Union Electric
Callaway Plant

PO Box 620
Fulton, MO 65251

January 18, 2001

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Stop P1-137
Washington, DC 20555-0001

ULNRC-04353

Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT
UNION ELECTRIC COMPANY
OPERATING LICENSE AMEMDMENT REQUEST:
"UNREVIEWED SAFETY QUESTION REGARDING INSTALLATION OF LOAD TAP CHANGING TRANSFORMERS TO PROVIDE OFFSITE POWER TO THE SAFETY RELATED ELECTRICAL BUSES"

(References: 1. ULNRC-04220, dated April 17, 1999
2. ULNRC-04239, (FSAR Update) dated May 1, 2000

Pursuant to 10 CFR 50.90, AmerenUE hereby requests an amendment to the Facility Operating License No. NPF-30 for Callaway Plant. Upon approval of this request the proposed changes will be incorporated into the Callaway Plant (Updated) Final Safety Analysis Report.

The proposed changes support the planned replacement of the Engineered Safety Features (ESF) Transformers with new transformers having active automatic Load Tap Changers (LTCs). This design change was evaluated per 10 CFR 50.59 and was determined to constitute an Unreviewed Safety Question as defined in 10 CFR 50.59 (a)(2)(i) and (ii). Specifically, a failure of the LTC controller, providing an active function to provide acceptable voltages to the safety-related electrical distribution system, could: increase the probability of malfunction of equipment important to safety previously evaluated in the FSAR, and could create the possibility of a malfunction of equipment important to safety of a different type than any evaluated previously in the

A053

FSAR. (50.59 criteria (a)(2)(i) and (ii) respectively.) However, a new accident is not being created and no radiological consequences are being affected.

AmerenUE has already installed capacitor banks associated with the ESF busses to compensate for low grid voltage. The capacitor banks were evaluated and installed under 10 CFR 50.59 and did not involve an unreviewed safety question. The new transformers with LTCs will work in conjunction with the installed capacitor banks.

Attachment 1 is the required Affidavit. Attachment 2 provides a detailed description of the proposed change and AmerenUE's determination that the proposed change does not involve a significant hazards consideration. Attachment 3 provides the existing FSAR pages marked-up to show the proposed change. Attachment 3 includes changes to the Callaway FSAR approved by AmerenUE since the required 10 CFR 50.71(e) update submitted in Reference 2, these pages are designated "OL-12 11/01". FSAR changes regarding the capacitor banks are not considered part of the aforementioned Unreviewed Safety Question. Attachment 4 provides the existing TS Bases pages marked-up to show the proposed change.

This letter identifies the actions committed to by AmerenUE in this submittal. Other statements are provided for information purposes and are not considered to be commitments. Commitments included in this submittal are as follows:

a. AmerenUE will begin to implement major portions of this modification during Refuel 11, starting on April 7, 2001.
b. Installation of the load tap changing transformer with the taps fixed is considered a like kind replacement which AmerenUE has evaluated and approved per 10 CFR 50.59.
c. Administrative controls and/or physical blocks will be implemented to ensure the load tap changers are fixed and not operational until approval of this amendment.
d. Post-modification testing of the LTCs will be performed during Refuel 11 to support automatic operation of the LTC after amendment approval. If this amendment is not approved prior to the completion of Refuel 11, no further testing will be required. Post modification testing procedures will be developed and evaluated in accordance with 10 CFR 50.59.

AmerenUE requests approval of this proposed License Amendment prior to the beginning of the next refueling outage scheduled for April 7, 2001. Receipt of this Amendment is not required to conduct the outage or to restart the unit following the outage (with tap changers fixed). However, approval of the requested change prior to the outage will allow the load tap changers to operate and enhance availability of offsite power to the Callaway Plant.

Pursuant to 10 CFR 50.91(b)(1), AmerenUE is providing the State of Missouri with a copy of this proposed amendment.

If you should have any questions on the above or attached, please contact Dave Shafer at (314) 554-3104 or Walter Muskopf at (573) 676-4327.

Very truly yours,

David Shafer

for Alan C. Passwater
Manager, Corporate Nuclear Services

ACP/WPM/mib

Attachments:
1) Affidavit
2) Description of Proposed Changes and Assessment
3) Existing Marked-up FSAR
4) Existing Marked-up Technical Specification Bases pages

cc: U. S. Nuclear Regulatory Commission (Original and 1 copy)
Attn: Document Control Desk
Mail Stop P1-137
Washington, DC 20555-0001

Mr. Ellis W. Merschoff
Regional Administrator
U.S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

Senior Resident Inspector
Callaway Resident Office
U.S. Nuclear Regulatory Commission
8201 NRC Road
Steedman, MO 65077

Mr. Jack N. Donohew (2 copies)
Licensing Project Manager, Callaway Plant
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Mail Stop 7E1
Washington, DC 20555-2738

Manager, Electric Department
Missouri Public Service Commission
PO Box 360
Jefferson City, MO 65102

Deputy Director
Department of Natural Resources
PO Box 176
Jefferson City, MO 65102

Mr. Thomas A. Baxter
Shaw, Pittman, Potts & Trowbridge
2300 N. Street N.W.
Washington, DC 20037

STATE OF MISSOURI)
) SS
COUNTY OF CALLAWAY)

David Shafer, of lawful age, being first duly sworn upon oath says that he is Supervising Engineer, Corporate Nuclear Services, Regulatory Operations for Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By David Shafer
David Shafer
Supervising Engineer,
Regulatory Operations,
Corporate Nuclear Services

SUBSCRIBED and sworn to before me this 18th day

of January, 2001.

Gloria J Taylor

GLORIA J. TAYLOR
NOTARY PUBLIC
STATE OF MISSOURI - CALLAWAY COUNTY
NOTARY SEAL
MY COMMISSION EXPIRES JUNE 21, 2003

ULNRC-04353

ATTACHMENT 2

DESCRIPTION OF PROPOSED CHANGES AND ASSESSMENT

Description of Proposed Changes and Assessment

1.0 INTRODUCTION

This modification will replace the existing Engineered Safety Features Transformers with transformers having automatic load tap changers. This constitutes an Unreviewed Safety question per 10CFR50.59 (a)(2)(i) and (ii)

2.0 DESCRIPTION:

Approval of the proposed amendment would result in the update of the Callaway FSAR to reflect this new feature and associated evaluation. References to the Callaway FSAR are to the FSAR as updated including changes submitted per 10 CFR 50.71(e) in Reference 2 and licensee approved changes hence.

3.0 BACKGROUND

This background information was summarized from LER 99-005 Revision 2, refer to Reference 1.

On August 12, 1999, with the plant in Mode 3 (Hot Standby), the switchyard voltage supplied from the grid was observed to decrease below the minimum operability limit established in station procedures. The Technical Specification action statement for inoperability of both offsite sources was entered, and the Control Area Operator within the Energy Supply Operations Department was contacted to initiate actions to increase switchyard voltage. The Control Area Operator's actions, combined with a decreasing system demand, subsequently restored switchyard voltages above the minimum operability limitation, and the Technical Specification action statement was exited. Both offsite power sources were inoperable for approximately 12 hours.
(Note: "Grid," refers to the North American Eastern Interconnection of which Ameren's Control Area is a part.)

Due to high ambient temperatures, service territory loading was near peak levels. Even at these peak levels, it was predicted that switchyard voltage would remain above the established operability limits based on previous load flow analyses. During investigations to establish the cause for this unanticipated switchyard voltage, engineering reviews determined that large amounts of power were being transported across the grid on the day of this occurrence. This power was being transported from northern utilities to the southern portion of the United States due to a shortfall in generation in that area and a significant weather diversity. The magnitude of the power being transported across the grid had not been previously observed and was far in excess of typical levels. The deregulated wholesale power market contributes to conditions where higher grid power flows are likely to occur. These large flows were observed at this time. Since load flow analyses had not analyzed this level of system loading, the minimum voltage previously established was not valid for verifying that the offsite source would have adequate capability to supply station loads during a design basis accident.

During plant operations, switchyard voltage indications were not adequate for determining operability of the offsite source in the event the plant should trip offline. Similar grid loading conditions were present on August 10, 1999, the day before the plant tripped. Low switchyard voltages were not observed at that time since Callaway generation was locally supporting grid voltage. Therefore, the capability (with the plant operating) of the offsite source could not be readily verified when the unit was in operation. Offsite source capability is normally confirmed by an analysis that considers the anticipated loading conditions on the grid. With grid loading above these previously analyzed values, the plant was placed in a condition which was outside of its design basis analysis for verifying the offsite source would have adequate capacity to supply station loads during a design basis accident.

The direct cause of the low switchyard voltage was a high service territory demand combined with large amounts of power being transported across the grid. The root cause attributed to this event was not anticipating the simultaneous occurrence of the aforementioned conditions. Widespread high temperatures in the South and lower Midwest, unavailability of generation in the South, and cool temperatures in the North combined together to create conditions for large grid power flows to occur. The deregulated power market used these conditions to transport large amounts of power from the north to the south. These high power flows and high native system loads exceeded the anticipated conditions modeled in the load flow analyses.

Another factor associated with this event was attributed to inadequate administrative controls for ensuring that the design analysis encompassed a sufficient range of grid operating conditions.

The corrective actions taken are as follows:

1) Conditions within the grid load flow analysis were revised and the analysis was re-performed. Restrictions on plant electrical lineups were subsequently implemented to support switchyard operability. These actions were implemented to support offsite source operability pending completion of plant modifications that will permit the onsite power distribution system to accommodate a wider range of offsite source voltages.

2) A program has been established to periodically review the grid load flow analysis prior to each peak loading season to ensure that anticipated changes in transmission system operation are incorporated into the analysis. Significant

changes in transmission system operating conditions or configuration which occur between review periods are also required to be evaluated to determine potential impacts on the grid load flow analysis.

3) Energy Supply Operations has implemented use of an online computer model for determining the adequacy of the grid to support Callaway offsite source operability requirements. The model continuously incorporates real-time measured grid powerflows and voltages, and predicts system conditions for a wide variety of grid contingencies. This model allows for near real time monitoring of the grid to ensure operability requirements of the offsite sources would be satisfied given a loss of Callaway generation.

4) Administrative controls have been established between plant staff departments and Energy Supply Operations in order to formalize the process in which the online computer model is utilized when monitoring offsite source operability. These administrative controls also outline the plant's design basis requirements for offsite source voltage and the specific responsibilities of these departments in maintaining offsite source voltage within these limitations.

5) Training has been provided to plant staff Operations personnel to enhance operator awareness of off-site source reliability and degraded voltage concerns.

6) Plant modifications include installation of capacitor banks and load tap changing transformers (This License Amendment Request) to improve voltage regulation on each of the plant's safety related 4.16 kV buses. These modifications will allow the plant's design basis to be supported by a wider range of offsite source voltages.

A historical review was performed to identify previous timeframes in which system loading conditions may have caused switchyard voltage to decrease below the minimum operability limit had the plant been offline. The timeframe chosen for this evaluation was from September 1997 to present, with a previous plant trip in August of 1995 also included within this evaluation. In addition to the 12 hours of inoperability observed on August 12, 1999 and the 1 hour observed on August 11, 1999, this review yielded an additional 23 hours for which these conditions may have been present. Eleven of these hours were observed across two days in July 1998, with the remaining hours observed across 6 days from late July to mid-August 1999. Both trains of emergency AC power (and their associated support systems) were operable for performing their intended safety function during these timeframes. The turbine driven auxiliary feedwater pump was also operable during the above timeframes.

4.0 TECHNICAL ANALYSIS

4.1.1 Design Description - General:

This modification is affecting the preferred power sources (i.e., the offsite source circuits) to the Class 1E electrical distribution systems. Due to changes in the electrical grid, a wider range of grid voltages is expected in the future. This modification will equip the preferred power sources with the ability to provide acceptable voltages to the safety related electrical distribution system given this wider range of voltages. The replacement of the Engineered Safety Features (ESF) transformers XNB01 and XNB02 with new transformers having automatic load tap changers (LTCs) on their secondary windings function along with the capacitor banks, to control the voltage from the preferred off site power sources. Table 1 lists the design parameters of the new ESF transformers with automatic LTCs. The capacitor banks were installed under licensee approval per 10 CFR 50.59.

Per 10CFR50 Appendix A GDC 17 criteria, a design shall be provided to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. As such, physical and electrical separation is provided. The LTC transformers do not share any common electrical or control circuits and cannot be paralleled even if the Class 1E 4.16kV Busses NB01 and NB02 are cross connected. Therefore, the probability that simultaneous failures of both transformers to cause both offsite sources to become inoperable is negligible. Addition of automatic load tap changing ESF transformers will support availability of the preferred offsite circuits and thus reduce the probability of unnecessarily shedding the offsite source and sequencing onto the onsite standby emergency diesel generators.

FSAR Figure 1.2-1 shows the location of the ESF transformers, FSAR Figure 8.3-1 Sheet 1 is a one-line diagram of the electrical distribution system, and FSAR Figure 8.3-3 shows the voltage control system interface with the Emergency Diesel Generator. These Figures are part of the proposed update per 10CFR50.71(e) and are included in Attachment 3. These updated Figures and the text portions of Attachment 3 reflect this license amendment request in the FSAR. The FSAR will be updated in accordance with 10 CFR 50.71(e) based on amendment approval.

Table 1

<u>ESF Transformer Design Specifications</u>

Phases per transformer	3
Frequency	60 Hz
Output at 65° C	12/16 MVA
Cooling Method	OA/FA (Oil Air/Forced Air)
Winding temperature rise by resistance	65° C
Impedance at 12 MVA base	5.35%
High Voltage Winding	13.8 kV
Low Voltage Winding	4.16 kV
Transformer connection High Voltage	Delta
Transformer connection Low Voltage	Grounded wye through resistor
High Voltage Phase relation	Standard HV leads
Low Voltage Phase relation	Lag HV by 30°
High Voltage Winding / Bushing BIL	110 kV (Basic Insulation Level)
Low Voltage Winding / Bushing BIL	75 kV
Neutral End Winding / Bushing BIL	75 kV
High Voltage Insulation Class, kV	15 kV
Low Voltage Insulation Class, kV	5 kV
Neutral Insulation Class, kV	5 kV
High Voltage Taps / Range	4 no-load / ± 5% (2.5% steps)
Low Voltage Taps / Range	Auto on-load / ± 16% (1% steps)

4.1.2 <u>Station Blackout 10 CFR 50.63:</u>

The new replacement transformers for XNB01 and XNB02 are non-safety related and will be connected to non-safety related capacitor banks NB03 and NB04 using manual full load break switches. The ESF transformers provide the ability to restore the preferred offsite power sources (i.e., SBO recovery). AmerenUE evaluations performed to establish compliance with 10CFR50.63 determined that only transformer XNB02 is required to be included in the SBO program. Replacement transformer XNB01 is associated with train "A", and therefore does not support nor is it required to be classified as Station Blackout Equipment (SBO). Replacement transformer XNB02 is associated with train "B", which is the defined SBO train. The new transformer and associated control equipment will retain an SBO classification. The additional small load placed on station blackout battery PK12 by XNB02 and NB04 will not adversely impact the battery's ability to fulfill its station blackout function.

4.1.3 Fire Protection Design License Condition - C(5)(d)

The new transformer's size and oil volume affects the physical separation design. The transformer oil volume is increasing approximately 2600 gallons and the physical outline is increasing. The existing XNB01 and XNB02 transformer pit design is divided into two main compartments and two sumps. As stated in FSAR Section 9.5.1.2.2.5, the pit is sized to contain oil from the largest transformer served by the pit and the water from two transformer fire protection systems operating for 10 minutes. The larger oil volume affects the margin in the pit sizing. FSAR Table 9.5.1-1 documents that the fire protection water flow rate is designed to be 0.25 gallons per minute per square foot of surface area protected. The larger transformer outline requires a revision to the fire protection deluge system. The transformer pit is designed such that the oil will be contained by the pit even with the additional water from two transformer water spray systems operating for ten minutes in accordance with requirements and is therefore acceptable. This fire protection design meets the Facility Operating License Condition C(5)(d) allowing the licensee to approve the change.

4.1.4 Off-Site Interface:

The existing minimum offsite voltage for the preferred off site power sources required in the Callaway switchyard after a Callaway plant trip is established by AmerenUE load flow analysis (References 7.10, 7.11).

This current minimum voltage is:

1. Capacitor banks OPERABLE	
Both ESF transformers in service	338.1 kV
One ESF transformer in service	346.0 kV
2. No capacitor banks OPERABLE	
Both ESF transformers in service	348.5 kV
One ESF transformer in service	354.2 kV

These voltage requirements are kept below the expected grid voltages in order to ensure adequate voltages from the off site power sources. Ameren Services Transmission Planning bi-annually calculates by load flow analysis the expected grid voltage range for peak conditions for Callaway's switchyard in accordance with 10CFR50 Appendix A GDC 17 criteria. In addition, the control area operator, AmerenUE Energy Supply Operations (ESO), monitors and models the available system grid voltage, including Callaway's switchyard voltage. Real time transmission system data is collected using a supervisory control and data acquisition (SCADA) system and then analyzed using a contingency computer. The ESO contingency computer uses the real-time SCADA system data and defined system failures to predict the final grid system load flows and voltages assuming predicted failures were to occur.

The ESO contingency model includes several defined failures that will help predict the minimum Callaway switchyard voltage after a Callaway plant trip. ESO has assigned a special watch guard alarm with a specific acceptance limit set high enough to help assure that the required minimum switchyard voltage would be available at Callaway following a trip if the predicted grid failures were present.

The replacement Engineered Safety Features transformers XNB01 and XNB02 will include automatic load tap changers on their secondary windings. The new transformers when combined with the previously installed six MVAr sized capacitor banks, NB03 and NB04, will help assure that the required minimum safe operating voltage is available at the Class 1E busses under a wider range of grid voltage. This equipment is adding voltage regulation capability to the off-site power sources. The new transformers meet the electrical design requirements of the original transformers.

The automatic load tap changers are capable of varying the voltage at the respective NB bus by ±16% (1% per step with 32 steps), the equivalent of approximately ± 665 Volts at the 4160 Volt level. The load tap changer range will be limited by a gear driven limit switch to a 6% buck and a 4% boost to limit the voltage extremes created by the transformers. Reference 7.10 documents the new Callaway switchyard voltage minimums required with the new transformers, combined with the existing capacitor banks installed. The results are shown in Table 2.

Table 2

Switchyard Voltage Minimums

1. Automatic LTCs and capacitor banks OPERABLE	
Both ESF transformers in service	329.8 kV
One ESF transformer in service	332.9 kV
2. Automatic LTCs with taps fixed and capacitor banks OPERABLE	
Both ESF transformers in service	335.7 kV
One ESF transformer in service	344 kV
3. Automatic LTCs OPERABLE and capacitor banks out of service	
Both ESF transformers in service	341.2 kV
One ESF transformer in service	344.3 kV
4. Automatic LTCs with taps fixed and capacitor banks out of service	
Both ESF transformers in service	347.1 kV

Note: Line up 4 operation is only used in a dual source lineup- one ESF transformer feeding one NB bus for an OPERABLE line up. A single source line up with one ESF transformer feeding two NB busses is allowed, but not considered OPERABLE under this line-up.

4.2 Failure Modes and Effects Analysis:

Each transformer is independent and can not be interconnected with the other transformer in any way. The failure of one transformer will have no effect on the operability of the other transformer or Class 1E equipment train. The credible failure mechanisms of the transformers that will have the worst-case effects on the associated Class 1E equipment can be categorized into the following distinct cases:

Case 1 The transformer tap changer control fails low and raises the NB bus voltage unexpectedly.

Case 2 The transformer tap changer control fails high and lowers the NB bus voltage unexpectedly.

Case 3 The tap changer fails to move.

Case 4 The transformer fails or faults which causes the upstream and downstream feeder breakers to the associated 13.8 kV to 4.16 kV transformer to trip.

These cases have been reflected in the update of FSAR Table 8.3-4, "Failure Modes and Effects Analysis," for the Callaway electrical system.

The failure modes and their effect follow:

Case 1 Failure mechanisms that cause the transformer tap changer to fail and raise the NB bus voltage unexpectedly.

- Tap changer control circuit failure mechanisms.
  - The tap changer primary and back-up voltage controllers fail low.

- EXPECTED RESULT--The transformer tap changer goes to full or partial boost. The voltage on the NB bus goes high. When the voltage goes high enough, the voltage at the NG Load Centers goes high and alarm in the Control Room. The capacitor banks will not interact. Gear driven limit switch prevents movement of tap to greater than 4% boost.

Case 2 Failure mechanisms that cause the transformer tap changer to fail and lower the NB bus voltage unexpectedly.

- Tap changer control circuit failure mechanisms.
  - The tap changer primary and back up voltage controllers fail high.
  - The tap changer primary and back-up controller potential transformer fail high.

- EXPECTED RESULT--The transformer tap changer goes to full or partial buck (subtraction) and the NB bus voltage decreases. The capacitor banks will step on to raise voltage dependant on the magnitude of the voltage drop. If the voltage is low enough, alarms are produced in the control room. If the low voltage actuates the Class 1E degraded voltage circuits, after the appropriate time interval, (8 seconds during a LOCA or 119 seconds during non-LOCA) the NB bus(es) are shed from the off-site power system and loaded onto the associated emergency diesel generator. Gear driven limit switch prevents movement of tap to less than 6% buck (subtraction).

Case 3 Failure mechanisms that cause the tap changer to fail to move.

- Tap changer control circuit failure mechanisms.
  - The tap changer primary controller locks up.
  - The tap changer back-up controller fails and blocks the primary controller signals.
  - The tap changer motor or power supply fails.
  - The tap changer primary and back-up controller potential transformers fail low.
  - The primary or secondary fuses for the voltage sensing transformers fail.

- EXPECTED RESULT--The transformer tap changer fails to move. The LTC self test alarm is annunciated through the XFMR trouble annunciator in the control room. The voltage on the NB bus may go high or low dependant on grid voltage changes. If the NB voltage goes high enough, the voltage at the NG Load Centers goes high and alarm in the Control Room. If the NB bus voltage goes low enough, the capacitor banks may step on. If the voltage is still too low, it alarms in the control room and after the appropriate time interval, 8 seconds during a LOCA or 119 seconds during non-LOCA, Class 1E circuits shed the NB bus(es) from the off-site power system and load onto the associated emergency diesel generator.

Case 4 Failure mechanisms that cause the high side and / or low side transformer breakers to trip or isolate the transformer from the NB bus.

- Internal and external faults:
  - Phase to ground short which occurs on the transformer primary 13.8 kV circuits.
  - Phase to phase short which occurs on the transformer primary 13.8 kV circuits
  - A single phase opens on the transformer primary 13.8 kV circuits.
  - Phase to ground short which occurs on the transformer secondary 4.16 kV circuits.
  - Phase to phase short which occurs on the transformer secondary 4.16 kV circuits
  - A single phase opens on the transformer secondary 4.16 kV circuits.
  - A fault internal to the transformer.

- EXPECTED RESULT--The protective relays for the associated NB transformer trip the 13.8 kV transformer feeder breaker and /or low side breaker(s) or Class 1E voltage relays actuate causing a transfer of the Class 1E NB bus to the associated emergency diesel generator. The capacitor bank is isolated along with the transformer.

Review of the failure cases listed above confirms that expected system responses are enveloped by the existing accident analysis except for the bus overvoltage issues in Case 1 and 3. Although not specifically discussed in the FSAR, limited bus overvoltage is an analyzed and accepted failure mode when within accepted limits.

4.3 Overvoltage Considerations:

Overvoltage may occur if the Beckwith M-2001B LTC voltage controller fails giving an increase tap signal and the Beckwith back-up control relay M-0329B fails to block and run back the tap changer. This is not a likely occurrence. A Probabilistic Risk Assessment, using manufacturer-provided meantime between failure (MTBF) data for the devices (MTBF 110 years for the primary controller and 296 years for the backup controller), results in an incremental conditional core damage frequency of 1.50E-8/year based on common cause failure of the primary controllers and the backup controllers. This frequency is three orders of magnitude below the existing core damage frequency. Thus, the design provides overvoltage control and protection whose simultaneous failure probability for both the voltage regulator and the back-up protection relay to fail is sufficiently low so that the overvoltage protection will be assumed to exist and provide protection.

This overvoltage hazard is not new as the grid; main generator and emergency diesel generators may also cause high voltages given component failures. These failures however have not been quantified or discussed in the FSAR and have been accepted as is. These hazards would have a low probability of occurrence.

In addition, design features also exist to identify failures and limit failure duration. These are the following features:

- The voltage controller is provided with a self-test alarm that determines the functionality of the device. This will have annunciation to detect the operational failure.
- The back-up protection relay will identify the controller failure when out-of-control range voltages occur. This is annunciated in the control room.
- The voltage controller and back up control relay are fed from separate potential transformers and fuses.
- The devices separately identify a voltage loss and inhibit voltage raise functions. This condition is identified by annunciation.
- The devices will have periodic testing to ensure their proper operation.

A significant number of nuclear power plant units incorporate the use of automatic load tap changing transformer to supply power to the Class 1E power systems. A number of these sites were contacted. Callaway's design was found to be equivalent or superior to these units. Most of the LTC transformers had been in service since issuance of their plant operating licenses and thus have considerable operating history. No adverse operations, which caused overvoltages in their plants, were noted due to controller failures. Thus, the automatic load tap changing transformer design is not new to the nuclear industry and has not been found to be a credible hazard.

