Sequoyah Nuclear Plant
USST Modification LAR Meeting
July 16, 2012

USST Modification LAR

Agenda:

- Purpose of License Amendment Request
- Technical Specifications
- Sequoyah Electrical Design
- USST Modification
- Proposed Technical Specification Change
- Compliance with GDC 17 Requirements
- Results of Risk Evaluation
- Summary

Purpose of License Amendment Request

TVA is implementing a modification in the Sequoyah switchyard to install new unit station service transformers (USSTs) to:

- Allow their use as an offsite power supply
- Eliminate a single point vulnerability for a dual unit trip

The proposed changes will revise Sequoyah Nuclear Plant (SQN) Technical Specifications to include a Surveillance Requirement to demonstrate the required offsite circuits are operable at least once per 18 months by manually and automatically transferring the power supply to each 6.9 kV Unit Board from the normal supply to the alternate supply.

Technical Specification (TS) 3/4.8.1, AC Sources – Operating

LCO 3.8.1.1 As a minimum, the following AC electrical power sources shall be OPERABLE:

a. Two physically independent circuits between the offsite transmission network and the onsite Class 1E distribution system

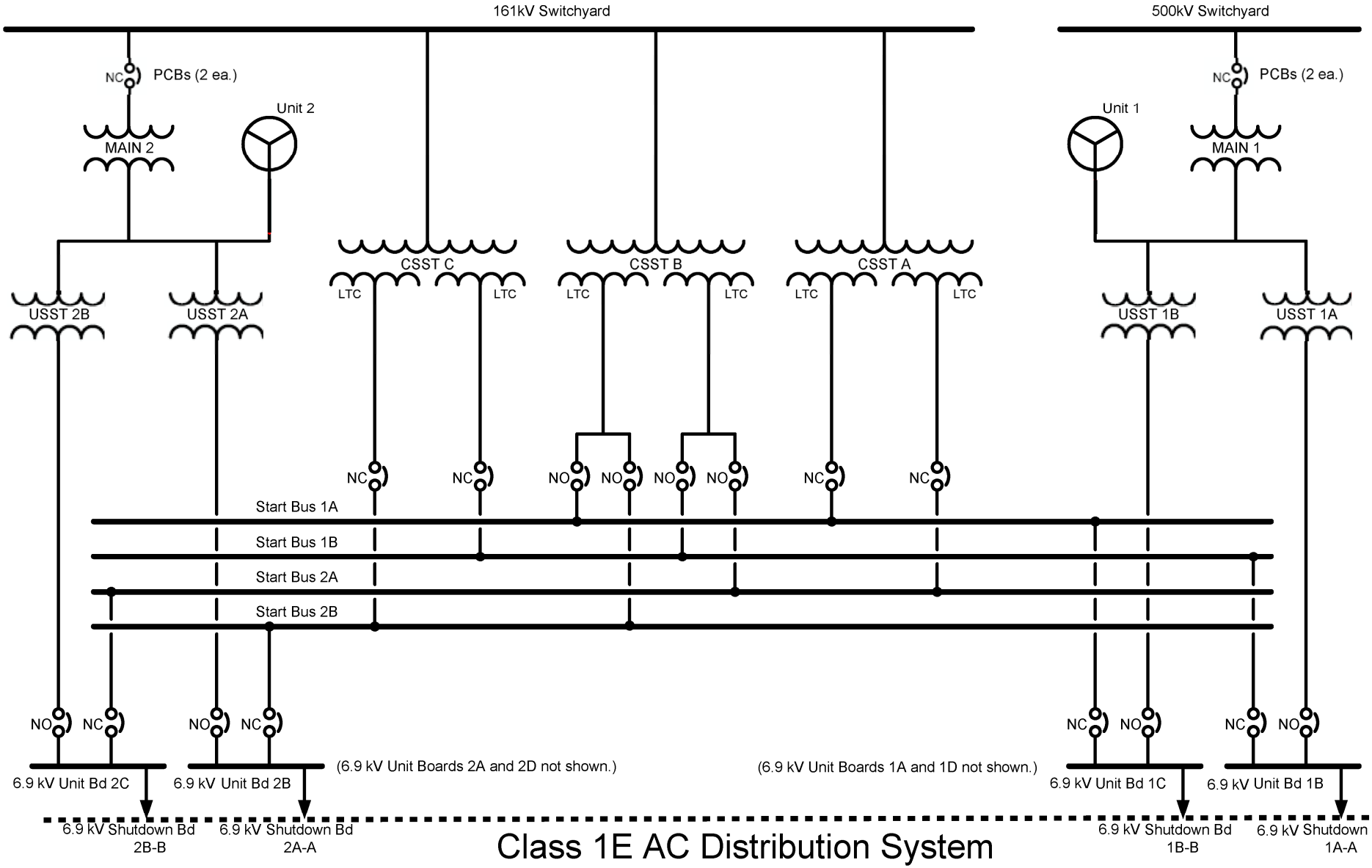
SR 4.8.1.1.1 Each of the above required independent circuits between the offsite transmission network and the onsite Class 1E distribution system shall be:

a. Determined OPERABLE at least once per 7 days by verifying correct breaker alignments and indicated power availability.

Currently, two independent offsite power sources are provided by the common station service transformers (CSSTs) to the Class 1E 6.9 kV Shutdown Boards via the 6.9 kV Start Buses and 6.9 kV Unit Boards.

