SECTION 8

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF FIGURES (CONTINUED)

SECTION 8

8.0 ELECTRICAL POWER

8.1 INTRODUCTION

The electric power systems for Davis-Besse Nuclear Power Station are designed to be electrically self-sufficient and to provide adequate, redundant, and reliable power sources for all electrical equipment for start-up, normal operation, safe shutdown and handling all emergency situations.

8.1.1 Utility Grid

The primary Toledo Edison transmission voltage is 345 kV (nominal). Davis-Besse is connected to nearby 345 kV substations at Bay Shore (NW of Davis-Besse), Lemoyne (SW of Davis-Besse), Ohio Edison - Beaver substation (SE of Davis-Besse) and Hayes substation (SE of Davis-Besse). Office building support equipment at Davis-Besse receives some power from local distribution systems, but there are no transmission connections other than the four 345 kV connections described above.

Toledo Edison uses other transmission voltages than 345 kV. The most important voltage used, other than 345 kV, is 138 kV (nominal). There are several interconnections to other utilities at 345 kV and 138 kV. Utilities connected to the Toledo Edison grid include Detroit Edison, American Electric Power, and Ohio Edison. Each of the 345 kV substations connected to Davis-Besse is associated with at least one inter-utility connection.

8.1.2 Onsite Systems

The onsite electrical systems consist of the 13.8kV, the 4.16kV, and the 480V AC distribution systems, the 120V AC instrumentation and control system, the 250/125V DC systems two 4.16kV emergency diesel-generator units and one non-Class 1E 4.16 kV diesel generator which serves as the alternate AC source for station blackout. The normal source is the unit auxiliary transformer. The reserve power supply and startup sources are the two startup transformers. The standby power supply is provided by the two emergency diesel-generators. All voltages are nominal.

8.1.2.1 Main Generation System

The main generator is rated at 1069 MVA at 0.9 power factor, 25kV, 60 Hz. The protection for the main turbine generator consists of generator protection and turbine protection.

The generator protection system can be divided into the following categories:

1. abnormal conditions originating in the grid system

2. abnormal conditions originating in the main generation system.

Abnormal conditions originating in the grid system are identified on the generator as:

1. out of step

2. under frequency
3. negative phase sequence
4. over current (voltage restraint)

Abnormal conditions originating in the main generation system are identified as:

1. generator low field and loss of field
2. unit auxiliary transformer 11
    a. sudden pressure
    b. primary phase over current
    c. secondary ground
    d. differential
3. main transformer 1
    a. sudden pressure
    b. differential
4. generator differential
5. dual volts/hertz (overexcitation)
6. generator reverse power
7. generator field ground (alarm only)
8. generator stator ground

When the unit is in normal operation, with auxiliary power supplied through the unit auxiliary transformer, the occurrence of any one of the above conditions originating in either the grid system or the main generator system will result in isolation of the turbine-generator unit from the 345kV grid system by opening breakers 34560 and 34561. The 13.8kV buses A and B are immediately fast transferred from the unit auxiliary transformer 11 to the startup transformer(s) 01 and/or 02. The specific startup transformer(s) is determined by preselection using the reserve source selector switches.

These switches can align either startup transformer to each 13.8kV bus. The immediate fast transfer of the electrical auxiliary system to the startup transformer(s) is performed for trips initiated by both categories of generator protection because all trips initiated by category 1 do not indicate the existence of a grid condition which is incapable of supplying the auxiliary system. While station auxiliaries could operate during some of the category 1 transient, the generator-turbine must be isolated to minimize the possibility of damage. Using the fast transfer scheme to take advantage of a potentially stable grid may reduce the number of challenges to the emergency diesel generators. Should the power system grid be incapable of supporting the station auxiliaries, existing relays will detect that condition and initiate appropriate changes in the station's electrical line up.

The turbine protection system detects abnormal conditions relating to the turbine. The more significant malfunctions or faults which cause turbine trips are listed in section 10.2.3.

