs. All electrical loads required to support this mode being supplied power from the startup transformer via the 115 Kv system while the 115 Kv system maintains a minimum operating voltage of 0.97 pu. This is to show realistic system voltage profiles based on the voltage schedules maintained by the system control center.

(3) The minimum transient voltage occurs when the plant is operating at 100% power and a unit trip occurs. The offsite 115 Kv system is at 0.95 pu and a reactor coolant pump is being started.

The analysis submitted demonstrated that the offsite source (voltage schedule of 0.97 pu to 1.01 pu) and the onsite distribution system has the capacity and capability to start and operate the Class IE equipment within their voltage design rating under worst case conditions. However as for the extremes of the grid voltages (0.95 pu to 1.06 pu) assumed in the analysis, this was shown to be marginal equipment voltages. To ensure the above grid voltage shedule is maintained the licensee has committed to install undervoltage and overvoltage monitors on the offsite 115 Kv system so that appropriate corrective action can be taken upon receiving an alarm.

CP&L verified their analytical results by performing tests. The power source for the test was the startup transformer loaded to a minimum of 40% and the unit at 50% reactor power. The verification test results indicated a maximum percentage error for steady state conditions of + 1.1% and - 2.69% for transient conditions at the 480-Volt class IE buses. A negative percentage error indicates that the measured values were higher than the calculated values. Nevertheless these percentage errors are within the accuracy requirement outlined in the staff position and are acceptable.

CONCLUSIONS

We have reviewed the LLL Technical Evaluation Report and concur in the findings that:

(1) CP&L has provided verified voltage analysis to demonstrate that Class 1E equipment voltage will remain within acceptable operating limits for the worst case conditions analyzed.

(2) The test used to verify the analysis was valid and showed the analysis to be acceptable.

(3) Spurious tripping from the offsite sources will not occur under worst case conditions. Spurious tripping is prevented during the starting of the reactor coolant pump by manually bypassing/reinstating the degraded grid protection scheme.

(4) For the maintained voltage schedule of 1.01 pu, the Class 1E equipment's maximum grid voltage design limit will not be exceeded under maximum grid voltage (minimum plant load) conditions.

(5) No event or condition will result in the simultaneous or consequential loss of both required circuits to the onsite distribution system (compliance with GDC 17). However, there will be a time delay of 16 to 24 hours if a loss of the immediate access offsite power supply occurs. During this contingency, the plant safety related equipment will be supplied by the emergency diesels. There are two such diesels, in addition, a third diesel dedicated to shutdown has been provided.

The following information is still required to be submitted by the licensee:

(1) The setpoints for the overvoltage and undervoltage monitors on the 115 Kv system and the corrective actions to be taken upon receiving an alarm.

(2) Update the plants FSAR and incorporate limiting conditions for operation in the Technical Specifications on the use of backfeeding through the main/unit auxiliary transformer to the Class 1E buses. It should also include any administrative controls.

(3) Include in the design modification for the bypassing/reinstatement of the degraded grid protection scheme during RCP starting, a failure-to-reinstate alarm or provide for automatic bypassing/reinstatement.

(4) Results of the in-plant tests for verifying the acceleration times of the starting loads used in the voltage profile analyses.

After resolution of the above items, PSB will issue a supplement to this evaluation report.

UCID- 19711

TECHNICAL EVALUATION REPORT ON THE ADEQUACY OF STATION ELECTRIC DISTRIBUTION SYSTEM VOLTAGES FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2

(Docket No. 50-261)

James C. Selan

July 22, 1983

Lawrence Livermore Laboratory

This is an informal report intended primarily for internal or limited external distribution. The opinions and conclusions stated are those of the author and may or may not be those of the Laboratory.

This work was supported by the United States Nuclear Regulatory Commission under a Memorandum of Understanding with the United States Department of Energy.
NRC FIN No. A-0250

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ABSTRACT

This report documents the technical evaluation of the adequacy of the station electric distribution system voltages for the H. B. Robinson Steam Electric Plant, Unit 2. The evaluation is to determine if the onsite distribution system in conjunction with the offsite power sources has sufficient capacity to automatically start and operate all Class 1E loads within the equipment voltage ratings under certain conditions established by the Nuclear Regulatory Commission.