AmerenUE has performed an overvoltage study. Results indicate that at worst case conditions, (high grid voltage, LTC controller failure causing uncontrolled boost, and back up protection relay failure.), equipment damage will not occur for several minutes. Load flow analyses performed for loads present during a loss of coolant accident indicates that the overvoltage hazard will not occur. This overvoltage study combined with the low probability of occurrence seen in the PRA analysis further indicate the overvoltage condition is not a credible new accident.

Furthermore, the LTC failure effects are limited to the associated ESF train, therefore this type of failure meets the definition of a single failure as defined in 10 CFR 50 Appendix A for operation under normal (Non T/S action) conditions.

4.4 System Operation and Coordination:

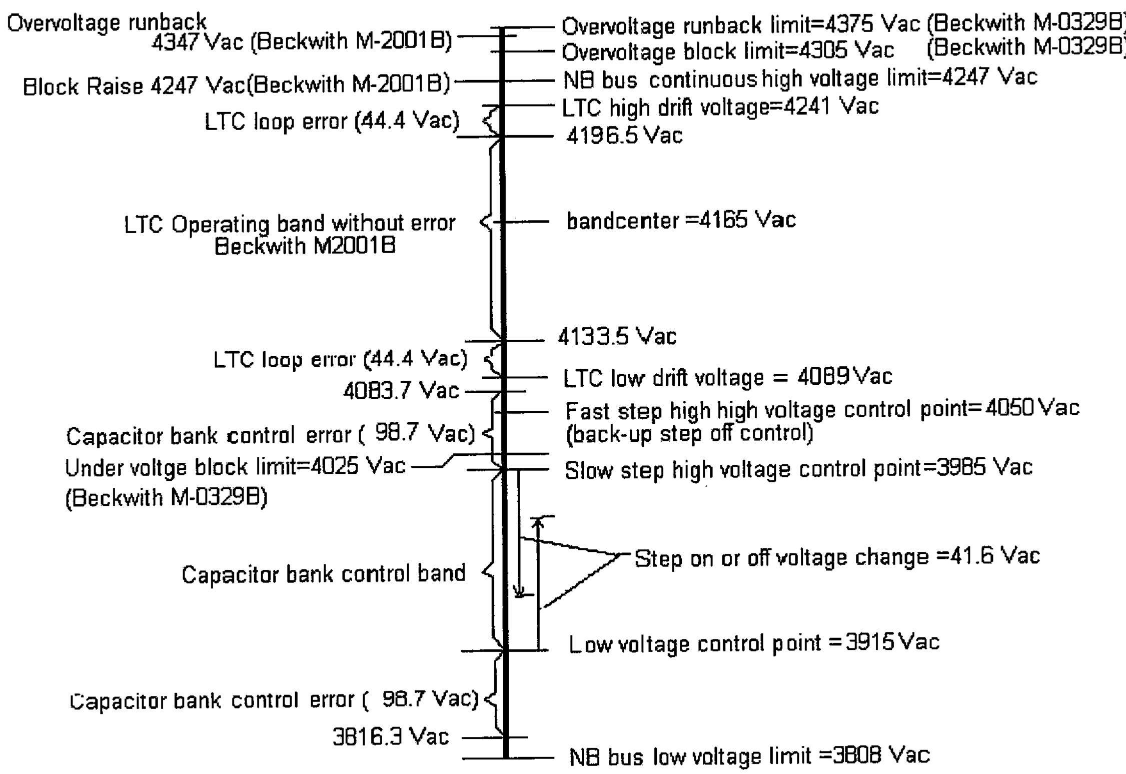
For normal operation (both LTCs and capacitor banks OPERABLE and both ESF transformers in service), the contingency computer Callaway watch guard alarm is set to approximately 333 kV to provide a 3 kV margin above the new minimum switchyard voltage documented in reference 7.10. The 3 kV margin allows time for ESO to contact the Callaway Control Room and to take actions to restore the minimum grid voltage before it drops below the Callaway operational requirement. Similarly for each possible line-up in Table 2, the ESO watch guard alarm is changed to give an approximate 3 kV margin depending on the plant configuration.

The replacement transformers combined with the existing capacitor banks are part of the offsite power system that provides power with adequate voltage to the safety related NB system. The LTC voltage control system is coordinated with the existing capacitor bank voltage control system. However, they are separate control systems. Each component functions without the other. The transformer voltage control point is coordinated with its associated capacitor bank voltage control point to assure that the capacitor bank steps are off during times that the NB bus is near its nominal 4.16 kV level. Figure 1 represents the voltage operation of the capacitor banks and the LTCs.

The new transformer with automatic load tap changer, in conjunction with the installed 6 MVAr capacitor bank, provides voltage support for the associated Class 1E NB bus. This is accomplished by making tap changes, as required, to maintain an acceptable NB bus voltage. The voltage control range for the new transformer will be coordinated with the existing capacitor bank controls as shown in the figure 1 below to assure that the capacitor bank steps are off when the transformer is operating in its nominal control band.

The control of the tap changer will be automatic, based on the secondary voltage of the transformer. The control circuits will be designed to limit the probability of either an under voltage or over voltage failure by using a Beckwith M-2001B primary controller and Beckwith M-0329B backup controller. The Beckwith 2001B is set to control the secondary voltage at 4165 ±31.5V. The Beckwith M-0329B backup relay will block tap changer signals to raise voltage if the secondary voltage is above 4305V and create a tap changer signal to lower voltage if the secondary voltage is above 4375V. The Beckwith M-0329B backup relay will block tap changer signals to lower voltage if the secondary voltage is below 4025V. The first tap change will take a minimum of 2.5 seconds with subsequent steps taking about 2 seconds. Each step will vary the NB bus voltage by approximately 1%. The control settings in Figure 1 are established by load-flow analysis.

Figure 1
LTC and Capacitor Bank Voltage Control



With both systems in operation, the general response to a LOCA is for the capacitor bank to provide a rapid voltage increase if needed and then the LTC will step to correct the voltage back to a 4.16 kV level and thus turn the capacitor bank off. The voltage control systems function to ensure that the voltage at NB01 and NB02 is sufficient to reset the safety related degraded voltage relays and loss of voltage relays before time limits are exceeded. With this, the preferred off site power sources are retained to power the safety related electrical distribution system. The voltage control systems also function to ensure that overvoltages are not present in the safety related electrical distribution system when fed from the preferred power sources.

The transformer automatic load tap changer control circuits, like the capacitor bank control circuits, will be interlocked with its respective Emergency Diesel Generator to "freeze" automatic actions and thereby prevent adverse system interactions during Emergency Diesel Generator testing. A Diesel Generator "freeze" interlock signal will be added to an annunciator window in the Control Room to confirm proper tap changer system interface.

In addition, Control Room annunciators are provided to indicate if the load tap changers or capacitor bank control circuits are not in automatic. Automatic control is needed to obtain the voltage control from the component.

Control Room annunciators will be used to provide indication of system trouble. A multi-point annunciator will be provided at each transformer to allow the quick determination of the cause of the trouble signal.

Operating procedures will address appropriate responses to control room and local annunciators.

Safety related circuit breakers provide the means of disconnecting the transformers from the safety related NB bus in the event of equipment maintenance or failure.

Per 10CFR50 Appendix A GDC 17 criteria, a design shall be provided to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. As such, physical and electrical separation is provided. The LTC transformers do not share any common electrical or control circuits and they cannot be paralleled even if the Class 1E 4.16kV Busses NB01 and NB02 are cross-connected. Therefore, the probability that simultaneous failures of both transformers to cause both offsite sources to become inoperable is negligible.

4.4.1 Manual Operation of LTCs:

The LTC's controller can be operated manually in the event the automatic system fails. This is accomplished locally at the transformers using the local control panel. As seen on FSAR Figure 1.2-1 the transformers are in relatively close proximity to the main control room. Additionally, the tap changers can be manipulated using a hand crank without the control system. However, due to equipment and personnel safety concerns the manufacturer recommends this manual manipulation be performed with the transformer de-energized.

Since the probability of failure of the LTC controllers is very low, the local manual actions are considered to be acceptable given the guidelines of NRC Information Notice 97-078, dated 10/23/97. No timed operator responses are assumed in the design.

Manual actions will be documented in plant operating procedures including normal, off-normal and annunciator response procedures.

As stated in the cover letter, AmerenUE has evaluated and approved installation and operation of the transformers with the automatic LTC fixed per 10 CFR 50.59. This configuration will be implemented in procedures and design documents if this amendment request is not approved prior to plant restart following Refuel 11. The optimal tap setting has been derived using load flow analysis.

4.5 Testing And Maintenance:

The inspections testing and maintenance described below demonstrate continuing compliance with General Design Criteria 18, Inspection and Testing of Electrical Power Systems. Testing and maintenance discussed below may be modified with appropriate engineering reviews.

4.5.1 Planned Post Modification Testing

The testing described includes all functions required to ensure appropriate operation of the LTC in the automatic mode after the unit is returned to service in manual mode after RF 11, until this amendment request is approved. These tests are performed on out of service equipment. This testing is not considered part of the Unreviewed Safety Question, this test summary is provided for information.

Post modification testing plans include:

ESF Transformers:
- Transformer inspection and core ground test
- Transformer dew point test prior to filling
- Filter and degassification of transformer oil
- Turns ratio verification, all windings
- Insulation power factor testing
- Winding resistance verification
- Sudden pressure relay calibration
- Winding vs oil temperature verification, no load
- Vacuum bleeder test
- Nitrogen gas system test that system maintains pressure
- Thermal switches for fan control and alarm, low and low-low level alarm switches should be checked for proper operation.

Tap Changer:
- Visual inspection
- Operating range verification to design requirements
- Manual handle inhibition of automatic tap changer verification
- Vacuum bottle sensing units should be checked by applying 20 amps current though the sensor and verified that the tap changer does not complete a step but returns to the previous position.

Transformer Controls:
- Scheme checks
- Protective relaying calibration
- Low voltage wiring insulation check per plant procedures

Functional Testing:
- Fan Operation
- Panel heater test
- Sudden pressure and low level relay trip checks trip high and low side breakers
- Transformer control and annunciator functions
- Transformer LTC and Capacitor bank coordination
- Test transformer controls for radio interference.

Energized Tests for Operability:

Modes 5 & 6 Operability Specific Test procedure

Modes 1, 2, 3, 4 complete ESFAS testing procedures performed during Refuel 11:

Testing required for operability of offsite sources for Modes 1, 2, 3, & 4:
- Capacitor bank in service, LTC in manual on –4% tap, perform Safety Injection without Blackout ESFAS test in accordance with ESFAS procedures.
- Capacitor bank in service, LTC in automatic, perform SI without Blackout ESFAS test in accordance with ESFAS procedures.
- LTC in automatic, capacitor bank out of service, perform SI without Blackout ESFAS test in accordance with ESFAS procedures.

Tests with transformers disconnected from ESF bus:
- High and low side controller voltages
- Apply signal to cause LTC to move through range as designed
- Energize associated capacitor bank for 12 hour heat run

Tests with transformers connected to bus:
- Phase check prior to bus connection
- Individual starts of RHR, CCW and ESW pumps
- A high current test should be completed to verify CT phasing and ratio of inputs to the differential relays.

4.5.2 <u>Operational Inspection, Testing to assure continued functionality</u>

- Monthly trending on the transformer gas pressure verses oil temperature is performed.
- Semi-annual oil samples are taken for total gas in oil and fluid analysis

- Semi-annually the transformers are inspected thermographically
- Every other refuel the transformers and bushings are power factored
- Every other refuel the transformer tap changer controls will be operated through out its range
- Every other refuel the capacitor banks will be operated placing all banks in service
- Every other refuel the protective relays and devices on the capacitor banks and transformers are calibrated.
- Every other refuel a trip check is performed verifying the function of the high and low side breakers from manipulation of transformer protective devices.
- Every other year the low and high side transformer cables are meggared.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Determination

AmerenUE has evaluated whether or not a significant hazards consideration is involved with the proposed changes by focusing on the three standards set forth in 10 CFR 50.92(c) as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No

   Based on the review of the modification details there is an insignificant increase in the probability of a malfunction of equipment important to safety, however there is no increase in the probability of an accident previously evaluated. The modification has no effect on the radiological consequences of accidents previously evaluated. Installation of the LTCs does not impact accident initiators though a failure mode has been identified that can increase the probability of malfunction, a risk study shows this risk is insignificant.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No

   The overall effect of the malfunction of the LTC controllers would lead to a loss of the associated ESF bus which is not a new failure mode that can lead to a new or different kind of accident than previously evaluated. The LTC failure effects are limited to the associated ESF train, therefore this type of failure meets the definition of a single failure as defined in 10 CFR 50 Appendix A for operation under normal (Non T/S action) conditions. Additionally, during the 10CFR 50.59 evaluation for the LTCs criteria (a)(2)(ii) with respect to accidents of a different type was not met.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No

The installation of the replacement transformers with load tap changers will help assure the required minimum NB bus voltage established by Reference 7.10 under a wider variation of grid voltage.

Current Technical Specification Bases for the offsite power distribution system are covered in sections B3.8.1—AC Sources - Operating, B3.8.9—Distribution Systems - Operating, B3.8.2—AC Sources - Shutdown, and B3.8.10—Distribution Systems - Shutdown. These bases ensure that sufficient power will be available to supply the safety-related equipment required for: (1) The safe shutdown of the facility, and (2) The mitigation and control of accident conditions within the facility. The minimum specified independent and redundant AC power and distribution systems satisfy the requirements of General Design Criterion 17 of Appendix A to 10 CFR Part 50. The ACTIONS sections of the applicable Technical Specifications provide requirements specified for various levels of degradation of the power sources and provide restrictions upon continued facility operation commensurate with the level of degradation. The Operability of the power sources are consistent with the initial condition assumptions of the safety analyses and are based upon maintaining at least one redundant set of onsite AC power sources and associated distribution systems operable during accident conditions coincident with an assumed loss of offsite power and single failure of the other onsite AC source.

The installation of the transformers with automatic load tap changers reduces the possibility of the loss of the offsite power system due to the increased grid voltage variations as documented in the description of the change in section 4.1.4. Therefore, the installation of the transformers with load tap changers will not reduce the margin of safety.

Conclusion:

Based on the above evaluations, AmerenUE concludes that the activities associated with the above described changes present no significant hazards under the standards set forth in 10 CFR 50.92 and that there is reasonable assurance that the health and safety of the public will not be endangered by the proposed change. Moreover, because this change does not involve a significant hazards consideration, it will also not result in a condition which significantly alters the impact of the station on the environment as described in the NRC Final Environmental Statement as stated in Section 6.

5.2 Regulatory Safety Analysis

Applicable Regulatory Requirements/Criteria

10 CFR 50.34(b)(2) regarding the Callaway FSAR continues to be met with the proposed update to the Callaway FSAR in Attachment 3. Additionally, the required level of detail in Attachment 3 has been determined to meet the requirements of 10 CFR 50.71(e), per the guidance of Regulatory Guide 1.70 and 1.181.

Callaway Plant License Condition C(5)(d) allows changes to the Fire Protection Program to be made without prior approval if the change does not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire. The analysis reflected in Section 4.1.3 demonstrates compliance of the new design to this criterion.

10 CFR 50.36 sets forth requirements for the Technical Specification contents. AmerenUE has determined that there are no changes to the Technical Specifications as part of the activities related to this Amendment. The existing Technical Specifications testing will demonstrate availability of the off-site power with the new transformers with LTCs.

10 CFR 50.36(a) requires that the Technical Specifications have a summary statement of the bases or reasons for such specifications, but shall not become part of the Technical Specifications. The markups of the Callaway Technical Specification Bases included in Attachment 4 are intended to reflect the new configuration of the Callaway electrical distribution system. These changes are to be implemented in accordance with the Callaway Technical Specification Bases Control Program as stated in Callaway Technical Specification 5.5.14.

10 CFR 50.59 allows licensees to make changes to the facility and procedures described in the FSAR, to conduct tests and experiments not described in the FSAR, as long as these activities do not change Technical Specifications or meet the criteria stated in 10 CFR 50.59 (c)(2). This amendment request is being submitted in accordance with 10 CFR 50.59 due to the criteria of (c)(2)(i) and (ii) are met with respect to the malfunction of equipment important to safety. Therefore, the requirements of 10CFR 50.59 are being met. The automatic LTC feature on the new ESF transformers cannot be operable and in-service without approval of this amendment request. The description added to the Callaway FSAR, Attachment 3, for this amendment (as approved) will ensure 10 CFR 50.59 is applied to future changes to the system.

10 CFR 50.63, Loss of All Alternating Current Power. This requirement continues to be met and was evaluated as stated in Section 4.1.2.

10 CFR 50 Appendix A, General Design Criteria for Nuclear Power Plants, GDC 17 Electric Power Systems. As stated in Section 4 the applicable portions of GDC 17 continue to be satisfied by the installation of the new ESF transformers with LTCs.

10 CFR 50 Appendix A, General Design Criteria for Nuclear Power Plants, GDC 18 Inspection Testing Electric Power Systems. As stated in Section 4.5 the applicable portions of GDC 18 will continue to be satisfied by testing post modification and preventive maintenance on a continuing basis commensurate with the inspection and testing of the current design.

Analysis:

Applicable regulatory requirements/criteria continue to be met.

Conclusion:

The proposed LAR is in compliance with the above-cited regulations.

6.0 ENVIRONMENTAL EVALUATION

This amendment request reflects an unreviewed safety question (USQ) associated with the replacement of the ESF transformers with transformers having automatic load tap changers. The USQ is associated with the portions of criteria (a)(2) (i) and (ii) of 10 CFR 50.59 related to the malfunction of equipment important to safety. This modification does not introduce new accidents or affect consequences of accidents or malfunctions.

Section 4.1.3 demonstrates addition of the larger transformers over the retention pit under the transformers will not adversely affect the environment.

These amendment request involves changes with respect to the use of the facility components located within the restricted area, as defined in 10CFR20. AmerenUE has determined that the proposed amendment does not involve:

(1) A significant hazard consideration, as discussed in Section 5 of this Attachment;

(2) A significant change in the types or significant increase in the amounts of any effluents that that may be released offsite;

(3) A significant increase in individual or cumulative occupational radiation exposure.

Accordingly, the proposed amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

7.0 REFERENCES

7.1	FSAR Chapters 6, "Engineered Safety Features"
7.2	FSAR Chapter 8, "Electric Power"
7.3	FSAR Chapter 15, "Accident Analysis"
7.4	NUREG 830 10/01/81 including supplement 1 to 4, "Callaway Safety Evaluation Report"
7.5	IEEE 279-1976, "Criteria for Protection Systems for Nuclear Power Generating Stations"
7.6	IEEE 308-1974, "Std Criteria for 1E Power for Nuclear Power Generating Stations"
7.7	10CFR50 Appendix A General Design Criteria 17 & 18
7.8	Reg. Guide 1.32 Rev 2, "Criteria for SR Electric Power Sys for Nuclear Power Plants"
7.9	Reg. Guide 1.75 Rev 2, "Physical Independence of Electric Systems"
7.10	AmerenUE calculation ZZ-62, "Load Flows" Revision 007
7.11	AmerenUE calculation ZZ-62, "Load Flows" Revision 006 including addenda
7.12	AmerenUE calculation ZZ-179, "AC Bus Load List" Revision 003
7.13	AmerenUE calculation ZZ-145, "Short Circuit Calculation" Rev. 02
7.14	AmerenUE calculation NB-05 "NB Protective relays" Revision 003
7.15	AmerenUE calculation NG-02 "MCC Circuit Voltage Drop" Rev. 00
7.16	AmerenUE calculation NG-05 "Ctrl Pwr Fuse Coordination" Rev. 00
7.17	Bechtel calculation C-24-01-F "Transformer Vault Layout"
7.18	Bechtel calculation C-24-05-F "Transformer Vaults"
7.19	Bechtel calculation C-24-10-F "Fire Deluge Support Pedestals in Transformer Vaults"
7.20	Bechtel calculation C-24-14-F "Transformer Vault Volume"
7.21	Bechtel calculation E-H-06 "PA Protective Relay Settings" Rev. 008
7.22	Bechtel calculation E-H-07 "PB Protective Relay Settings" Rev. 002
7.23	Bechtel calculation E-H-09 " NG/PG Protective Relay Settings" Rev. 003
7.24	S&P calculation SPJ-02 "Site Protective Relay Settings" Rev. 000
7.25	NRC Generic Issue 171 "Loss of Offsite Power Subsequent to a LOCA"
7.26	NRC 455th meeting of "Advisory Committee on reactor Safeguards" Sept. 3, 1998
7.27	Letter to D.W. Capone (Manager Nuclear Engineering) from S.M. Hoyt
7.28	RE: "Load Dispatching Order for restoring AC supply to Callaway" dated 3/29/1984
7.29	Bechtel letter to SNUPPS BLSE-13168 dated Jan 19, 1984
7.30	Bechtel letter to SNUPPS BLSE-1851 dated May 28, 1975
7.31	Technical Specification Bases Change Notice 00-029
7.32	FSAR Change Notice 00-045
7.33	Operating License Change Notice OL-1210
7.34	NRC Information Notice 97-078, dated October 23, 1997

8.0 PRECEDENTS

Pacific Gas & Electric Submittal dated, 1/14/98
NRC Amendments: 132 Diablo Canyon 1(DPR-82), 130 Diablo Canyon 2, dated 4/29/99

Illinois Power Submittal dated, 5/20/98
NRC Amendment: 116 Clinton Power Station (NPF-62), dated 10/1/98

These precedents are provided to show recent NRC reviews of design changes relating to the use of load tap changing transformers. Similarities to the above amendments are limited due to grid configurations, multiple unit sites, and electrical system configurations.

ULNRC- 04353

ATTACHMENT 3

EXISTING MARKED-UP FSAR PAGES
(FSAR CN 00-045)

List

Standard Plant FSAR:

Page 1.2-14
Page 1.2-15
Figure 1.2-1
Figure 1.2-1 (Revised)
Figure 1.2-44
Figure 1.2-45
Figure 2.2-4
Page 8.1-1
Page 8.1-2
Page 8.1-3
Page 8.1-4
Page 8.1-22
Page 8.2-2
AmerenUE Drawing E-21NB01 (Incorporated by Reference from page 8.2-2)
AmerenUE Drawing E-21NB02 (Incorporated by Reference from page 8.2-2)
Page 8.3-1: Information removed in accordance with Regulatory Guide 1.181
Page 8.3-2
Page 8.3-3
Page 8.3-3a
Insert 8.3-3a
Page 8.3-4
Page 8.3-5
Table 8.3-4 Sheet 3
Insert 8.3-4(1)
Table 8.3-4 Sheet 4
Insert 8.3-4 (2)
Figure 8.3-1
Figure 8.3-1 (Revised)
Figure 8.3-3
Figure 8.3-3 (Revised)
Page 9.5.1-20
Page 9.5.1-21

Site Addendum FSAR:

Figure 2.1-3
Page 8.2-2

1.2.6.3 Radiation Monitoring System

The liquid and gaseous effluents from the plant are continuously monitored for radioactivity. Release rates are monitored and recorded. The process radiation monitoring system detects radioactivity in fluid systems which is indicative of fuel clad defects and/or fluid leakage between process systems.

Area monitoring stations are provided to measure gamma radiation at selected locations in the plant. Radiation levels, as detected by these monitors, are indicated in the control room, and above normal values are annunciated.

1.2.6.4 Balance-of-Plant Instrumentation and Control Systems

The turbine and generator control systems are designed to regulate generator load. The turbine-generator protection system is designed to ensure safe operation of the unit.

Additional instrumentation and controls allow manual or automatic control of various temperatures, pressures, flows, and liquid levels throughout the plant. Indicators, recorders, annunciators, and the plant computer inform the operating personnel at the equipment location and/or the control room of plant conditions and performance.

1.2.7 PLANT ELECTRIC POWER SYSTEM

1.2.7.1 Transmission and Generation Systems

The generating unit is connected to the utility transmission system. The Union Electric Co. transmission system (Nominal) voltage is 345 kV. Union Electric has integrated transmission networks and interconnections with neighboring systems. A description of system network and interconnection is given in Chapter 8.0.

The main generator is a General Electric 1,800 rpm, three-phase, 60-cycle synchronous unit. The generator is connected directly to the turbine shaft and is equipped with an excitation system coupled directly to the generator shaft.

Power from the generator is stepped up from 25 kV by the main transformer and supplied by overhead lines to the switchyard. An auxiliary transformer is connected to the main generator through an isolated phase bus duct to supply the auxiliary loads of the plant during power generation.

1.2.7.2 Electric Power Distribution System

Electric power is supplied from the switchyard to the on-site power system for the electrical auxiliaries through two independent circuits. One circuit supplies power through a startup transformer and the other through an engineered safety

FSAR on 00-045 wm 1/10/01 (info)

features (ESF) transformer. The startup transformer feeds two 13.8-kV busses and a second ESF transformer. Power is supplied to auxiliaries at 13.8 kV, 4.16 kV, 480 V, 480/277 V and 208/120 V ac. Refer to Figure 8.3-1.

The power distribution system includes the Class IE and non-Class IE ac and dc power systems. The Class IE power system supplies equipment used to shut down the reactor and limit the release of radioactive material following a design basis event.

