SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION IN SUPPORT OF MODIFICATIONS TO THE CLASS 1E ELECTRIC DISTRIBUTION SYSTEM RANCHO SECO NUCLEAR GENERATING STATION DOCKET NO. 50-312

1.0 INTRODUCTION

By letter dated December 19, 1986 (Reference 1), Sacramento Municipal Utility District (SMUD), the licensee, submitted proposed license amendment 147 and requested changes to the Rancho Seco Technical Specification (TSs) involving the modifications to the facility electric distribution system. The amendment also included the design information to support the proposed changes to the technical specifications. This Safety Evaluation (SE) addresses the modifications to the electric distribution system, excluding the technical specifications, and is based on the design information provided with the amendment. A portion of the design information provided with proposed amendment 147 describes the modifications that were included in Amendment 68 and were reviewed and approved by the staff in our SER (Reference 2). The licensee incorporated most of the approved Amendment 68 modification in Rancho Seco onsite power system during the 7th refueling outage of the generating station.

The documentation provided in proposed amendment 147 includes design information of the confirmatory items of Amendment 68 SER (e.g., Emergency Diesel Generators (EDGs), tie breakers interlock, etc.). Design details of proposed modifications of the 125 VDC systems and their associated 120 VAC vital instrument power systems, and changes in the 4160 VAC undervoltage/overvoltages protective relaying scheme were included. In addition to these, the amendment includes a comparison of Rancho Seco onsite AC power system design to the requirements of Section 8.3.1 of the Standard Review Plan - NUREG-0800.

If found acceptable by the staff, the licensee plans to incorporate the proposed changes in Rancho Seco plant during the current outage.

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2.0 BACKGROUND

The Rancho Seco Nuclear Generating Station was licensed with an electrical systems design of sufficient capacity to service design safety loads, and with a two redundant safety train configuration. The design provided one 4160 VAC EDG and two 125 volts DC batteries in each train of the onsite power system in compliance with the General Design Criterion (GDC) 17 of Appendix A to the CFR 10 Part 50.

The modification in the plant safety systems design required by NUREG-0737 "Clarification of TMI Action Plan" and NUREG-0696 "Functional Criteria for Emergency Response Facilities" resulted in addition of both AC and DC loads. The existing EDG and battery capacity on each redundant train was found inadequate to supply the additional loads. Consequently, the licensee proposed to add the following equipment to the existing onsite AC and DC power systems as shown on Figures 1 and 2 of this SER.

(1) Two EDGs (Transamerica Delaval, Inc., TDI).

(2) Two trains of independent Class 1E 4160/480 volt electric distribution, each with an independent load sequencer.

(3) Four trains of independent Class 1E 125 VDC power with the associated batteries, primary and standby chargers, and 120 volts AC vital instrument power supplies.

To house this new equipment, the licensee constructed two new Category 1 structures: a Diesel Generator Building and a Nuclear Service Electrical Building (NSEB).

Following the licensee's submittal of these proposed changes to the NRC in license Amendment 68, a generic problem was identified in the proposed TDI diesel engines which needed further evaluation before they could be used at Rancho Seco. Nonetheless, the licensee proposed means (both automatic and manual) to power the essential additional loads using all available capacities

of the existing diesel generators pending qualification of the new TDI diesel engines. The licensee also proposed revision to the facility technical specification to reflect this temporary mode of plant operation. The staff reviewed the proposed modifications and proposed revision to the plant technical specifications for a temporary mode of operation until the qualification of the new EDGs was approved by the NRC and the EDGs were put in service. Our SER in reference 2 found the proposed modifications and technical specification changes in compliance with the requirements of the applicable GDCs, NRC Regulatory Guides and Branch Technical Positions listed in NUREG-0800. The SER concluded that the proposed modifications and temporary modes of operations were acceptable.

3.0 SCOPE OF REVIEW

This review is limited to the evaluation of the modifications proposed after our SER for Amendment 68 and the design adequacy of certain confirmatory items of the SER as follows:

(A) The new TDI Emergency Diesel Generators

(B) 120 VAC vital instrument power system modification and addition of a static Transfer Switch and a Maintenance Bypass Switch in the new inverter output circuit.

(C) Deletion of overvoltage trip relays and modifications in the Undervoltage/Degraded Grid Voltage relaying scheme.

(D) Change from the temporary modes of manual and automatic means of supplying power to all class 1E buses while one EDG per train was operational due to the non-qualified status of the new Delaval EDGs.

Our review of the design information on the EDG and the proposed changes, and our conclusions are based on the conformance of the proposed design to the applicable design criteria, NRC Regulatory Guides, NRC Branch Technical Positions and industry standard committed for compliance by the licensee in the SER

for Amendment 68. Our review has also considered the licensee's comparison of the proposed modification with the requirements of Standard Review Plan (SRP) Section 8.3.1 provided in proposed amendment 347.

4.0 EVALUATION

A. New TDI Emergency Diesel Generators (EDGs)

The design and test capability of the new EDGs were reviewed to establish compliance with the applicable GDC's (GDC 2,4,17 and 18), Regulatory Guides (RG 1.6, 1.9, 1.108), Branch Technical Position BTP 8, and IEEE Standard 323-1974.