Any of these abnormal conditions or trips results in a turbine trip which closes the main steam stop valves and the combined intercept valves. With the closure of these valves and any of the breakers 34560, 34561, HX11A, or HX11B closed, the generator anti-motoring circuit becomes functional in combination with a reverse power relay. The output of the anti-motoring circuit in series with the output of the reverse power relay operates a relay which trips breaker(s) 34560, 34561, HX11A, and HX11B.

Under normal operation with breakers 34560 and/or 34561 closed and breakers HX11A and HX11B closed, a turbine trip results in a delayed transfer of the 13.8kV buses A and B from the unit auxiliary source to the preselected startup transformer(s). The actual transfer is a fast transfer, but the transfer initiation is delayed by the generator protective relaying.
In addition to protecting the main turbine generator and the turbine, a turbine trip, if it occurs above a certain reactor power setpoint, will initiate the Anticipatory Reactor Trip System (ARTS) which trips the reactor. This system is also actuated by the trip of both main feedwater pump turbines or an SFRCS trip.

8.1.3 Essential Functions

The station essential functions are:

1. Emergency Core Cooling
2. Containment Cooling
3. Containment Isolation
4. Emergency Ventilation
5. Safe Shutdown
6. Containment Vessel Combustible Gas Control

8.1.4 Essential Loads

The station essential loads, related essential functions, and type of electric power supply to each load are:

Load	Related Essential Function (refer to Section 8.1.3)	Power Supply
High pressure injection pumps	(1)	4.16kV AC
Decay heat removal pumps	(1)	4.16kV AC
Component cooling pumps	(1)(2)(5)	4.16kV AC
Service water pumps	(1)(2)(5)	4.16kV AC
Containment spray pumps	(2)	480V AC
Containment air cooler fans	(2)	480V AC
Containment vessel hydrogen dilution blowers	(6)	480V AC
Hydrogen recombiner	(6)	480V AC
Containment vessel isolation valves	(3)	480V AC
Emergency ventilation fans	(4)	480V AC
Control room emergency ventilation fans	(4)	480V AC
Emergency diesel generator auxiliaries	(1)(2)(3)(4)(5)(6)	480V AC
Engineered safety feature valves	(1)(2)(3)(5)	480V AC and 125V DC
Auxiliary feed pump controls	(5)	125V DC
Safety features actuation system	(1)(2)(3)(4)	120V AC
Reactor protection system	(5)	120V AC
Main steam atmospheric vent valves	(5)	125V DC

8.1.5 Design Bases

The electrical systems are designed to ensure that no single component failure will prevent operation of engineered safety systems. Redundant power sources are provided to ensure continuous operation of equipment under all modes of operation. Testing of systems is possible with the station in operation. Electrical and physical separation of cables and equipment associated with redundant elements is provided.

The design documents that are implemented in the design of the electrical systems are listed below:

	Document No.	Title	Approval Date
1.	AEC		
	Safety Guide 6	Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems	3-10-71
	Safety Guide 9	Selection of Diesel Generator Set Capacity for Standby Power Supplies	3-10-71
	Safety Guide 22	Periodic Testing of Protection System Actuation Functions	2-17-72
	Safety Guide 30	Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment	8-11-72
	Safety Guide 32	Use of IEEE Standard 308-1971 “Criteria for Class 1E Electric System for Nuclear Power Generating Stations”	8-11-72
	10CFR50, Appendix A	General Design Criteria for Nuclear Appendix Power Plants (as applicable)	2-10-71
2.	IEEE		
	308	Criteria for Class 1E Electric Systems for Nuclear Power Generating Stations	9-16-71
	317	Electrical Penetration Assemblies In Containment Structures For Nuclear Fueled Power Generating Stations	2-4-71
	323	General Guide for Qualifying Class 1E Electric Equipment for Nuclear Power Generating Stations	2-4-71
	334	Type Tests of Continuous-Duty Class 1E Motors Installed Inside the Containment of Nuclear Power Generating Stations	9-16-71
	336	Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations	9-16-71
	344	Seismic Qualification of Class 1E Electric Equipment for Nuclear Generating Stations	9-16-71
	387	Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations	12-2-71

3. In addition to the above, the relevant ANSI, IPCEA and NEC recommendations are used as guides in the design.

4. An ongoing program for environmental qualification is being implemented by DBNPS to qualify Class 1E equipment to the requirements of 10CFR50.49.