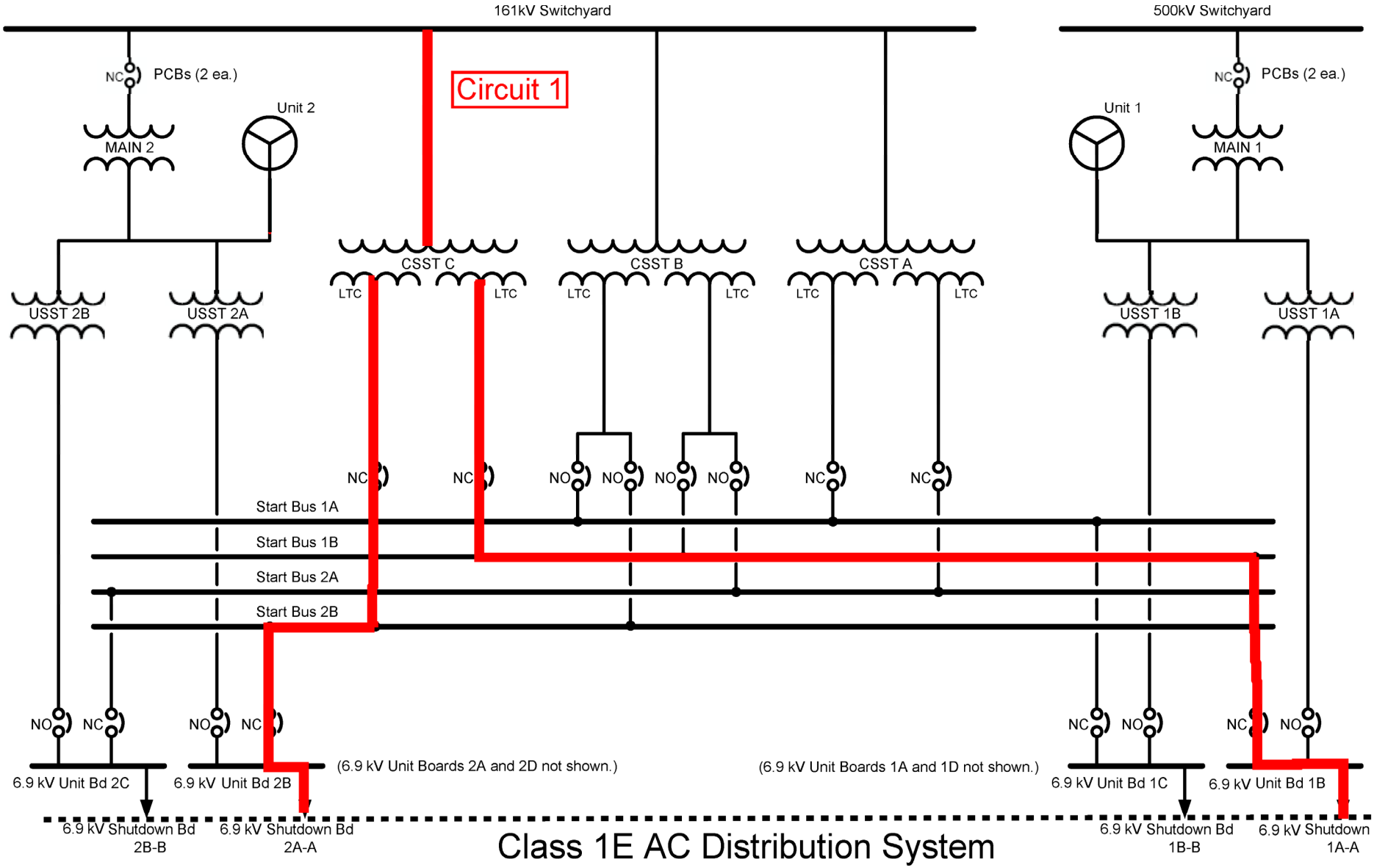
- The output of CSST C is the normal power source for 6.9 kV Shutdown Boards 1A-A and 2A-A (Train A), and the output of CSST A is the normal power source for the 6.9 kV Shutdown Boards 1B-B and 2B-B (Train B).
- CSST B is a spare transformer with two sets of secondary windings that can be used to power two Start Buses, with each Start Bus on a separate secondary winding.
- This lineup provides two immediate access offsite circuits to each unit (one to each load group).
- On a failure of either CSST, offsite power continues to be provided to one load group, assuring that core cooling, containment integrity, and other vital functions are maintained.
- Transfers from one offsite power source to the other offsite power source are not required.

Current Offsite Power Configuration: Two Circuits Supplied From CSSTs



Class 1E AC Distribution System

Current Offsite Power Configuration: Two Circuits Supplied From CSSTs



Class 1E AC Distribution System

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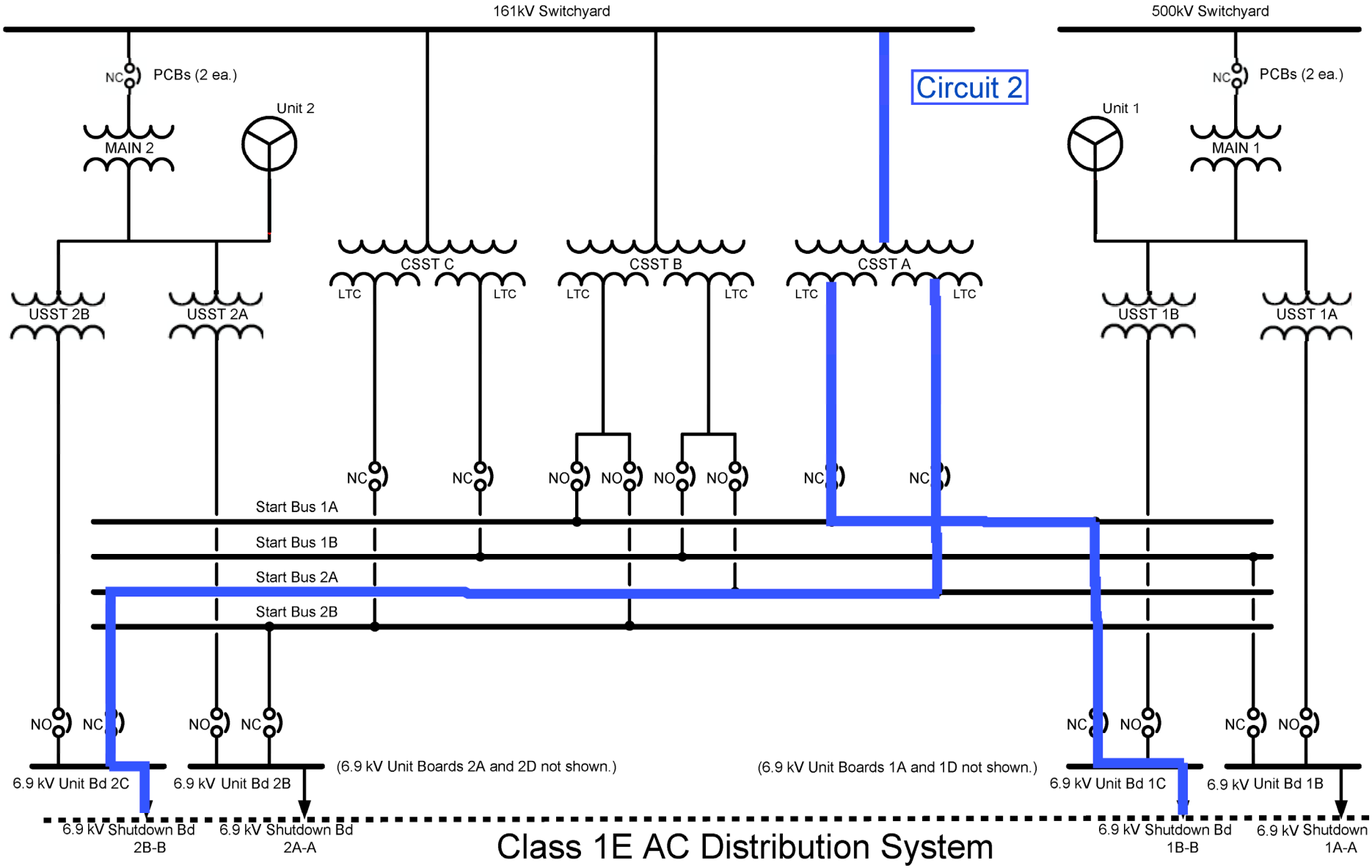