The Class IE ac system consists of two independent and redundant load groups and four independent 120-V vital ac instrumentation and control power supply systems. The load groups include 4.16-kV switchgear, 480-V load centers, and motor control centers.

Two diesel generators are provided as a standby power source, one for each of the two Class IE load groups. Each generator has sufficient capacity to operate all the equipment of one load group, which is necessary to prevent undue risk to public health and safety in the event of a design basis accident.

The non-Class IE ac system includes 13.8-kV switchgear, 4.16-kV switchgear, 480-V load centers, and motor control centers.

The vital ac instrumentation and control power supply systems include battery systems, static inverters, and distribution panels. All voltages listed are nominal values, and all electrical Class IE equipment is designed to accept the expected range in voltage.

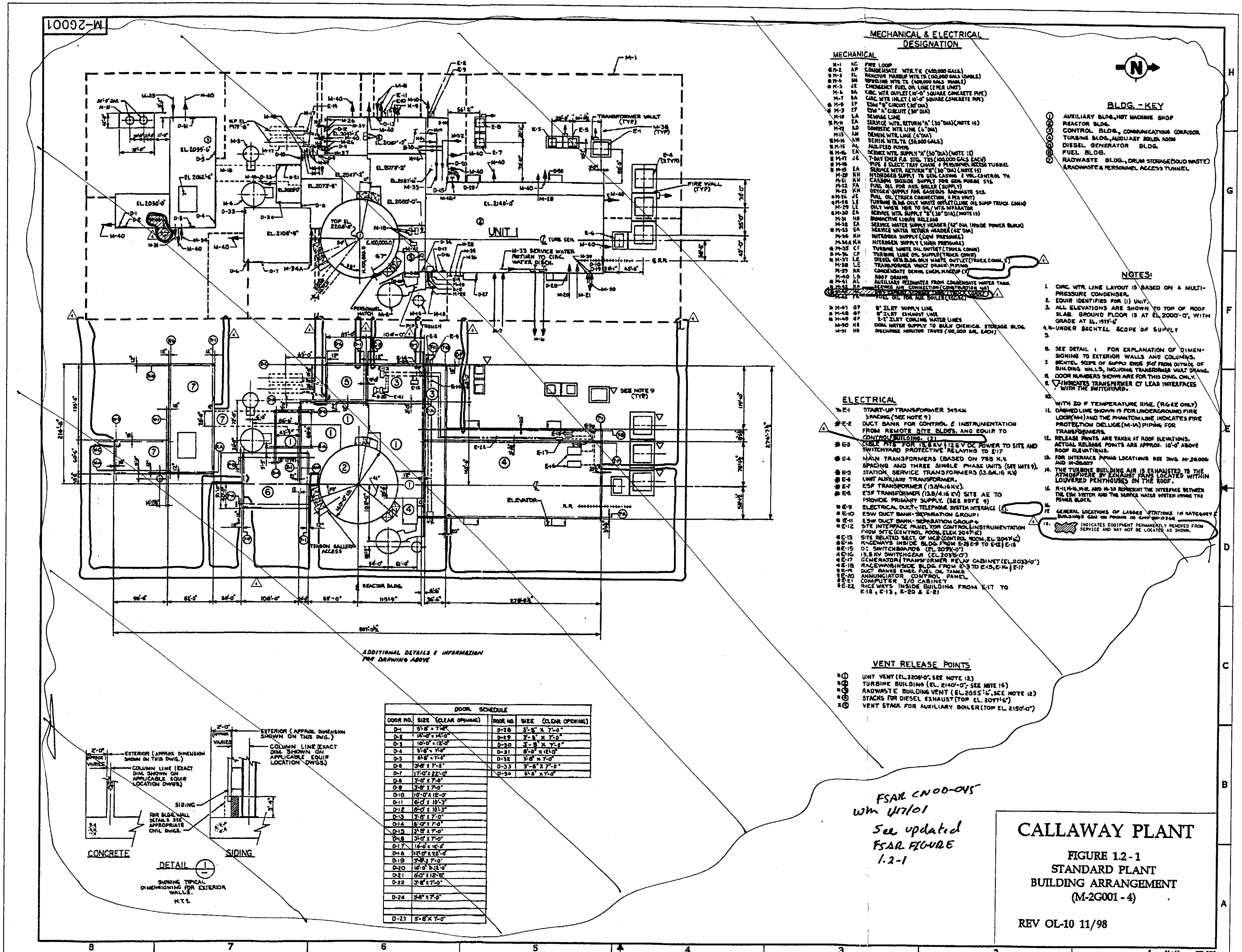
The Class IE electrical systems are similar to Class IE systems utilized on many other Bechtel-designed plants since designs that meet the requirements and standards of the nuclear industry develop in a similar manner. The Class IE dc systems and components are similar to the dc systems and components at Palo Verde.

Direct current power for the Class IE dc loads is supplied by four independent Class IE 125-V dc batteries and associated battery chargers. One 250-V and two 125-V non-Class IE batteries and associated battery chargers are also provided to supply 250-V and 125-V dc power for the non-Class IE dc system loads.

1.2.8 POWER CONVERSION SYSTEM

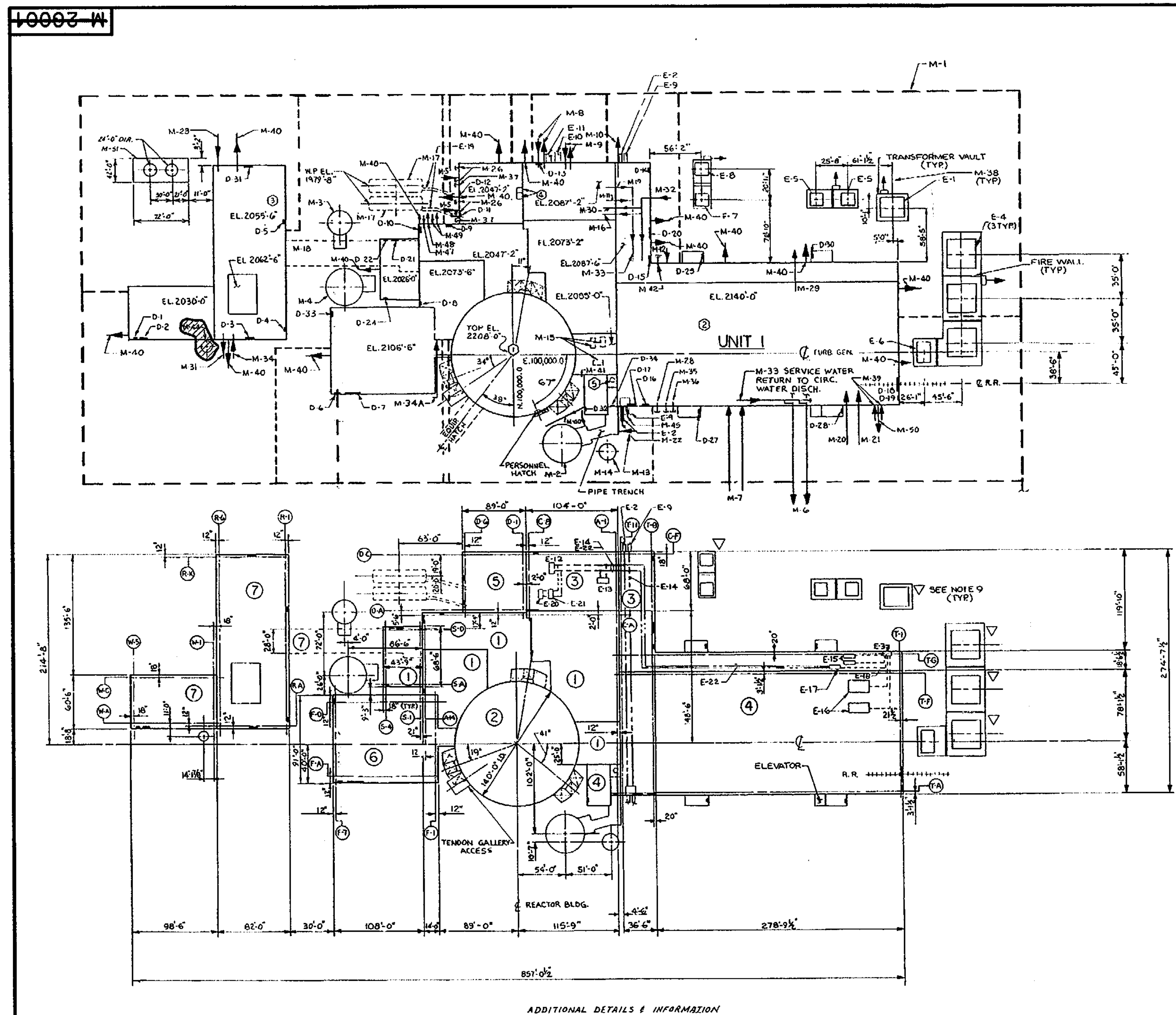
Thermal energy that is generated by the NSSS is converted into electrical energy through the steam cycle process by the turbine generator.

The turbine is a tandem-compound, six-flow, four-element, 1,800-rpm unit, having one high-pressure and three low-pressure elements. Combination moisture separator-reheaters are employed to dry and reheat the steam between the high- and low-pressure



M-2G001
MECHANICAL & ELECTRICAL DESIGNATION
MECHANICAL
ELECTRICAL
BLDG. - KEY
AUXILIARY BLDG., HOT MACHINE SHOP
REACTOR BLDG.
CONTROL BLDG., COMMUNICATIONS CORRIDOR
TURBINE BLDG., AUXILIARY BOILER ROOM
DIESEL GENERATOR BLDG.
FUEL BLDG.
RADWASTE BLDG., DRUM STORAGE (SOLID WASTE) & RADWASTE & PERSONNEL ACCESS TUNNEL
NOTES:
VENT RELEASE POINTS
UNIT VENT (EL. 2208'-0", SEE NOTE 12)
TURBINE BUILDING (EL. 2140'-0", SEE NOTE 14)
RADWASTE BUILDING VENT (EL. 2055'-6", SEE NOTE 12)
STACKS FOR DIESEL EXHAUST (TOP EL. 2097'-6")
VENT STACK FOR AUXILIARY BOILER (TOP EL. 2150'-0")
DOOR SCHEDULE
UNIT 1
ADDITIONAL DETAILS & INFORMATION FOR DRAWING ABOVE
CONCRETE
DETAIL 1
SIDING
SHOWING TYPICAL DIMENSIONING FOR EXTERIOR WALLS.
N.T.S.
FSAR CN00-045
wm 4/17/01
See updated FSAR FIGURE 1.2-1
CALLAWAY PLANT
FIGURE 1.2-1
STANDARD PLANT
BUILDING ARRANGEMENT
(M-2G001 - 4)
REV OL-10 11/98

updated Figure 1.2-1
FSAR CN 00-045
WM 1/17/01



ADDITIONAL DETAILS & INFORMATION FOR DRAWING ABOVE

MECHANICAL & ELECTRICAL DESIGNATION

MECHANICAL

M-1	KC	FIRE LOOP
*M-2	AP	CONDENSATE WTR. TK (450,000 GALS.)
*M-3	BL	REACTOR MAKEUP WTR TK (150,000 GALS USABLE)
*M-4	BN	REFUELING WTR TK (400,000 GALS USABLE)
*M-5	JE	EMERGENCY FUEL OIL LINE (2 PER UNIT)
M-6	DA	CIRC. WTR OUTLET (10'-0" SQUARE CONCRETE PIPE)
M-7	DA	CIRC. WTR INLET (10'-0" SQUARE CONCRETE PIPE)
*M-8	EF	ESW "B" CIRCUIT (30" DIA)
*M-9	EF	ESW "A" CIRCUIT (30" DIA)
M-10	LA	SEWAGE LINE
*M-11	EA	SERVICE WTR. RETURN "A" (30" DIA) (NOTE 15)
M-12	KD	DOMESTIC WTR LINE (6" DIA)
M-13	AN	DEMIN. WTR. LINE (4" DIA)
*M-14	AN	DEMIN. WTR. TK (50,000 GALS.)
*M-15	AL	AUX. FEED PUMPS
*M-16	EA	SERVICE WTR. SUPPLY "A" (30" DIA) (NOTE 15)
*M-17	JE	7-DAY EMER F.O. STG. TKS (100,000 GALS EACH)
*M-18		PIPE & ELECT. TRAY CHASE & PERSONNEL ACCESS TUNNEL
*M-19	EA	SERVICE WTR RETURN "B" (30" DIA) (NOTE 15)
M-20	KH	HYDROGEN SUPPLY TO GEN. CASING & VOL. CONTROL TK
M-21	KH	CARBON DIOXIDE SUPPLY FOR GEN. PURGE SYS.
M-22	FA	FUEL OIL FOR AUX. BOILER (SUPPLY)
M-23	KH	OXYGEN SUPPLY FOR GASEOUS RADWASTE SYS.
*M-26	JE	FUEL OIL (TRUCK CONNECTION, 4 PER UNIT)
*M-28	LF	TURBINE BLDG. OILY WASTE OUTLET (LUBE OIL SUMP TRUCK CONN)
M-29	LE	OILY WASTE HDR TO OIL/WTR. SEPARATOR
*M-30	EA	SERVICE WTR. SUPPLY "B" (30" DIA) (NOTE 15)
M-31	HB	RADIOACTIVE LIQUID RELEASE
M-32	EA	SERVICE WATER SUPPLY HEADER (42" DIA INSIDE POWER BLOCK)
*M-33	EA	SERVICE WATER RETURN HEADER (42" DIA)
M-34	KH	NITROGEN SUPPLY (LOW PRESSURE)
M-34A	KH	NITROGEN SUPPLY (HIGH PRESSURE)
*M-35	CF	TURBINE WASTE OIL OUTLET (TRUCK CONN)
*M-36	CF	TURBINE LUBE OIL SUPPLY (TRUCK CONN)
*M-37	LE	DIESEL GEN. BLDG. OILY WASTE OUTLET (TRUCK CONN, 2)
M-38	LE	TRANSFORMER VAULT DRAIN PIPING
M-39	AK	CONDENSATE DEMIN. CHEM. MAKEUP (2)
M-40	LB	ROOF DRAINS
*M-41	AL	AUXILIARY FEEDWATER FROM CONDENSATE WATER TANK
*M-42	KA	SERVICE AIR CONNECTION (CONSTRUCTION AIR)
[illegible]		[illegible]
M-45	FA	FUEL OIL FOR AUX BOILER (RECIRC)
*M-47	GP	8" ILRT SUPPLY LINE
*M-48	GP	8" ILRT EXHAUST LINE
*M-49	GP	2-2" ILRT COOLING WATER LINES
M-50	KS	DOM. WATER SUPPLY TO BULK CHEMICAL STORAGE BLDG.
M-51	HB	DISCHARGE MONITOR TANKS (100,000 GAL. EACH)

ELECTRICAL

*E-1	START-UP TRANSFORMER 345KV. SPACING (SEE NOTE 9)
*E-2	DUCT BANK FOR CONTROL & INSTRUMENTATION FROM REMOTE SITE BLDGS. AND EQUIP. TO CONTROL BUILDING. (2)
*E-3	CABLE PITS FOR 13.8 KV & 125 V DC POWER TO SITE AND SWITCHYARD PROTECTIVE RELAYING TO E-17
*E-4	MAIN TRANSFORMERS (BASED ON 765 K.V. SPACING AND THREE SINGLE PHASE UNITS (SEE NOTE 9).
*E-5	STATION SERVICE TRANSFORMERS (13.8/4.16 KV)
*E-6	UNIT AUXILIARY TRANSFORMER.
*E-7	ESF TRANSFORMER (13.8/4.16 KV) - CAPACITOR BANK
*E-8	ESF TRANSFORMER (13.8/4.16 KV) - CAPACITOR BANK SITE AE TO PROVIDE PRIMARY SUPPLY. (SEE NOTE 9)
*E-9	ELECTRICAL DUCT - TELEPHONE SYSTEM INTERFACE (2).
*E-10	ESW DUCT BANK - SEPARATION GROUP 1
*E-11	ESW DUCT BANK - SEPARATION GROUP 4
*E-12	SITE INTERFACE PANEL FOR CONTROL & INSTRUMENTATION FROM SITE (CONTROL ROOM, ELEV. 2047'-6")
*E-13	SITE RELATED SECT. OF MCB (CONTROL ROOM, EL. 2047'-6")
*E-14	RACEWAYS INSIDE BLDG. FROM E-2 & E-9 TO E-12 & E-13
*E-15	DC SWITCHBOARDS (EL. 2033'-0")
*E-16	13.8 KV SWITCHGEAR (EL. 2033'-0")
*E-17	GENERATOR & TRANSFORMER RELAY CABINET (EL. 2033'-0")
*E-18	RACEWAYS INSIDE BLDG. FROM E-3 TO E-15, E-16 & E-17
*E-19	DUCT BANKS EMER. FUEL OIL TANKS
*E-20	ANNUNCIATOR CONTROL PANEL
*E-21	COMPUTER I/O CABINET
*E-22	RACEWAYS INSIDE BUILDING FROM E-17 TO E-12, E-13, E-20 & E-21

VENT RELEASE POINTS

*① UNIT VENT (EL. 2208'-0", SEE NOTE 12)
*② TURBINE BUILDING (EL. 2140'-0"; SEE NOTE 14)
*③ RADWASTE BUILDING VENT (EL. 2055'-6", SEE NOTE 12)
*④ STACKS FOR DIESEL EXHAUST (TOP EL. 2097'-6")
*⑤ VENT STACK FOR AUXILIARY BOILER (TOP EL. 2150'-0")

BLDG. - KEY

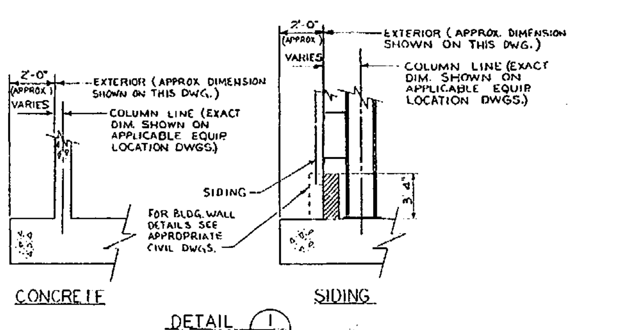
① AUXILIARY BLDG., HOT MACHINE SHOP
② REACTOR BLDG.
③ CONTROL BLDG., COMMUNICATIONS CORRIDOR
④ TURBINE BLDG., AUXILIARY BOILER ROOM
⑤ DIESEL GENERATOR BLDG.
⑥ FUEL BLDG.
⑦ RADWASTE BLDG., DRUM STORAGE (SOLID WASTE) & RADWASTE & PERSONNEL ACCESS TUNNEL

NOTES:

1. CIRC. WTR. LINE LAYOUT IS BASED ON A MULTI-PRESSURE CONDENSER.
2. EQUIP. IDENTIFIED FOR (1) UNIT.
3. ALL ELEVATIONS ARE SHOWN TO TOP OF ROOF SLAB. GROUND FLOOR IS AT EL. 2000'-0", WITH GRADE AT EL. 1999'-6"
4. *-UNDER BECHTEL SCOPE OF SUPPLY
5.
6. SEE DETAIL 1 FOR EXPLANATION OF DIMENSIONING TO EXTERIOR WALLS AND COLUMNS.
7. BECHTEL SCOPE OF SUPPLY ENDS 5'-0" FROM OUTSIDE OF BUILDING WALLS, INCLUDING TRANSFORMER VAULT DRAINS.
8. DOOR NUMBERS SHOWN ARE FOR THIS DWG. ONLY.
9. ▽-INDICATES TRANSFORMER CT LEAD INTERFACES WITH THE SWITCHYARD.
10. WITH 20 F TEMPERATURE RISE. (RG&E ONLY)
11. DASHED LINE SHOWN IS FOR UNDERGROUND FIRE LOOP (M-1) AND THE PHANTOM LINE INDICATES FIRE PROTECTION DELUGE (M-1A) PIPING FOR TRANSFORMERS.
12. RELEASE POINTS ARE TAKEN AT ROOF ELEVATIONS. ACTUAL RELEASE POINTS ARE APPROX. 10'-0" ABOVE ROOF ELEVATIONS.
13. FOR INTERFACE PIPING LOCATIONS SEE DWG M-2G006 AND M-2G007
14. THE TURBINE BUILDING AIR IS EXHAUSTED TO THE ATMOSPHERE BY EXHAUST FANS LOCATED WITHIN LOUVERED PENTHOUSES ON THE ROOF.
15. M-11, M-16, M-19, AND M-30 REPRESENT THE INTERFACE BETWEEN THE ESW SYSTEM AND THE SERVICE WATER SYSTEM INSIDE THE POWER BLOCK.
16.
17. GENERAL LOCATIONS OF LADDER STATIONS IN CATEGORY I BUILDINGS CAN BE FOUND IN CMP 85-0363.
18. INDICATES EQUIPMENT PERMANENTLY REMOVED FROM SERVICE AND MAY NOT BE LOCATED AS SHOWN.

DOOR SCHEDULE

DOOR NO.	SIZE (CLEAR OPENING)	DOOR NO.	SIZE (CLEAR OPENING)
D-1	3'-8" x 7'-0"	D-28	3'-8" X 7'-0"
D-2	14'-0" x 14'-0"	D-29	3'-8" X 7'-0"
D-3	10'-0" x 12'-0"	D-30	3'-8" X 7'-0"
D-4	3'-8" x 7'-0"	D-31	8'-0" x 12'-0"
D-5	3'-8" x 7'-0"	D-32	3'-8" x 7'-0"
D-6	3'-8" X 7'-0"	D-33	3'-8" X 7'-0"
D-7	17'-0" X 22'-0"	D-34	3'-8" x 7'-0"
D-8	3'-8" X 7'-0"		
D-9	3'-8" X 7'-0"		
D-10	10'-0" X 12'-0"		
D-11	6'-0" X 10'-3"		
D-12	6'-0" x 10'-3"		
D-13	3'-8" X 7'-0"		
D-14	5'-0" X 7'-0"		
D-15	3'-8" X 7'-0"		
D-16	3'-8" X 7'-0"		
D-17	10'-0" x 12'-0"		
D-18	17'-0" X 22'-0"		
D-19	3'-8" X 7'-0"		
D-20	10'-0" x 12'-0"		
D-21	8'-0" X 12'-0"		
D-22	3'-8" X 7'-0"		
D-24	3'-8" X 7'-0"		
D-27	3'-8" X 7'-0"		



DETAIL 1
SHOWING TYPICAL DIMENSIONING FOR EXTERIOR WALLS.
N.T.S.