5. The design basis for the Emergency Diesel Generator excitation system also includes the following standards or regulatory documents used to qualify the replacement system. The first two guidelines below apply only to the RA70 Microprocessor-based Reference Unit.

EPRI TR-102348, Revision 1	Guideline on Licensing Digital Upgrades: TR-102348, Revision 1, NEI 01-01: A Revision of EPRI TR-102348 to Reflect Changes to the 10CFR50.59 Rule.	Endorsed by NRC Regulatory Issue Summary 2002-22
EPRI TR-106439	Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications, October 1996.	Accepted by NRC SER March 1997
EPRI TR-102323, Revision 2	Guidelines for Electromagnetic Interference Testing of Power Plant Equipment	Issued November 2000

During the design phase of Davis-Besse Unit 1, complete adherence to the (February 1974) Regulatory Guide 1.75 “Physical Independence of Electric Systems” was not possible since plant design pre-dated the issuance of 1.75 as well as IEEE 384-1974. However, the independence principles followed in the design are considered adequate to preclude a common failure mode for any design basis event and do, in fact, represent partial conformance. IEEE 279 and IEEE 308, both 1971, were used as guides during the design phase of the plant with the exception, noted in Chapter 7. Separation between redundant Class 1E equipment and circuits is mainly by separate safety class structures (rooms). However, distance and barriers are utilized as acceptable alternates. Further, there is compatibility of mechanical and electrical system design which provides that failure of related mechanical equipment of one redundant system cannot disable Class 1E circuits and equipment essential to the operation of the other redundant system. The routing of non-Class 1E cables is discussed in Subsection 8.3.1.2.18.

8.2 OFFSITE POWER SYSTEM

8.2.1 Description

Station output generated at 25kV, is fed through an isolated phase bus to the 980 MVA main transformer where it is stepped up to 345kV transmission voltage and delivered to the station switchyard. The 345kV switchyard includes one line to Bayshore Substation, one line to Lemoyne Substation, one line to Beaver Substation (Ohio Edison), and one line to Hayes Substation.

Three overhead 345kV lines are provided from the switchyard to the onsite station distribution system, one line to each of the two startup transformers and a third line to the main transformer (see Figure 8.2-2).

One or both of the two 345kV overhead lines to the startup transformers will be available to supply all essential loads within a few seconds of a loss-of-coolant accident. The third overhead line to the main and auxiliary transformers can be made available to supply all essential loads following a loss of all onsite alternating current power supplies by removing the generator main leads disconnecting links and changing the auxiliary transformer tap.

The third overhead line to the main and auxiliary transformers may be utilized in place of a startup transformer to supply all essential loads within a few seconds of a loss-of-coolant-accident provided the unit auxiliary transformer is aligned to the 13.8kV bus(es) and the generator main leads disconnecting links are removed.

8.2.1.1 Reliability Considerations

The possibility of power failure due to faults in the network interconnections and the associated switching is minimized by the following arrangements:

a. Any one of the four 345kV transmission lines may be interrupted, and the others will be capable of carrying the load.

b. There are no offsite transmission line crossovers which would jeopardize availability of offsite power.

c. There are no transmission line crossovers onsite which would jeopardize the availability of offsite power. The 345 kV transmission tie lines between the switchyard and startup transformers No. 01 and 02 originate at separate positions in the switchyard and are routed on separate structures, adequately separated to minimize the possibility of their simultaneous failure.

d. There are no known offsite structures such as microwave towers or sources of fire, explosion or missiles, which, if postulated to fail in the worst possible manner, could result in damage which precludes meeting the requirements of General Design Criterion 17.