Class 1E AC Distribution System

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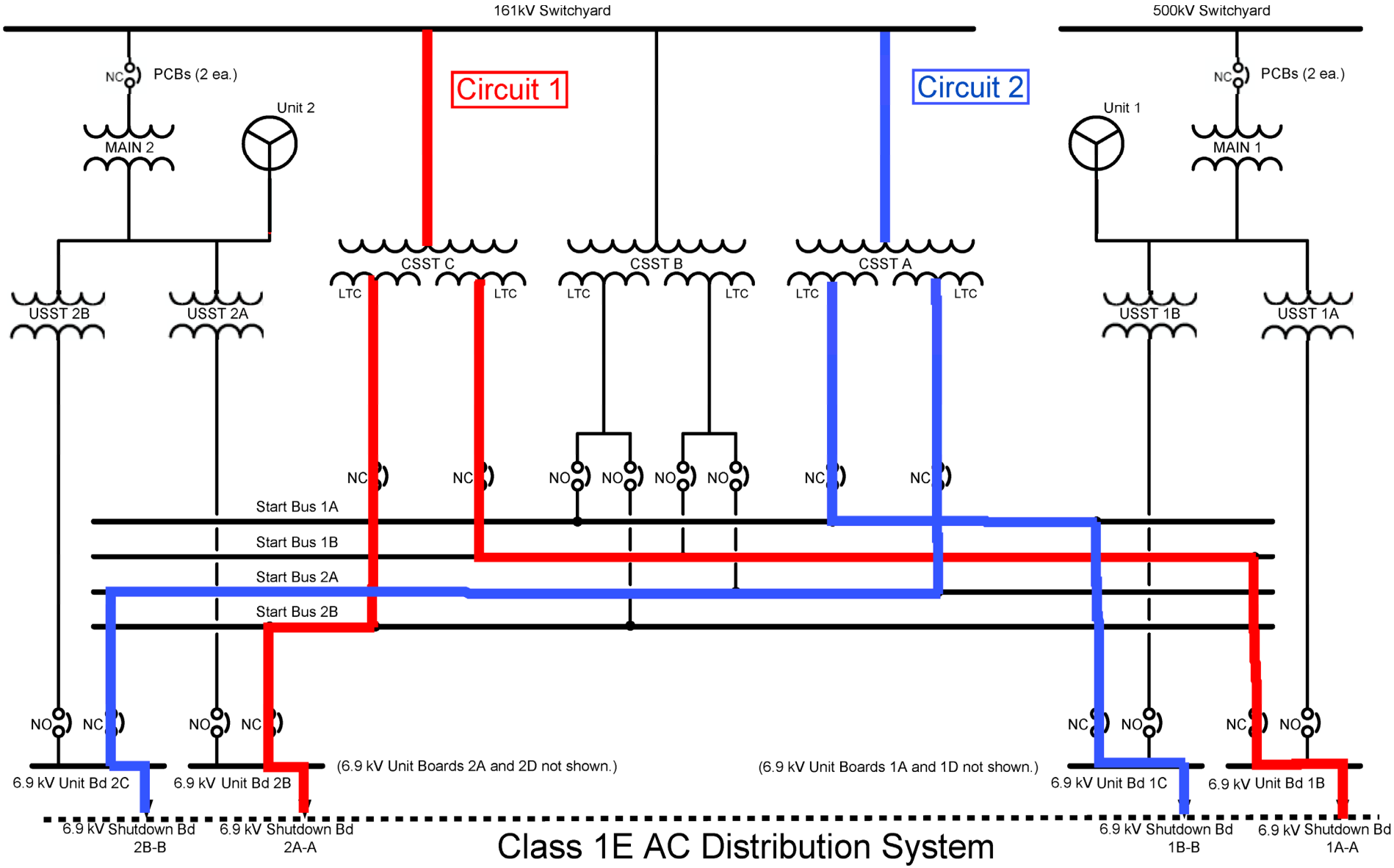


Class 1E AC Distribution System

- **Electrical Design Background**
- **Modification Overview and Schedule**
- **Key Changes to Electrical Design**
- **Intermediate Offsite Configuration**
- **Final Offsite Configuration**

Electrical Design Background

- The original SQN electrical design was:
  - USSTs supplying unit power to the 6.9 kV Unit Boards during plant operation.
  - CSSTs available to provide offsite power via the Start Buses.
  - In the event of a loss of a USST or a unit trip, offsite power to the Class1E 6.9 kV Shutdown Boards was transferred at the 6.9 kV Unit Boards to the CSSTs.
  - TS SR 4.8.1.1.1.b required demonstration of manual and automatic transfer capability from the normal power supply to the alternate power supply at least once every 18 months.

Electrical Design Background (Cont.)

- In the 1990's an issue was discovered where USST impedance challenged the 6.9 kV Unit Board circuit breaker short circuit ratings.
- TVA implemented a design change to replace the CSSTs with transformers with auto load tap changers (LTCs) to accommodate voltage variations in the 161 kV system.
- The offsite power configuration became CSST A providing power to 6.9 kV Shutdown Boards 1B-B and 2B-B, and CSST C providing power to 6.9 kV Shutdown Boards 1A-A and 2A-A.
- Therefore, it was no longer necessary to transfer power during unit startups and shutdowns, or to rely on an automatic power transfer in the event of a fault or plant trip in order to maintain power to the Class1E distribution system.

Electrical Design Background (Cont.)

- SR 4.8.1.1.1.b was not deleted at the time of the design change to allow use of the USST as a power supply as a contingency for maintenance activities.
- Subsequently, it was determined that placing the units on the unit generator supported supply would only be necessary for maintenance on the offsite circuits. In that situation, the offsite circuit would be inoperable, even if the transfer scheme was operable.
- Once it was determined there were no practical opportunities to utilize the unit generator support circuit, a license amendment request was submitted to eliminate SR 4.8.1.1.1.b.
- On September 23, 1997, the NRC approved an amendment to eliminate SR 4.8.1.1.1.b from the SQN, Unit 1 and 2, Technical Specifications.

Modification Overview and Schedule

- New Unit 1 and Unit 2 USSTs are being installed to allow offsite power to normally be provided by the USSTs with automatic transfer to the alternate power supply provided by a CSST.
- Schedule
  - Unit 2 USST modifications are scheduled to be implemented during the fall 2012 refueling outage.
  - Unit 1 USST modifications are scheduled to be implemented during the fall 2013 refueling outage.
  - NRC approval of the LAR is being requested by December 1, 2012 to support startup from the Unit 2 refueling outage.