MOD. REG. NO.	DRAWING NO.	REV.	SEQ.
99-1038	M-2G001	004	000

NO.	DATE	REVISIONS	BY	CHK				APPR
4		INCORP. CMP 89-1045 AND DEC-1384	RLW	DLB	N/A			AMR
3		INCORP. RMP 94-2006A.	MAL		--			
2	1-91	INCORP. DEC-587						
1		INCORP. CMP-85-0363			N/A	N/A	N/A	
0	86	REFLECTS TURNOVER TO UE; SUPERSEDES M-0G001 R-1 & INCORP. RFR-2109	ALP	82	N/A	N/A	N/A	

SCALE 1"=50'-0" DATE 2-7-74 DESIGNED DRAWN CB

BECHTEL
GAITHERSBURG, MARYLAND

SNUPPS

PENINSULAR PLANT ARRANGMENT
STANDARD POWER SYSTEMS
& STRUCTURE INTERFACE

AS-BUILT

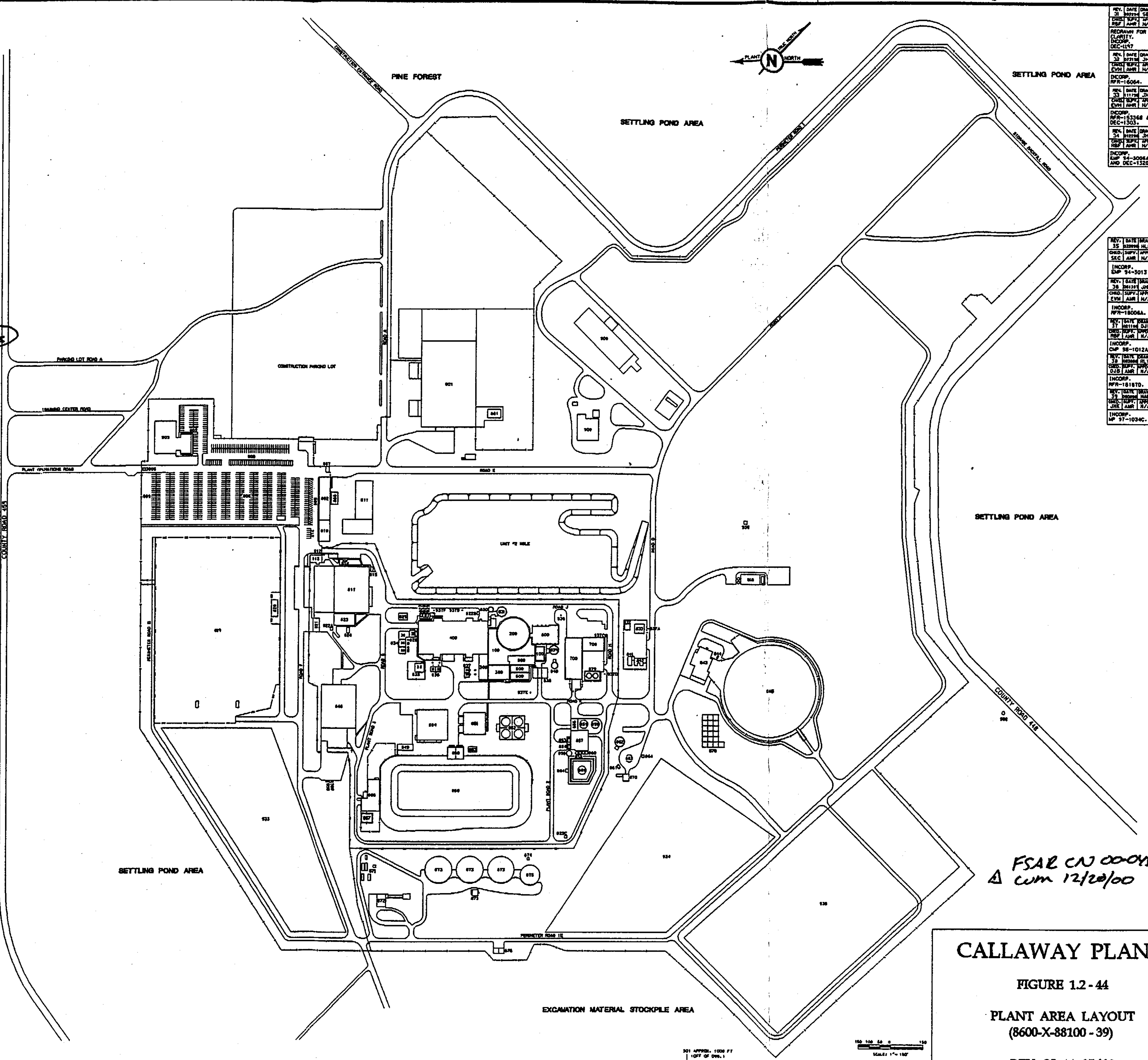
UTILITY DRAWING NO. REV

JOB NO. 10466 BECHTEL DRAWING NO. ~~M-2G001~~ REV ~~4~~

DRAWING APPLICABLE TO UNITS 2

34x44 "E" SIZE

00188-X-0698



LEGEND

PERMANENT PLANT FACILITIES

100 - AUXILIARY BUILDING, HOT MACHINE SHOP
200 - REACTOR BUILDING
300 - CONTROL BUILDING, COMMUNICATIONS CORRIDOR
400 - TURBINE BUILDING, AUXILIARY BOILER
500 - DIESEL GENERATOR BUILDING
501 - LANDFILL MONITORING WELL #501
502 - LANDFILL MONITORING WELL #502
600 - FUEL BUILDING
700 - RADWASTE BUILDING, DRUM STORAGE
801 - STORES II BUILDING
802 - PARKING-TRAINING CENTER
803 - TRAINING CENTER
805 - WATCHMAN GATEHOUSE
808 - PARKING OPERATIONAL
809 - PARKING VISITORS
810 - SECURITY OFFICES
811 - ADMINISTRATION/ENGINEERING BUILDING
812 - MAIN ENTRANCE
813 - SECURITY BUILDING/MAIN ACCESS FACILITY
814 - SECURITY DIESEL FUEL TANK
815 - SECURITY DIESEL GENERATOR
816 - PARKING RESERVED
817 - SERVICE BUILDING
818 - COOLING WATER CHEMICAL CONTROL
819 - SWITCHYARD
820 - SWITCHYARD CONTROL BUILDING
821 - SECONDARY ACCESS FACILITY
822 - REMOTE MLTPLEX UNIT A,B,C
823 - TECHNICAL SUPPORT CENTER
824 - SITE SWITCHGEAR BUILDING
825 - SPARE MAIN TRANSFORMER
826 - UNIT AUXILIARY TRANSFORMER
827 - AMMONIA STORAGE TANK
828 - SULFURIC ACID STORAGE TANK
829 - CAUSTIC STORAGE TANK
830 - DEMINERALIZED WATER TANK
831 - CONDENSATE WATER TANK
832 - CARBON DIOXIDE CO2 STORAGE
833 - HYDROGEN STORAGE
834 - MAIN TRANSFORMER
~~835 - STARTUP TRANSFORMER~~
836 - STATION SERVICE TRANSFORMER
837 - ESF TRANSFORMERS /Capacitor Banks
~~838 - EMERGENCY DIESEL FUEL TANK~~
839 - REFUELING WATER TANK
840 - REACTOR MAKEUP WATER TANK
841 - OXYGEN STORAGE
842 - NITROGEN STORAGE
843 - CIRC SERVICE WATER PUMPHOUSE
844 - CIRC WATER H2SO4 TANK
845 - COOLING TOWER
846 - STORES I BUILDING
849 - HEALTH PHYSICS CALIBRATION FACILITY
850 - ESSENTIAL SERVICE WATER PUMPHOUSE (OFFICES)
851 - MAINTENANCE TRAINING ANNEX
852 - UHS COOLING TOWER I
853 - DEMINERALIZED CAUSTIC STORAGE TANK
854 - DEMINERALIZED H2SO4 STORAGE TANK
855 - DEMINERALIZED CLEAR WELL
856 - FIRE PUMPHOUSE
857 - DEMINERALIZED POTABLE WATER BUILDING
858 - GRAVITY SAND FILTER TANK
859 - FIRE WATER STORAGE TANK
860 - ACTIVATED CARBON FILTER TANK
861 - RECLAIMED OIL STORAGE TANK
862 - NEUTRALIZATION TANK
863 - EQUALIZATION BASIN
864 - AUXILIARY OIL TRANSFER
865 - GASOLINE STORAGE TANK
866 - SOLVENT STORAGE
867 - GAS CYLINDER STORAGE
868 - UHS RETENTION POND
869 - FUEL OIL STORAGE TANK
870 - OILY WASTE TREATMENT AREA
871 - SEWAGE TREATMENT PLANT
872 - WATER TREATMENT CONTROL BUILDING
873 - WATER TREATMENT PLANT
874 - WELL NO. 3
875 - WATER TREATMENT PLANT CLEARWELL
876 - SLUDGE PUMP STATION
878 - SITE CATHODIC PROTECTION ANNODE BED
879 - LCD RADWASTE STORAGE TANK
881 - LUBE OIL STORAGE BUILDING
882 - CENTRAL PROCESS FACILITY
883 - HELPERS PAINT SHOP
884 - OUTAGE MAINTENANCE FACILITY
886 - VEHICLE DIESEL FUEL STORAGE TANK
887 - FOOD VENDOR STORAGE BUILDING
888 - FITNESS FOR DUTY BUILDING
889 - RAM STORAGE BUILDING
906 - MAINTENANCE SHOP ANNEX (FAB SHOP)
909 - QUALITY CONTROL BUILDING
933 - SAN. LANDFILL (PER. #102704)
934 - SAN. LANDFILL (PER. #102702 (202701))
935 - SAN. LANDFILL (PER. #102705)
936 - DIESEL FUEL REMEDIATION WELL
937 - MONITORING WELL
938 - PEREGRINE FALCON HACK

OWNER CONTROLLED AREA FENCE
PROTECTED AREA FENCE
SWITCHYARD FENCE

NOTE:

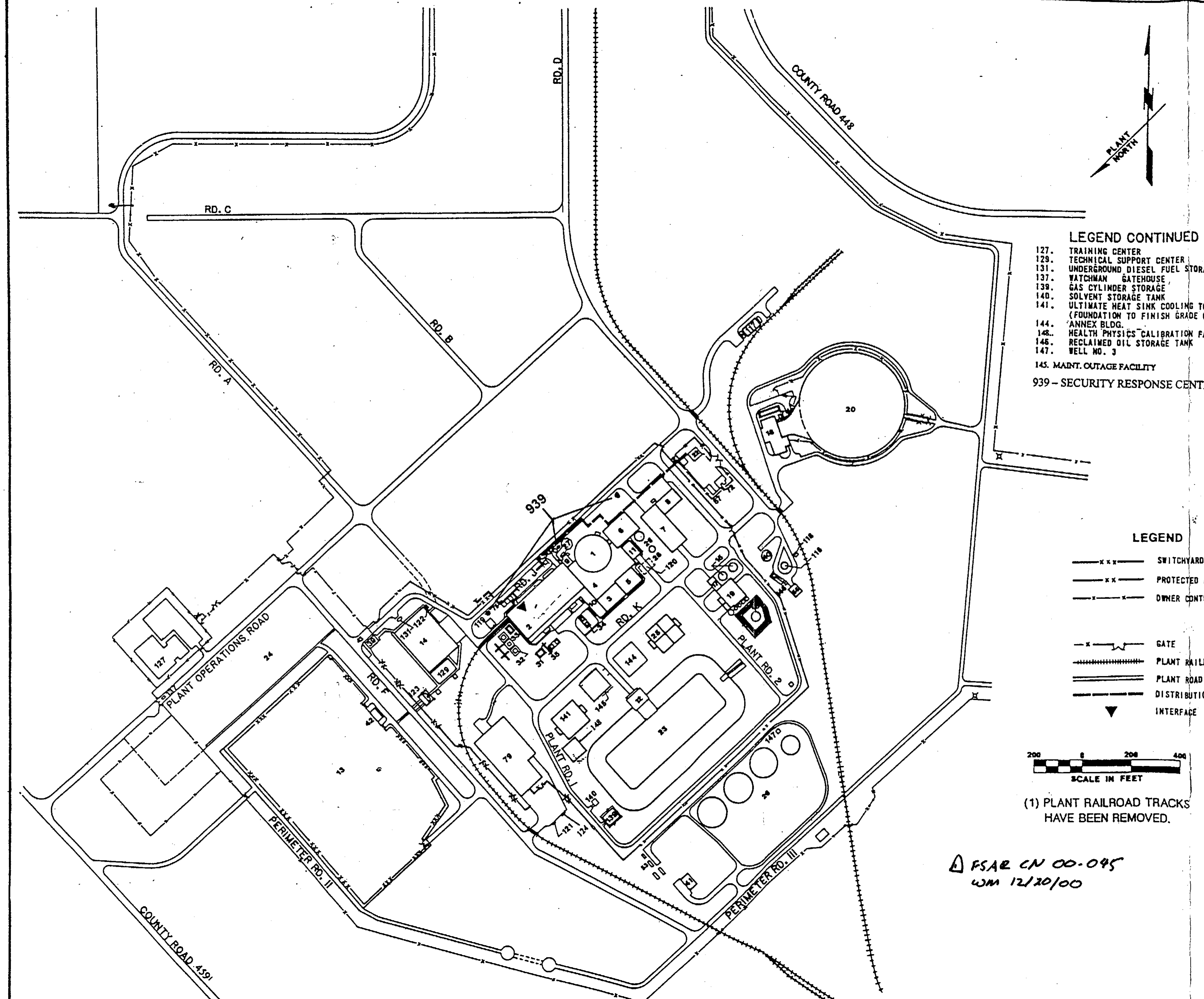
1. SEE 8600-X-90443 FOR VEHICLE BARRIER SYSTEM AT PA FENCE.
2. SEE 8600-X-89157 FOR FLOPPY FENCES INSIDE PA FENCE AND LOCATION OF SECURITY RESPONSE CENTERS. (39)

CALLAWAY PLANT

FIGURE 1.2-44

PLANT AREA LAYOUT
(8600-X-88100-39)

REV OL-11 05/00



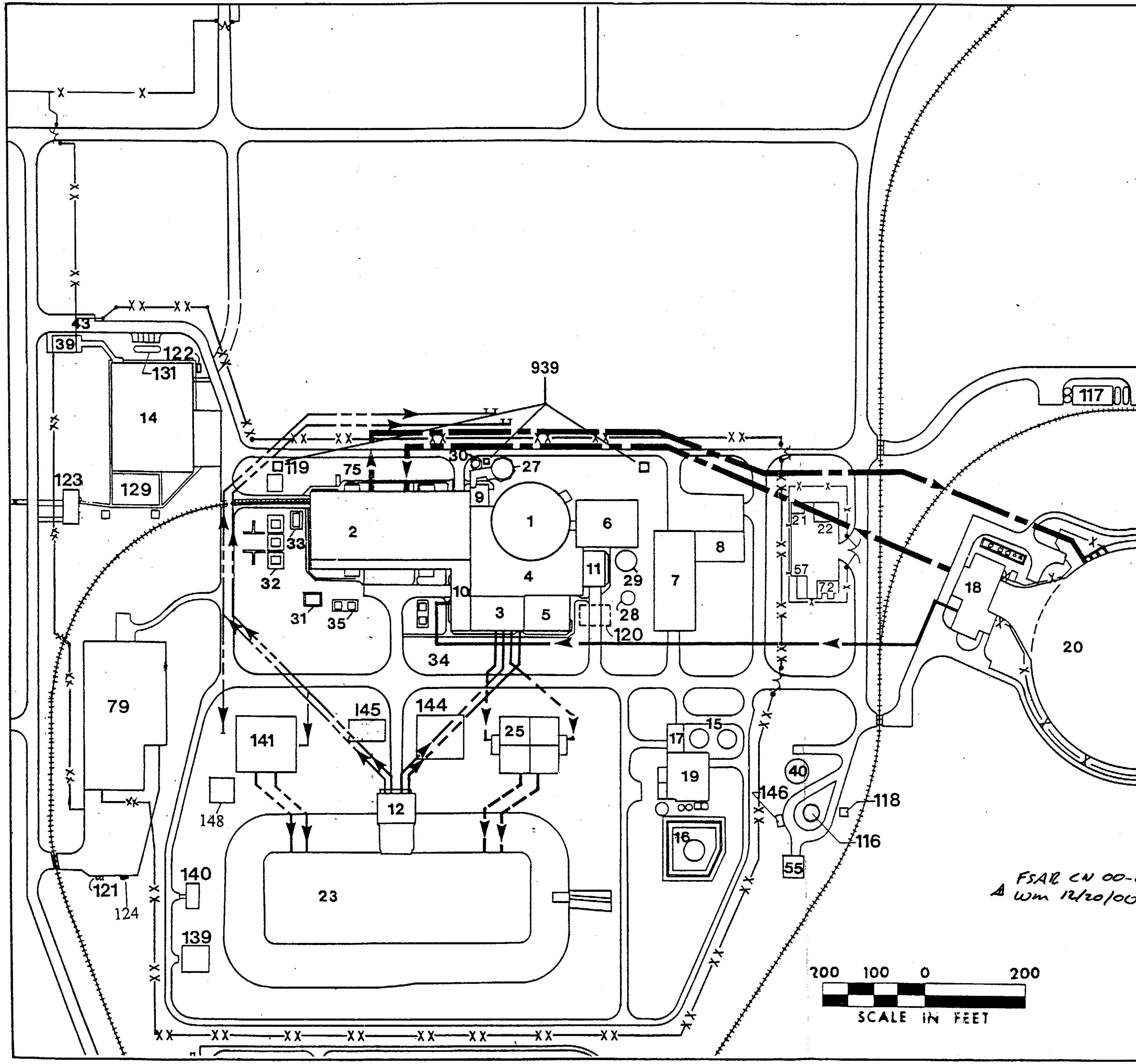
LEGEND

1. REACTOR BLDG.
2. TURBINE BLDG.
3. CONTROL BLDG.
4. AUXILIARY BLDG.
5. DIESEL GENERATOR BLDG.
6. FUEL BLDG.
7. RADWASTE BLDG.
8. DRUM STORAGE (SOLID WASTE)
9. AUXILIARY BOILER ROOM
10. CONTROL BLDG. COMMUNICATIONS CORR.
11. HOT MACHINE SHOP
12. ESSENTIAL SERVICE WATER PUMPHOUSE
13. SWITCHYARD
14. SERVICE BLDG.
15. FIRE WATER STORAGE TANKS
16. FUEL OIL STORAGE TANK
17. FIRE PUMPHOUSE
18. COOLING WATER SYSTEM PUMPHOUSE (CIRC & SERVICE)
19. DEMINERALIZED & POTABLE WATER PLANT
20. COOLING TOWER
21. CO2 STORAGE
22. HYDROGEN STORAGE
23. ULTIMATE HEAT SINK RETENTION POND
24. PARKING—OPERATIONAL
25. ULTIMATE HEAT SINK COOLING TOWER NO. 1
26. WATER TREATMENT PLANT
27. CONDENSATE WATER STORAGE TANK
28. REACTOR MAKEUP WATER STORAGE TANK
29. REFUELING WATER STORAGE TANK
30. DEMINERALIZED WATER STORAGE TANK
31. START—UP TRANSFORMER
32. MAIN TRANSFORMERS
33. ~~UNIT AUXILIARY TRANSFORMER~~
34. ESF TRANSFORMER – CAPACITOR BANK
35. STATION SERVICE TRANSFORMER
39. SECURITY BLDG.
40. NEUTRALIZATION TANK
41. WATER TREATMENT PLANT CONTROL BLDG.
42. SWITCHYARD CONTROL BLDG.
43. MAIN PERMANENT ENTRANCE
53. SEWAGE TREATMENT PLANT
55. OILY WASTE TREATMENT AREA
57. OXYGEN STORAGE
72. NITROGEN STORAGE
75. BULK CHEMICAL STORAGE
79. STORES BLDG.
116. EQUALIZATION BASIN
117. COOLING WATER CHEMICAL CONTROL AREA
118. AUXILIARY OIL TRANSFER
119. SPARE MAIN TRANSFORMER STORAGE AREA
120. UNDERGROUND DIESEL FUEL STORAGE TANKS
121. ABOVEGROUND GASOLINE STORAGE TANK
122. SECURITY DIESEL GENERATOR BLDG.
123. SECONDARY ACCESS FACILITY
124. DIESEL FUEL STORAGE TANK

REV. OL-~~10~~ 12
11/~~98~~ 01

UNION ELECTRIC COMPANY
CALLAWAY PLANT
FINAL SAFETY ANALYSIS REPORT

FIGURE 2.2-4
HYDROGEN SYSTEM
STORAGE & DISTRIBUTION



124. DIESEL FUEL STORAGE TANK

145. MAINT. OUTAGE FACILITY

939 – SECURITY RESPONSE CENTERS

(1) PLANT RAILROAD TRACKS HAVE BEEN REMOVED.

LEGEND

- SWITCHYARD FENCE
- PROTECTED AREA FENCE
- OWNER CONTROL FENCE
- GATE
- PLANT RAILROAD (1)
- PLANT ROAD
- CIRCULATING WATER SYSTEM PIPE
- SERVICE WATER SYSTEM PIPE
- ESSENTIAL SERVICE WATER PIPE
- U.H.S. COOLING TOWER PIPE

LEGEND

1. REACTOR BLDG.
2. TURBINE BLDG.
3. CONTROL BLDG.
4. AUXILIARY BLDG.
5. DIESEL GENERATOR BLDG.
6. FUEL BLDG.
7. RADWASTE BLDG.
8. DRUM STORAGE (SOLID WASTE)
9. AUXILIARY BOILER ROOM
10. CONTROL BLDG. COMMUNICATIONS CORR.
11. HOT MACHINE SHOP
12. ESSENTIAL SERVICE WATER PUMPHOUSE
13. SWITCHYARD
14. SERVICE BLDG.
15. FIRE WATER STORAGE TANKS
16. FUEL OIL STORAGE TANK
17. FIRE PUMPHOUSE
18. COOLING WATER SYSTEM PUMPHOUSE (CIRC & SERVICE)
19. DEMINERALIZED & POTABLE WATER PLANT
20. COOLING TOWER
21. CO2 STORAGE
22. HYDROGEN STORAGE
23. ULTIMATE HEAT SINK RETENTION POND
24. PARKING–OPERATIONAL
25. ULTIMATE HEAT SINK COOLING TOWER NO.1
26. WATER TREATMENT PLANT
27. CONDENSATE WATER STORAGE TANK
28. REACTOR MAKEUP WATER STORAGE TANK
29. REFUELING WATER STORAGE TANK
30. DEMINERALIZED WATER STORAGE TANK
31. START–UP TRANSFORMER
32. MAIN TRANSFORMERS
33. UNIT AUXILIARY TRANSFORMER
34. ESF TRANSFORMER – CAPACITOR BANK
35. STATION SERVICE TRANSFORMER
39. SECURITY BLDG.
40. NEUTRALIZATION TANK
41. WATER TREATMENT PLANT CONTROL BLDG.
42. SWITCHYARD CONTROL BLDG.
43. MAIN PERMANENT ENTRANCE
53. SEWAGE TREATMENT PLANT
55. OILY WASTE TREATMENT AREA
57. OXYGEN STORAGE
72. NITROGEN STORAGE
75. BULK CHEMICAL STORAGE
79. STORES BLDG.
116. EQUALIZATION BASIN
117. COOLING WATER CHEMICAL CONTROL AREA
118. AUXILIARY OIL TRANSFER
119. SPARE MAIN TRANSFORMER
120. UNDERGROUND DIESEL FUEL STORAGE TANKS
121. ABOVEGROUND GASOLINE STORAGE TANK
122. SECURITY DIESEL GENERATOR BLDG.
123. SECONDARY ACCESS FACILITY
129 TECHNICAL SUPPORT CENTER
131. UNDERGROUND DIESEL FUEL STORAGE TANK
139. GAS CYLINDER STORAGE
140. SOLVENT STORAGE TANK
141. ULTIMATE HEAT SINK COOLING TOWER NO. 2 (FOUNDATION TO FINISH GRADE ONLY)
144. ANNEX BLDG.
148. HEALTH PHYSICS CALIBRATION FACILITY
146. RECLAIMED OIL STORAGE TANK

FSAR CN 00-045
Δ WM 12/20/00

REV. OL-10
11/98

UNION ELECTRIC COMPANY
CALLAWAY PLANT
FINAL SAFETY ANALYSIS REPORT

FIGURE 1.2-45
COOLING WATER YARD PIPING SYSTEMS

CHAPTER 8.0

ELECTRIC POWER

8.1 INTRODUCTION

8.1.1 UTILITY GRID DESCRIPTION

The generator units are connected to the respective transmission systems. The transmission system voltage is 345 kV for Callaway. The utility has integrated transmission networks and interconnections with neighboring systems. A description of the system network and interconnections is given in Section 8.1.1 of the Site Addendum.

8.1.2 ONSITE POWER SYSTEM DESCRIPTION

The onsite power system is provided with preferred (offsite) power from the offsite system through two independent and redundant sources of power. One preferred circuit from the switchyard supplies power to a three-winding startup transformer. This startup transformer feeds two medium-voltage 13.8-kV busses and a 13.8/4.16-kV ESF transformer (equipped with an automatic load tap changer) with its associated capacitor bank. The second preferred (offsite) circuit is connected to the second 13.8/4.16-kV ESF transformer (equipped with an automatic load tap changer) with its associated capacitor bank. Each transformer normally supplies its associated medium voltage 4.16-kV Class IE bus. Refer to Figure 8.3-1.

The two 13.8-kV busses supply power to the nonsafety-related auxiliary loads of the unit. The 13.8-kV busses are also connected to a three-winding unit auxiliary transformer, in addition to the startup transformer. The unit auxiliary transformer is connected to the main generator through an isolated phase bus duct.

Two 4.16-kV non-Class IE busses are supplied power from two 13.8-kV busses through two 13.8/4.16-kV station service transformers.

Non-Class IE low-voltage 480-V loads are supplied power from two 13.8-kV busses through 480-V load centers and 480-V motor control centers.

The onsite power system is divided into two separate load groups, each load group consisting of an arrangement of busses, transformers, switching equipment, and loads fed from a common power supply. Power is supplied to auxiliaries at 13.8 kV, 4.16 kV, 480 V, 480/277 V, 208/120 V, 120 V ac, 250 V dc, and 125 V dc.

The onsite standby power system includes the Class IE ac and dc power for equipment used to maintain a cold shutdown of the plant and to mitigate the consequences of a DBA.

FSAR CN 00-045
WM 1/7/00 (INFO)

Class IE ac system loads are separated into two load groups which are powered from separate ESF transformers or two independent diesel generators (one per load group). Each load group distributes power by a 4.16-kV bus, 480-V load centers, and 480-V motor control centers.

The Class IE dc system provides four separate 125-V dc battery supplies per unit for Class IE controls, instrumentation, power, and control inverters. Refer to Figure 8.3-6.

8.1.3 SAFETY-RELATED LOADS

Refer to Figure 8.3-2 for a listing of loads supplied by the Class IE ac system. Refer to Table 8.3-1 for a list of loads supplied by the Class IE dc system. The loads and their safety functions are identified in the above references.

8.1.4 DESIGN BASES

8.1.4.1 Offsite Power System

8.1.4.1.1 Safety Design Bases

SAFETY DESIGN BASIS ONE - Electrical power from the power grid to the plant site is supplied by two physically independent circuits designed and located so as to minimize the likelihood of simultaneous failure.

SAFETY DESIGN BASIS TWO - Each of these independent circuits has the capability to safely shut down the unit. The first preferred circuit, which is connected to the startup transformer, has the capacity to supply the startup and all the auxiliary loads (both group 1 and group 2 simultaneously) of the unit.

SAFETY DESIGN BASIS THREE - The second preferred power circuit, which supplies power to the ESF transformer, has the capacity to supply all the safety-related loads of the unit.