   There are no onsite structures such as microwave towers which, if failed, would result in the loss of both sources of offsite power. The microwave tower is located in the southwest corner of the site, remote from the switchyard and transmission lines.

The only source of fire, explosion, or missiles in the switchyard that if postulated to fail in the worst possible manner could result in not meeting the requirements of Criterion 17 are the two switchyard a-c station service transformers and the 345 kV power circuit breakers.

The two a-c station service transformers are separated by a masonry firewall and are located remote from any essential switchyard equipment.

The 345 kV power circuit breakers are adequately separated (minimum 100 feet) to minimize the possibility of missile damage to equipment in separate positions in the event of a breaker blowup.

e. Two of the 345kV transmission lines are constructed on the same right of-way for a part of their length (about 2 ½ miles), but the lines are supported on independent structures set far enough apart to avoid the possibility of structural collapse of one causing an outage of both lines.

f. The 345kV system is protected from lightning and switching surges by lightning protection equipment and by overhead grounded shield wires.

g. The 345kV system stability will be maintained on the loss of the generator.

h. The bus switching arrangement in the 345kV switchyard includes two full capacity main buses. Primary and backup relaying (redundant systems) are provided for each circuit along with circuit breaker failure backup protection. These provisions permit the following:

    1. Any transmission line can be cleared under normal or fault conditions without affecting any other transmission line.

    2. Any single circuit breaker can be isolated for maintenance without interrupting the power or protection to any circuit.

    3. Short circuits on a section of bus will be isolated without interrupting service to any circuit, other than that connected to the faulted bus section.

    4. Short circuit failure of power circuit breaker No. 34562 will result in the loss of the startup transformer No. 02 and the Bay Shore line until the point of the fault is isolated by disconnect switches.

    5. Short circuit failure of power circuit breaker No. 34561 will result in the loss of the main unit and the Bay Shore line, until the point of fault is isolated by disconnect switches.

    6. Short circuit failure of power circuit breaker No. 34564 will result in the loss of the Ohio Edison tieline and the Lemoyne line, until the point of fault is isolated by disconnect switches.

    7. Short circuit failure of power circuit breaker No. 34560 will result in tripping the generator main breakers, the loss of the unit from the system and of startup transformer No. 01, until the point of fault is isolated by disconnect switches.

8. Short circuit failure of power circuit breaker No. 34563 will result in the loss of the startup transformer No. 01 and the Lemoyne line until the point of fault is isolated by disconnect switches.

9. Short circuit failure of power circuit breaker No. 81-B-67 will result in the loss of startup transformer No. 02 and the Hayes line until the point of fault is isolated by disconnect switches.

10. Short circuit failure of power circuit breaker No. 81-B-66 will result in the loss of startup transformer No. 01 and the Hayes line until the point of fault is isolated by disconnect switches.

11. Short circuit failure of power circuit breaker No. 81-B-65 will result in the loss of startup transformer No. 02 and the Ohio Edison (Beaver) line until the point of fault is isolated by disconnect switches.

Providing all switchyard circuits, breakers, and transformers are in service, there are no known aspects of the Davis-Besse design that do not meet the requirement of General Design Criterion (GDC) 17. A single switchyard circuit or breaker(s) can be removed from service and the remaining circuits, breakers, and transformers will still meet the requirements of GDC 17.

8.2.1.2 Stability Analysis

Completed system studies have shown that the system meets Criterion 17. The results show that losing station output will not adversely affect the capability of providing offsite power to the essential buses.

These analyses are reviewed and revised as needed following significant long-term changes in the transmission or loading characteristics of the FirstEnergy grid, or when a system operating event otherwise demonstrates a need for analysis update. These analyses are generally performed by offsite personnel responsible for system planning or transmission system design. The results of the most recent analyses are summarized below:

A steady state analysis simulated anticipated summer loads with normal system conditions, single element outages, and multiple element outages. There were no thermal or voltage criteria issues identified at the Davis-Besse Nuclear Power Station.