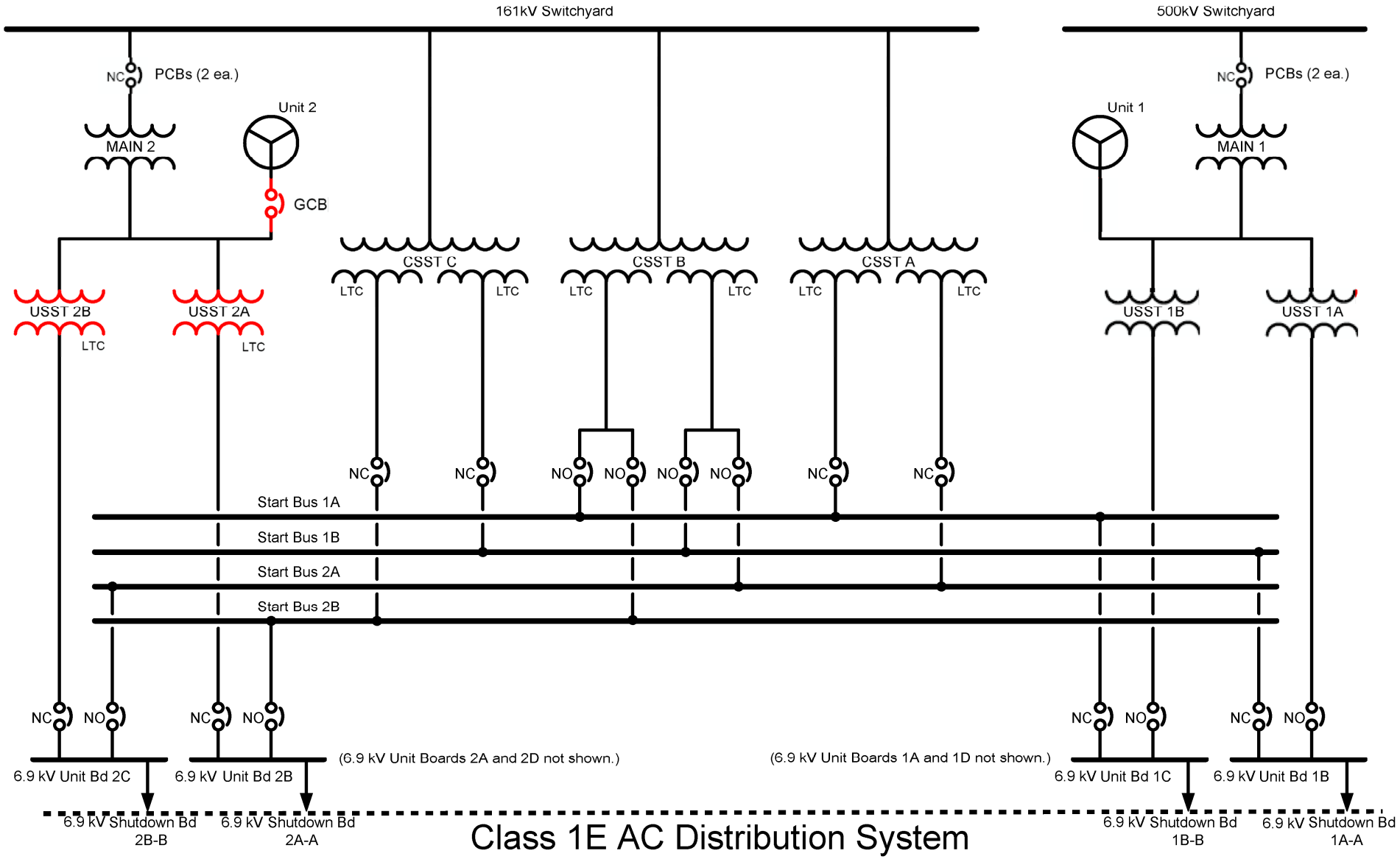
Key Changes to Electrical Design

- Unit Station Service Transformers (USSTs)
  - Larger transformers to meet offsite power loading requirements.
  - Higher impedance to limit fault current to below the 6.9 kV Unit Board circuit breaker rating.
  - Automatic LTCs to provide the required 6.9 kV voltage regulation.
  - Main generator will be capable of supplying electrical power to the offsite grid, as well as supplying power to the offsite circuit (via the USSTs through the isolated phase bus (IPB)).
  - Unit 1 will be powered from the 500 kV grid and Unit 2 will be powered from the 161 kV grid in the backfeed mode (i.e., with the main generator not operating).
- Generator Circuit Breakers (GCBs)
  - Installed in the IPB between the main generator and main bank transformers.
  - GCBs will trip open on a unit trip, isolating the generator from the main bank transformers to enable USSTs to be energized from the grid.
  - Switchyard power circuit breakers (PCBs) will trip open on a fault between the GCBs and the PCBs, or a failure of the GCBs to open on a valid command signal.

Intermediate Offsite Power Configuration (Only Unit 2 USST Modification Implemented)

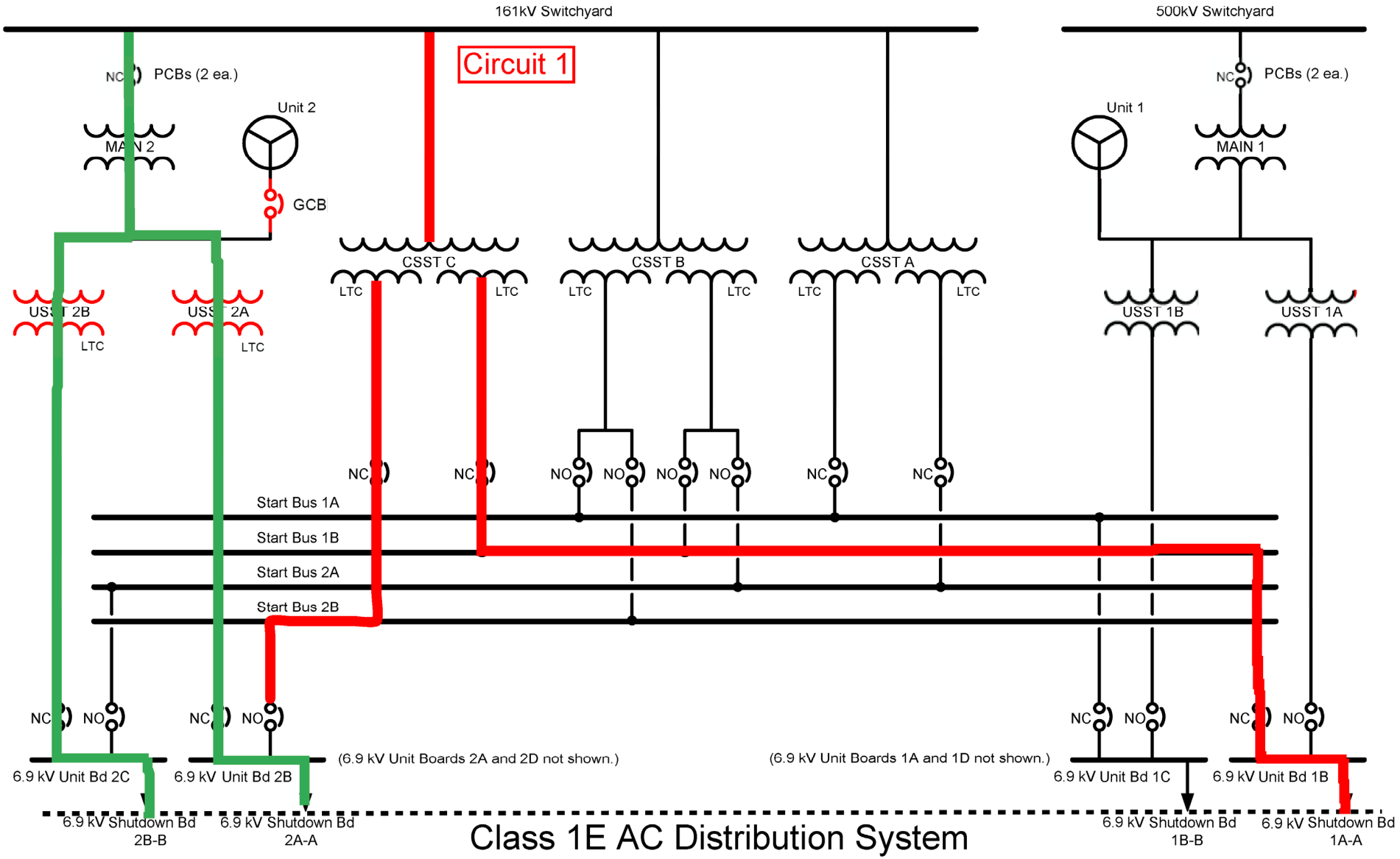
- USST 2A will be used as the normal power supply to 6.9 kV Shutdown Board 2A-A via Unit Board 2B.
- USST 2B will be used as the normal power supply to 6.9 kV Shutdown Board 2B-B via Unit Board 2C.
- CSST C will provide an alternate source of power for 6.9 kV Shutdown Board 2A-A via Unit Board 2B.
- CSST A will provide an alternate source of power for 6.9 kV Shutdown Board 2B-B via Unit Board 2C.
- Power to 6.9 kV Shutdown Board 1A-A will continue to be supplied by CSST C via Start Bus 1B and Unit Board 1B. (No alternate supply required.)
- Power to 6.9 kV Shutdown Board 1B-B will continue to be supplied by CSST A via Start Bus 1A and Unit Board 1C. (No alternate supply required.)
- This lineup requires USST 2A/2B, CSST A, and CSST C to supply the two offsite power circuits.