The new TDI EDG has a nominal capacity rating of 3500 kW and is designed to withstand 10% overload for at least two hours out of every 24 hours of operation and is also capable of operation at low loads for extended periods without degradation. As a result of the TDI generic issue, the EDG has been requalified to supply 3300 kW continuous load. The safety loads on each redundant train will be supplied by two independent diesel generators. The loads on the old EDG (Bruce GM) and the new EDG (TDI) are so distributed that any combination of two EDGs (one old and one new on either of the two trains) can provide power to safely shutdown the plant given the Design Basis Accident. The load margin available for future addition of loads is 51% and 24% of the engine rating in the new and old EDGs respectively.

The new EDGs are located in a new Quality Assured (QA) seismic Category 1 diesel generator building, and their associated engine and generator control panels are located in rooms separate from the EDGs themselves. The EDGs and control panels are seismically qualified. Each EDG is automatically started by an Emergency Safety Feature Actuation Signal (ESFAS) or a Loss Of Offsite Power signal (LOOP) and will be connected to its associated bus following a loss of voltage to the bus. The loss of bus voltage signal is bypassed after the EDG breaker is closed. The EDGs can be monitored and controlled from the main control room or locally. Additionally, the controls of the new EDG in one redundant train can be isolated from the main control room by means of a switch located in the NSEB to provide an alternate emergency control capability in case of a control room fire. The DC power source for each new EDG control and

instrumentation is from the same train as the EDG and its associated switchgear. To supply power to the EDG support (auxiliaries) AC components, the licensee has added MCCs (two for each EDG) on the 480 VAC load center buses associated with each EDG. Regarding the SRP comparison Section 8.3.1.111.6, the licensee stated that the design of these MCCs will meet the same independence, redundancy and separation requirements as their associated EDG system and the specific design requirements of the electrical distribution system licensed by Amendment 68.

In response to the staff's questions regarding voltage, frequency, bypass circuits, tests and qualification of the proposed TDI EDGs, the licensee submitted in reference 3 that the installed EDGs meet the qualification requirements of IEEE standard 323-1974 and Regulatory Guide (RG) 1.100, the design requirements of the Regulatory Guide (RG) 1.9 and testing requirements of RG 1.108 and GDC 18.

Position 7 of RG 1.9, "Selection, Design, and Qualification of Diesel-Generator Units Used as Standby (Onsite) Electric Power Systems at Nuclear Power Plants," Revision 2, allows engine overspeed and generator differential to trip the diesel generator by a single channel trip. All other diesel generator protective trips are to be implemented with two or more independent measurements for each trip parameter with coincident logic or be bypassed under accident conditions provided the operator has sufficient time to react appropriately to an abnormal condition of the diesel generator. The licensee is retaining engine overspeed and generator differential with a single channel trip and low lube oil pressure with coincident logic during an accident, and bypassing all other protective trips, maintaining that the operator has sufficient time to respond to an alarm for an abnormal condition. This is in compliance with the regulatory guide and is, therefore, acceptable.

As shown in Fig. 1 of this SER, the A2 Train is powered from Startup Transformer No. 1 and B2 train is powered from Startup Transformer No. 2. Electrical interlocks permit testing of A train diesel generators through Startup Transformer No. 1 only and of B train diesel generators through Startup Transformer No. 2 only. This precludes the possibility of paralleling of the diesel generators

of one train to the 4.16 kV bus or the EDGs of the redundant train. Regarding compliance to BTP-8 and RG 1.6 requirements, the licensee has committed in proposed amendment 147 to not use the EDGs for commercial power production.

Only one of the four EDGs can be tested at a time, using administrative procedure (keylock arrangement for the selector switches) to prevent interaction of the EDGs within and between the redundant trains. However, the test set-up design uses one synchroscope which can be connected through selector switches to the potential transformers (PT) on the buses, EDGs, and offsite power sources in both trains. A single failure in the selector switches associated with an EDG in one train, while its counterpart in the redundant train is being synchronized with its associated offsite source of power, could cause redundant EDG's PTs to parallel and cause blowing of fuses or relays energizing redundant EDG's instrumentation circuits. The licensee's response to this concern is documented in Reference 3. It provides a failure modes and effects analysis which concludes that even a complete failure of any of the several selector switches will not result in paralleling of redundant division EDGs. For the scenario identified in the staff's question, the licensee stated that the voltage balance relays associated with the EDGs will be energized to cause EDG control circuit lock out and "DG inoperative" alarm in the EDG rooms and the main control room. The staff found the licensee's response acceptable and has concluded that the postulated failure would not result in paralleling or otherwise compromising redundant EDGs power sources.

SRP Section 8.3.1.4.f(3) requires the licensee's preventive maintenance program to encompass investigative testing and replacement plan. The licensee's comparison of the EDG system design with this section of the SRP indicates that this program was under review. However, it is not specified if the program will include SRP requirements. The licensee has informed the staff in Reference 3 that the Rancho Seco maintenance and preventive maintenance program will comply with the requirements of NUREG-1216 "SER Related to The Operability and Reliability of EDG Manufactured by TDI." This NUREG includes the required investigative testing and replacement plan for TDI-EDGs and the program is, therefore, acceptable.