The analyses submitted demonstrated that the station's electric distribution system will supply adequate voltage to the Class 1E equipment for the worst-case conditions analyzed.

FOREWORD

This report is supplied as part of the Selected Operating Reactor Issues Program II being conducted for the U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Licensing, by Lawrence Livermore National Laboratory.

The U. S. Nuclear Regulatory Commission funded the work under the authorization entitled "Selected Operating Reactor Issues Program II," B&R 20 19 10 11 1, FIN A-0250.

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ILLUSTRATIONS

TECHNICAL EVALUATION REPORT ON THE ADEQUACY OF STATION ELECTRIC DISTRIBUTION SYSTEM VOLTAGES FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2

(Docket No. 50-261)

James C. Selan

Lawrence Livermore National Laboratory, Nevada

1. INTRODUCTION

The Nuclear Regulatory Commission (NRC) by a letter dated August 8, 1979 [Ref. 1] expanded its generic review of the adequacy of the station electric distribution systems for all operating nuclear power facilities. This review is to determine if the onsite distribution system in conjunction with the offsite power sources has sufficient capacity and capability to automatically start and operate all required safety loads within the equipment voltage ratings. In addition, the NRC requested each licensee to follow suggested guidelines and to meet certain requirements in the analysis. These requirements are detailed in Section 5 of this report.

By letters dated October 5, 1979 [Ref. 2], July 23, 1980 [Ref. 3], October 14, 1982 [Ref. 4], and March 23, 1983 [Ref. 5], Carolina Power and Light Company (CP&L), the licensee, submitted their analysis and conclusion regarding the adequacy of the electrical distribution system's voltages at H. B. Robinson Steam Electric Plant, Unit 2.

The purpose of this report is to evaluate the licensee's submittal with respect to the NRC criteria and present the reviewer's conclusion on the adequacy of the station electric distribution systems to maintain the voltage within the design limits of the required Class 1E equipment for the worst case starting and load conditions.

2. DESIGN BASIS CRITERIA

The design basis criteria that were applied in determining the adequacy of station electric distribution system voltages to start and operate all required safety loads within their required voltage ratings are as follows:

(1) General Design Criterion 17 (GDC 17), "Electric Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," in the Code of Federal Regulations, Title 10, Part 50 (10 CFR 50) [Ref. 6].

(2) General Design Criterion 13 (GDC 13), "Instrumentation and Control," of Appendix A, "General Design Criteria for Nuclear Power Plants," in the Code of Federal Regulations, Title 10, Part 50 (10 CFR 50) [Ref. 6].

(3) ANSI C84.1-1977, "Voltage Ratings for Electric Power Systems and Equipment" [Ref. 7].

(4) IEEE Std 308-1974, "Class 1E Power Systems for Nuclear Power Generating Stations" [Ref. 8].

(5) "Guidelines for Voltage Drop Calculations," Enclosure 2, to NRC letter dated August 8, 1979 [Ref. 1].

3. SYSTEM DESCRIPTION

An electrical one-line diagram of the distribution system for the H. B. Robinson Steam Electric Plant, Unit 2, is shown in Figure 1. The output of the main generator is connected to the 230 kV offsite system through a main transformer bank (three single phase transformers). The unit auxiliary transformer (UAT), which is also connected to the main generator output, supplies the majority of the auxiliary electrical system during on-line operation. The startup transformer (SUT) No. 2 is connected to the 115 kV offsite system which is tied to the 230 kV system by an autotransformer. The buses supplied by the "Y" winding of SUT No. 2 are 4160-volt Bus No. 3, 480-volt Bus No. 3, Emergency 480-volt Bus No. 2, 480-volt MCC No. 6, and 208/120 MCC No. 9. Auxiliary power during startup, shutdown, or after a reactor trip, is supplied by the 115 kV system.