Intermediate Offsite Power Configuration: With Backfeed Through Unit 2 Main Transformers



Class 1E AC Distribution System

Intermediate Offsite Power Configuration:
With Backfeed Through Unit 2 Main Transformers



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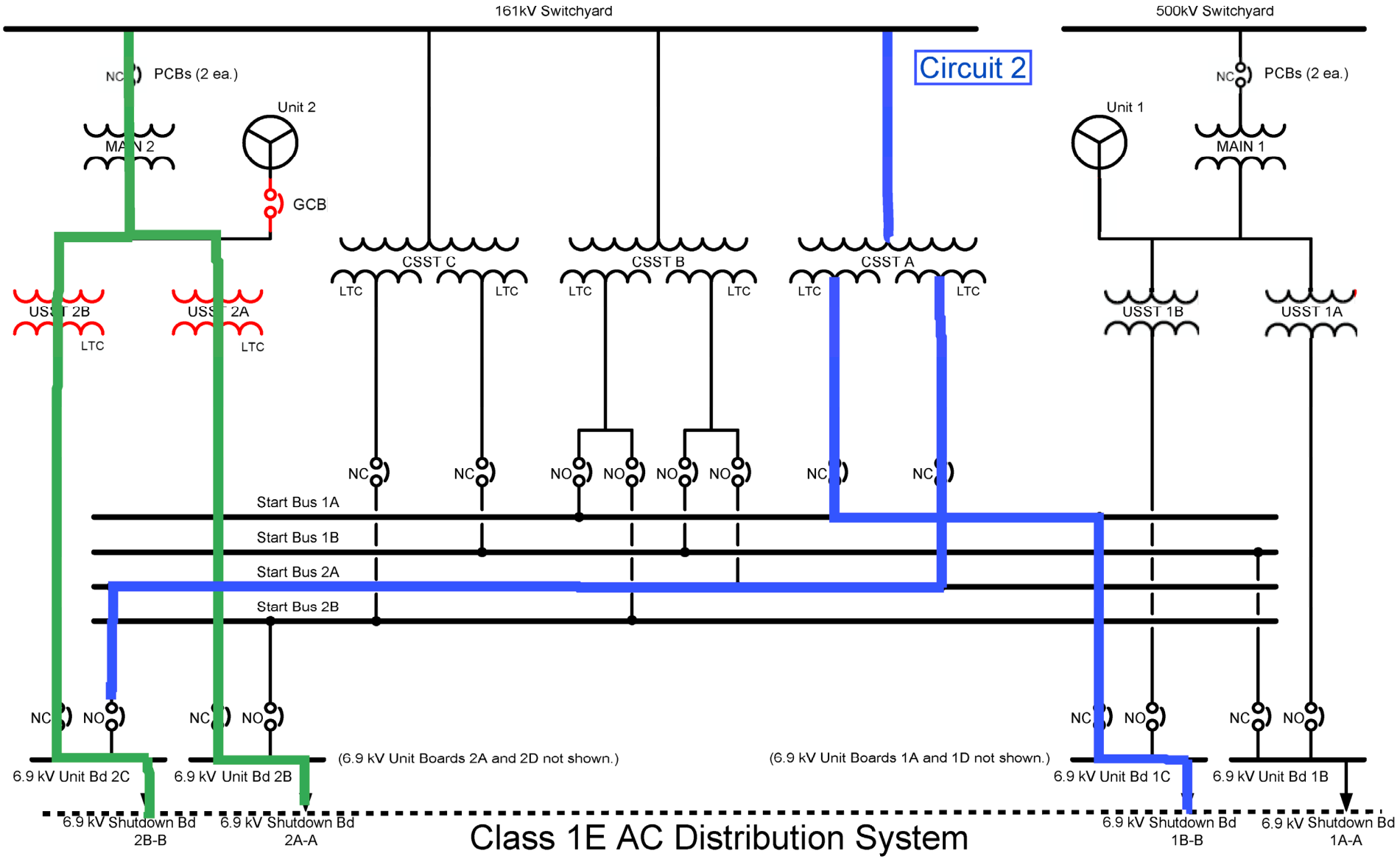