Our review of the design information provided with proposed amendment 147 indicates that the EDG design complies with GDC 2, 4 and 17 and meets the requirements of RG 1.6 and BTP-8. Compliance of the new EDG installation, power, control, and instrument circuits to the requirements of RG 1.75, and the EDG auxiliary and support systems design, were evaluated in separate staff reviews and are not included in this evaluation. The design information provided with proposed amendment 147 did not specifically address compliance to the regulatory positions of RG 1.9 and 1.108 and did not include the qualification documents to establish compliance to RG 1.100 and IEEE Std. 323-1974. However, in response to our questions, the licensee has committed to compliance with these regulatory positions. Based upon our evaluation of the information in proposed amendment 147 and SMUD's commitment for design compliance to the NRC regulatory positions, we conclude that the proposed design of the electrical aspect of the EDGs is acceptable.

B. 120 VAC Vital Instrument Power Systems (UPS) Modification

The purpose of this modification is to improve the reliability of the vital 120 VAC power supplies. As shown on Figure 2 of this SER, the design of 120 VAC vital power systems consisted of the four, inverter supplied, 120 VAC buses in the auxiliary building (original design) and a similar set of four buses in the nuclear service electrical building (additions in response to NUREG-0737 and NUREG-0696). The licensee's proposal in proposed amendment 147 changes the present configuration as shown on figure 3 of this SER. As a result of the modifications, the 120 VAC vital buses in the auxiliary building will be disconnected from their associated inverters which were found to be unreliable. Because they have experienced several recent failures and difficulty in obtaining replacement parts (the vendor of these inverters has gone out of business), these inverters are being removed from the plant. Their associated 120 VAC vital buses in the auxiliary building will be supplied by the recently added NSEB inverters as shown on figure 3. In essence, the existing 8 inverters/8 buses system will be modified into a 4 inverter/8 buses system. Each of the four inverters is rated 25 KVA. The maximum combined two bus load on any one inverter will be less than 15.2 KVA.

The proposed modification also includes a seismically qualified Class 1E static transfer switch and a manual bypass switch with each of the four inverters. The function of the transfer switch is to immediately and automatically transfer the 120 VAC vital bus load to a back-up source of 120 VAC regulated power in case of a loss of its associated inverter. The design is such that each of the two uninterruptible power supplies (UPS) in one train are backed up by both EDGs in that train. If one EDG in a train fails, or both primary and back up chargers supplying an inverter fail, or the inverter itself fails, the static transfer switch will automatically switch both of the associated UPS buses over to the other EDG in that train. If both EDG supplies to any one of the two associated UPS in a train fail, the affected UPS will operate from its associated battery for at least two hours. The function of the manual bypass switch is to ensure that 120 VAC regulated power is available to the UPS buses in those cases when the associated inverter and the static transfer switch have failed or are out for maintenance.

Our review of the licensee's submittal indicates that the proposed design of the 120 VAC vital instrument power has the required redundancy with sufficient capacity and adequate capability to provide the design safety function. In response to the staff's question on testability, the licensee documented that the design is testable in accordance with the periodic testing requirement of GDC 18. The physical and electrical independence of the modification was previously reviewed by the staff and the findings were provided in the Rancho Seco restart SER. The staff concludes that the proposed modification meets the redundancy, capacity, capability, and testability requirements of GDC 17 and thus is acceptable.

C. 4160 Volt VAC Class 1E Bus Overvoltage/Undervoltage Alarm and Trip Relaying Scheme Modification

At Rancho Seco, the existing schemes for alarming and tripping an abnormal offsite power to protect the Class 1E electric equipment from overvoltage and undervoltage was implemented in response to the NRC generic letter to SMUD dated June 3, 1977. This letter required all plants to have a second level of undervoltage or overvoltage protection. SMUD did not rely on operator action

for overvoltage protection and proposed to implement automatic protection from undervoltage as well as from overvoltage. The proposed scheme included one relay for overvoltage alarm and 3 relays in a 2-out-of-3 coincident logic on each 4160 volt Class 1E bus for overvoltage trip. Similarly there are 3 relays on each 4160 volt Class 1E bus to provide undervoltage trip (combined loss of voltage and degraded grid voltage) in a 2-out-of-3 coincident logic. Both overvoltage and undervoltage protection schemes were reviewed and approved by the staff in References 4 and 5.

In the recent past, the plant experienced spurious overvoltage tripping due to transient overvoltages associated with reactor coolant pump (RCP) starting or high grid voltages of short duration. The RCPs are supplied by one winding of the start-up transformer while the Class 1E buses are supplied from the other winding. The transformer design characteristics are such that when low voltage occurs on one winding during RCP start, voltage compensation causes higher voltage on the other winding (to Class 1E buses). This increase in voltage exceeds the overvoltage, 8-second time delay, trip setpoint and causes bus tripping from the off-site source of power and the consequential start of the EDGs. To prevent this unnecessary challenge to the emergency AC power systems, the licensee has proposed elimination of the overvoltage trip and implementation of operating procedures to limit 4160 volt Emergency Safety Features (ESF) bus voltage within the acceptable range. If the operator cannot reduce the overvoltage to the normal operating range of the 4160V Class 1 bus after the alarm, then the operator must start the diesel generator, parallel it with the offsite source, reduce the load on the 4160V ESF bus to allowable limit of diesel generator loading and then trip the offsite power circuit breaker.

The modification to the overvoltage alarm design is to replace the existing alarm relay with a voltage transducer to provide analog signals for logging and alarming the 4160 volt ESF bus overvoltages at the plant computer (IDADs) located in the main control room.

