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Docket No. 50-255
LS05-80-11-020

NOVEMBER 16 1980

Mr. David P. Hoffman
Nuclear Licensing Administrator
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Hoffman:

RE: SEP TOPIC VI-7.C.1, INDEPENDENCE OF REDUNDANT ONSITE POWER SOURCES (PALISADES PLANT)

Enclosed is a copy of our evaluation of Systematic Evaluation Program Topic VI-7.C.1 - Independence of Redundant Onsite Power Sources. This assessment compares your facility, as described in Docket No. 50-255, with the criteria currently used by the regulatory staff for licensing new facilities. Please inform us if your as-built facility differs from the licensing basis assumed in our assessment within 30 days of receipt of this letter.

This evaluation will be a basic input to the integrated safety assessment for your facility unless you identify changes needed to reflect the as-built conditions at your facility. This topic assessment may be revised in the future if your facility design is changed or if NRC criteria relating to this topic is modified before the integrated assessment is completed.

Sincerely,

Original signed by
Dennis M. Crutchfield

Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing

Enclosure:
Completed SEP
Topic VI-7.C.1

cc w/enclosure:
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NRC FORM 318 (9-76) NRCM 0240 ☆U.S. GOVERNMENT PRINTING OFFICE: 1979-289-369

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

November 18, 1980

Docket No. 50-255
LS05-80-11-020

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Nuclear Licensing Administrator
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Jackson, Michigan 49201

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Dennis M. Crutchfield

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Operating Reactors Branch #5
Division of Licensing

Enclosure:
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ENCLOSURE

EVALUATION REPORT OF SEP TOPIC VI-7.C.1
INDEPENDENCE OF REDUNDANT ONSITE POWER SOURCES
PALISADES
DOCKET NO. 50-255

I. Introduction

The purpose of this evaluation is to ascertain the independence of redundant onsite power sources. Review criteria, review guidelines, and review areas, to be covered in this evaluation, are defined in sections II and IV. Review areas that are not covered, but are related and essential to the completion of this topic, are covered by other SEP topics defined in section III. SEP topics are defined in the Report on the Systematic Evaluation of Operating Facilities dated November 25, 1977.

This topic evaluation report is limited to identification of compliance to review criteria, identification of deviation from review criteria, and identification of any viable corrective measures for each deviation identified. An integrated system assessment of the identified deviation's significance and recommendation as to the imposition of corrective measures will be the subject of a subsequent report.

II. Review Criteria

Review criteria that govern the subject safety topic are identified in section 8.3.1, part II, items 1 and 2 and section 8.3.2, part II, items 1 and 2 of NUREG-75/087, NRC Standard Review Plan.

III. Related Safety Topics

The following listed review areas are not covered in this report, but are related and essential to the completion of this topic. These review areas are covered by other SEP topics as indicated below.

1. The capability of the electrical, instrumentation, and control system components to function during and after design basis events, such as earthquakes and anticipated operational occurrences, is covered by SEP topic III-6 and III-12;

2. The capacity, capability, and reliability of standby power supplies is covered by SEP topic VIII-2;

3. The offsite power system is covered by topic VIII-1;

4. Electrical and physical separation between safe shutdown system components including the shutdown system's vital support system components is covered by topic VII-3. This area includes cables from the Class 1E distribution system to the system loads;

5. Technical Specification requirements are covered by topic XVI;

6. System testing and surveillance requirements are covered by topics VIII-3A, VIII-3B, and VI-10A;

7. Capability of heating and ventilation systems to maintain a controlled environment for safety related instrumentation and electrical equipment located outside containment is covered by topic IX-5;

8. The adequacy of the quality assurance program is covered by topic XVII;

9. Systems required for safe shutdown are identified by topic VII-3;

10. Shared engineered safety features, onsite emergency power, and service systems for multiple unit facilities are covered by topic VI-10B;

11. The ECCS Actuation System is covered by topic VI-7.A.3 and VII-2;

12. The capacity, capability, and reliability of DC power supply is covered by topic VIII-3;

13. The effects of connecting nonsafety loads to safety related power sources and routing of non-safety cables with safety related cables is covered by topic VII-4 and VIII-2; and

14. The capacity, capability, and reliability of the onsite power system to supply connected loads under all modes of plant operation is covered by topic VIII-1A.