A voltage stability analysis modeled anticipated load, system reinforcements, and topology for summer operating conditions. The analysis evaluated a single generator and one line out of service and evaluated two lines and one generator out of service. For all of the applied FirstEnergy Planning outage contingencies to the voltage stability analysis, there were no voltage stability issues identified with the Davis-Besse Nuclear Power Station.

Transient stability studies performed by PJM (Pennsylvania-New Jersey-Maryland Interconnection) evaluated a number of contingencies and determined that all faults were stable and that the Davis-Besse Power Station had acceptable damping. The evaluated contingencies include:

1. Loss of the main generating unit.
2. Three phase fault on each transmission line.
3. Stuck breaker conditions for clearing single phase fault on each transmission line.

4. Back-up relay breaker clearing for three phase fault at remote terminal of each transmission line.

8.2.1.3 Switchyard DC System

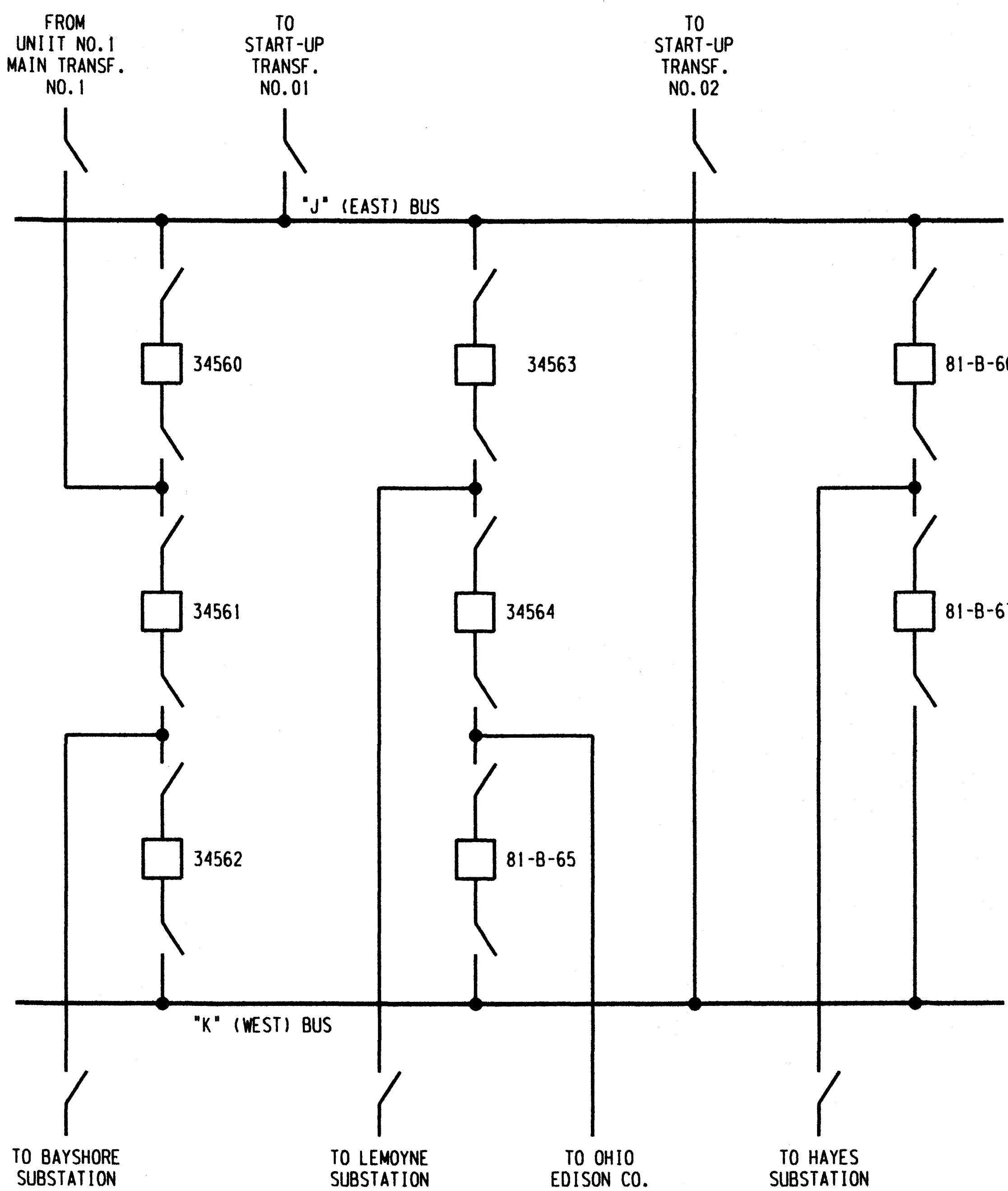
The design of the 125V DC system for the switchyard consists of two independent systems. A fused safety switch permits these two systems to be connected during periods of battery/battery charger maintenance and testing. This fused safety switch will normally be locked open to maintain system independence. Each consists of one 125V DC, 290 amp-hour battery (nominal), one battery charger, and one 125V DC 400 ampere distribution panel. Cable separation is maintained between the two systems.