Our review finds the alarm modification acceptable. However, the operator action to parallel EDGs with an abnormal offsite power source and operating the EDGs to assume loads from the higher voltage offsite power supply has a potential for common mode failure, an unacceptable condition. The licensee did not

include any justification as to why the time delay for overvoltage trip should not be increased from present value of 8 seconds to accommodate the RCP starting transient and continue to provide the required automatic overvoltage protection. The proposed operator action would override the transient and would only be applicable in the case of sustained overvoltage on the offsite power system. The sustained overvoltage of the offsite power would be due to grid overvoltage and would affect all four 4160-volt ESF buses. In response to the staff's concern, the licensee has committed in Reference 3 to not parallel the EDGs with the offsite source of power except for testing. The offsite power supply breakers to the 4160-volt Class 1E buses will be tripped before the bus voltage reaches to its analyzed limit of 4626 volts. This is in compliance with BTP-ICSB-8 which requires precluding interconnection of onsite and offsite power sources except for short periods for the purpose of load testing. The staff finds the licensee's proposal acceptable.

In the Rancho Seco design, both loss of voltage trip and the degraded grid undervoltage trip were provided by the same set of inverse characteristic undervoltage relays. The trip setpoint for these undervoltage relays was chosen to protect class 1E electric equipment from harmful undervoltages during all plant operating conditions and transients. The trip setpoint provided in the Rancho Seco Technical Specification is 3771±38 volts on the 4160 volt nominal voltage base and the tested relay operating characteristic is to drop out within 8.2±0.82 seconds at 98% of the setpoint, within 5.2±0.52 seconds at 90% of the setpoint, within 3.1±0.31 seconds at 70% of the setpoint, and within 1.5±0.15 seconds at 0 volts.

However, the relay operating accuracy is not predictable because the inverse operating characteristic of the relay does not accurately repeat for certain voltage zones of the relay operation. The licensee experienced unpredictable drifts in the relay operation thus causing non-compliance with the technical specification limits. The licensee's proposed modification is to provide a set of definite time delay undervoltage relays in a 2-out-of-3 trip logic in conjunction with the existing inverse characteristic undervoltage relays. The inverse characteristic relays will be used for first level of protection (loss of offsite power) to drop out at 70% of the trip setpoint with a time delay of

3.5 seconds. At or below this voltage, the operating characteristic of the inverse relays is well defined and the setpoint repeatability is predictable. The definite time delay relays will be used for the second level of protection (long time undervoltage due to degraded grid) to drop out at 98% of the trip setpoint with a time delay of 5±0.5 seconds. Both relays are set to trip at the existing setpoint of 3771± 38 volts. With this selection of time delays, the definite time delay relay will always operate faster than the inverse characteristic relays above 90% of the undervoltage trip setpoint. This design will eliminate dependence on the inverse characteristic relays for their operation in the steep portion of the time delay curve where the setpoints are not accurately repeatable. The staff has reviewed the time delay curves in Reference 3 and agrees with the licensee's approach.

The new relays and their associated cables and raceways will be qualified for their Class 1E function and will be tested to ensure their qualification for seismic Category 1 service. The installation will meet quality assured Category 1 requirement. The staff finds this modification acceptable.

D. Class 1E Electrical Distribution System Changes From Temporary Modes Of Manual And Automatic Operation To The Final Design Configuration

(1) Pending qualification of the new TDI EDGs, certain manual and automatic means of operation were proposed by the licensee and approved by the staff in Amendment 68. These operations were necessary to provide emergency AC power to those additional essential Class 1E equipment which were added and designed to be powered by the new EDGs as shown on Figure 1 of this SER. This was accomplished by automatic closure of train B load center tie breakers in the case of loss of offsite power to train B and consequential start of the associated EDG. By using the load center tie breakers, both 4160 volt buses (S4B and S4B2) and both 480 volt buses (S3B and S3B2) in train B can be supplied by the old EDG (Bruce GM-GEB). The load center tie breakers in train A were manually closed for the conditions and purpose, similar to those for train B. For the final configuration when the new TDI-EDGs in both trains are in service, these tie breakers will only

be used for maintenance during cold shutdown. The automatic closure circuitry of the B train load center tie breakers for the loss of offsite power will be removed. Both train load center tie breakers will be operated only manually. During normal operation these breakers will be racked out and kept under administrative control. Additionally, interlocks will be provided between the tie breakers and the main feeder breakers to the load center buses such that each tie breaker can be closed only if at least the feeder breaker to one of the two load center buses is open. This feature will prevent paralleling of the two EDGs in a train. In the final configuration the interdependence of the two 4160 volt buses in both trains will be removed, thus increasing the train reliability. A loss of offsite power (LOOP) to any one of the four 4160 volts Class 1E buses will cause its associated undervoltage scheme to trip its offsite source feeder breaker, starting of the associated EDG, and initiation of the bus unloading (load shed) and loading (load sequencing) scheme, independent of the other EDG in the same train or the redundant train. The staff finds this change acceptable.