15. Protection of the Class 1E power system components from design basis events such as flooding, missiles, pipe breaks, and fires are covered by topics II-3, III-4, III-5, and IX-6.

16. The independence of the onsite power system with respect to the offsite power system is covered by SEP topic VIII-1A.

IV. Review Guidelines

The purpose of this evaluation is to ascertain the degree to which Palisades design complies with review criteria that deal with the onsite electric power

distribution system. The review areas to be covered in this evaluation include (A) the required redundancy of the onsite power system, (b) the electrical interconnection between redundant portions of the system, and (c) the physical separation between redundant components of the system including power, instrument, and control cables. Review guidelines that address this topic's defined review areas are delineated in the following sections of NRC Standard Review Plan: Section 8.3.1, part III, items 1 and 2 and Section 8.3.2, part III, items 1 and 2.

Review guidelines that address physical separation of power, instrumentation, and control cables are defined in Regulatory Guide 1.75 and IEEE Standard 384. These physical separation guidelines are included with this topic review. Additional review guidelines for cable separation, as well as for the physical separation of redundant distribution system components, are defined in section 9.5.1, Appendix A, "Guidance for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976," positions D.1.(a).(2) and D.1.(C) of the NRC Standard Review Plan. [Refer to the Palisades X fire hazards analysis, the NRC Palisades X Fire Protection Safety Evaluation Report, and any supplements thereto for identification of compliance to and deviation from section 9.5.1 guidelines.]

V. Evaluation

A simplified diagram of the onsite Class 1E power system for Palisades is presented in figure 1. The diagram is based on Palisades electrical drawings E-1 through E-17. The following evaluation is based on the simplified diagram and the Palisades FSAR. The numbered items on the diagram identify interconnections between redundant distribution systems. The letter-number items

identify distribution system components reviewed for physical separation. Determination of component location and physical separation from redundant counterparts is based upon Palisades equipment location drawings M-1 through M-15.

A. Required Redundancy

The Palisades onsite Class 1E AC power system consists of two redundant diesel generator (DG) supplied power divisions. DG 1-1 supplies 2400 V bus 1C and, DG 1-2 supplies 2400 V bus 1D and, through Station Power Transformer 12, 480 V bus 12 and 480 V MCC 2.

The Palisades onsite Class 1E DC power system consists of two redundant 125 V DC divisions. Battery No. 1, Charger No. 1 and Charger No. 3 supply 125 V DC Bus No. 1. Charger No. 1 is supplied from MCC 1 (and utilimately DG 1-1). Charger No. 3 is supplied from MCC 2 (DG 1-2). Both chargers are normally connected to 125 V DC Bus No. 1. The supply arrangement to 125 V DC Bus No. 2 is again, similar, with Charger No. 2 fed from MCC 3 and Charger No. 4 fed from MCC 1.

Based upon the need for a two division Emergency Core Cooling capability and safe shutdown capability. We conclude that the two redundant onsite AC and DC power systems described above meet the redundancy requirements. This meets the review guidelines and criteria defined in Section II and IV of this report.

The Palisades 120 volt AC instrument power is supplied from a single, non-redundant, 120 volt AC instrument bus (Y01). The instrument bus can receive power from either 480 volt motor control center 1 or 480 volt motor control center 3 via an automatic transfer switch. We conclude that the single instrument bus does not meet the minimum redundancy requirements and is a deviation from the review guidelines and criteria defined in Section II and IV of this report. Redundant instrument loads supplied from this single bus do not meet the single failure criterion. The requirement that safe shutdown loads meet the single failure criterion is covered by topic VII-3, Systems Required for Safe Shutdown. Deviations and recommendation for corrective measures are addressed in topic VII-3.

The Palisades 120 volt AC vital power is supplied from four 120 volt preferred AC busses numbered 1 through 4. Preferred AC buses 1 and 3 comprise one division of preferred AC: Preferred AC buses 2 and 4 comprise the other. Buses 1 and 3 are supplied by Inverters 1 and 3 respectively, or by the Bypass Regulator; the supply arrangement for buses 2 and 4 is similar.

The Reactor Protection System and the Engineered Safety Features Actuation System are four channel systems requiring a redundant power supply for each channel. We conclude that the four preferred AC buses described above meet these redundancy requirements. This meets the review guidelines and criteria defined in Section II and IV of this report.