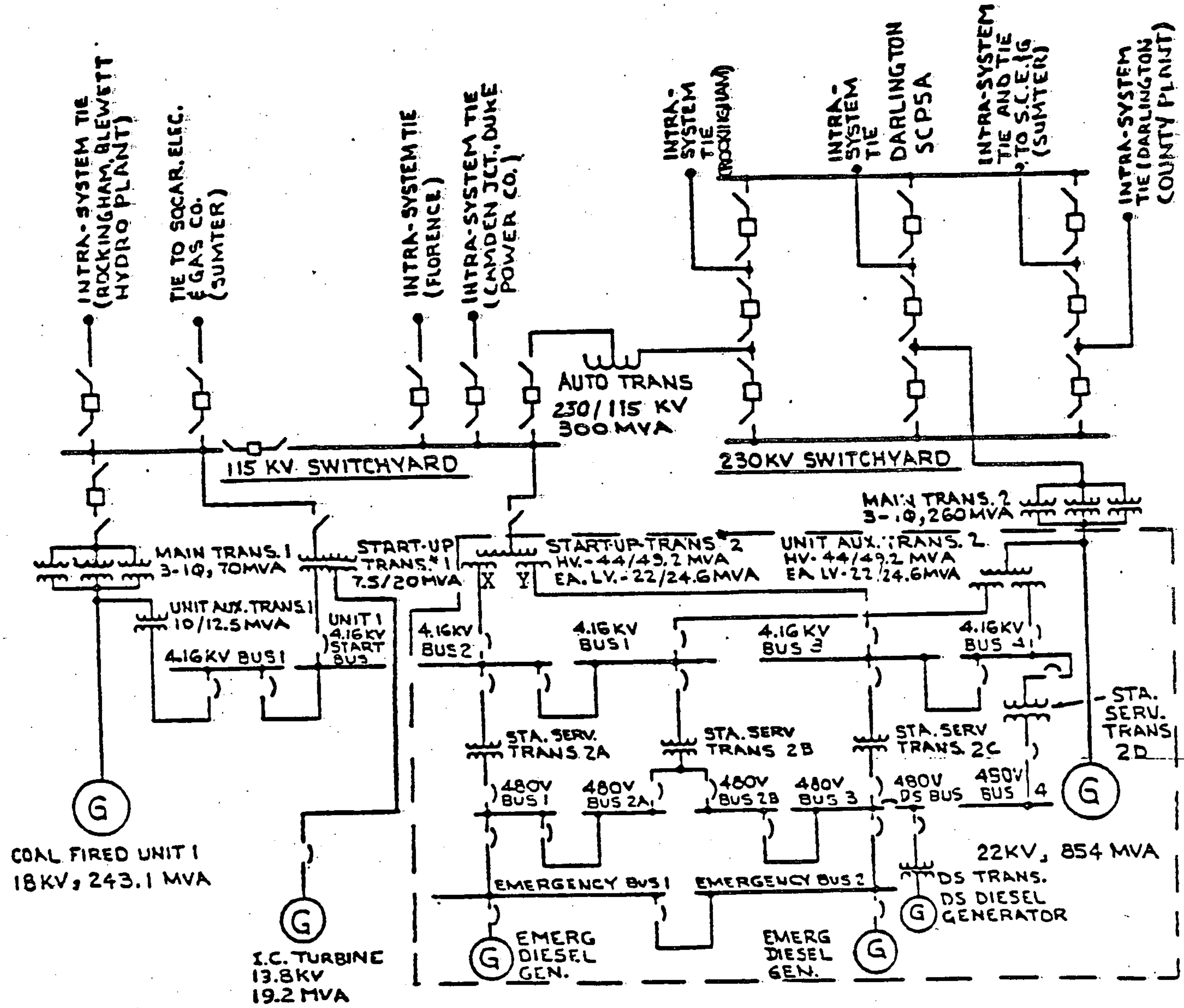

FIGURE 1 - H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2
ELECTRICAL ONE-LINE DIAGRAM

An engineered safeguards signal will result in a reactor trip with an engineered safety features (ESF) load sequence occuring. With offsite power available, the first ESF loads will start at T=5 seconds and the last loads at T=40 seconds. At T=60 seconds, the turbine will trip with the UAT loads transferring to the SUT. For the failure of the single SUT, power could be supplied by placing either into service a spare SUT (minimum of 24 hours to connect) or enable backfeeding through the main transformer bank and UAT (minimum of 16 hours to enable). The use of the onsite sources in the interim time will be governed by limiting conditions for operations in the plant's Technical Specifications.