(2) During the interim period till the new TDI-EDGs are placed in service, the automatic start of certain essential Heat Ventilation Air Condition (HVAC) systems was blocked (staff review in Amendment 68) during LOOP conditions to provide the total capacity of the existing EDGs to only the safety loads. These blocking circuits will be removed prior to restart and the HVAC loads will be automatically loaded on to their respective EDGs. In addition to the blocking circuits, timers were provided to allow closing of the essential HVAC system feeder breakers during a LOOP or ESFAS with LOOP, following closure of the maintenance tie breakers. The proposed modification will remove the timers and replace them with electric reset relays to provide a maintained close permissive for the load sequencer to automatically close the HVAC system feeder breakers. The licensee's proposal also includes providing similar electric reset relays to provide a similar function to the load center bus supply circuit breakers. This modification eliminates dependence on the timer and allows the sequencer to close the breakers. The reset relays will be qualified to the requirements of IEEE Std. 323-1974 and IEEE Std. 344-1975. The staff finds this modification acceptable.

(3) The existing sequencer loading status indicating lights at the control room panel are located in the back panel and below the standing line of sight making it difficult to read. The proposed modification will remove these lights from the back panel and will provide the sequencer loading status indication for all the four sequences at the computer (IDADs) in the control room. Indication via IDADs is better as it provides also a back up means of indication. Furthermore, an audible alarm will also be generated from the computer. The change does not involve device addition and equipment qualification. Isolation between the Class 1E control circuits and IDADs is evaluated in a separate staff review (Part of the start up SER). The staff finds this modification acceptable.

(4) In the Rancho Seco design, the physical position of the battery charger output circuit breaker is not monitored as required by Section 5.3.4(5)c of IEEE Std. 308-1974. Instead, the charger failure alarm and administrative control was used for this function. A confirmatory item of Amendment 68 required the licensee to install "battery bank voltage monitoring" which will reflect the charger output breaker open or close positions. The proposed modification is to install undervoltage relays to monitor voltage on the 125 VDC Class 1E buses. The relays are set at 125 volts with a 30 second time delay alarm via the IDADs. Since the battery is floated at 130 VDC, a voltage drop to 125 volts will indicate loss of input from the battery charger and thus the position of the battery charger output circuit breaker. The proposed 30-second time delay will prevent undesirable alarm due to transients. The relays are qualified to the requirements of IEEE Std. 323-1974 and IEEE Std. 344-1975 and will be installed to quality assured Category 1 requirements, maintaining the seismic qualification of the DC panels. The staff finds this modification acceptable.

(5) During the interim period until the new TDI EDGs are placed in service, the Rancho Seco design provided interlocks to prevent the pressurizer heaters from being energized by the existing EDGs if the reactor building spray pump is energized. The purpose of the interlock was to prevent overloading the existing EDGs beyond their capacity and to use the EDGs

available capacity for only the safety loads. The proposed modification eliminates these interlocks and permits the pressurizer heater energization from the new TDI-EDGs on demand. There will no longer be a need to block the energization of these heaters when the new EDGs are put in service. The staff agrees with the licensee's approach and finds the modification acceptable.

5.0 CONCLUSION

The staff has reviewed and evaluated the design modifications to the emergency electrical distribution system as described in the licensee's letter of December 19, 1986 (proposed amendment 147) and in subsequent submittals from the licensee in response to the staff's requests for additional information, and concludes that the design modifications are acceptable.

REFERENCES

(1) SMUD letter, John E. Ward (SMUD) to Frank J. Miraglia, (NRC), dated December 19, 1986.

(2) NRC letter, Sydney Miner (NRC) to Ronald J. Rodriguez, (SMUD), dated June 4, 1985.

(3) SMUD's response to staff questions in SMUD letters, John E. Ward (SMUD) to F. Miraglia, (NRC), dated April 1, 1987 and Joseph F. Firlit (SMUD) to F. Miraglia, (NRC), dated October 30, 1987.

(4) NRC letter, Frank J. Miraglia to Gus C. Lainas dated August 10, 1983.

(5) NRC letter, Paul S. Check to Thomas Novak dated December 4, 1980.