B. Electrical Interconnections

A simplified diagram of the onsite power system is presented in figure 1. Each of the following paragraph number designations correspond to numbers shown on figure 1 and to interconnections between redundant Class 1E divisions or between Class 1E and non-Class 1E systems.

1. The 2400 V buses 1C and 1D (and, therefore, DG 1-1 and D 1-2) can be tied together only if either offsite feeder breakers 152-105 and 152-203 (normally closed) or breakers 152-106 and 152-202 (normally open) are closed. On loss of the offsite source, these breakers each receive an automatic open signal from independent low voltage sensing devices located on bus 1C for breakers 152-105 and 152-106 and on bus 1D for breakers 152-202 and 152-203. Thus, there is no single failure that can cause the interconnection of bus 1C and 1D and the paralleling of the standby onsite power sources after loss of offsite power. This meets the review criteria and guidelines defined in Section II and IV of this report.

2. See item 1.

3. The 480 V buses 11 and 12 may be tied together by closing breakers 52-1118 and 52-1217 (normally open). An interlock prevents the closure of these tie breakers if both breakers connecting the redundant sources to buses 11 and 12 (breakers 5201102 and 52-1202, respectively) are closed; one of these two supply breakers must be open in order to close the tie breakers. This meets the review criteria and guidelines defined in Section II and IV of this report.

There are no limiting conditions for plant operation when 480 volt bus 12 receives power from 2400 V bus 1C through 480 volt bus 11 or when 480 volt bus 11 receives power from 2400 V bus 1D through 480 volt bus 12. This is a deviation from review guidelines defined in section II and IV of this report. An example of an approach that could correct this deviation, would be to include the appropriate limiting conditions for operation in the Palisades Technical Specifications.

The Palisades design does not include control circuitry to open the two tie breakers automatically upon the loss of offsite power. This is a deviation from review guidelines. An example of an approach that could correct this deviation would be to install appropriately designed control circuitry to prevent possible paralleling of standby power sources, or overloading of one onsite source on loss of offsite power.

4. 480 volt motor control center number 2 (MCC #2) and MCC #1 were tied together through instrument AC bus as shown on figure 1. This interconnection was deleted on Palisades drawing E-1, Plant Singie Line Diagram, Revision 1, dated March 28, 1978. The power source to the instrument AC bus was changed from MCC #2 to MCC #3. The change represents a new interconnection between MCC #1 and MCC #3. See item 10 for the evaluation of this new interconnection.

By the deletion of the interconnection between MCC #2 and MCC #1, the concern for possible failure of both redundant divisions because of failure of the common instrument AC bus, has been eliminated.

5. Each of the two battery chargers which supply power to a given 125 V DC bus, are undersized. Thus both chargers or the battery and one charger will be needed to supply the required maximum steady state DC load. Given a LOCA with simultaneous loss of offsite power, one of the two battery chargers will be automatically disconnected to maintain the independence of the two Class 1E power divisions. Also, given a single failure of a battery charger or its association AC power source, one of the two battery chargers will be lost. Present review guidelines require battery charger capacity to be sufficient to carry the maximum steady state DC loads as well as recharge the battery following an accident. The present design at Palisades is a deviation from these review guidelines. An example of an approach that could correct this deviation would be to replace two of the four battery chargers (one per division) with larger capacity battery chargers.

6. See item number 5.

7. Each preferred AC bus my be supplied by its inverter or the Bypass Regulator. The supply breakers to each preferred AC bus are interlocked to preclude the possibility of a bus being tied to both sources simultaneously. This meets review guidelines. However, it

is possible to supply all four Preferred AC buses from the Bypass Regulator simultaneously. This is a deviation from review guidelines. An example of an approach that could correct this deviation would be to limit the number of preferred AC buses that could be simultaneously connected to the Bypass Regulator and provide limiting conditions for operation in the Technical Specifications.

8. Associated non-Class 1E 480 volt bus 77 is interconnected with non-Class 1E bus 78 by a single tie breaker. The supply breakers to bus 77 and 78 are interlocked with the tie breaker such that one of the two supply breakers must be open to close the tie breaker. Thus, Class 1E bus 1C cannot be paralleled with non-Class 1E bus 1E through bus 77 and 78. Also, the load breaker on bus 1C opens on loss of offsite power to prevent diesel generator 1-1 overload. This meets the review guidelines.