There are two batteries for the control and protective relay functions of the 345kV switchyard and transmission lines. The two batteries are located on opposite walls in the switchyard relay house basement. Each battery is supplied by a separate battery charger, each charger is supplied from a separate and independent AC station service distribution panel. In the event of the loss of one battery, the other battery has sufficient capacity to supply all the DC circuits required to detect and clear a single fault including faults requiring initiation of breaker failure protection.

The DC circuits associated with each battery are routed in physically separate raceway systems. DC circuits for transmission line protective relays, J and K Bus differential relays, and 345kV breaker trip coils are completely redundant. The AC supplies to each battery charger are also physically separated.

8.2.1.4 Switchyard Systems

During normal operation, a single failure caused by a malfunction of either of the two switchyard DC systems will not affect the fault detection and fault clearing capabilities of the other system. The ability of the switchyard to supply offsite power to the station will not be affected by the loss of the two 125V DC systems because a loss of DC power will not cause equipment to change state.



DAVIS-BESSE NUCLEAR POWER STATION
345 KV SWITCHYARD ONE-LINE DIAGRAM
FIGURE 8.2-2
REVISION 30
OCTOBER 2014

DB 07-18-14 DFN: G/USAR/UFIG822.DGN

8.3 ONSITE POWER SYSTEMS

8.3.1 AC Power System

8.3.1.1 Description

The station distribution system consists of various auxiliary electrical systems designed to provide reliable electrical power during all modes of station operation and shutdown conditions (see Figures 8.3-1 and 8.3-2). The systems are designed with sufficient power sources, redundant buses and required switching, to ensure reliability. Engineered safety feature circuits are arranged so that a loss of a single bus section, for any reason, results in only single losses of auxiliaries leaving redundant auxiliaries to perform the same function.

The station distribution system is capable of starting and accelerating the largest required drive with the remainder of the connected motor loads in service. The system will have a fast transfer to the reserve power source following a turbine generator or reactor trip, without the loss of auxiliary load.

Protective relaying is arranged for selective tripping of circuit breakers or fused disconnect switches, thus limiting the loss of power to the affected area.

Separate analyses were performed assuming the power sources from the offsite network to the safety related buses as derived from (1) unit auxiliary transformer and (2) the startup transformer(s). For each case it was assumed that the need for electric power was initiated by an anticipated transient such as a unit trip or an accident, whichever presented the largest load demand. Manual load shedding was not assumed. The computer model developed to perform the analyses incorporated preliminary load data collected at the plant with the unit operating at 100 percent of the electrical output power. In addition, the computer model used actual test data for the installed equipment. The plant’s existing electrical auxiliary system configuration (e.g., breaker status, transformer taps, etc.) was included in the computer model.