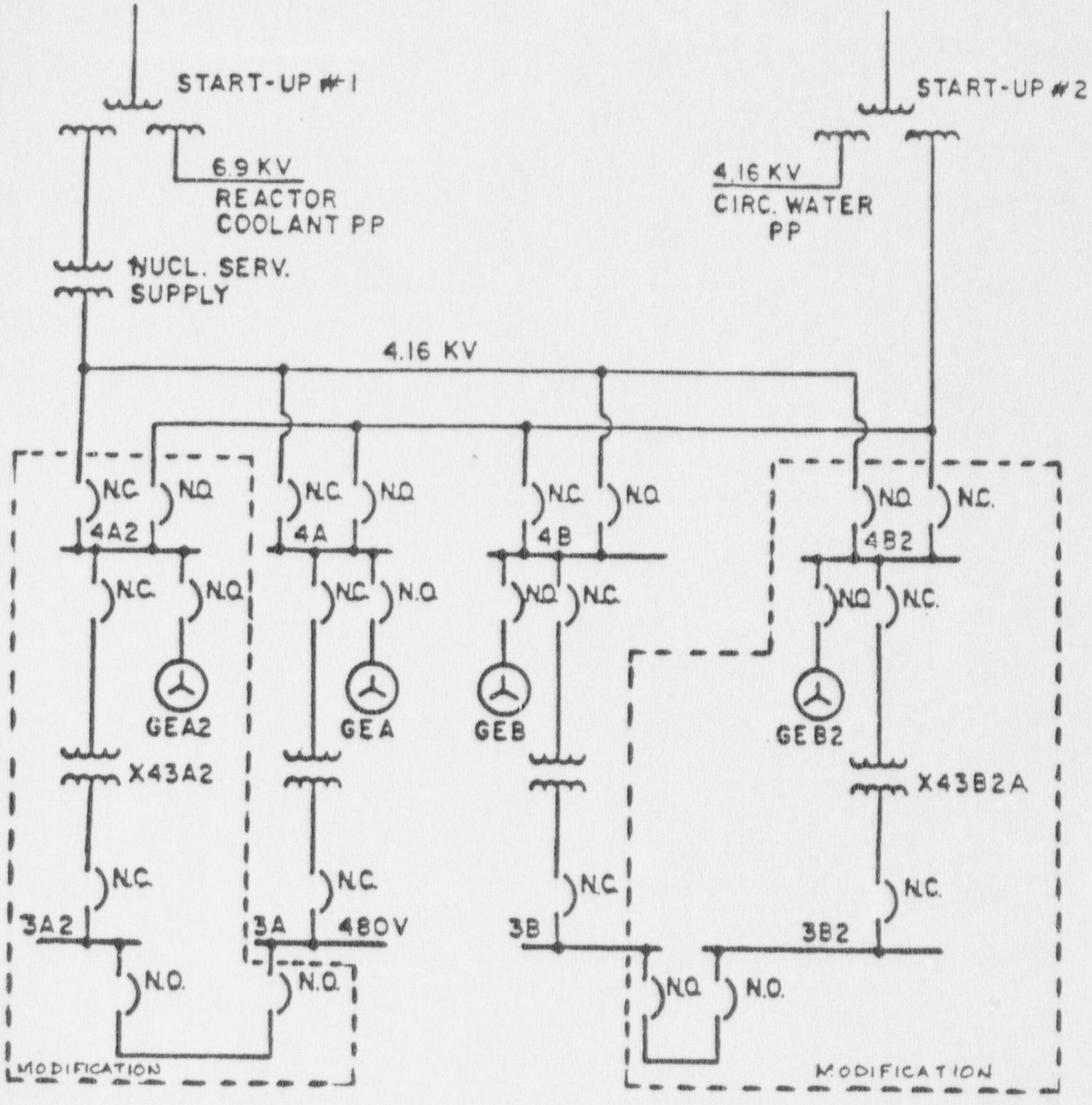
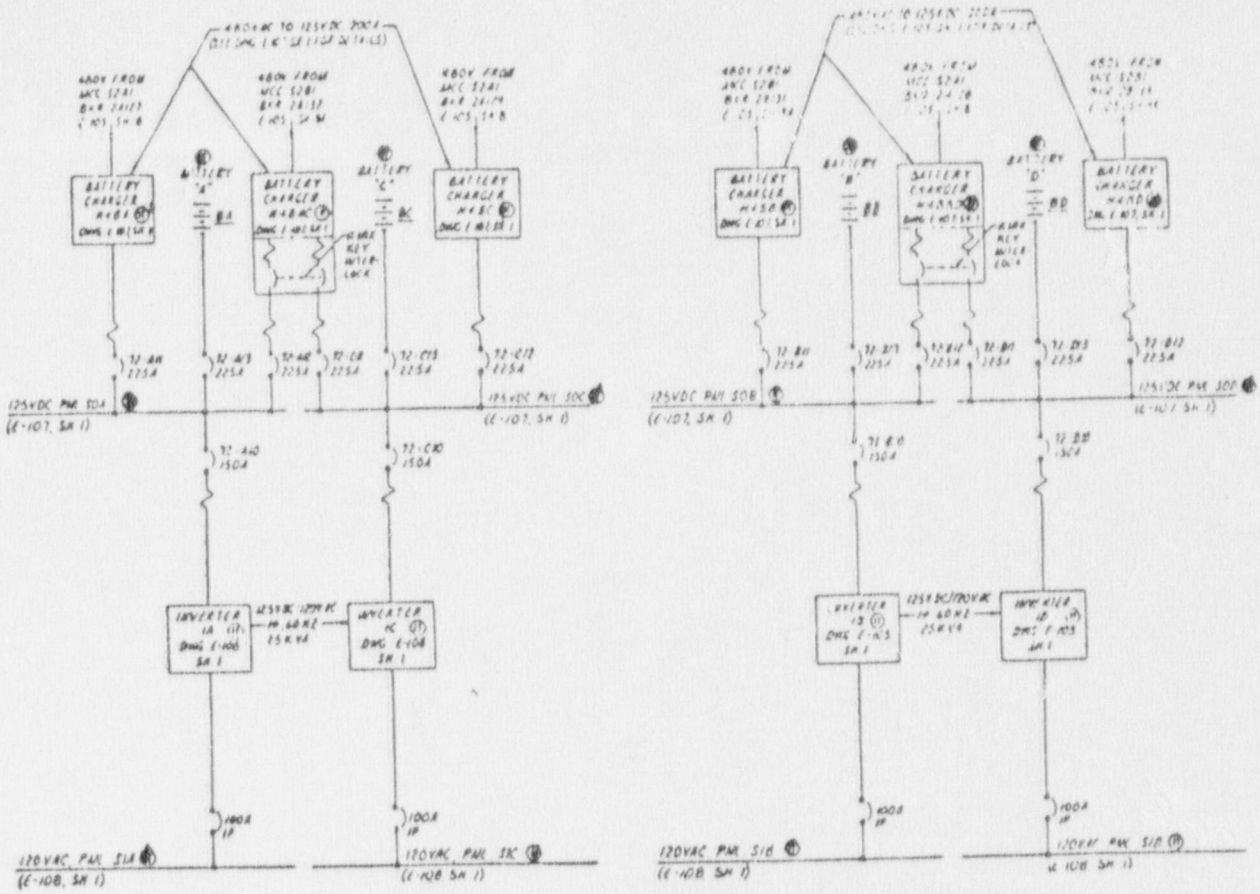