SAFETY DESIGN BASIS FOUR - The loss of the nuclear unit or the most critical unit on the grid will not result in the loss of offsite power to the Class IE busses.

8.1.4.1.2 Power Generation Design Bases

POWER GENERATION DESIGN BASIS ONE - The switchyard power circuit breaker control for 345-kV breakers is designed with duplicate and redundant systems, i.e., two independent battery systems, two trip coils per breaker, and two independent protective relay schemes.

FSAR CN 00-045
Δ wm 1/10/01
FSAR CN 00-008 incorporated

8.1.4.2 Onsite Power System

8.1.4.2.1 Safety Design Bases

SAFETY DESIGN BASIS ONE - The onsite power system includes a separate and independent Class IE electric power system for each unit (GDC-17).

SAFETY DESIGN BASIS TWO - The onsite Class IE electric power system is divided into two independent load groups, each with its own power supply, busses, transformers, loads, and associated 125-V dc control power. Each load group is independently capable of maintaining the plant in a cold shutdown (GDC-17).

SAFETY DESIGN BASIS THREE - One independent diesel generator is provided for each Class IE ac load group in each unit.

SAFETY DESIGN BASIS FOUR - No provisions are made for automatic transfer of load groups between redundant power sources.

SAFETY DESIGN BASIS FIVE - No portion (ac or dc) of the onsite standby power systems is shared between units (GDC-5).

SAFETY DESIGN BASIS SIX - The Class IE electric systems are designed to satisfy the single failure criterion (GDC-17).

SAFETY DESIGN BASIS SEVEN - For each of four protection channels, one independent 125-V dc and one 120-V vital ac power source are provided. Batteries are sized for 200 minutes of operation without the support of battery chargers.

SAFETY DESIGN BASIS EIGHT - Raceways are not shared by Class IE and non-Class IE cables. However, associated cables connected to Class IE busses are treated as Class IE cables with regard to separation and identification and are run in their related Class IE raceway system.

SAFETY DESIGN BASIS NINE - Special identification criteria are applied for Class IE equipment, including cabling and raceways. Refer to Section 8.3.1.3.

SAFETY DESIGN BASIS TEN - Separation criteria are applied which establish requirements for preserving the independence of redundant Class IE load groups or power systems. Refer to Section 8.3.1.4.1.

SAFETY DESIGN BASIS ELEVEN - Class IE equipment is designed with the capability of being tested periodically (GDC-18).

SAFETY DESIGN BASIS TWELVE - Two physically and electrically independent ESF transformers, with associated capacitor banks are provided to supply the Class IE ac electric power system for the Callaway Plant.

equipped with automatic load tap changers,

Δ

8.1.4.2.2 Power Generation Design Bases

POWER GENERATION DESIGN BASIS ONE - A separate non-Class IE dc system is provided for non-Class IE controls and dc motors.

8.1.4.3 Design Criteria, Regulatory Guides, and IEEE Standards

The onsite power system is generally designed in accordance with IEEE Standards 279, 308, 317, 323, 334, 344, 379, 382, 383, 384, 387, 450, and 484.

Compliance with Regulatory Guides 1.6, 1.9, 1.22, 1.29, 1.30, 1.32, 1.40, 1.41, 1.47, 1.53, 1.62, 1.63, 1.68, 1.73, 1.75, 1.81, 1.89, 1.93, 1.100, 1.106, 1.108, 1.118, and 1.131 and IEEE Standards 323-1974, 338-1971, 344-1975, 384-1974, 387-1977, 308-1974, and 317-1976 are discussed below:

Refer to Appendix 3A for the applicable revision dates on regulatory guides.

Compliance with General Design Criteria 17 and 18 is discussed in Section 3.1 and Section 8.2 of the Site Addendum FSAR.

REGULATORY GUIDE 1.6, INDEPENDENCE BETWEEN REDUNDANT STANDBY (ONSITE) POWER SOURCES AND BETWEEN THEIR DISTRIBUTION SYSTEMS - The Class IE system is divided into redundant load groups so that loss of any one group will not prevent the minimum safety functions from being performed. Figure 8.3-1 shows this arrangement.

Each ac load group has connections to two preferred (offsite) power supplies and to a single diesel generator. Each diesel generator is exclusively connected to a single Class IE 4.16-kV load group and has no automatic connection to the redundant load group.

For a discussion of this regulatory guide, with respect to the Class IE dc system, refer to Section 8.3.2.2.1.

No provisions exist for automatic transfer of loads between redundant onsite power supplies.

The diesel generator of one load group cannot be automatically paralleled with the diesel generator of the redundant load group.

Interlocks are provided to assure that a single operator error would not parallel the standby power sources of redundant load groups. Refer to Section 8.3.1.1.3.

REGULATORY GUIDE 1.9, SELECTION OF DIESEL GENERATOR SET CAPACITY FOR STANDBY POWER SUPPLIES - The continuous rating of each diesel generator is greater than the sum of the conservatively

FSAR CN 00-045
Δ wm 12/20/00 (editorial)

Principal design criteria for these assemblies include the following:

a. The mechanical design, materials, fabrication, examination, and testing of the pressure-retaining boundary of the electrical penetration assembly, excluding optical fibers, electrical conductors, feed-through connectors, insulation, potting compounds, and gaskets, are in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Subsection NE, for Class MC compounds.

b. The electrical penetration assembly is designed to meet all the electrical requirements for the specified service environment without dielectric breakdown or overheating.

c. The electrical penetration assembly is designed to have a total gas leakage rate through its pressure-retaining boundary exclusive of the aperture seal not greater than 1×10^{-6} standard (20°C at one atmosphere of pressure) ~~cubic~~ centimeters per second of dry helium (or equivalent means of measurement) at the maximum specified containment design pressure.

d. A leak test is performed on each penetration assembly following installation. The test is capable of detecting a leakage rate of 10^{-2} cubic centimeters per second or less of dry nitrogen with maximum containment pressure applied across the penetration assembly pressure barrier seal at ambient temperature.

e. Each penetration room has a continuous nitrogen supply system manifolded to each penetration assembly. The design and installation of the system facilitates periodic individual penetration assembly gas leak rate testing after installation.

f. The electrical penetration assembly design is such that safety-related channel separation is maintained.

g. The penetration assembly design is qualified by testing for the intended service within the service and DBE environment.

is sized to carry its anticipated load continuously, but may be slightly overloaded under certain abnormal conditions. For additional details of the sizing of these components, refer to Section 8.3.1.

The two offsite power circuits are fully testable. Since they are continuously energized and ~~largely passive~~, they are continuously tested by their use. When one circuit is shutdown, relays, meters, and other instruments can be tested and calibrated as required. XNB01 and XNB02 LTC control is tested during ESFAS testing.

Control and instrumentation power for these offsite power circuits is provided by the Non-Class 1E dc system. A dc power source from separate station batteries is provided to each offsite power circuit for control and relaying purposes.

From the above considerations, it is concluded that the installation, sizing, and control of both of the offsite power circuits are designed so as to minimize the likelihood of their simultaneous failure under operating and accident conditions.

For additional details concerning the compliance of the offsite power system with General Design Criteria, refer to Section 3.1.

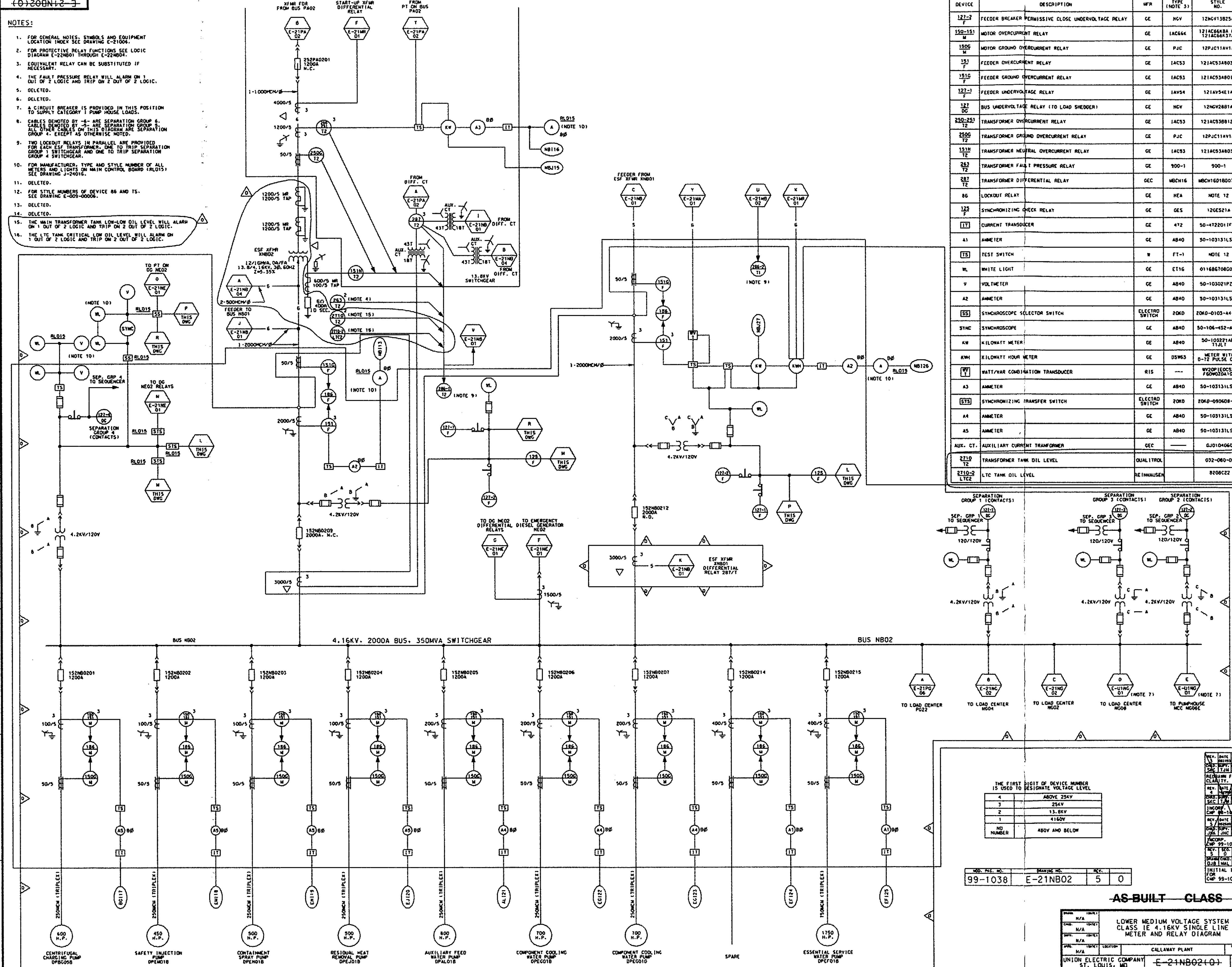
The instrumentation associated with the offsite ac power system provides sufficient information to determine the system availability at any time.

Drawings E-21NB01 and E-21NB02 Single Line Meter and Relay Diagrams for the Safety-Related 4.16-kV Busses NB01 and NB02 show the surveillance details of the ESF transformers and their associated 4.16-kV busses. Table 8.3-4 of the FSAR, Failure Modes and Effects Analysis, shows the system failure modes and the method of such failure detection.

~~E-21NB02(0)~~

NOTES:

1. FOR GENERAL NOTES, SYMBOLS AND EQUIPMENT LOCATION INDEX SEE DRAWING E-21006.
2. FOR PROTECTIVE RELAY FUNCTIONS SEE LOGIC DIAGRAM E-22NB01 THROUGH E-22NB04.
3. EQUIVALENT RELAY CAN BE SUBSTITUTED IF NECESSARY.
4. THE FAULT PRESSURE RELAY WILL ALARM ON 1 OUT OF 2 LOGIC AND TRIP ON 2 OUT OF 2 LOGIC.
5. DELETED.
6. DELETED.
7. A CIRCUIT BREAKER IS PROVIDED IN THIS POSITION TO SUPPLY CATEGORY I PUMP HOUSE LOADS.
8. CABLES DENOTED BY -6- ARE SEPARATION GROUP 6. CABLES DENOTED BY -5- ARE SEPARATION GROUP 5. ALL OTHER CABLES ON THIS DIAGRAM ARE SEPARATION GROUP 4. EXCEPT AS OTHERWISE NOTED.
9. TWO LOCKOUT RELAYS IN PARALLEL ARE PROVIDED FOR EACH ESF TRANSFORMER, ONE TO TRIP SEPARATION GROUP 1 SWITCHGEAR AND ONE TO TRIP SEPARATION GROUP 4 SWITCHGEAR.
10. FOR MANUFACTURER, TYPE AND STYLE NUMBER OF ALL METERS AND LIGHTS ON MAIN CONTROL BOARD (RL015) SEE DRAWING J-24016.
11. DELETED.
12. FOR STYLE NUMBERS OF DEVICE 86 AND TS. SEE DRAWING E-009-00006.
13. DELETED.
14. DELETED.
15. THE MAIN TRANSFORMER TANK LOW-LOW OIL LEVEL WILL ALARM ON 1 OUT OF 2 LOGIC AND TRIP ON 2 OUT OF 2 LOGIC.
16. THE LTC TANK CRITICAL LOW OIL LEVEL WILL ALARM ON 1 OUT OF 2 LOGIC AND TRIP ON 2 OUT OF 2 LOGIC.



DEVICE	DESCRIPTION	MFR	TYPE (NOTE 3)	STYLE NO.
127-2/F	FEEDER BREAKER PERMISSIVE CLOSE UNDERVOLTAGE RELAY	GE	NGV	12NGV13B25A
150-151/M	MOTOR OVERCURRENT RELAY	GE	IAC66K	121AC66K8A OR 121AC66K37A
150G/M	MOTOR GROUND OVERCURRENT RELAY	GE	PJC	12PJC11AV1A
151/F	FEEDER OVERCURRENT RELAY	GE	IAC53	121AC53A803A
151G/F	FEEDER GROUND OVERCURRENT RELAY	GE	IAC53	121AC53A801A
127-1/F	FEEDER UNDERVOLTAGE RELAY	GE	IAV54	121AV54E1A
127/DG	BUS UNDERVOLTAGE RELAY (TO LOAD SHEDDER)	GE	NGV	12NGV28B1A
250-251/T2	TRANSFORMER OVERCURRENT RELAY	GE	IAC53	121AC53B812A
250G/T2	TRANSFORMER GROUND OVERCURRENT RELAY	GE	PJC	12PJC11AV1A
151N/T2	TRANSFORMER NEUTRAL OVERCURRENT RELAY	GE	IAC53	121AC53A803A
263/T2	TRANSFORMER FAULT PRESSURE RELAY	GE	900-1	900-1
287/T2	TRANSFORMER DIFFERENTIAL RELAY	GEC	MBCH16	MBCH16D1BD0751
86	LOCKOUT RELAY	GE	HEA	NOTE 12
125/F	SYNCHRONIZING CHECK RELAY	GE	GES	12GES21A
IT	CURRENT TRANSDUCER	GE	472	50-472201IFOC
A1	AMMETER	GE	AB40	50-103131LSSC
TS	TEST SWITCH	W	FT-1	NOTE 12
WL	WHITE LIGHT	GE	ET16	0116B6708G045
V	VOLTMETER	GE	AB40	50-103021PZUL
A2	AMMETER	GE	AB40	50-103131LSTM
SS	SYNCHROSCOPE SELECTOR SWITCH	ELECTRO SWITCH	20KD	20KD-0103-A4-001
SYNC	SYNCHROSCOPE	GE	AB40	50-106-452-AAAA
KW	KILOWATT METER	GE	AB40	50-103221ARE T1JLT
KWH	KILOWATT HOUR METER	GE	DSW63	METER WITH 0-72 PULSE GEN.
WV/T	WATT/VAR COMBINATION TRANSDUCER	RIS	---	WV20PIEOC5X1 F60W0Z0A100
A3	AMMETER	GE	AB40	50-103131LSSV
STS	SYNCHRONIZING TRANSFER SWITCH	ELECTRO SWITCH	20KD	20KD-090608-001
A4	AMMETER	GE	AB40	50-103131LSRL
A5	AMMETER	GE	AB40	50-103131LSPK
AUX. CT.	AUXILIARY CURRENT TRANFORMER	GEC	—	GJ0104060
2710/T2	TRANSFORMER TANK OIL LEVEL	QUALITROL		032-080-01
2710-2/LTC2	LTC TANK OIL LEVEL	REINHAUSEN		8208C22

FSAR CN 00-045
Modification
Drawing incorporated
by reference into
FSAR Section 8.2
wm 12/20/00

THE FIRST DIGIT OF DEVICE NUMBER IS USED TO DESIGNATE VOLTAGE LEVEL

4	ABOVE 25KV
3	25KV
2	13.8KV
1	4160V
NO NUMBER	480V AND BELOW

MOD. PKG. NO.	DRAWING NO.	REV.	
99-1038	E-21NB02	5	0

REV.	DATE	DRAWN	CHKD.	SUPV.	APPD.	DESCRIPTION
3		DJB	SKC	TJM	N/A	REDRAWN FOR CLARITY.
4		SBR	SKC	TJM	N/A	INCORP. CMP 98-1024.
5		SKC	JMK	JHC	N/A	INCORP. CMP 99-1038.
5 (SEQ. 0)		DJB	MAL			INITIAL ISSUE FOR CMP 99-1038C

~~AS-BUILT CLASS 1~~

DRAWN N/A · CHKD. N/A · SUPV. N/A · APPD. N/A

LOWER MEDIUM VOLTAGE SYSTEM CLASS IE 4.16KV SINGLE LINE METER AND RELAY DIAGRAM

LOCATION: CALLAWAY PLANT

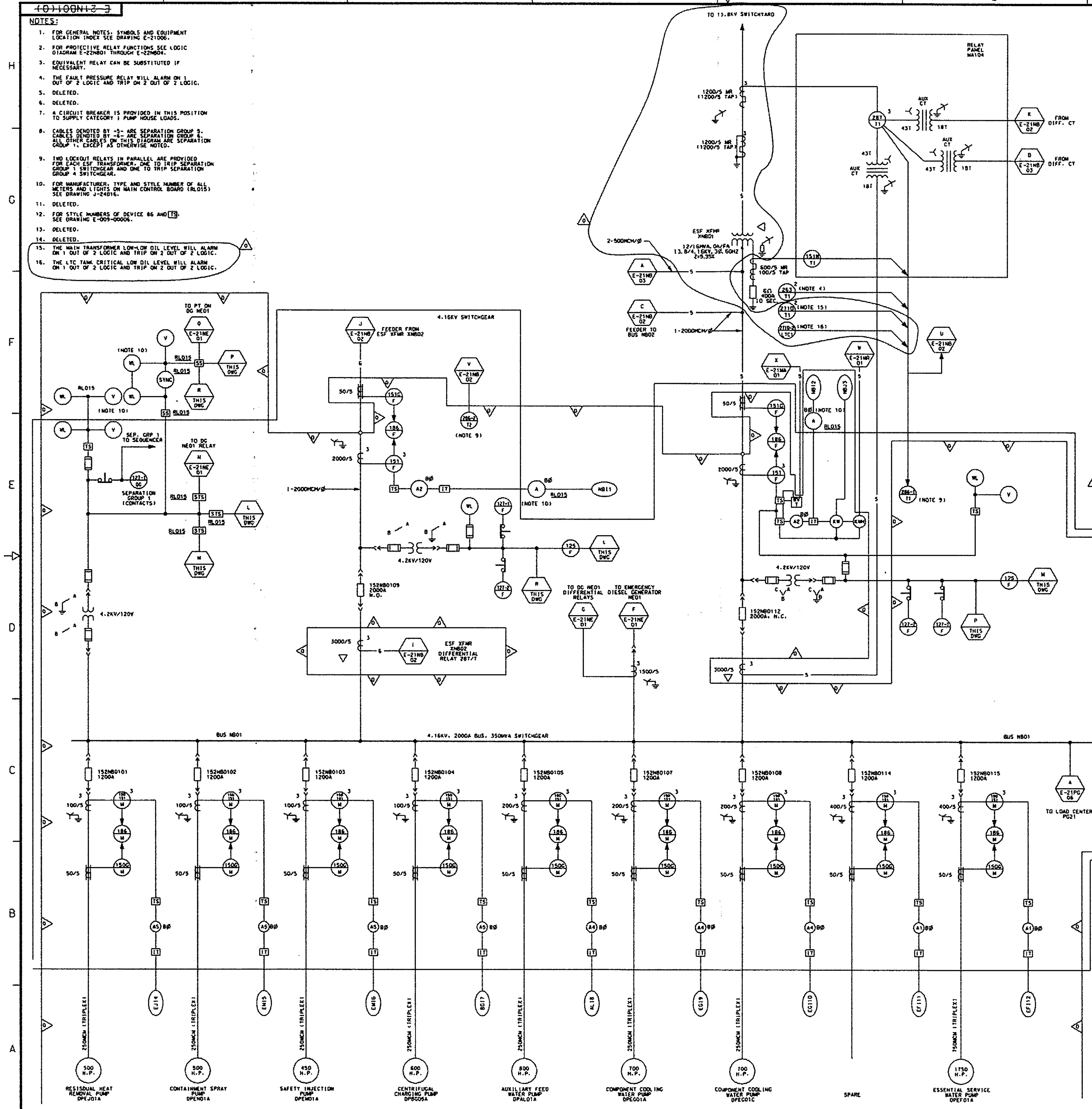
UNION ELECTRIC COMPANY ST. LOUIS, MO

~~E-21NB02(0)~~ REV. ~~5~~

E-21NB01(0)

NOTES:

1. FOR GENERAL NOTES, SYMBOLS AND EQUIPMENT LOCATION INDEX SEE DRAWING E-21006.
2. FOR PROTECTIVE RELAY FUNCTIONS SEE LOGIC DIAGRAM E-22NB01 THROUGH E-22NB04.
3. EQUIVALENT RELAY CAN BE SUBSTITUTED IF NECESSARY.
4. THE FAULT PRESSURE RELAY WILL ALARM ON 1 OUT OF 2 LOGIC AND TRIP ON 2 OUT OF 2 LOGIC.
5. DELETED.
6. DELETED.
7. A CIRCUIT BREAKER IS PROVIDED IN THIS POSITION TO SUPPLY CATEGORY I PUMP HOUSE LOADS.
8. CABLES DENOTED BY -5- ARE SEPARATION GROUP 5. CABLES DENOTED BY -6- ARE SEPARATION GROUP 6. ALL OTHER CABLES ON THIS DIAGRAM ARE SEPARATION GROUP 1, EXCEPT AS OTHERWISE NOTED.
9. TWO LOCKOUT RELAYS IN PARALLEL ARE PROVIDED FOR EACH ESF TRANSFORMER, ONE TO TRIP SEPARATION GROUP 1 SWITCHGEAR AND ONE TO TRIP SEPARATION GROUP 4 SWITCHGEAR.
10. FOR MANUFACTURER, TYPE AND STYLE NUMBER OF ALL METERS AND LIGHTS ON MAIN CONTROL BOARD (RL015) SEE DRAWING J-24016.
11. DELETED.
12. FOR STYLE NUMBERS OF DEVICE 86 AND [TS], SEE DRAWING E-009-00006.
13. DELETED.
14. DELETED.
15. THE MAIN TRANSFORMER LOW-LOW OIL LEVEL WILL ALARM ON 1 OUT OF 2 LOGIC AND TRIP ON 2 OUT OF 2 LOGIC.
16. THE LTC TANK CRITICAL LOW OIL LEVEL WILL ALARM ON 1 OUT OF 2 LOGIC AND TRIP ON 2 OUT OF 2 LOGIC.