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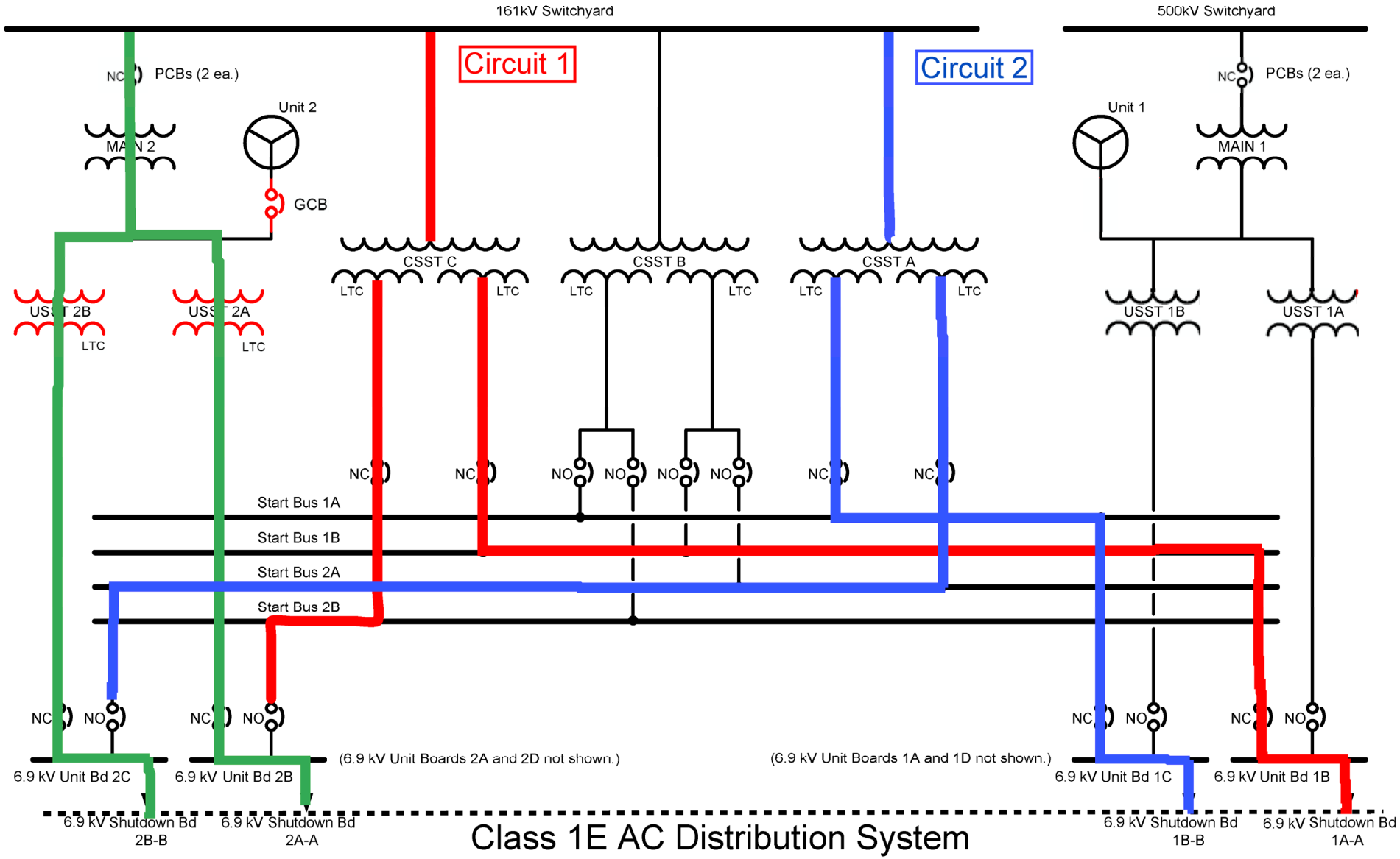
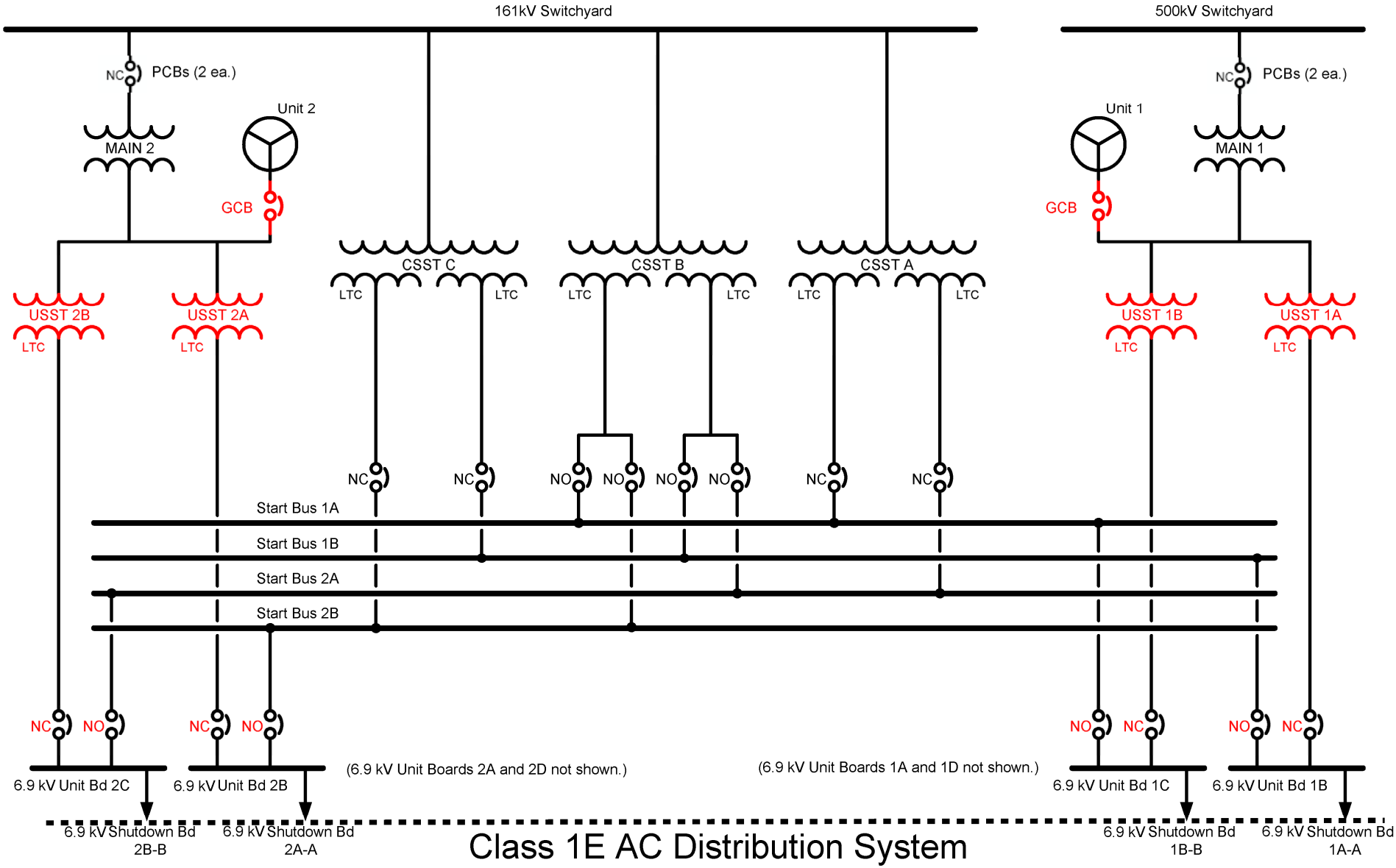


Final Offsite Power Configuration (Unit 1 and 2 USST Modifications Implemented)