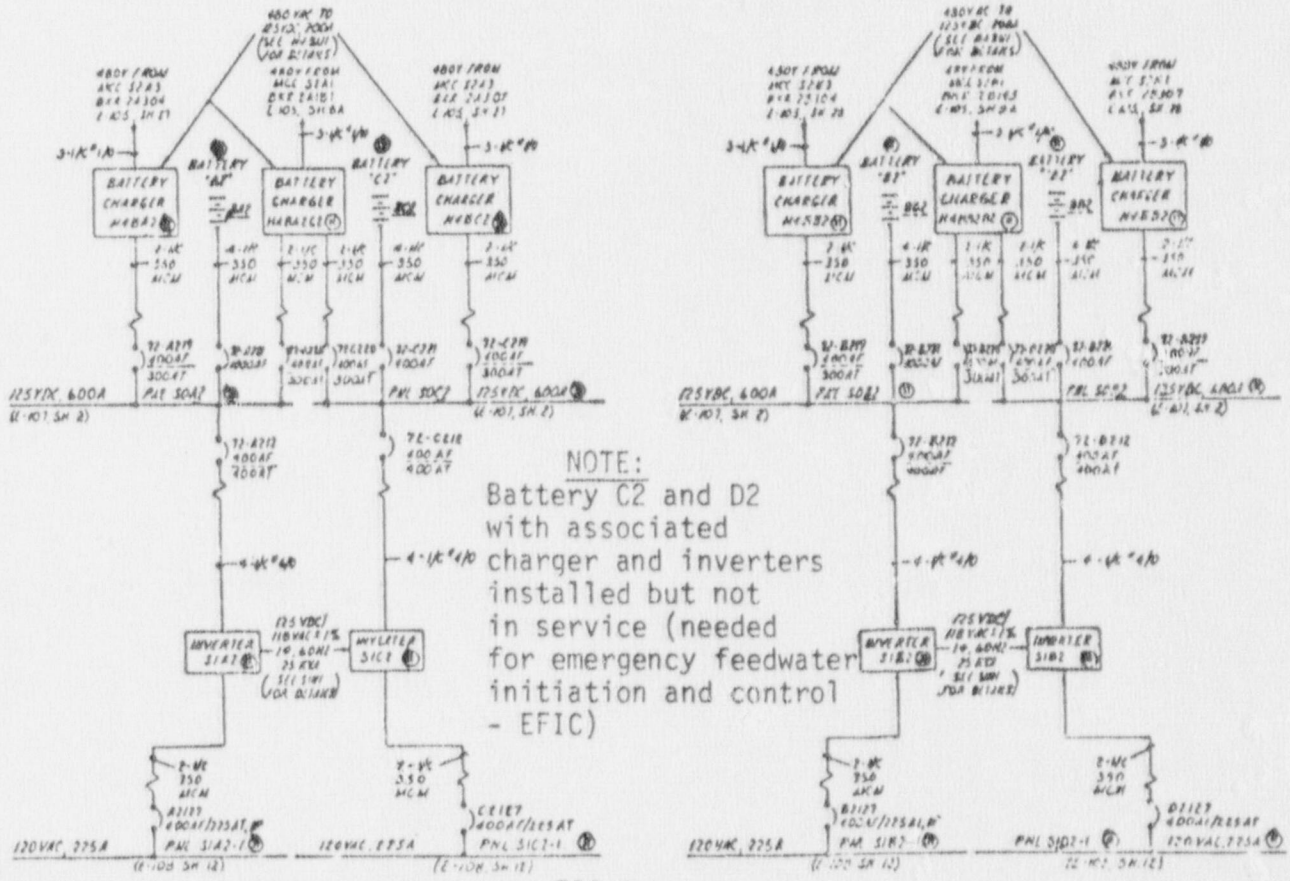
FIGURE 1

RANCHO SECO CLASS 1E AC ELECTRIC POWER DISTRIBUTION
FINAL DESIGN PER AMENDMENT 147



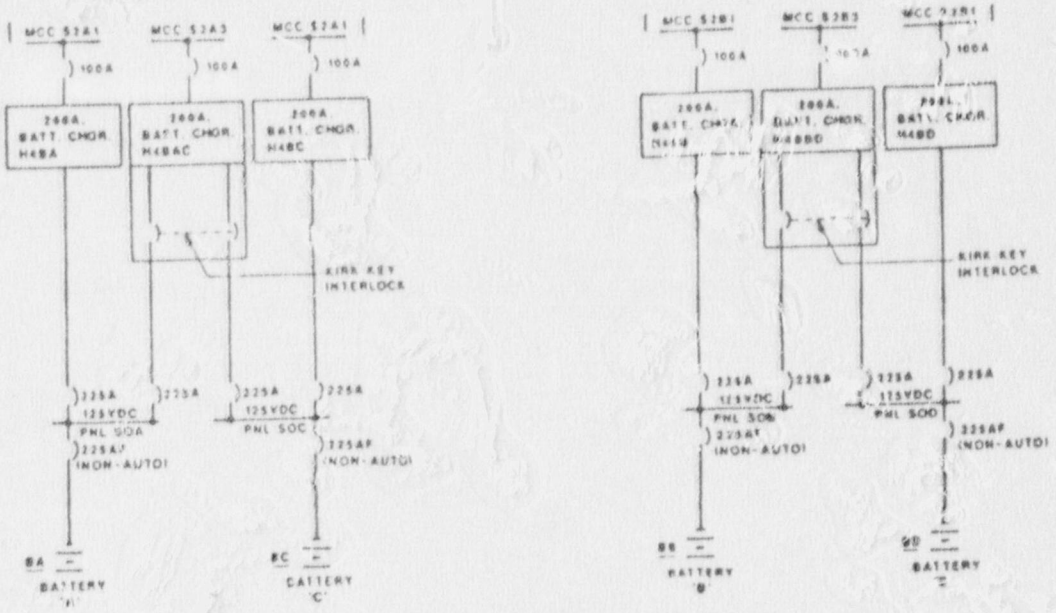
ORIGINAL DESIGN (LOCATED IN THE AUXILIARY BUILDING)

ADDITION PER AMENDMENT NO. 68
LOCATED IN THE NUCLEAR SERVICE ELECTRICAL BUILDING (NSEB)

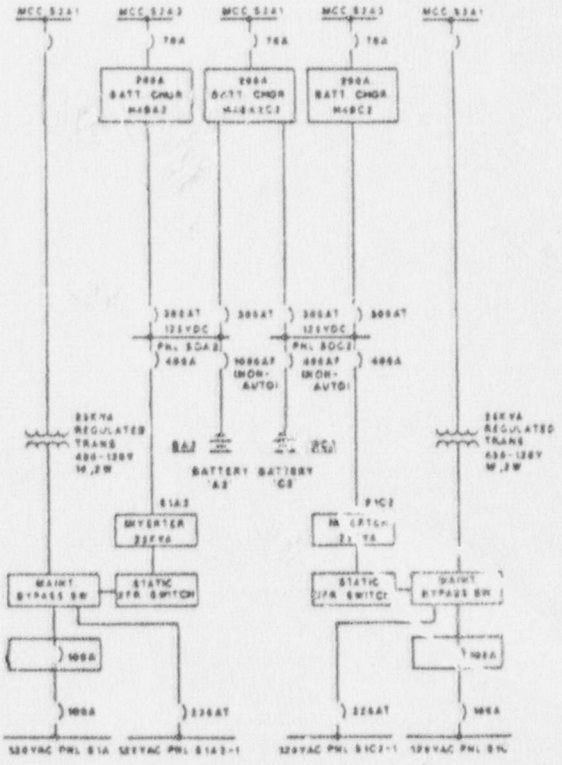


NOTE:
Battery C2 and D2 with associated charger and inverters installed but not in service (needed for emergency feedwater initiation and control - EFIC)