A voltage schedule at the plant's switchyard is maintained at 0.97 per unit (pu) to 1.01 pu and monitored by the system's control center. Should the voltage begin to drop, capacitor banks in the effected areas will automatically come on-line to correct the low voltage problem.

The onsite auxiliary system consists of four 4160-volt non-Class 1E buses and eight 480-volt buses, five of which are non-Class 1E, two are emergency (Class 1E), and one dedicated shutdown bus (Class 1E). The dedicated shutdown bus can be supplied by offsite power, onsite emergency diesels, or a dedicated diesel generator.

The Class 1E equipment is protected from sustained undervoltage conditions by two levels of undervoltage protection schemes. The first level scheme (loss-of-voltage) has a voltage setpoint of 328 volts ± 1 volt (68% of 480 volts) with a time delay of 0.75 ± 0.25 seconds. The second level scheme (degraded voltage) has a voltage setpoint of 412 volts ± 1 volt (86% of 480 volts) with a time delay of 10 seconds ± 0.5 seconds.

4. ANALYSIS

4.1 ANALYSIS CONDITIONS

Carolina Power and Light Company analyzed the adequacy of the plant's electrical distribution system for various plant operating scenarios. Voltage profiles were made using computerized load flow programs. The analyses were performed using an offsite grid voltage range from 0.95 pu to 1.06 pu which is outside the voltage schedule maintained by system control center of 0.97 to 1.01 pu of the 115 kV nominal. In conjunction with the minimum and maximum grid voltage, worst case plant load conditions of maximum load (accident) and minimum load (cold shutdown) were used in the analyses. In addition to the above analysis conditions several other assumptions were made and are as follows:

(1) Design brake horsepower (BHP) was used for the large and medium sized motors (approximately 10% greater than the recorded running load). The data is taken from the FSAR and manufacture speed-torque curves.

(2) Nameplate horsepower, $Pf_{run} = 0.88$, $Pf_{start} = 0.20$, eff = 0.92 and LRA/FLA = 6.5 was used where actual data was not available.

(3) Motor cable feeder size and length used from breaker coordination study.

(4) Transformer nameplate data with assumed X/R ratios. The assumed ratios were based on NEMA and ANSI standards and actual compiled Westinghouse transformer data.

(5) MCC starter data from manufacturer.

(6) Safety injection loads per FSAR.

(7) Power factor used at BHP extrapolated from typical motor characteristic curves.

Using the above analysis parameters and assumptions, the transient voltage profile analysis was based on starting the largest motor on each bus; 6000 Hp on the 4 kV buses, 350 Hp on the 480-volt buses, 125 Hp on the 480-volt MCCs and 3.9 Hp on the 208/120-volt MCCs.

4.2 ANALYSIS RESULTS

The initial results of the analyses showed that with the grid voltage (0.95 to 1.06 pu) outside of the plant's required voltage schedule (0.97 to 1.01 pu), the worst case terminal voltages were in most cases within the equipments design ratings. In those instances where the voltage was marginal, the cases were reanalyzed with the grid voltage at 0.97 pu, a tap change (lowered by 2 1/2%) to 4056 volts on the station service transformers, actual measured load values, and with the automatic load shedding of the steam generator feedwater pump (SGFP) with a LOCA signal. Also included in the reanalysis was the tripping (manual) of a reactor coolant pump at 30 seconds after a LOCA signal. Various other loads may also be tripped off manually from 20 minutes to 30 minutes following a LOCA signal [Ref. 5, p. 12].