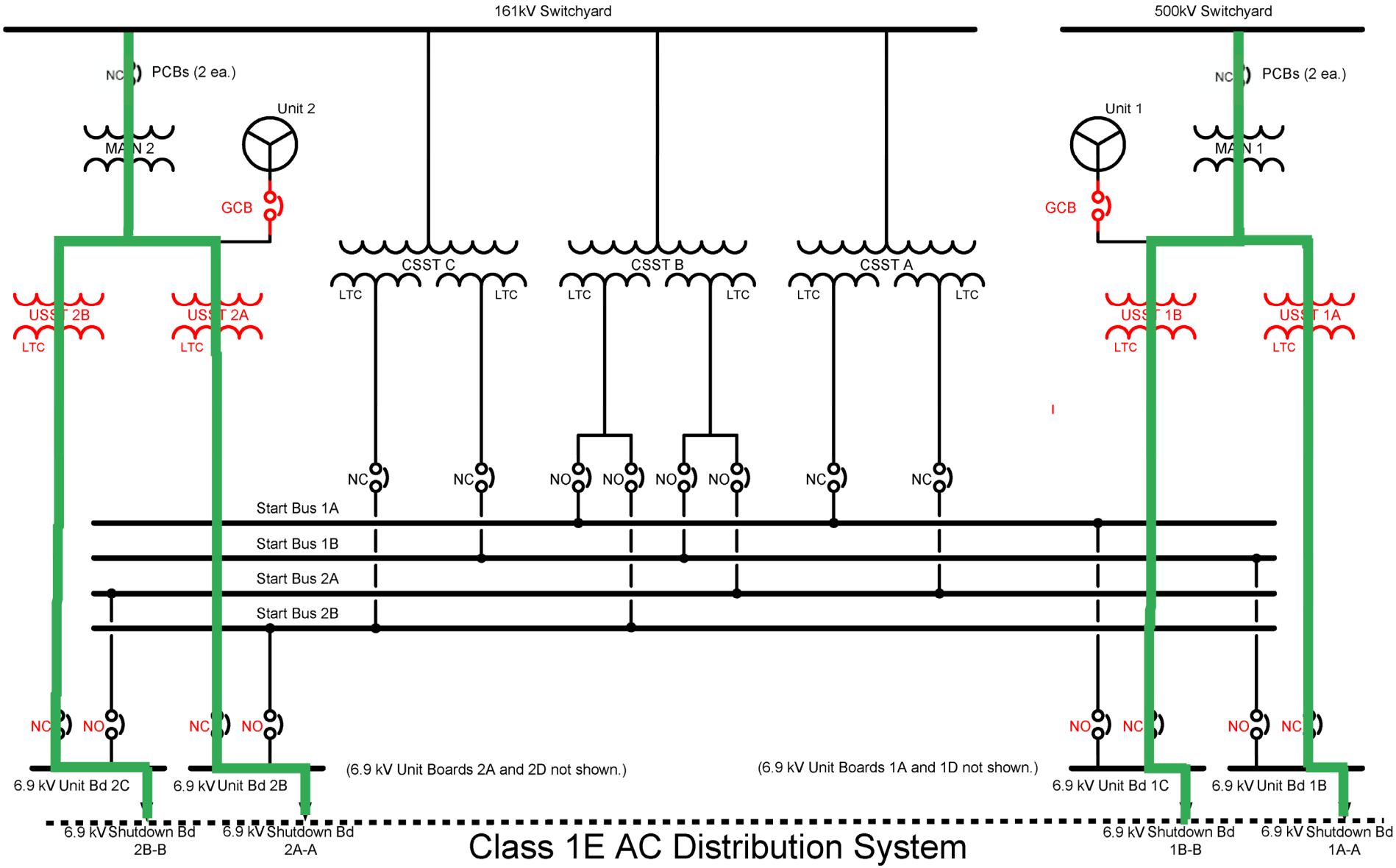
- USSTs will be used as the normal power supply to 6.9 kV Shutdown Boards via the 6.9 kV Unit Boards.
- CSST A or C will provide an alternate source of power via automatic transfer at the 6.9 kV Unit Boards.
- This lineup requires USSTs 1A/1B, USSTs 2A/2B, and CSST A or CSST C to supply the two offsite power circuits.
- CSST B can be used to provide power to two Start Buses normally powered by CSST A or CSST C.

Final Offsite Power Configuration:
With Backfeed Through Unit 1 and Unit 2 Main Transformers



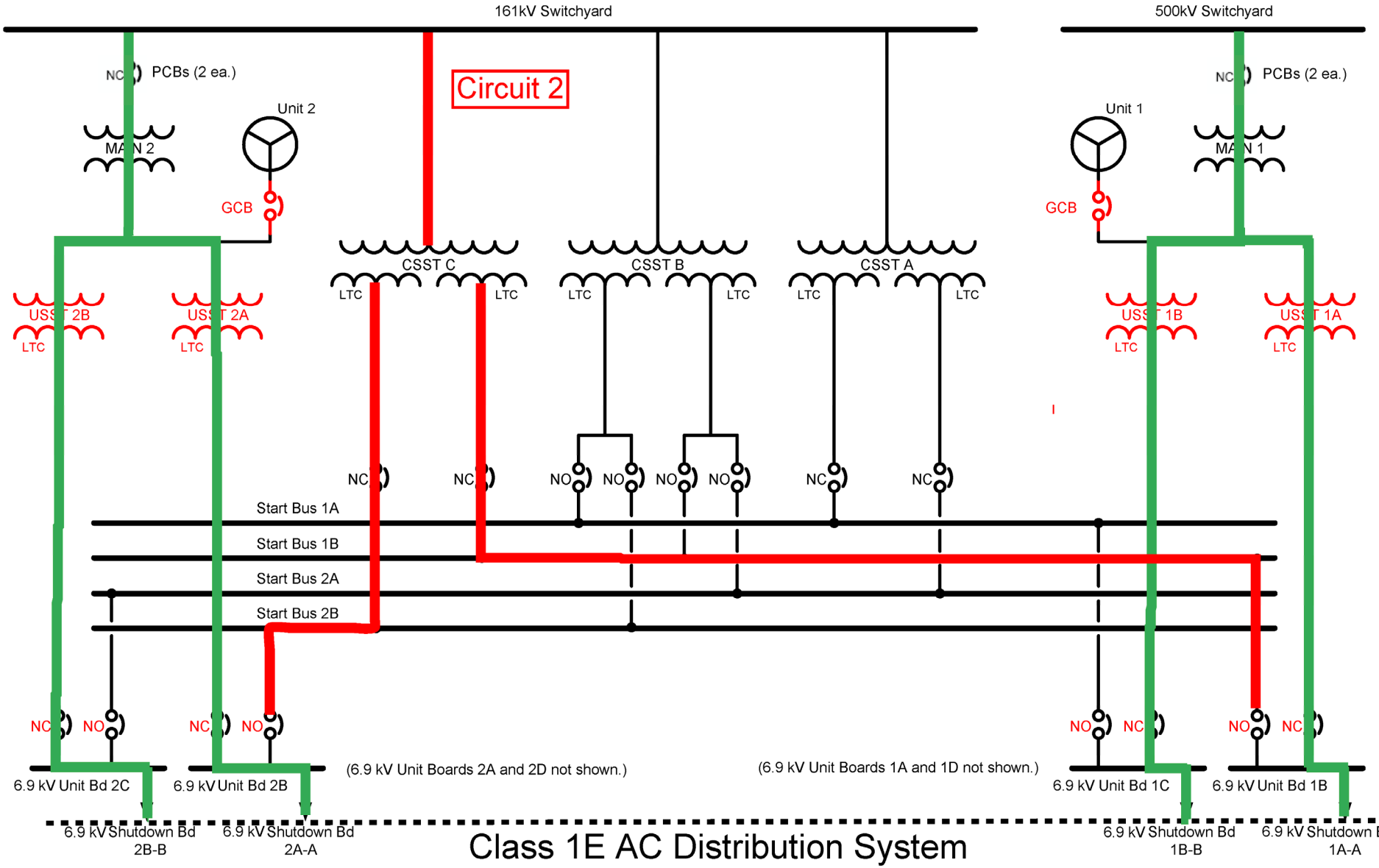
Class 1E AC Distribution System

Final Offsite Power Configuration:
With Backfeed Through Unit 1 and Unit 2 Main Transformers