DEVICE	DESCRIPTION	MFR	TYPE (NOTE 3)	STYLE NO.
150-151/M	MOTOR OVERCURRENT RELAY	GE	IAC66K	12IAC66K37A
150G/M	MOTOR GROUND OVERCURRENT RELAY	GE	PJC	12PJC11AV1A
151/F	FEEDER OVERCURRENT RELAY	GE	IAC53	12IAC53A803A
151G/F	FEEDER GROUND OVERCURRENT RELAY	GE	IAC53	12IAC53A801A
127-1/F	FEEDER UNDERVOLTAGE RELAY	GE	IAV54	12IAV54E1A
127/DC	BUS UNDERVOLTAGE RELAY (TO LOAD SHEDDER)	GE	NGV	12NGV28B1A
A4	AMMETER	GE	AB40	50-103131LSRL
A5	AMMETER	GE	AB40	50-103131LSPK
151N/T1	TRANSFORMER NEUTRAL OVERCURRENT RELAY	GE	IAC53	12IAC53A803A
263/T1	TRANSFORMER FAULT PRESSURE RELAY	GE	900-1	900-1
287/T1	TRANSFORMER DIFFERENTIAL RELAY	GEC	MBCH16	MBCH1601B00751
86	LOCKOUT RELAY	W	HEA	NOTE 12
125/F	SYNCHRONIZING CHECK RELAY	GE	GES	12GES21A
[IT]	CURRENT TRANSDUCER	GE	472	50-472201TFDC
A1	AMMETER	GE	AB40	50-103131LSSC
[TS]	TEST SWITCH	W	FT-1	NOTE 12
WL	WHITE LIGHT	GE	ET16	0116B6708C045
V	VOLTMETER	GE	AB40	50-103021PZUL
A2	AMMETER	GE	AB40	50-103131LSTM
KWH	KILOWATT HOUR METER	GE	DSW63	METER WITH 0-72 PULSE GEN.
[SS]	SYNCHRONIZING SELECTOR SWITCH	ELECTRO SWITCH	20KD	20KD-0103-A4-001
SYNC	SYNCHROSCOPE	GE	AB40	50-106452AAAA
KW	KILOWATT METER	GE	AB40	50-103221ARE TJLT
[WV/T]	WATT/VAR COMBINATION TRANSDUCER	RIS	---	WV20P1EDC5X1 F60W020A1C0
[STS]	SYNCHRONIZING TRANSFER SWITCH	ELECTRO SWITCH	20KD	20K0090608-001
127-2/F	FEEDER BREAKER PERMISSIVE CLOSE UNDERVOLTAGE RELAY	GE	NGV	12NGV13B25A
AUX CT	AUXILIARY CURRENT TRANSFORMER	GEC	---	GJ0104060
2710/T1	TRANSFORMER TANK OIL LEVEL	QUALITROL		032-060-01
2710-2/LTC1	LTC TANK OIL LEVEL	REINHAUSEN		8208C72

FSAR CN 00-045
Modification
Drawing incorporated
by reference into
FSAR Section 8.2
WM 12/20/00

THE FIRST DIGIT OF DEVICE NUMBER IS USED TO DESIGNATE VOLTAGE LEVEL

4	ABOVE 25KV
3	25KV
2	13.8KV
1	4160V
NO NUMBER	480V AND BELOW

REV.	SEQ.	DATE
5	0	
DRAWN DJB	CHKD. MAL	APPD.
INITIAL ISSUE FOR CMP 99-1038C		

REV. 3 DRAWN DJB CHKD. SRC SUPV. TJH APPD. N/A REDRAWN FOR CLARITY.
REV. 4 DRAWN MAL CHKD. EMK SUPV. TEH APPD. N/A INCORP. MP 99-1038A.
REV. 5 DRAWN SKC CHKD. JKK SUPV. AMR APPD. N/A INCORP. MP 99-1038B.

MOD. PKG. NO.	DRAWING NO.	REV.	SEQ.
99-1038	E-21NB01	5	0

~~AS-BUILT CLASS 1~~

DRAWN N/A
CHKD. N/A
SUPV. N/A
APPD. N/A

LOWER MEDIUM VOLTAGE SYSTEM
CLASS IE 4.16KV SINGLE LINE
METER AND RELAY DIAGRAM

LOCATION: CALLAWAY PLANT

UNION ELECTRIC COMPANY
ST. LOUIS, MO

~~E-21NB01(0)~~ REV. ~~5~~

 FSAR CN 00-045 Q WM 12/20/00

8.3 ONSITE POWER SYSTEMS

The onsite power system is comprised of a standardized portion within the power block and a nonstandardized portion outside of the power block. The electrical power systems within the power block and Class IE nonstandard site portions are described in this section. The non-Class IE electrical power systems outside of the power block are described in Section 8.3 of the Site Addendum.

8.3.1 AC POWER SYSTEMS

8.3.1.1 Description

The onsite ac power system includes a Class IE system and a non-Class IE system.

8.3.1.1.1 Non-Class IE System

The non-Class IE ac system is that part of the power system outside the broken-line enclosures indicated in Figure 8.3-1. The non-Class IE ac system distributes power at 13.8 kV, 4.16 kV, 480 V, and 208/120 V ac for all nonsafety-related loads. The non-Class IE ac system also supplies preferred (offsite) power to the Class IE ac system through two ESF transformers. One ESF transformer is supplied power directly, by one of the preferred power circuits, from the offsite power system. The second ESF transformer is supplied power from one of the secondary windings of the startup transformer. This startup transformer is supplied power from the second preferred power circuit from the offsite power system. Routing of cables from the ESF transformers to the Class IE switchgear is shown on drawings E-0R0224, E-2R3321, E-0R3221, and E-2R3211. Routing of cables from the startup transformer to the 13.8-kV switchgear and from the 13.8-kV switchgear to ESF transformer XNB02 is shown on drawings E-0R0223, E-2R4331, E-2R4321, and E-0R0224. Feeds to ESF transformer XNB01 and the startup transformer are described in the Site Addendum.

The unit auxiliary transformer and the startup transformer each have two secondary windings rated at 13.8 kV.

Two 13.8-kV busses supply power to nonsafety-related loads. Each 13.8-kV bus is connected to a secondary winding of the startup transformer and also to a secondary winding of the unit auxiliary transformer. During starting of the unit, both 13.8-kV busses are supplied power from the startup transformer. The busses are later transferred to the unit auxiliary transformer, during power generation, by a manually initiated transfer. Automatic transfer of the 13.8-kV busses from the unit auxiliary transformer to the startup transformer is provided.

The transfer functions in accordance with the following criteria:

a. The bus transfer is performed immediately following electrical faults and critical turbine trips (trips immediately hazardous to the turbine) in the generation system, where the generator/network can no longer supply power to the reactor coolant pumps. Critical turbine trips are low vacuum and thrust bearing wear (upper and lower).

b. The bus transfer is delayed 30 seconds following noncritical turbine generator trips not involving electrical faults. The turbine generator will remain connected to the switchyard during the delayed period to allow the switchyard to supply power to the reactor coolant pump busses for 30 seconds before any transfer is made.

The unit auxiliary and startup transformer has the capacity to supply both non-Class IE and both Class IE load groups simultaneously. Refer to Section 8.1.2 for a definition of load group. Figure 8.3-1 shows the transformers, feeders, busses, and their connections. It also lists all loads directly supplied from each 13.8-kV and 4.16-kV bus.

Two feeders from each of the two 13.8-kV busses supply power to non-Class IE site loads located outside the power block. The maximum load per bus is 21.7 MVA. Loads and power distribution systems are described in detail in Section 8.3.1 of the Site Addendum.

The startup transformer is equipped with two secondary windings, each rated at 13.8 kV, 50 MVA FOA.

The startup transformer, ESF transformers, and their associated feeder cables have all been sized to carry their expected loads continuously. During normal system operation, transformer loads are below the manufacturer's FOA design limitations. Under abnormal system configurations, such as when an ESF or station service transformer is out of service, loads may be transferred to the alternate startup transformer secondary winding. Provisions exist for the automatic transfer of busses PB03/PB04 and for manual transfer of busses NB01/NB02 to their alternate source. Under these conditions, additional loads may be placed on a startup transformer secondary winding. The secondary winding that supplies power to 13.8 kV bus PA02 and ESF transformer XNB02 has been selected for a load analysis.

Analyses have been performed to evaluate the maximum bus and transformer loadings that may result from these transformer failures. Under conditions whereby a station service transformer has failed prior to an accident, the startup transformer

FSAR CN 00-045
WM 12/20/00 (INFO)
FSAR CN 00-008 incorporated

winding supplying XNB02 may be loaded to 56.5 MVA, or 113 percent of its FOA rating. Under conditions whereby an ESF transformer has failed prior to an accident, the same winding may be loaded to 54.3 MVA, or 108 percent of its FOA rating. Under conditions whereby both a station service and an ESF transformer have failed prior to an accident, the subject startup transformer winding may be loaded to 63 MVA, or 126 percent of its FOA rating. These loads represent the maximum credible loads that may be achieved during abnormal system operation.

Using the guidelines of ANSI C57.92-1962, operation of oil-immersed power transformers in an overloaded condition is permissible. Measurable loss of transformer life occurs if the overload is allowed to persist for extended periods of time. For the overload conditions described above, the startup transformer may suffer a .5 percent, .25 percent, and 2 percent loss of life, respectively if the overloads are allowed to persist for 8 hours. This is based on an ambient temperature of 40°C and the conservative assumption that the startup transformer is loaded to 50 percent of its FOA rating prior to the overload.

The protective relays associated with the startup transformer are set above these maximum overload values.

The continuous ampacity of the feeder cables from the startup transformer to the 13.8 kV switchgear PA02 and ESF transformer XNB02 is not exceeded under any loading condition described above.

Each offsite power source (Engineered Safety Features transformers XNB01 and XNB02) is provided with a separate capacitor bank. They do not share any common electrical or control circuits and they cannot be paralleled even if the Class 1E 4.16kV Busses NB01 and NB02 are cross connected. Therefore, the probability that simultaneous failures of both capacitor banks will cause both offsite sources to become inoperable is negligible. Each capacitor bank has the capacity to raise the voltage at its respective NB bus by reducing the inductive losses in the system.

Capacitor banks NB03 and NB04 are non-safety related and are connected to the non-safety related transformers using manual full load break switches. Capacitor bank NB03 is associated with train "A" equipment. Capacitor bank NB04 is associated with train "B" equipment.

Full load break switches NB0301 and NB0401 provide a means of disconnecting the capacitor banks from the transformers for equipment maintenance. Each capacitor bank is interlocked with its respective Emergency Diesel Generator to "freeze" automatic actions and thereby prevent system interactions during Emergency Diesel Generator testing. Each capacitor bank receives an interlock signal from its respective LOCA sequencer to prevent excessive capacitor cycling during sequencer operation.

FSAR CN 00-045 Δ WM 12/20/00 FSAR CN 00-008 incorporated

Control Room annunciation is provided to indicate system trouble, lockout relay trips, and manual control switches out of position. The Diesel Generator "freeze" interlock is annunciated in the Control Room to confirm proper system interface.

Two over voltage protection relays are installed in each capacitor bank control section to protect against NB bus over voltages caused by inadvertent actuation of the capacitor banks.

The credible failure mechanisms of the Capacitor Banks that have the worst-case potential effect on Class 1E equipment can be categorized into three distinct cases. Case 1 is the failure of the capacitor banks to turn on, Case 2 is the failure of the capacitor banks to turn off, and Case 3 is a failure in the capacitor bank that causes the feeder breaker to the associated 13.8 kV to 4.16 kV transformer to trip. A failure modes and effects analysis was performed and appropriate portions are included in Table 8.3-4.

The review of the failure cases listed above confirms that expected system responses are enveloped by the existing accident analysis. Case 2 bus high voltage, is an analyzed and accepted failure case.

This small voltage increase may cause a slight increase in the thermal aging of any energized electric equipment. In order to prevent the aging, two specific design features have been included. The first design feature consists of over voltage Control Room annunciators to NG busses NG01, NG02, NG03, NG04, NG07, and NG08. The second design feature consists of over voltage protection relays in each of the capacitor banks to shut the capacitors off if an over voltage condition is detected.

Δ INSERT 8.3-2a →

8.3.1.1.2 Class IE AC System

The Class IE ac system is that portion of the onsite power system inside the broken-line enclosures shown in Figure 8.3-1.

The Class IE ac system distributes power at 4.16 kV, 480 V, 208/120 V, and 120 V ac to all safety-related loads. Also, the Class IE ac system supplies certain selected loads which are not safety related but are important to the plant operation. Figure 8.3-2 lists the major safety-related and isolated nonsafety-related loads supplied from the Class IE ac system.

In addition to the above power distribution, the Class IE ac system contains standby power sources which provide the power required for safe shutdown in the event of a loss of the preferred power sources.

The following describes various features of the Class IE systems:

POWER SUPPLY FEEDERS - Each 4.16-kV load group is supplied by two preferred power supply feeders and one diesel generator

INSERT 8.3-3a

The ESF transformers are equipped with automatic on-load tap changers. The automatic load tap changers are capable of varying the voltage at the respective NB bus by ±16% (1% per step with 32 steps), the equivalent of approximately ± 665 Volts at the 4160 Volt level. The load tap changer range is limited by a gear driven limit switch limiting the voltage extremes created by the transformers.

The LTC transformers do not share any common electrical or control circuits and they cannot be paralleled even if the Class 1E 4.16kV Busses NB01 and NB02 are cross connected. Therefore, the probability that simultaneous failures of both transformers to cause both offsite sources to become inoperable is negligible.

The failure of one transformer will have no effect on the operability of the other transformer or Class 1E equipment train. The credible failure mechanisms of the transformers that will have the worst-case effects on the associated Class 1E equipment are summarized on Table 8.3-4.

The control circuits, like the capacitor bank control circuits, are interlocked with its respective Emergency Diesel Generator to "freeze" automatic actions and thereby prevent adverse system interactions during Emergency Diesel Generator testing. A Diesel Generator "freeze" interlock signal annunciator in the Control Room to confirms proper tap changer system interface.

In addition, Control Room annunciators are provided to indicate if the load tap changers or capacitor bank control circuits are not in automatic. Automatic control is needed to obtain the voltage control from these components.

Control Room annunciator provide indication of system trouble. A multi-point annunciator is provided at each transformer to allow the quick determination of the cause of the trouble signal.

With both systems (load tap changers and capacitor banks) in operation, the general response to a voltage decrease is for the capacitor bank to provide a rapid voltage increase if needed, then the LTC will step to correct the voltage back to a 4.16 kV level and thus turn the capacitor bank off.

The voltage control systems function to ensure that the voltage at NB01 and NB02 is sufficient to reset the safety related degraded voltage relays and loss of voltage relays before time limits are exceeded. With this, the preferred off site power sources are retained to power the safety related electrical distribution system. The voltage control systems also function to ensure that overvoltages are not present in the safety related electrical distribution system when fed from the preferred power sources.

 FSAR CN00-045 WM 12/20/00 (INFO)

(standby) supply feeder. Each 4.16-kV bus supplies motor loads and 4.0-kV/480-V load center transformers with their associated 480-V busses.

BUS ARRANGEMENTS - The Class IE ac system is divided into two redundant load groups per unit (load groups 1 and 2). For each unit, either one of the load groups is capable of providing power to safely reach cold shutdown for that unit. Each ac load group consists of a 4.16-kV bus, 480-V load centers, 480-V motor control centers, and lower voltage ac supplies.

LOADS SUPPLIED FROM EACH BUS - Refer to Figure 8.3-2 for a listing of Class IE system loads and their respective busses.

MANUAL AND AUTOMATIC INTERCONNECTIONS BETWEEN BUSSES, BUSSES AND LOADS, AND BUSSES AND SUPPLIES - No provisions exist for automatically connecting one Class IE load group to another redundant Class IE load group or for automatically transferring loads between load groups. The incoming preferred power supply associated with a load group can supply the 4.16-kV Class IE bus of the other load group by manual operation of the requisite 4.16-kV circuit breakers when required.

Interlocks are provided that would prevent an operator error that would parallel the standby power sources of redundant load groups.

For a further discussion of interlocks, refer to Section 8.3.1.1.3.

INTERCONNECTIONS BETWEEN SAFETY-RELATED AND NONSAFETY-RELATED BUSSES - No interconnections are provided between the safety- and nonsafety-related busses. The startup transformer supplies power through the same winding to a 13.8-kV bus and a 13.8/4.16-kV ESF transformer.

REDUNDANT BUS SEPARATION - The Class IE switchgear, load centers, and motor control centers for the redundant load groups are located in separate rooms of the control building and auxiliary building in such a way as to ensure physical separation. Refer to Section 8.3.1.4.1 and Section 8.3.1.1.7 for the criteria governing redundant bus separation.

FSAR CN 00-045
△ wm 12/20/00
FSAR CN 00-008 incorporated.

CLASS IE EQUIPMENT CAPACITIES -

a. 4.16-kV Switchgear

Bus	2000A continuous rating
Incoming breakers	2000A continuous, 350 MVA interrupting
Feeder breakers	1200A continuous, 350 MVA interrupting

b. 480-V Unit Load Centers

Transformers	1000 kVA, 3 phase, 60-Hz, 4000/480 V
Bus	1600A continuous
Incoming breakers	1600A continuous, 50,000A rms symmetrical interrupting
Feeder breakers	800A continuous, 30,000A rms symmetrical interrupting (with instantaneous trip) 25,000A rms symmetrical interrupting (without instantaneous trip)

c. 480-V Motor Control Centers

Horizontal bus	600A continuous, 25,000A rms symmetrical
Vertical bus	300A continuous, 25,000A rms symmetrical
Breakers (molded case)	25,000A rms symmetrical, minimum interrupting (singly for thermal-magnetic breakers and in combination with a starter for magnetic only breakers)

AUTOMATIC LOADING AND LOAD SHEDDING - The automatic loading sequence of the Class IE busses is indicated in Figure 8.3-2.

If preferred power is available to the 4.16-kV Class IE bus following a LOCA, the Class IE loads will be started in programmed time increments by the load sequencer. The sequencer provides an interlock signal to the capacitor banks (and ESF transformer load tap changers) to assure proper system operation and coordination. The emergency standby diesel generator will be automatically started but not connected to the bus. However, in the event that preferred power is lost following a LOCA, the load sequencer will function to shed selected loads and automatically start the associated standby diesel generator (connection of the standby diesel generator to the 4.16-kV Class IE bus is performed by the diesel generator control circuitry). Load sequencers will then function to start the required Class IE loads in programmed time increments.

FSAR CN 00-008 Incorporated
FSAR CN 00-045
Δ wm 12/20/00

TABLE 8.3-4 (Sheet 3)

B. FAILURE MODES AND EFFECTS ANALYSIS

Equip. No.	Equip. Name	Function	Failure Mode	Effect on Subsystem	Method of Failure Detection	Effect on Total System	Causes of Failure
N/A	Offsite power	Provides power to startup xfmr XMR01	Loss of power	Loss of preferred power to xfmr XMR01	Undervoltage relays, volt-meters, lights or undervoltage annunciation.	None-offsite power supplied by alternate source through ESF xfmr XNB01	Offsite system failure, transmission line failure, bus fault, failure of swyd C.B. Low grid voltage.
N/A	Offsite power	Provides power to ESF xfmr XNB01	Loss of power	Loss of preferred power to XNB01	Undervoltage relays, volt meters, lights or undervoltage annunciation	None-offsite power supplied by alternate source through startup xfmr XMR01	Offsite system failure, transmission line failure, bus fault, failure of swyd C.B. Low grid voltage.
XMR01	Startup transformer	Provides preferred power to ESF xfmr XNB02	Fails to provide power	Loss of preferred power to XNB02	Overcurrent, neutral ground overcurrent, and differential relays, fault pressure annunciation; undervoltage annunciation for bus NB02.	None-offsite power supplied by alternate source through ESF xfmr XNB01	Internal fault, lightning arrestor failure, bushing failure, cooling system failure (during startup only)
XNB01	ESF transformer	Provides preferred power to bus NB01 and backup power to bus NB02	Fails to provide power	Loss of preferred power to bus NB01 and backup power to bus NB02	Undervoltage annunciation on bus NB01 Periodic testing and inspection	None-D-G NE01 energizes NB01 until bkr 152NB0109 is manually closed	Internal fault, bushing failure
Δ → INSERT 8.3-4 (1)							
NB03	XNB01 voltage support capacitor bank	Provides voltage support for the NB01 Class 1E bus	Fails to provide voltage support to NB01 Control system fails, provides excessive voltage to NB01	Loss of preferred power to bus NB01 and backup power to bus NB02 Slight overvoltage	UV annunciation on bus NB01 . Periodic testing and inspection Overvoltage annunciation on NG load centers	None D-G NE01 energizes NB01 until bkr 152NB0109 is manually closed. None, short duration overvoltage operation is evaluated	Internal fault, Internal part failure, Loss of control power. Capacitor bank PLC failure.

INSERT 8.3-4 (1)

Equip. No.	Equip. Name	Function	Failure Mode	Effect on Subsystem	Method of failure detection	Effect on Total System	Cause of Failure
	ESF Transformer XNB01 automatic load tap changer (LTC)	Provides voltage support for ESF busses	Controllers fail low	Raises NB bus voltage unexpectedly	Overvoltage Annunciation from NG load centers.	None. Capacitor banks will not interact. Short term overvoltage has been evaluated. Limit device prevents extreme voltage changes. XNB02 offsite power available.	Primary and back-up controllers fail low.
			Control fails high	Lowers NB bus voltage unexpectedly	Undervoltage annunciation	None. Capacitor Banks step on. Eventually degraded voltage circuits shed bus. Loads are transferred to Diesel Generators. XNB02 offsite power available.	Primary and back-up controllers fail high. LTC controller potential transformers fail high
			Tap changer fails to move	NB bus voltage remains as is without LTC control	LTC controller self check causes MCB LTC trouble annunciation. Over/Under Voltage annunciation	None. Voltage will not be adjusted. Can result in overvoltage or undervoltage depending on offsite voltage. Undervoltage may result in load shed. Loads are transferred to Diesel generator Overvoltage is evaluated. XNB02 offsite power available.	Controller lock-up LTC motor failure LTC potential transformers fail low. Voltage sensing transformer fuses fail.

FSAR CN 00-045
Δ wm 12/20/00
FSAR CN 00-008 incorporated

TABLE 8.3-4 (Sheet 4)

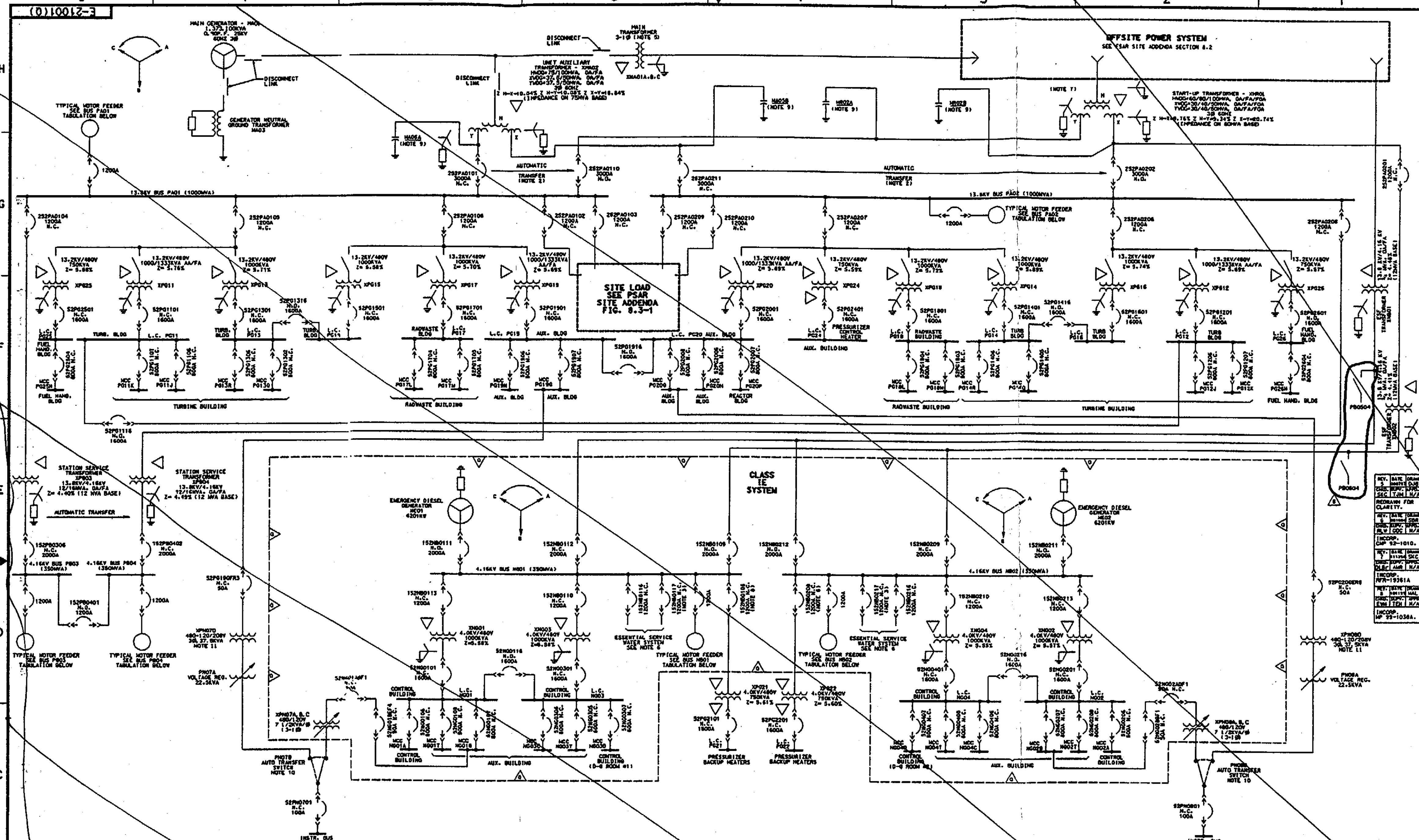
Equip. No.	Equip. Name	Function	Failure Mode	Effect on Subsystem	Method of Failure Detection	Effect on Total System	Causes of Failure
XNB02	ESF transformer	Provides preferred power to bus NB02 and backup power to bus NB01	Fails to provide power	Loss of preferred power to bus NB02 and backup power to bus NB01	Undervoltage annunciation on bus NB02 Periodic testing and inspection	None-D-G NE02 energized NB02 until bkr 152NB0212 is manually closed	Internal fault, bushing failure

Δ → INSERT 8.3-4(2)

Equip. No.	Equip. Name	Function	Failure Mode	Effect on Subsystem	Method of Failure Detection	Effect on Total System	Causes of Failure
NB04	XNB02 voltage support capacitor bank	Provides voltage support for the NB02 Class 1E bus	Fails to provide voltage support to NB02	Loss of preferred power to bus NB02 and backup power to bus NB01	UV annunciation on bus NB02 . Periodic testing and inspection	None D-G NE01 energizes NB01 until bkr 152NB0212 is manually closed.	Internal fault, Internal part failure, Loss of control power.
			Control system fails, provides excessive voltage to NB02	Slight overvoltage	Overvoltage annunciation on NG load centers	None, short duration overvoltage operation is evaluated	Capacitor bank PLC failure.
252PA0201	1,200-A 13.8-kV N.C. incoming feeder bkr	Provides power to and protects ESF xfmr XNB02	Fails open	Loss of preferred power to xfmr XNB02	Indicating lights, undervoltage annunciation on bus NB02	None-D-G NE02 feeds bus NB02 until bkr 152NB0212 is closed	Mechanical failure, relay failure, control power failure
			Fails closed	Swyd bkr isolates xfmr XMR01	Periodic testing and inspection	None-D-G NE02 feeds bus NB02 until bkr 152NB0212 is closed.	
152NB0209	2,000-A, 4.16-kV N.C. breaker	Provides preferred power to and protects bus NB02	Fails open	Loss of preferred power to bus NB02	Indicating lights, undervoltage annunciation on bus NB02	Non-bus NB02 supplied by NE02	Mechanical failure, relay failure, loss of control power
			Fails closed	Bus NB02 isolated by N.C. bkr 252PA0201	Periodic testing and inspection	None-bus NB02 isolated by N.C. bkr 252PA0201; ESF loads fed by L.G.1	
152NB0109	2,000-A, 4.16-kV N.O. breaker	Provides backup power to and protects bus NB01	Fails open	Loss of backup power to bus NB01	Indicating lights, undervoltage annunciation on bus NB01	None-backup power to bus NB01 supplied by D-G NE01	Mechanical failure, relay failure, loss of control power
			Fails closed	Bus NB01 isolated by N.C. bkr 252PA0201	Periodic testing and inspection	None-ESF loads fed by L.G.2	

INSERT 8.3-4(2)

Equip. No.	Equip. Name	Function	Failure Mode	Effect on Subsystem	Method of failure detection	Effect on Total System	Cause of Failure
	ESF Transformer XNB02 automatic load tap changer (LTC)	Provides voltage support for ESF busses	Controllers fail low	Raises NB bus voltage unexpectedly	Overvoltage Annunciation from NG load centers.	None. Capacitor banks will not interact. Short term overvoltage has been evaluated. Limit device prevents extreme voltage changes. XNB01 offsite power available.	Primary and back-up controllers fail low.
			Control fails high	Lowers NB bus voltage unexpectedly	Undervoltage annunciation	None. Capacitor Banks step on. Eventually degraded voltage circuits shed bus. Loads are transferred to Diesel Generators. XNB01 offsite power available.	Primary and back-up controllers fail high. LTC controller potential transformers fail high
			Tap changer fails to move	NB bus voltage remains as is without LTC control	LTC controller self check causes MCB LTC trouble annunciation. Over/Under Voltage annunciation	None. Voltage will not be adjusted. Can result in overvoltage or undervoltage depending on offsite voltage. Undervoltage may result in load shed. Loads are transferred to Diesel generator Overvoltage is evaluated. XNB01 offsite power available.	Controller lock-up LTC motor failure LTC potential transformers fail low. Voltage sensing transformer fuses fail.