9. The interconnection between 480v bus 13 and 480v bus 14 is the same as item 8 evaluation.

10. Division 1 Class 1E MCC #1 is interconnected with non-Class 1E MCC #3 through an auto transfer switch via the instrument AC bus. Power to the instrument AC bus is normally supplied by MCC #1. With loss of MCC #1 the power source is automatically transferred from MCC #1 to MCC #3. Because MCC #3 is non-Class 1 and is not interconnected with MCC #2 (MCC #1's redundant counterpart), this design meets the review guidelines.

11. Two associated non-Class 1E 480 volt busses for switchyard loads are interconnected by a single tie breaker. The supply breakers to these busses are interlocked with tie breaker such that one of the two supply breakers must be open to close the tie breaker. Thus, Class 1E bus 1C cannot be paralleled with non-Class 1E buses. The evaluation of item 8 applies to this design.

C. Physical Separation

A simplified diagram of the onsite power system is presented in figure 1. The letter-number designations on figure 1 identify distribution system components herein evaluated for physical separation. The following letter-number designation correspond to letter-number designations shown on figure 1.

(A) Each of the following items are located in a dedicated room or are separated by the equivalent of a three-hour rated fire barrier from their redundant counterpart or from components associated with their redundant counterpart. This meets the review criteria and guidelines defined in Section II and IV of this report.

(1) Diesel generator 1-2

(2) Diesel generator 1-1

(3) 2400 V bus 1D

(4) 2400 V bus 1C

(5) 125 V batteries

(B) Each of the following items are located in the general area of their redundant counterparts or in the area of components associated with their redundant counterparts. The separation between components is less than the equivalent of a three-hour rated fire barrier. This is a deviation from Section 9.5.1 review guidelines defined in Section IV of this report. Refer to the Palisades fire hazards analysis, the NRC Palisades Fire Protection Safety Evaluation Report, and any supplements thereto for identification of compliance to, deviation from, and corrective design measures required for deviations from those review guidelines.

(1) Cable between 2400v bus 1D and DG 1-2

(2) Cable between 2400v bus 1C and DG 1-1

(3) Cable between 2400v bus 1D and bus 12

(4) Cable between 2400v bus 1C and bus 11

(5) 480v bus 12

(6) 480v bus 11

(7) Cable between bus 12 and MCC #8

(8) Cable between bus 11 and MCC #7

(9) MCC #8

(10) MCC #7

(11) Cable between bus 12 and MCC #2

(12) Cable between bus 11 and MCC #1

(13) MCC #2

(14) MCC #1

(15) Battery Charger C-2

(16) Battery Charger C-1

(17) 125v DC bus #2

(18) 125v DC bus #1

(19) DC-AC inverters I-1, 2, 3, and 4 including associated cables

(20) Preferred AC busses 1, 2, 3, and 4

For the above listed cables and for instrumentation and control cables associated with the Class 1E power distribution system components, the separation is less than the 5 ft. vertical 3 ft. horizontal recommended by Regulatory Guide 1.75. This is a deviation from the review guidelines. An example of an approach that could correct this deviation would be to perform an analysis for the above defined cables to identify the specific deviations from the recommendations of Regulatory Guide 1.75. For each specific deviation identified, corrective measures such as installation of barriers, rerouting of redundant cables, or supplemental analyses justifying the existing separation on some other defined basis are acceptable approaches to removing this deviation.

VI. Conclusion

The following list itemizes the deviations from review guidelines that have been identified and described in Section V of this report.

1. The single 120 volt AC instrument bus does not meet the minimum redundancy requirement. (The deviation and recommendation for corrective measures are addressed in topic VII-3.)

2. There are no limiting conditions for plant operation when bus 12 receives power from bus 1C through bus 11 or when bus 11 receives power from bus 1D through bus 12.

3. In regard to the tie breakers between 480 V bus 11 and 12, control circuitry to automatically open these tie breakers concurrent with a loss of offsite power is not included in the design.

4. Each of the four battery chargers, supplying the 125v DC system, are undersized with respect to carrying maximum steady state DC load following an accident.

5. Each preferred AC bus may be supplied by its inverter or the Bypass Regulator. It is possible to supply all four preferred AC buses from the Bypass Regulatory simultaneously.

6. The physical separation of distribution system components (identified in section V-C items B1 through B20) are less than the equivalent of a three-hour fire rated barrier from their redundant counterparts or from components associated with their redundant counterparts.