The worst case Class 1E equipment terminal voltages occur under the following conditions and are summarized in Table 1:

4.2.1 Overvoltage: Plant in a cold shutdown mode, offsite grid voltage of 1.06 pu of the 115 kV nominal, supply power through the SUT 'Y' winding, buses loaded to their most lightly loaded condition.

4.2.2 Undervoltage - Steady State: Plant operating at 100% power and a LOCA occurs, all electrical loads required to support this mode being supplied power from the SUT via the 115 kV system, the 115 kV system is at 0.97 of nominal, all normal loads are running with the Class 1E loads sequencing on, station service transformers at the 4056-volt tap, actual measured load values used, and automatic tripping of the SGFP.

TABLE 1

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2
CLASS 1E EQUIPMENT VOLTAGE RATINGS AND ANALYZED
WORST CASE TERMINAL VOLTAGES
(in % of Equipment Nominal Voltage Rating)

		Maximum		Minimum		
		Rated	Analyzed	Rated	Analyzed	
Equipment	Nominal Voltage Rating (100%)		Steady State		Steady State	Transients[a]
Motors	460					
Start				75		86.1/74.1
Operate		110	113.3	90	92.4	
MOVs						
Start				—		82.5/72.0
Operate	200	110	110.0	90	89.0[b]	
Starters	480					
Pickup				84	86.7	
Dropout		60.4				80.4/70.2
Operate		110	107.3	85	86.7	
Starters	208/120					
Pickup				79.8	85.6	
Dropout		53.4				79.3/69.2
Operate		110	105.8	85	85.6	
Other[c] Equipment						

(a) The first worst case transient value represents the Class 1E loads starting (see Section 4.2.2) while the second value represents the worst case transient caused by starting the 6000 Hp reactor coolant pump (see Section 4.2.3). The Class 1E loads are sequenced on.

(b) Duration of motor operated valve actuation is 1 minute to 4 minutes. If RCP is tripped off at 30 seconds, steady state voltage will be 90.5%.

(c) Fed from inverters or regulating transformers which maintains an output voltage of 120 volts ± 0.5% over an input range of 380 to 520 volts (79% to 108% of 480 volts).

4.2.3 Undervoltage - Transient: Plant operating at 100% power and a unit trip occurs, all electrical loads required to support power operation are running with the electrical loads being supplied by the SUT from the 115 kV system, the 115 kV system is at 0.95 of nominal and the 6000 Hp reactor coolant pump is being started.

4.3 ANALYSIS VERIFICATION

Carolina Power and Light Company verified their analytical results by performing two tests. The first test was to determine the degree of validity of the computerized analysis. The power source for the test was the start-up transformer loaded with a minimum load of 40% and the unit at 50% reactor power. The loading on the associated connected buses was with a total minimum load on the 4160-volt buses of 40% and a combined minimum total load on the 480/208/120-volt systems of 40%. Recording meters were used to record the test data. The results of the first test indicated a maximum deviation of 4.88% in the comparison of the calculated to measured values. Evaluation of this percentage error led to the formulation of the second test which was to determine the accuracy of the assumed power factor used in the analysis. System loading was used as close as possible to the first test. The results of the test indicated that the power factor was indeed lower than assumed which accounted for the larger percentage error. The new power factors were then used in the computer model to determine the analysis accuracy. The test verification results now indicate a maximum percentage error for steady state conditions of +1.1% and -2.69% for transient conditions at the 480-volt Class 1E buses. A negative percentage error indicates that the measured values were higher than the calculated values.

5. EVALUATION

The NRC generic letter [Ref. 1] stated several requirements that the plant must meet in the voltage analysis. These requirements and an evaluation of the licensee's submittals are as follows:

(1) With the minimum expected grid voltage and maximum load condition, each offsite source and distribution system connection must be capable of starting and continuously operating all Class 1E equipment within the equipment's voltage ratings.