13.8KV

BUS PA01

	H.P.	BREAKER NO.
REACTOR COOLANT PUMP DPBB01A	7000	252PA0107
REACTOR COOLANT PUMP DPBB01B	7000	252PA0108

BUS PA02

	H.P.	BREAKER NO.
REACTOR COOLANT PUMP DPBB01C	7000	252PA0205
REACTOR COOLANT PUMP DPBB01D	7000	252PA0204

4.16KV

CLASS 1E BUS NB01

	H.P.	BREAKER NO.
RESIDUAL HEAT REMOVAL PUMP DPEJ01A	500	152NB0101
SAFETY INJECTION PUMP DPEM01A	450	152NB0103
CENTRIFUGAL CHARGING PUMP DPBG05A	600	152NB0104
COMPONENT COOLING WATER PUMP DPEG01A	700	152NB0107
COMPONENT COOLING WATER PUMP DPEG01C	700	152NB0108
CONTAINMENT SPRAY PUMP DPEN01A	500	152NB0102
AUXILIARY FEEDWATER PUMP DPAL01A	800	152NB0105
ESSENTIAL SERVICE WATER PUMP DPEF01A	1750	152NB0115

4.16KV

CLASS 1E BUS NB02

	H.P.	BREAKER NO.
RESIDUAL HEAT REMOVAL PUMP DPEJ01B	500	152NB0204
SAFETY INJECTION PUMP DPEM01B	450	152NB0202
CENTRIFUGAL CHARGING PUMP DPBG05B	600	152NB0201
COMPONENT COOLING WATER PUMP DPEG01B	700	152NB0206
COMPONENT COOLING WATER PUMP DPEG01D	700	152NB0207
CONTAINMENT SPRAY PUMP DPEN01B	500	152NB0203
AUXILIARY FEEDWATER PUMP DPAL01B	800	152NB0205
ESSENTIAL SERVICE WATER PUMP DPEF01B	1750	152NB0215

BUS PB03

	H.P.	BREAKER NO.
HEATER DRAIN PUMP DPAF01A	1600	152PB0303
CONDENSATE PUMP DPAD01A	3500	152PB0304
CONDENSATE PUMP DPAD01C	3500	152PB0305
CENTRAL CHILLER COMPRESSOR DSGB01A	[illegible]	152PB0302
NORMAL CHARGING PUMP DPBG04	600	152PB0301

BUS PB04

	H.P.	BREAKER NO.
CONDENSATE PUMP DPAD01B	3500	152PB0403
HEATER DRAIN PUMP DPAF01B	1600	152PB0404
CENTRAL CHILLER COMPRESSOR DSGB01B	927	152PB0405
MOTOR DRIVEN FEEDWATER PUMP DPAE02	300	152PB0406

NOTES:

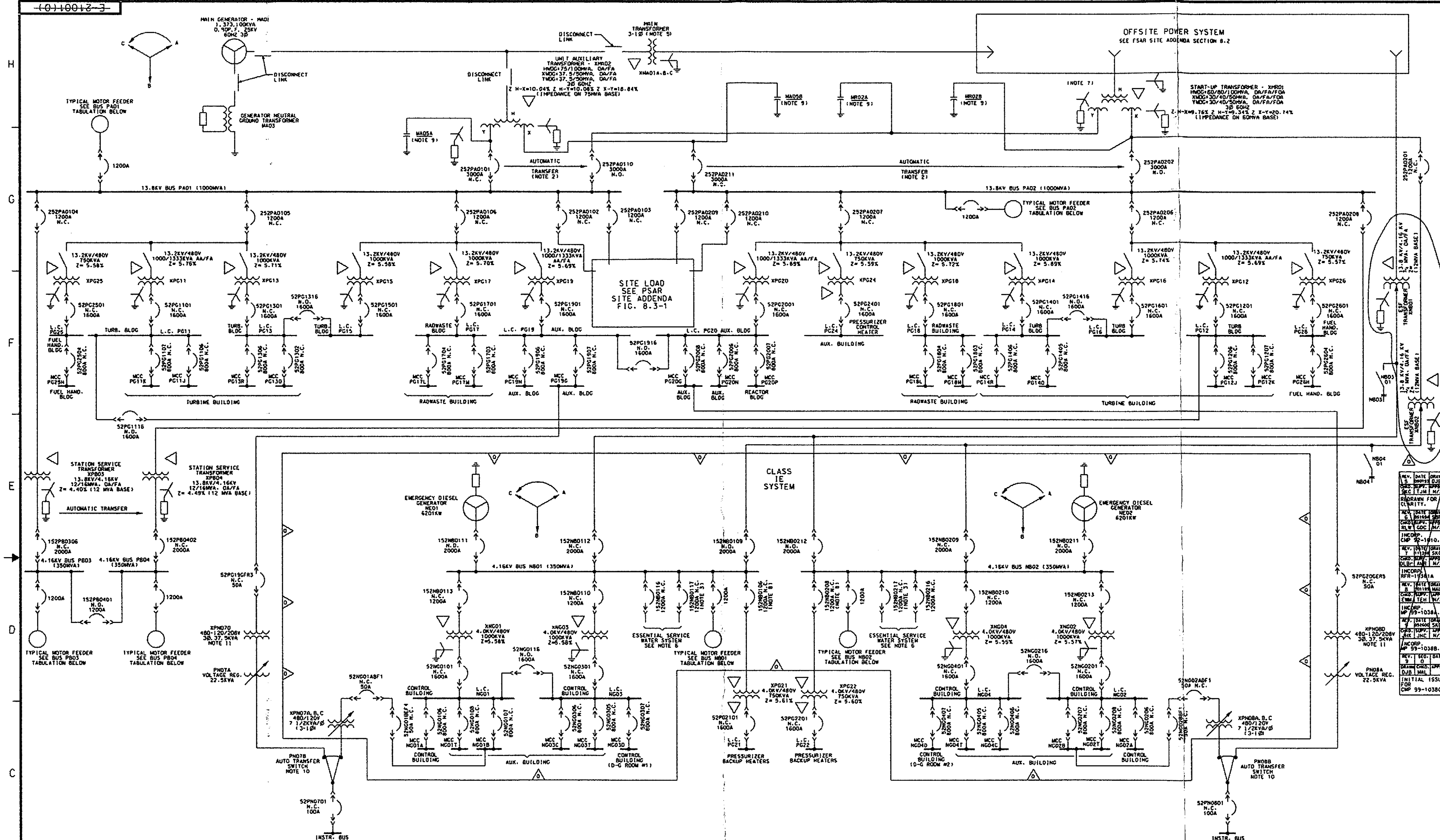
1. DELETED.
2. AUTOMATIC TRANSFER WILL BE INITIATED IMMEDIATELY FOLLOWING GENERATION SYSTEM FAULTS AND TURBINE TRIPS RESULTING FROM VIBRATION, LOW VACUUM AND THRUST BEARING WEAR. ALL OTHER TURBINE TRIPS WILL BE DELAYED 30 SECONDS BEFORE TRANSFER.
3. THIS CIRCUIT BREAKER SUPPLIES ESSENTIAL SERVICE WATER LOADS.
4. DELETED.
5. EACH SINGLE PHASE TRANSFORMER WILL BE RATED 345KV, 415MVA. IMPEDANCE ON TRANSFORMER MVA BASE IS 8.8%.
6. SEE DRAWING E-U1001.
7. DELTA CONNECTED STABILIZING WINDING WILL NOT BE INCLUDED ON UNION ELECTRIC TRANSFORMER. PRIMARY WINDING WILL BE RATED 345KV.
8. THIS BREAKER IS TRIPPED BY THE LOAD SHEDDER/SEQUENCER FOLLOWING AN SIS OR ESSENTIAL BUS UNDERVOLTAGE SIGNAL.
9. TRV SURGE CAPACITORS MA05A, MA05B, MR02A AND MR02B SHALL BE RATED 13.8KV 750nF PER PHASE.
10. RETRANSFER TIME SETTING AT 2 MINUTES.
11. XPN07B (XPN08D) IS OVERSIZED TO ACCOUNT FOR THE IN RUSH/OPERATING CURRENT REQUIREMENTS OF PN07A (PN08A).

△ FSAR CN 00-045 wm 12/20/00 See MOD DRAWING 99-1038 E-21001-9

CALLAWAY PLANT

FIGURE 8.3-1
MAIN SINGLE LINE DIAGRAM
(E-21001-9)

REV OL-12 2/1/01 SHEET 1



13.8KV

BUS PA01

	H.P.	BREAKER NO.
REACTOR COOLANT PUMP DPBB01A	7000	252PA0107
REACTOR COOLANT PUMP DPBB01B	7000	252PA0108

BUS PA02

	H.P.	BREAKER NO.
REACTOR COOLANT PUMP DPBB01C	7000	252PA0205
REACTOR COOLANT PUMP DPBB01D	7000	252PA0204

4.16KV

CLASS IE BUS NB01

	H.P.	BREAKER NO.
RESIDUAL HEAT REMOVAL PUMP DPEJ01A	500	152NB0101
SAFETY INJECTION PUMP DPEM01A	450	152NB0103
CENTRIFUGAL CHARGING PUMP DPBG05A	600	152NB0104
COMPONENT COOLING WATER PUMP DPEG01A	700	152NB0107
COMPONENT COOLING WATER PUMP DPEG01C	700	152NB0108
CONTAINMENT SPRAY PUMP DPEN01A	500	152NB0102
AUXILIARY FEEDWATER PUMP DPAL01A	800	152NB0105
ESSENTIAL SERVICE WATER PUMP DPEF01A	1750	152NB0115

4.16KV

CLASS IE BUS NB02

	H.P.	BREAKER NO.
RESIDUAL HEAT REMOVAL PUMP DPEJ01B	500	152NB0204
SAFETY INJECTION PUMP DPEM01B	450	152NB0202
CENTRIFUGAL CHARGING PUMP DPBG05B	600	152NB0201
COMPONENT COOLING WATER PUMP DPEG01B	700	152NB0206
COMPONENT COOLING WATER PUMP DPEG01D	700	152NB0207
CONTAINMENT SPRAY PUMP DPEN01B	500	152NB0203
AUXILIARY FEEDWATER PUMP DPAL01B	800	152NB0205
ESSENTIAL SERVICE WATER PUMP DPEF01B	1750	152NB0215

BUS PB03

	H.P.	BREAKER NO.
HEATER DRAIN PUMP DPAF01A	1500	152PB0303
CONDENSATE PUMP DPAD01A	3500	152PB0304
CONDENSATE PUMP DPAD01C	3500	152PB0305
CENTRAL CHILLER COMPRESSOR DSGB01A	927	152PB0302
NORMAL CHARGING PUMP DPBG04	600	152PB0301

BUS PB04

	H.P.	BREAKER NO.
CONDENSATE PUMP DPAD01B	3500	152PB0403
HEATER DRAIN PUMP DPAF01B	1500	152PB0404
CENTRAL CHILLER COMPRESSOR DSGB01B	927	152PB0405
MOTOR DRIVEN FEEDWATER PUMP DPAE02	300	152PB0406

NOTES:

1. DELETED.
2. AUTOMATIC TRANSFER WILL BE INITIATED IMMEDIATELY FOLLOWING GENERATION SYSTEM FAULTS AND TURBINE TRIPS RESULTING FROM VIBRATION, LOW VACUUM AND THRUST BEARING WEAR. ALL OTHER TURBINE TRIPS WILL BE DELAYED 30 SECONDS BEFORE TRANSFER.
3. THIS CIRCUIT BREAKER SUPPLIES ESSENTIAL SERVICE WATER LOADS.
4. DELETED.
5. EACH SINGLE PHASE TRANSFORMER WILL BE RATED 345KV, 415MVA. IMPEDANCE ON TRANSFORMER MVA BASE IS 8.87%.
6. SEE DRAWING E-U1001.
7. DELTA CONNECTED STABILIZING WINDING WILL NOT BE INCLUDED ON UNION ELECTRIC TRANSFORMER. PRIMARY WINDING WILL BE RATED 345KV.
8. THIS BREAKER IS TRIPPED BY THE LOAD SHEDDER/SEQUENCER FOLLOWING AN SIS OR ESSENTIAL BUS UNDERVOLTAGE SIGNAL.
9. TRV SURGE CAPACITORS MA05A, MA05B, MR02A AND MR02B SHALL BE RATED 13.8KV 750nF PER PHASE.
10. RETRANSFER TIME SETTING AT 2 MINUTES.
11. XPN07D (XPN08D) IS OVERSIZED TO ACCOUNT FOR THE IN RUSH/OPERATING CURRENT REQUIREMENTS OF PN07A (PN08A).

MOD. PKG. NO.	DRAWING NO.	REV.	SEQ.
99-1038	E-21001	9	0

~~AS-BUILT~~ ~~CLASS 1~~

MAIN SINGLE LINE DIAGRAM

CALLAWAY PLANT

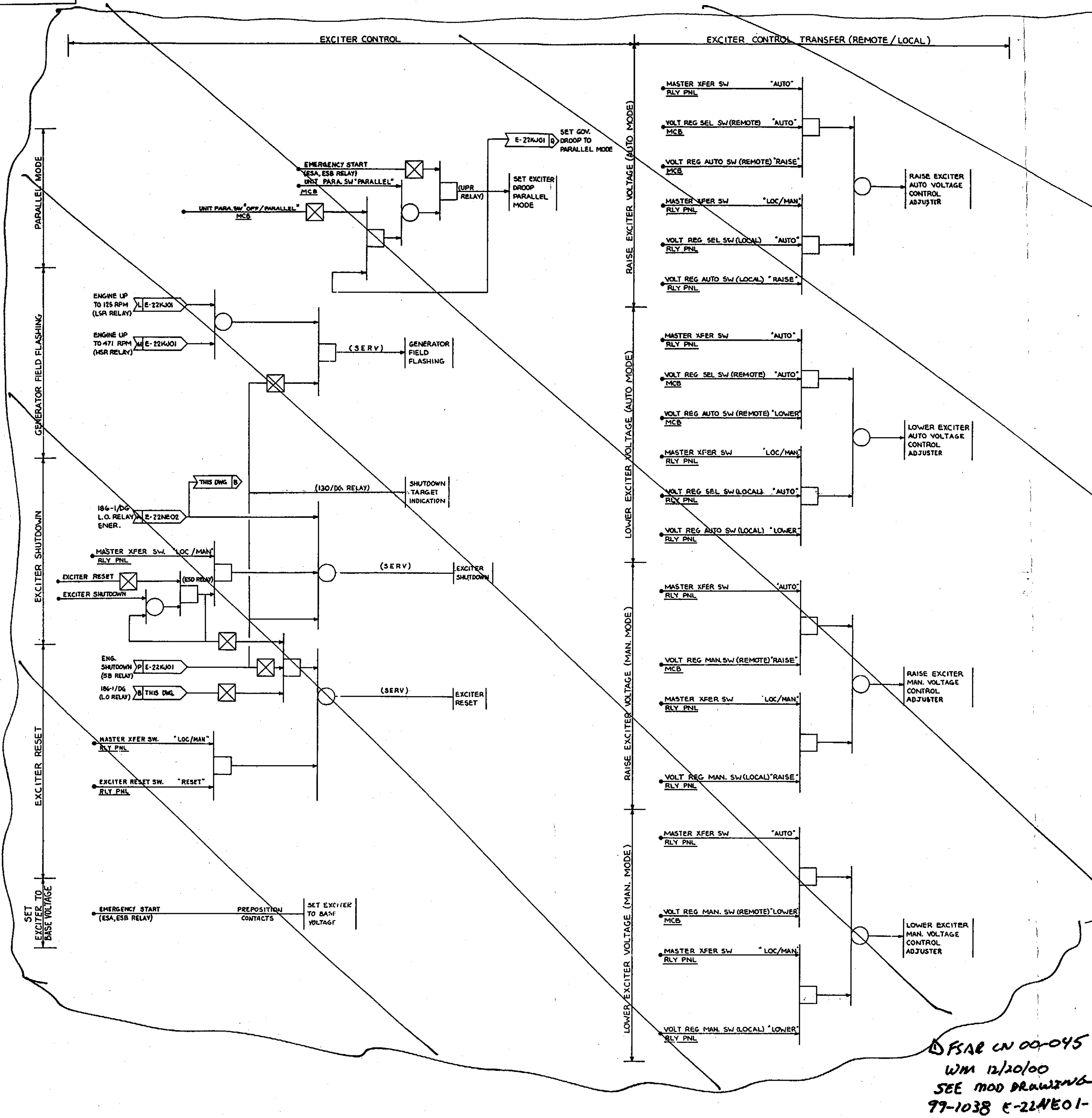
UNION ELECTRIC COMPANY ST. LOUIS, MO

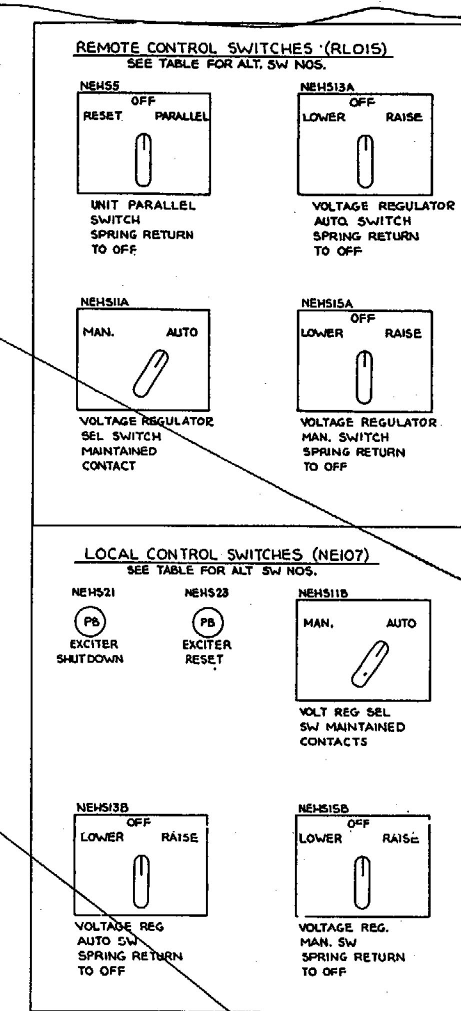
~~E-21001(0)~~ REV. 9

wm 12/20/00

FSAR CN 00-045

E-22NE01(Q)





EQUIPMENT	NE01	NE02
MASTER TRANSFER SW (NOTE 1)	KJHS9	KJHS109
DIESEL START/STOP SW (NOTE 1)	KJHS8A	KJHS108A
UNIT PARALLEL SWITCH	NEHS5	NEHS6
EXCITER RESET SWITCH	NEHS23	NEHS24
EXCITER SHUTDOWN SW	NEHS21	NEHS22
VOLT REG SEL SW (REMOTE)	NEHS11A	NEHS12A
VOLT REG SEL SW (LOCAL)	NEHS11B	NEHS12B
VOLT REG AUTO. SW (REMOTE)	NEHS13A	NEHS14A
VOLT REG AUTO. SW (LOCAL)	NEHS13B	NEHS14B
VOLT REG MAN. SW (REMOTE)	NEHS15A	NEHS16A
VOLT REG MAN. SW (LOCAL)	NEHS15B	NEHS16B
RELAY PANEL - RLY PNL	NE107	NE106
MAIN CONTROL BOARD - MCB	RL015	RL015

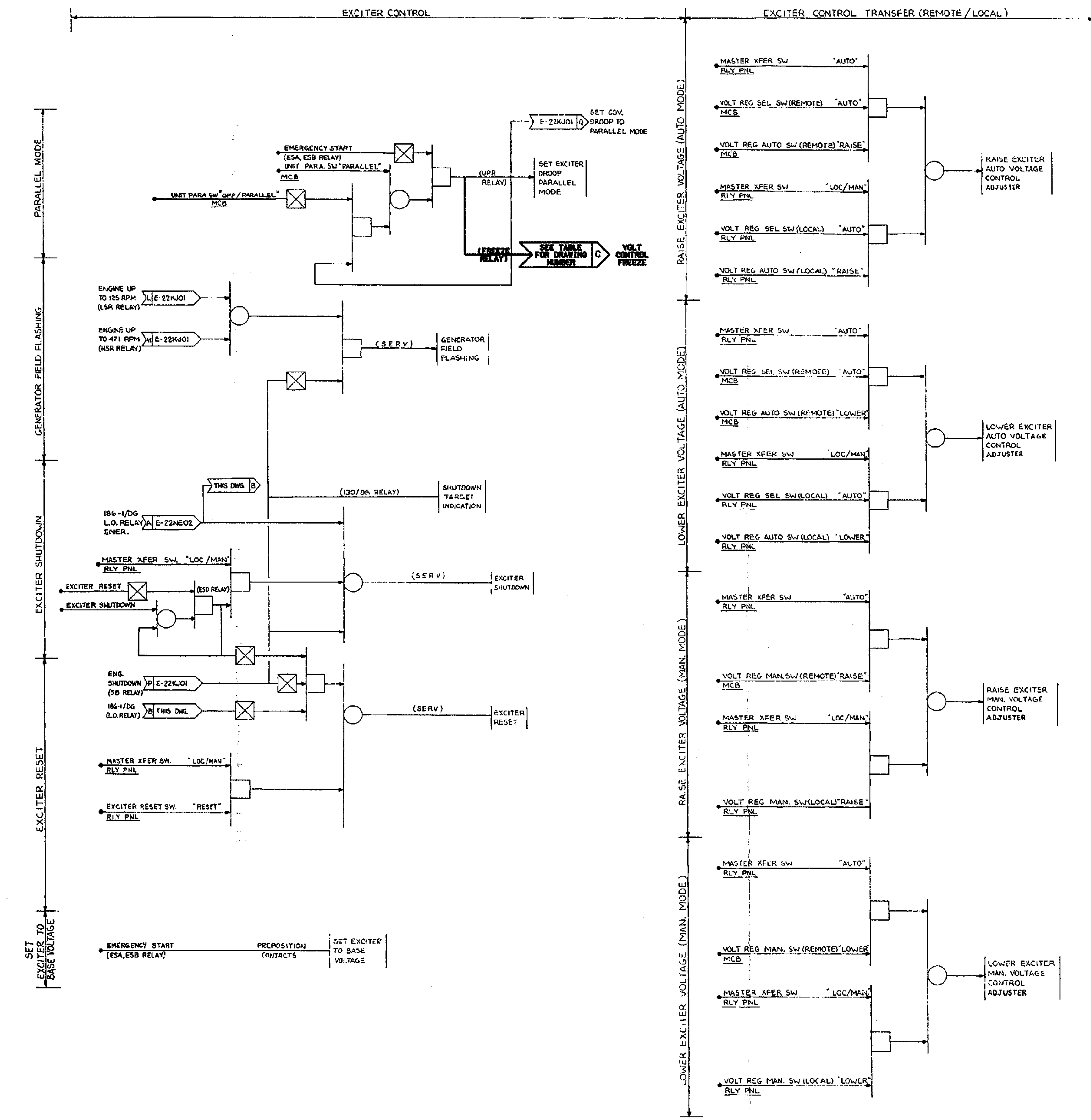
NOTES
1. THE MASTER TRANSFER SWITCH AND DIESEL START/STOP SWITCH ARE PART OF THE KJ SYSTEM AND APPEAR ON LOGIC DIAGRAM E-22KJ01.