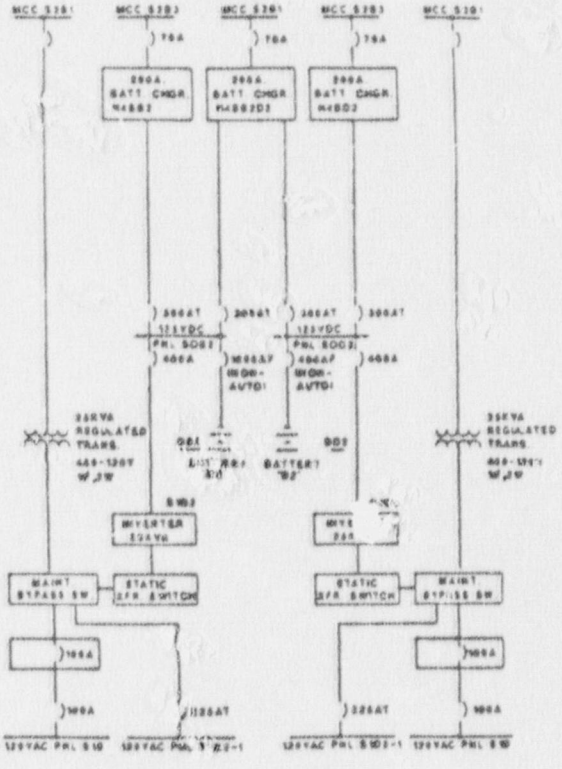
FIG 2
RANCHO SECO CLASS 1E 125 VDC SYSTEM AND ASSOCIATED AC EQUIPMENT



125 V DC BATTERIES A, B, C AND D AND ASSOCIATED EQUIPMENT



125VDC BATTERY A3 AND C3 AND ASSOCIATED EQUIPMENT



125VDC BATTERY B3 AND D3 AND ASSOCIATED EQUIPMENT

FIG 3

RANCHO SECO CLASS 1E 125 VDC SYSTEM AND ASSOCIATED AC EQUIPMENT
FINAL DESIGN PER AMENDMENT NO. 147