The original analyses showed that for grid voltage of 0.95 pu to 1.06 pu of nominal (outside the plant's voltage schedule), the equipment terminal voltages were only marginal in a few cases. The licensee submitted a reanalysis for the worst case conditions using the voltage schedule of 0.97 pu to 1.01 pu of nominal, which demonstrated that the offsite source connection through SUT No. 2 and the onsite distribution system has the capacity and capability to automatically start and continuously operate the Class 1E equipment within their voltage design ratings under worst case conditions. The licensee has committed to install undervoltage monitors on the 115 kV system to alarm in the control room of a potential low grid voltage condition [Ref. 5]. The exact setpoint would be determined from additional studies. The licensee is required to submit the undervoltages alarm setpoint and the procedures for corrective action upon receiving the low voltage alarm.

In addition to the above analyses, the licensee is proposing to place operating limits on the use of the backfeed feature through the main/unit auxiliary transformers. The Class 1E buses will be supplied by the backfeeding feature only in a cold shutdown condition. The Class 1E buses will be supplied by the diesel generators during a hot shutdown condition with the remaining station buses supplied by backfeeding. An analysis was not required for the cold shutdown condition since plant loading will be at a minimum. These operating limits are required to be incorporated in the plant's Technical Specifications.

(2) With the maximum expected offsite grid voltage and minimum load condition, each offsite source and distribution system connection must be capable of continuously operating the required Class 1E equipment without exceeding the equipment's voltage ratings.

The analysis submitted demonstrated that under the worst case condition of minimum load/maximum grid voltage that a potential overvoltage of approximately 3% above the +10% design rating could occur. However, the analysis voltage of 1.06 pu is above that restricted in the plant's voltage schedule of 1.01 pu which is to be maintained by Systems Control Center. Therefore, based upon the plant's voltage schedule and planned corrective actions, the length of time of the 3% potential overvoltage which could occur as analyzed is considered to have little to no adverse effects on the equipment before corrective actions are taken. The licensee has committed to install overvoltage monitors on the 115 kV system to alarm in the control room of a potential high grid voltage condition. The setpoint for the alarm has not been determined. Therefore, the licensee is required to submit the alarm setpoint after determination and the procedures for corrective action upon receiving a high voltage alarm.

(3) The analysis must show that there will be no spurious separation from the offsite power source to the Class 1E buses by the voltage protection relays when the grid is within the normal expected limits and the loading conditions established by the NRC are being met.

Based on the observed estimate acceleration times ($\leq$ 7 seconds) of the starting loads (except for the reactor coolant pumps), spurious separations from the offsite sources will not occur [Ref. 5]. The accelerating time for the RCP varies from 11.5 seconds (motor manufacturer data) at 96% bus voltage to 38.5 seconds at 77.3% bus voltage. The starting of the RCP could cause a voltage transient of sufficient magnitude and duration to exceed the degraded grid undervoltage relay setpoint of 412 volts $\pm$ 1 volt with a time delay of 10 seconds $\pm$ 0.5 seconds. The licensee has installed a manual key lock switch and indicating light in the trip circuit of the degraded grid relays for bypassing/reinstating the protective feature [Ref.5].

Based on the review of the bypassing/reinstating design modification, I recommend that the licensee be required to install a failure-to-reinstate alarm in conjunction with the indicating light for reinstatement. A more acceptable and preferred method is to install an automatic bypass/reinstatement design by utilizing, in part, a definite time-delay relay in the RCP starting circuit. The starting of the RCP would automatically disable the undervoltage relays, and after the time delay relay times out, automatically reinstate the undervoltage relays. The time-delay would be determined by the coordination of the undervoltage relay setpoint (412 volts $\pm$ 1 volt for 10 $\pm$ 0.5 seconds) with the motor accelerating time at the setpoint.

The licensee has committed to do an in-plant test to verify the acceleration times of the starting loads used in the analyses.

(4) Test results are required to verify the voltage analyses calculations submitted.

CP&L verified their analytical results by performing several tests. The test results produced worst case percentage errors of +1.1% for steady state conditions and -2.69% for transient conditions. These percentage errors are within the degree of accuracy of the recording equipment and are judged acceptable.