7. In regard to distribution system cables (identified in section V-C items B1 through B20) and instrumentation and control cables associated with the distribution system components, the physical separation is less than the 5 ft. vertical 3 ft. horizontal recommended by regulatory guide 1.75.

FIGURE 1 SHEET 1 OF 2.

SIMPLIFIED ONSITE POWER SYSTEM FOR PALISADES

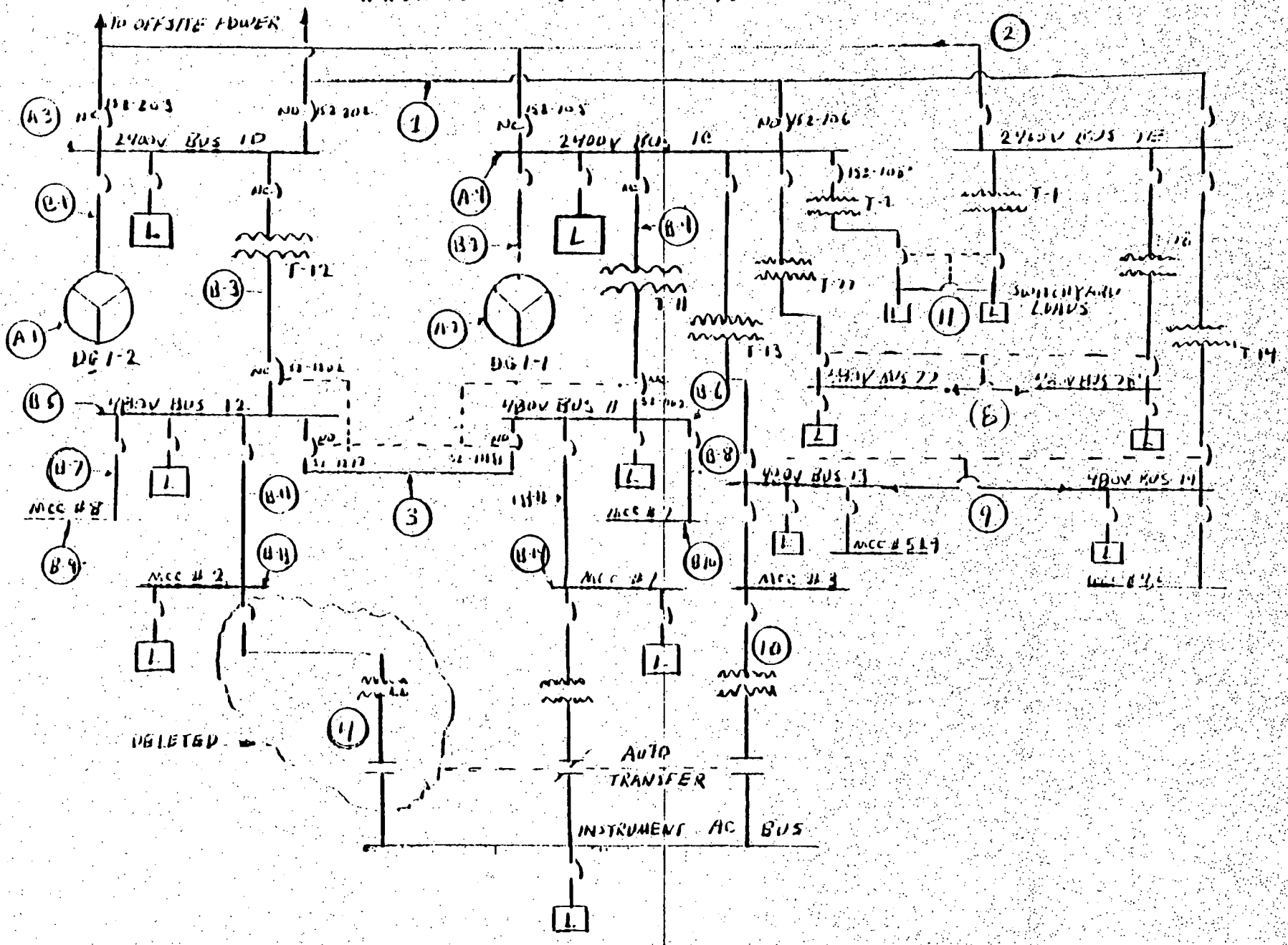

FIGURE 1 SHEET 2 OF 2

SIMPLIFIED ONSITE POWER SYSTEM FOR PALISADES