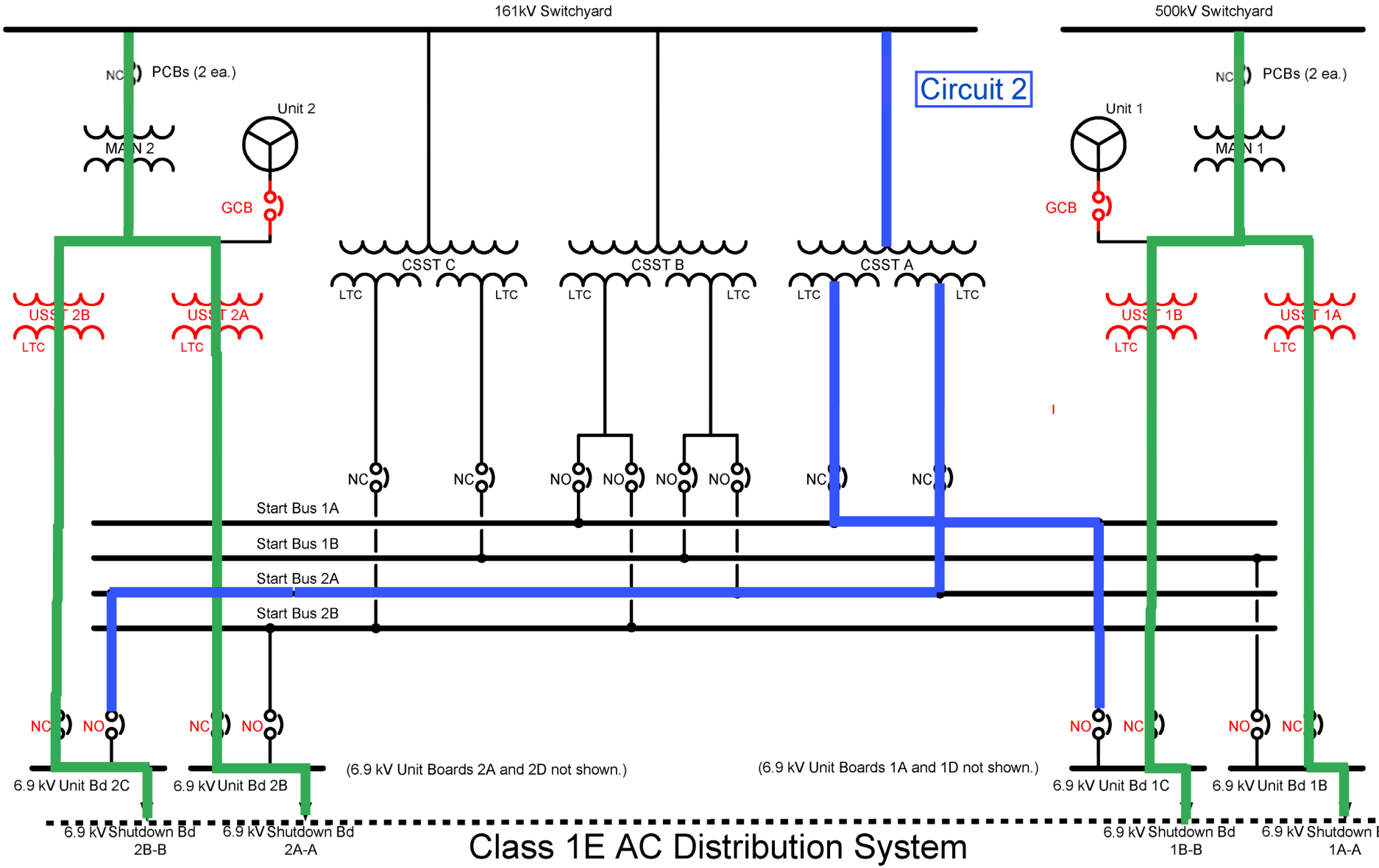
Class 1E AC Distribution System

Final Offsite Power Configuration:
With Backfeed Through Unit 1 and Unit 2 Main Transformers



Class 1E AC Distribution System

Final Offsite Power Configuration:
With Backfeed Through Unit 1 and Unit 2 Main Transformers



Class 1E AC Distribution System

To facilitate the transition to the new USSTs as the normally aligned offsite power source, the following change to the TS is necessary:

- TS Surveillance Requirement (SR) 4.8.1.1.1 is modified to add a requirement (4.8.1.1.1.b) to demonstrate the capability of manually and automatically transferring the power supply to each 6.9 kV Unit Board from the normal supply to the alternate supply once per 18 months.
- SR 4.8.1.1.1.b is modified by two Notes.
  - Note # prohibits the performance of the SR for the associated unit's 6.9 kV Unit Boards in MODES 1 and 2.
  - Note ## specifies transfer capability is only required to be met for 6.9 kV Unit Boards requiring normal and alternate power supplies.

"The onsite electric power sources, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure."

The SQN Class 1E onsite electrical distribution system consists of two independent and redundant electrical subsystems with two diesel generator sets on each subsystem. Each subsystem is capable of supplying the necessary safety-related loads.

"Electric power from the transmission network to the onsite Electric Distribution System shall be supplied by two physically independent circuits. . . Each of these circuits shall be designed to be available in sufficient time following a loss of all onsite alternating current power supplies and the other offsite electric power circuit to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded."

At SQN, two physically independent offsite circuits will be met by a combination of power sources (USSTs and CSSTs) whereby each load group is either powered from a separate offsite circuit, or an alternate power source is available to one of the offsite circuits.

"One of these circuits shall be designed to be available within a few seconds following a LOCA to assure that core cooling, containment integrity, and other vital safety functions are maintained."

- The intermediate offsite power circuit configuration will consist of either:
  - Two independent offsite circuits continuously connected (one CSST supplying each load group for both units); or
  - Unit 2's load groups connected to its USSTs with alternate power immediately available via automatic transfer to the CSSTs, and Unit 1's load groups connected to the CSSTs.
- The final offsite power circuit configuration will consist of either:
  - Two independent offsite circuits continuously connected (one CSST supplying each load group for both units); or
  - Two offsite circuits connected to the USSTs with alternate power immediately available to one load group via automatic transfer to a CSST.

USST Modification LAR
Results of Risk Evaluation

A risk evaluation was performed on the proposed intermediate offsite power alignment, the proposed final offsite power alignment, and on performance of the proposed SR.

- In the intermediate alignment phase (USSTs implemented on Unit 2 only), the altered power alignment to the 6.9kV Unit Boards on Unit 2, results in no risk impact to Unit 1 or Unit 2.
- For the final alignment phase (USSTs implemented on both units), the new alignment slightly reduces risk by adding redundancy to the Unit Boards on both units, which is acceptable by Regulatory Guide 1.174.
- During performance of the manual and automatic transfer function surveillance on a Unit Board, its associated Shutdown Board loads will be transferred to another Unit Board that is not being tested. Since the Unit Board surveillance is performed on an unloaded board, it has no impact on risk.

USST Modification LAR Summary

- New Unit 1 and Unit 2 USSTs are being installed to allow offsite power to normally be provided by the USSTs with automatic transfer to the alternate power supply provided by a CSST.
- The purpose of the proposed TS change is to add a requirement to verify the capability to manually and automatically transfer the power supply to each 6.9 kV Unit Board from the normal supply to the alternate supply.
- This change will eliminate a single point vulnerability for a dual unit trip.
- Schedule
  - Unit 2 USST modifications are scheduled to be implemented during the fall 2012 refueling outage.
  - Unit 1 USST modifications are scheduled to be implemented during the fall 2013 refueling outage.
  - NRC approval of the LAR is being requested by December 1, 2012 to support startup from the Unit 2 refueling outage.