(5) Review the plant's electrical power systems to determine if any events or conditions could result in the simultaneous loss of both offsite circuits to the onsite distribution system (compliance with GDC 17).

In Figure 1, two offsite circuit paths to the onsite distribution system exist through startup transformer No. 2 and by backfeeding through the main transformer bank No. 2 and the unit auxiliary transformer No. 2. As stated in the plant's updated FSAR, the loss of the single startup transformer would result in putting into service a spare SUT (minimum of 24 hours) or by backfeeding through the main/unit auxiliary transformers (minimum of 4 hours). The licensee has revised the 4 hours to a more realistic time of

16 hours to accomplish the backfeeding [Ref. 5]. The licensee states that no event or condition could cause the loss of both circuits [Ref. 5]. However, the GDC 17 criterion assumes the "loss of all onsite alternating current power supplies". Therefore, the licensee has not demonstrated, and is required to, that in the minimum time frame from 16 to 24 hours (no AC power available), that the reactor could be maintained in a safe condition until the restoration of at least one offsite circuit is accomplished.

6. CONCLUSIONS

Based on the information submitted by Carolina Power and Light Company for the H. B. Robinson Steam Electric Plant, Unit 2, it is concluded that:

(1) The offsite power source through the SUT in conjunction with the onsite distribution system, has the capacity and capability to supply voltage to the Class 1E equipment within the voltage design ratings under worst case conditions.

(2) Spurious tripping from the offsite sources will not occur under worst case conditions. Spurious tripping is precluded during the starting of the reactor coolant pump by manually bypassing/reinstating the degraded grid protection scheme.

(3) For the maintained voltage schedule of 1.01 pu, the Class 1E equipment's maximum grid voltage design limit will not be exceeded under maximum grid voltage/minimum plant load conditions.

(4) Acceptable test verifications were made to verify the analytical data submitted.

(5) No event or condition will result in the simultaneous or consequential loss of both required circuits to the onsite distribution system. However, a minimum of 16 to 24 hours is required before a delayed offsite source connection can be accomplished.

The information still required to be submitted by the licensee to supplement the voltage profile analyses is as follows:

(1) The setpoints for the overvoltage and undervoltage monitors on the 115 kV system and the corrective actions to be taken upon receiving an alarm.

(2) Update the plants FSAR and incorporate limiting conditions for operation in the Technical Specifications on the use of back-feeding through the main/unit auxiliary transformers to the Class 1E buses. Should also include any administrative controls.

(3) Include in the design modification for the bypassing/reinstatement of the degraded grid protection scheme during RCP starting, a failure-to-reinstate alarm or provide for automatic bypassing/reinstatement.

(4) Results of the in-plant tests for verifying the acceleration times of the starting loads used in the voltage profile analyses.

(5) Demonstrate that during the minimum time frame of 16 to 24 hours necessary to restore at least one offsite source (no onsite sources available), the reactor can be maintained in a safe condition.

Accordingly, I recommend that the NRC accept the voltage analyses submitted which demonstrates the adequacy of voltage to the Class 1E equipment for starting and continuous operation under worst case conditions.

REFERENCES

1. NRC letter (W. Gammill) to all Power Reactor Licensees, dated August 8, 1979.
2. CP&L letter (E. E. Utley) to NRC (A. Schwencer), dated October 5, 1979.
3. CP&L letter (E. E. Utley) to NRC (S. A. Varga), dated July 23, 1980.
4. CP&L letter (L. W. Eury) to NRC (S. A. Varga), dated October 14, 1982.
5. CP&L letter (L. W. Eury) to NRC (S. A. Varga), dated March 23, 1983.
6. Code of Federal Regulations, Title 10, Part 50 (10 CFR 50), General Design Criterion 13 and 17 of Appendix A for Nuclear Power Plants.
7. ANSI C84.1977, "Voltage Rating for Electric Power Systems and Equipment."
8. IEEE Std. 308-1974, "Criteria for Class 1E Power Systems for Nuclear Generating Stations."