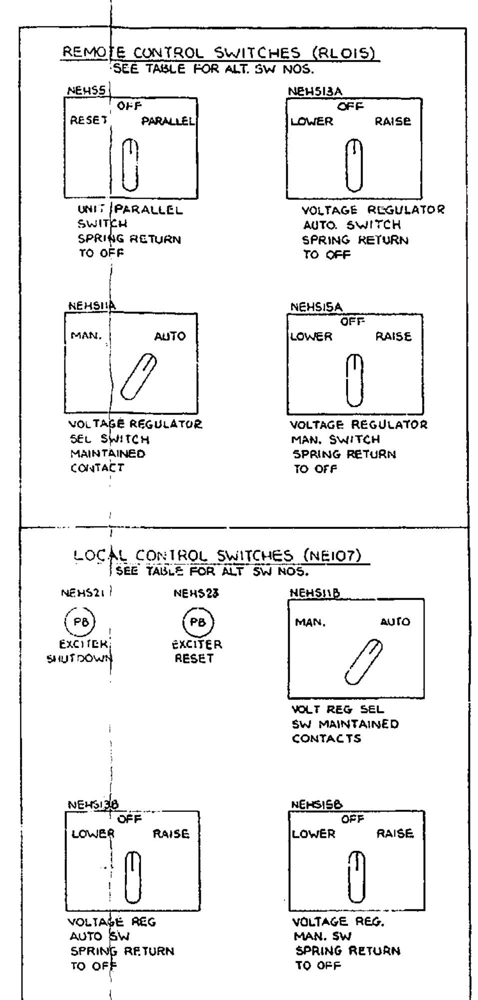
△ FSAR CN 00-045
WM 12/20/00
SEE MOD DRAWING
99-1038 E-22NE01-2

12
REV. OL-~~5~~ 6/~~94~~ 11/01

CALLAWAY PLANT

FIGURE 8.3-3
LOGIC DIAGRAM STANDBY GENERATOR EXCITATION CONTROL
(E-22NE01)





EQUIPMENT	NE01	NE02
MASTER TRANSFER SW (NOTE 1)	KJHS9	KJHS109
DIESEL START/STOP SW (NOTE 1)	KJHS8A	KJHS108A
UNIT PARALLEL SWITCH	NEHS5	NEHS6
EXCITER RESET SWITCH	NEHS23	NEHS24
EXCITER SHUTDOWN SW	NEHS21	NEHS22
VOLT REG SEL SW (REMOTE)	NEHS11A	NEHS12A
VOLT REG SEL SW (LOCAL)	NEHS11B	NEHS12B
VOLT REG AUTO SW (REMOTE)	NEHS13A	NEHS14A
VOLT REG AUTO SW (LOCAL)	NEHS13B	NEHS14B
VOLT REG MAN. SW (REMOTE)	NEHS15A	NEHS16A
VOLT REG MAN. SW (LOCAL)	NEHS15B	NEHS16B
RELAY PANEL - RLY PNL	NE107	NE106
MAIN CONTROL BOARD - MCB	RL015	RL015
VOLT CONTROL FREEZE	NB03 E-22NB05 XNB01 E-22NB07	NB04 E-22NB06 XNB02 E-22NB07

NOTES
1. THE MASTER TRANSFER SWITCH AND DIESEL START/STOP SWITCH ARE PART OF THE KJ SYSTEM AND APPEAR ON LOGIC DIAGRAM E-22KJ01.

99-1038 | E-22NE01 | 2 | 0

BECHTEL
GAITHERSBURG, MARYLAND
SNUPPS
STANDBY GENERATION EXCITATION CONTROL LOGIC DIAGRAM

~~AS BUILT~~
10466

FSAR CN 00-045 wm 12/19/00

c. Following a fire, the fire dampers are accessible only from that area where they are located. Major other systems and components would be remotely operable from the control room.

d. All exhaust fans, with the exception of the control building fans, are centrifugal with the motor located outside of the airstream, making them less susceptible to high gas temperatures. The fans are capable of processing air of temperatures at least as high as the fusible link melting temperature (160°F/165°F) of the fire dampers. The control building exhaust fans are vaneaxial with the motors located in the process airstream. The fan motor is designed for a minimum 150°F temperature rise.

Since the exhaust fans are all downstream of the system filter units, they will not be subject to damage from high temperature particles.

9.5.1.2.2.5 Other Fire Protection Features

EMERGENCY LIGHTING - Section 9.5.3 describes the emergency lighting system and the design features provided for post fire access and egress. Table 9.5.3-1 provides a listing of rooms in which operator actions are required for safe shutdown following control room evacuation.

RADIO COMMUNICATION - A portable radio annunciation system will be provided which may be used by the fire brigade and other operations personnel involved in safe plant shutdown.

FIRE RESISTANT AND NONCOMBUSTIBLE MATERIALS - Construction materials are noncombustible to the maximum extent practical. Noncombustible materials are those which have a maximum rating of 25 for smoke contribution, fuel contribution, and flame spread. Insulation over metal roof decking and the vapor barrier will be securely attached by approved noncombustible adhesive and perimeter fastening.

Suspended acoustical ceilings and their supports are of UL listed, noncombustible construction. Insulation for pipes and ducts and their adhesives are noncombustible and UL listed, where practical. Concealed spaces are devoid of combustibles, as practical. Materials which give off toxic fumes when exposed to fire are prohibited. Excluding charcoal adsorbers, all ventilation prefilters for filtration units are UL Class 1.

COMBUSTIBLE OIL - Areas in which combustible oil-filled equipment is located are prepared to eliminate the spread of the combustible oil from the immediate area of the equipment. An enclosed gravel filled pit is located beneath the yard transformers. The pit is sized to contain oil from the largest

 FSAR CN 00-045 wm 1/5/01

INSERT 9.5.1-21

transformer served by the pit, ~~and the~~ water from two transformer water spray systems operating for 10 minutes (unless the pit serves only one transformer). All transformers inside the building are the dry type. A fire barrier of at least 2-hour rating is provided between all oil-filled transformers which are separated by less than 50 feet (except between the station service and start-up transformers which are within 40 feet of each other without requiring a wall).

The underground diesel fuel storage tanks are set on a firm foundation, backfilled with noncorrosive sand surrounding the tank (6 inches minimum) and provided with a covering of 2 feet (minimum) of earth.

Each diesel fuel oil day tank is provided with protection features to preclude the uncontrolled leakage of diesel fuel. The design features provided for the day tank were reviewed and accepted by the NRC at the Wolf Creek Fire Protection Audit of February 6 to 9, 1984. This audit was also applicable to the Callaway Plant.

An oil collection system to collect and contain the lubricating oil for each reactor coolant pump is installed. Two 300-gallon lube oil collection tanks are installed. One tank serves to collect lube oil from either of two pumps. The tanks will be manually drained as required. The hydrogen bulk supply manifold is located out of doors, at an unexposed location.

ION EXCHANGE RESINS - To ignite and to sustain combustion is relatively difficult in ion exchange resins that are in a hydrated form (as opposed to those in dehydrated form).

The ion exchange resins are received and stored in a hydrated form in nonsafety-related areas of the plant (radwaste and turbine buildings) which are separated from the safety-related areas by 3-hour fire barriers. The only safety-related area of the plant which normally contains resins is Fire Area A-8 at elevation 2000 in the auxiliary building. All of the resin, however, is contained in ASME pressure vessels filled with water. Spent resin is sluiced in a closed pipe to the spent resin storage tank in the radwaste building. Fresh resins, still the hydrated form, will be introduced into the resin filler hopper in Room 1307 above the ion exchange vessels from elevation 2026 of the auxiliary building Room 1405. The ion exchange vessels are then filled from the resin filler hopper. Administrative controls will ensure that Room 1405 is separated from adjacent areas by a 3-hour-rated fire barrier, and automatic smoke detection is provided at the ceiling of the room. This zone is within 75 feet of the hose stations in the corridor (Room 1408 - see Figure 9.5.1-2, Sheet 3). Portable extinguishers are installed outside the room in the corridor.

INSERT 9.5.1-21

In addition, the pit is designed such that the oil will be contained with the addition of

Rev. OL-0
6/86

8600-X-88100

LEGEND

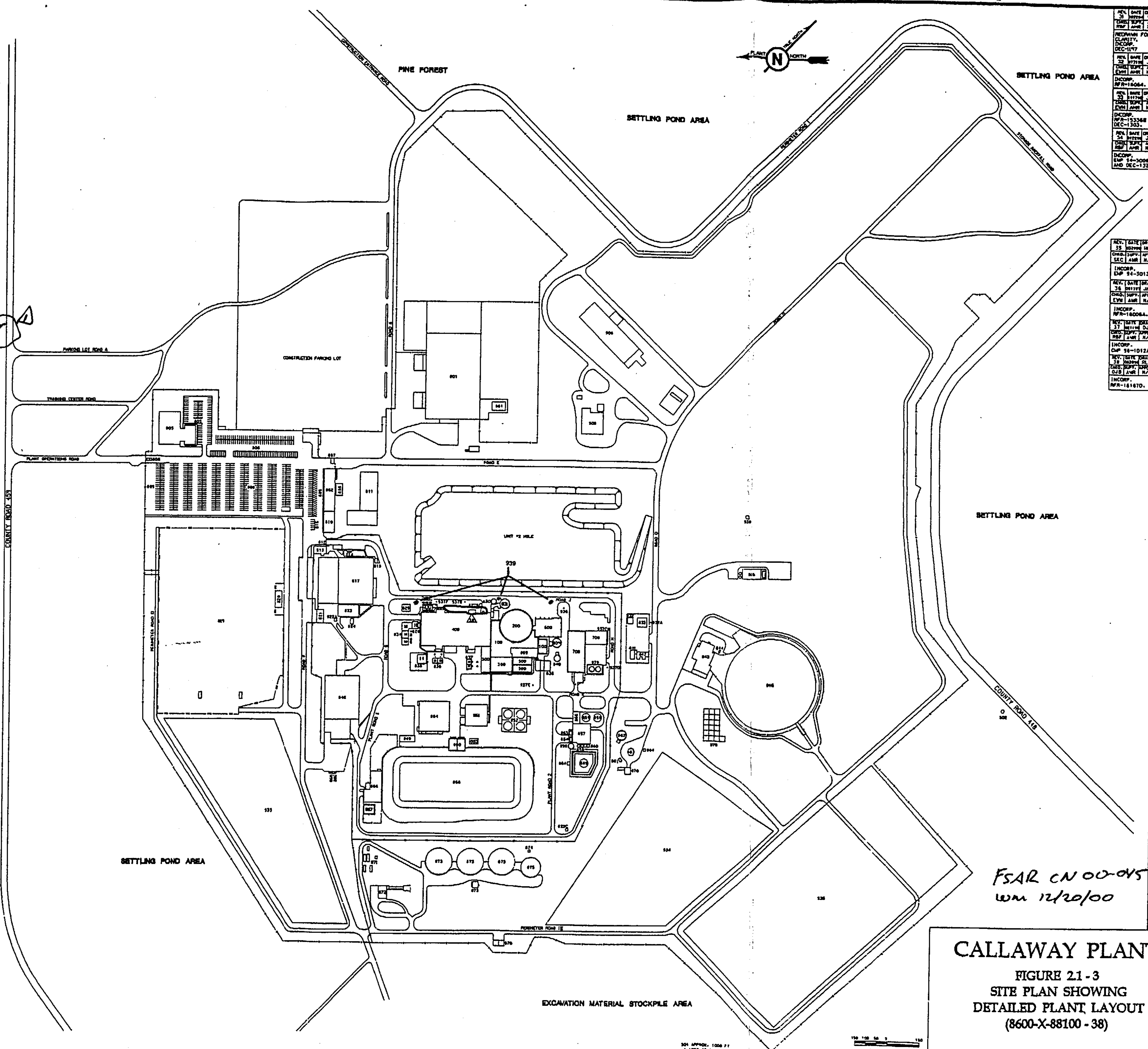
PERMANENT PLANT FACILITIES

100 - AUXILIARY BUILDING, HOT MACHINE SHOP
200 - REACTOR BUILDING
300 - CONTROL BUILDING, COMMUNICATIONS CORRIDOR
400 - TURBINE BUILDING, AUXILIARY BOILER
500 - DIESEL GENERATOR BUILDING
501 - LANDFILL MONITORING WELL #501
502 - LANDFILL MONITORING WELL #502
600 - FUEL BUILDING
700 - RADWASTE BUILDING, DRUM STORAGE
801 - STORES II BUILDING
802 - PARKING-TRAINING CENTER
803 - TRAINING CENTER
805 - WATCHMAN GATEHOUSE
808 - PARKING OPERATIONAL
809 - PARKING VISITORS
810 - SECURITY OFFICES
811 - ADMINISTRATION/ENGINEERING BUILDING
812 - MAIN ENTRANCE
813 - SECURITY BUILDING/MAIN ACCESS FACILITY
814 - SECURITY DIESEL FUEL TANK
815 - SECURITY DIESEL GENERATOR
816 - PARKING RESERVED
817 - SERVICE BUILDING
818 - COOLING WATER CHEMICAL CONTROL
819 - SWITCHYARD
820 - SWITCHYARD CONTROL BUILDING
821 - SECONDARY ACCESS FACILITY
822 - REMOTE MLTPLEX UNIT A.B.C
823 - TECHNICAL SUPPORT CENTER
824 - SITE SWITCHGEAR BUILDING
825 - SPARE MAIN TRANSFORMER
826 - UNIT AUXILIARY TRANSFORMER
827 - AMMONIA STORAGE TANK
828 - SULFURIC ACID STORAGE TANK
829 - CAUSTIC STORAGE TANK
830 - DEMINERALIZED WATER TANK
831 - CONDENSATE WATER TANK
832 - CARBON DIOXIDE CO2 STORAGE
833 - HYDROGEN STORAGE
834 - MAIN TRANSFORMER
835 - STARTUP TRANSFORMER
836 - STATION SERVICE TRANSFORMER
837 - ESF TRANSFORMER #1 ← Capacitor Banks
838 - EMERGENCY DIESEL FUEL TANK
839 - REFUELING WATER TANK
840 - REACTOR MAKEUP WATER TANK
841 - OXYGEN STORAGE
842 - NITROGEN STORAGE
843 - CIRC SERVICE WATER PUMPHOUSE
844 - CIRC WATER H2SO4 TANK
845 - COOLING TOWER
846 - STORES I BUILDING
849 - HEALTH PHYSICS CALIBRATION FACILITY
850 - ESSENTIAL SERVICE WATER PUMPHOUSE (OFFICES)
851 - MAINTENANCE TRAINING ANNEX
852 - UHS COOLING TOWER I
853 - DEMINERALIZED CAUSTIC STORAGE TANK
854 - DEMINERALIZED H2SO4 STORAGE TANK
855 - DEMINERALIZED CLEAR WELL
856 - FIRE PUMPHOUSE
857 - DEMINERALIZED POTABLE WATER BUILDING
858 - GRAVITY SAND FILTER TANK
859 - FIRE WATER STORAGE TANK
860 - ACTIVATED CARBON FILTER TANK
861 - RECLAIMED OIL STORAGE TANK
862 - NEUTRALIZATION TANK
863 - EQUALIZATION BASIN
864 - AUXILIARY OIL TRANSFER
865 - GASOLINE STORAGE TANK
866 - SOLVENT STORAGE
867 - GAS CYLINDER STORAGE
868 - UHS RETENTION POND
869 - FUEL OIL STORAGE TANK
870 - OILY WASTE TREATMENT AREA
871 - SEWAGE TREATMENT PLANT
872 - WATER TREATMENT CONTROL BUILDING
873 - WATER TREATMENT PLANT
874 - WELL NO. 3
875 - WATER TREATMENT PLANT CLEARWELL
876 - SLUDGE PUMP STATION
878 - SITE CATHODIC PROTECTION ANNODE BED
879 - LCD RADWASTE STORAGE TANK
881 - LUBE OIL STORAGE BUILDING
882 - CENTRAL PROCESS FACILITY
883 - HELPERS PAINT SHOP
884 - OUTAGE MAINTENANCE FACILITY
886 - VEHICLE DIESEL FUEL STORAGE TANK
887 - FOOD VENDOR STORAGE BUILDING
888 - FITNESS FOR DUTY BUILDING
889 - RAM STORAGE BUILDING
908 - MAINTENANCE SHOP ANNEX (FAB SHOP)
909 - QUALITY CONTROL BUILDING
933 - SAN. LANDFILL (PER. #102704)
934 - SAN. LANDFILL (PER. #102702 (202701))
935 - SAN. LANDFILL (PER. #102705)
936 - DIESEL FUEL REMEDIATION WELL
937 - MONITORING WELL
938 - PEREGRINE FALCON HACK

939 - SECURITY RESPONSE CENTERS

OWNER CONTROLLED AREA FENCE
PROTECTED AREA FENCE
SWITCHYARD FENCE

NOTE:
1. SEE 8600-X-90443 FOR VEHICLE BARRIER SYSTEM AT PA FENCE.



CALLAWAY PLANT

FIGURE 2.1-3
SITE PLAN SHOWING
DETAILED PLANT LAYOUT
(8600-X-88100 - 38)

SITE ADDENDUM
REV OL-10 11/98

8.2.1.2 Plant Site Switchyard and Connections to Onsite Distribution System

The 345-kV Callaway Switchyard consists of circuit breakers, disconnect switches, buses, transformers, and associated equipment. The switchyard is arranged in a modified breaker-and-a-half configuration with the Montgomery-Callaway-7 line connected as a radial circuit on Bus B as shown in Figure 8.2-5.

A 345/13.8-kV Safeguard Transformer is connected directly to each 345-kV bus through a disconnect switch which is capable of interrupting magnetizing current. Safeguard Transformer A is a three-winding transformer rated 60/80/100-MVA which is identical to the Startup Transformer and can be used to replace it if necessary. Safeguard Transformer B is a two-winding transformer rated 30-MVA. Each transformer has two low side breakers connected so that either transformer may supply via underground duct a 13.8/4.16-kV Engineered Safety Feature (ESF) Transformer at the plant. The Safeguard Transformers are sized so that either Transformer A or B has the capacity to handle the design shutdown or the design basis LOCA load. The 13.8-kV breakers are electrically interlocked so that the low side windings of the Safeguard Transformers cannot be connected together.

Another offsite supply consists of a 345-kV overhead circuit from the switchyard to the Start-up Transformer. The capacity of the 345-kV circuit to the Start-up Transformer is more than adequate to supply the total connected loads on the Start-up Transformer. A tap off of one of the secondaries of this Start-up Transformer supplies the second ESF Transformer. The two ESF transformers with their associated capacitor banks and supply circuits from the 345-kV Switchyard provide two independent sources of offsite power for the Class 1E buses.

Each ESF Transformer (and associated automatic load tap changer) △ is rated 12/16-MVA and has adequate capacity to supply the maximum loads of both safety-related systems simultaneously during normal and abnormal operating conditions, accident conditions or plant shutdown conditions. Their associated capacitor banks provide voltage correction for the NB busses if required.

The 13.8 kV cables to the ESF Transformers are designed for 16MVA at 95% voltage. The secondary cables are sized for 8MVA per 4 kV Class 1E Bus at 95% voltage. The ampacity and group derating factors of the cables are in accordance with the manufacturer's recommendations and IPCEA publication P46-426 for cables in duct banks and maintained spaced trays. The cable ampacities are based on a maximum conductor temperature of 90 degrees C, 100 percent load factor and all cables fully loaded.

The second feeder from the Safeguard Transformer will be used to serve site facilities such as the water intake, demineralizer, service building, stores building, 345-kV switchyard station service, etc., as described in Section 8.3 and shown in Figure 8.3-1.

The physical arrangement of the 345-kV switchyard will be as shown in

ULNRC- 04353

ATTACHMENT 4

EXISTING MARKED-UP TECHNICAL SPECIFICATION BASES PAGES
(TSB CN 00-029)

LIST

Page B 3.8.1-1
Page B 3.8.1-3
Insert B 3.8.1-3

TSB CN 00-029
Δ wm 1/10/01

B 3.8 ELECTRICAL POWER SYSTEMS

B 3.8.1 AC Sources - Operating

BASES

BACKGROUND

The unit Class 1E AC Electrical Power Distribution System AC sources consist of the offsite power sources (preferred power sources, normal and alternate), and the onsite standby power sources (Train A and Train B diesel generators (DGs)). As required by 10 CFR 50, Appendix A, GDC 17 (Ref. 1), the design of the AC electrical power system provides independence and redundancy to ensure an available source of power to the Engineered Safety Feature (ESF) systems.

The onsite Class 1E AC Distribution System is divided into redundant load groups (trains) so that the loss of any one group does not prevent the minimum safety functions from being performed. Each train has connections to two preferred offsite power sources and a single DG.

Offsite power is supplied to the unit switchyard from the transmission network by three transmission lines. From the switchyard, two electrically and physically separated circuits provide AC power, through ESF transformers, to the 4.16 kV ESF buses. A detailed description of the offsite power network and the circuits to the Class 1E ESF buses is found in the FSAR, Chapter 8 (Ref. 2). Δ voltage regulation equipment

An offsite circuit consists of all breakers, transformers, switches, interrupting devices, cabling, and controls required to transmit power from the offsite transmission network to the onsite Class 1E ESF buses.

Certain required unit loads are returned to service in a predetermined sequence in order to prevent overloading the transformer supplying offsite power to the onsite Class 1E Distribution System. Within 1 minute after the initiating signal is received, all automatic and permanently connected loads needed to recover the unit or maintain it in a safe condition are returned to service via the load sequencer.

The onsite standby power source for each 4.16 kV ESF bus is a dedicated DG. DGs NE01 and NE02 are dedicated to ESF buses NB01 and NB02, respectively. A DG starts automatically on a safety injection (SI) signal (i.e., low pressurizer pressure, steam line pressure or high containment pressure signals) or on an ESF bus undervoltage signal (refer to LCO 3.3.5, "Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation"). After the DG has started, it will automatically tie to its respective bus after offsite power is tripped as a consequence of ESF bus undervoltage or degraded voltage, independent of or coincident with an SI

(continued)

TSB CN 00-029
wm 1/10/01

BASES

APPLICABLE SAFETY ANALYSES (continued)

The AC sources satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

Two qualified circuits between the offsite transmission network and the onsite Class 1E Electrical Power System and separate and independent DGs for each train ensure availability of the required power to shut down the reactor and maintain it in a safe shutdown condition after an anticipated operational occurrence (AOO) or a postulated DBA.

Qualified offsite circuits are those that are described in the FSAR and are part of the licensing basis for the unit.

In addition, one required LSELS per train must be OPERABLE.

Each offsite circuit must be capable of maintaining rated frequency and voltage, and accepting required loads during an accident, while connected to the ESF buses.

One offsite circuit consists of either Safeguards TransformerA or B, which is supplied from Switchyard Bus A or B, and feeds through a breaker to ESF transformer XNB01, which, in turn, powers the NB01 ESF bus through its normal feeder breaker or NB02 ESF bus through its alternate feeder breaker, if needed. Another offsite circuit consists of the Startup Transformer, which is normally fed from the Switchyard feeding through breaker PA 0201, to ESF transformer XNB02, which, in turn, powers NB02 ESF bus through its normal feeder breaker and NB01 through its alternate feeder breaker, if needed.

INSERT B 3.8.1-3

Each DG must be capable of starting, accelerating to rated speed and voltage, and connecting to its respective ESF bus on detection of bus undervoltage. This will be accomplished within 12 seconds. Each DG must also be capable of accepting required loads within the assumed loading sequence intervals, and continue to operate until offsite power can be restored to the ESF buses. These capabilities are required to be met from a variety of initial conditions such as DG in standby with the engine hot and DG in standby with the engine at ambient conditions. Additional DG capabilities must be demonstrated to meet required Surveillance, e.g., capability of the DG to revert to standby status on an ECCS signal while operating in parallel test mode.

Initiating a DG start upon a detected undervoltage condition, tripping of the incoming offsite power upon a detected undervoltage or degraded voltage condition, shedding of nonessential loads, and proper sequencing

(continued)

INSERT B 3.8.1-3

Voltage regulation equipment consisting of automatic load tap changing ESF transformers and associated capacitor banks maintain the preferred sources in the event of changing switchyard voltage.