Additional calculations were performed to analyze the transients caused by starting either a reactor coolant pump or condensate pump under full load conditions plus with all Class 1E loads already running. This was performed for different onsite distribution conditions and the bus voltages were determined for each case. The analyses show that the transient voltage dips caused by starting a reactor coolant pump or condensate pump do not fall below the voltage values needed by the Class 1E equipment to traverse the transient. Class 1E equipment is not required to actuate during the transient since all Class 1E loads are running in these cases.

Calculations were also done to determine the voltages on safety-related buses from a SFAS start which confirm that the equipment would be operating within their capabilities to perform their functions.

In conclusion the analyses have demonstrated that adequate voltage will exist on the safety-related buses so that the safety systems can perform their functions. The analyses have included contingency cases which further support the capabilities of the plant’s electrical auxiliary system. The analyses have included comparison of the safety-related equipment capabilities to continuous operating conditions, transient conditions and actuation conditions.

The steady-state analysis shows that the voltage on the Class 1E 4160V bus does not drop below the degraded voltage relay setting during the worst operating conditions of full auxiliary load and full Class 1E load.

8.3.1.1.1 Unit Auxiliary and Startup Transformers

During normal operation of the station, the 52/69 MVA unit auxiliary power transformer, connected to the generator isolated phase bus, provides the normal source of electrical power for station auxiliaries.

Two startup transformers, each 39/52/65 MVA, are supplied from different 345kV switchyard bus sections. Each startup transformer provides power for startup, shutdown, and post-shutdown requirements. The two transformers will also serve as a complete reserve power source for the station auxiliaries in the event of failure of the unit auxiliary transformer supply.

The impact of open phase conditions on the capability of the startup transformers to perform their functions was evaluated. The conditions analyzed consisted of single (one of three) and double (two of three) open phase conductors on the high voltage (345 kV) side of the startup transformers. The analysis considered open phase conditions with and without a ground. Open phase detection and isolation systems for the startup transformers were installed to ensure that plant structures, systems, and components important to safety can perform their intended functions under postulated open phase conditions. Upon detection of an open phase condition, the system will isolate the affected startup transformer and provide operator indication of the open phase condition.

After initial installation, the OPPS will be operated with the automatic isolation function of the OPPS disabled for initial monitoring period, which is expected to last up to one operating fuel cycle. The monitoring period will used to confirm that the system performance and associated setpoints provide the correct level of protection.

During Operational Mode 3, 4, 5, 6, or defueled, the circuit connecting the 345 kV switchyard to the 13.8 kV buses through the main transformer and the auxiliary transformer may be utilized in place of a startup transformer, provided the generator main leads disconnecting links are removed and the auxiliary transformer tap is changed. Additional restrictions apply to bus configuration when the backfeed alignment is in use. Refer to the Technical Specification bases for more information.

Normally each startup transformer is the reserve power source of only one 13.8kV bus. However, if either transformer is out of service, the remaining startup transformer is available (by manual pre-selection) to automatically supply both 13.8kV buses should the normal source (auxiliary transformer) fail. Note that in MODES 1, 2, 3 and 4, a single startup transformer and a single bus tie transformer, supplying the loads normally served by two startup transformers and two bus tie transformers, can not be guaranteed to provide adequate voltage to all equipment required for safe shutdown following a LOCA.

The secondaries of all three transformers are of low-resistance grounded, wye-connected construction.

8.3.1.1.2 13800 Volt Auxiliary System

During normal operation each 13.8kV bus is fed from one of the 13.8kV secondary windings of the unit auxiliary transformer. During startup and shutdown, each bus is fed from the 13.8kV secondary winding of either startup transformer No. 01 or No. 02, or, during operational Mode 3, 4, 5, 6, or defueled, backfed through the main power transformer and unit auxiliary transformer with the generator links removed and the auxiliary transformer tap is changed.

The unit 13.8kV auxiliary distribution system consists of two 2000 A buses: A and B (see Figure 8.3-1). Each bus supplies the following loads:

two	9000 HP Reactor Coolant Pumps
two	4500 HP Circulating Water Pumps
one	12/16 MVA Bus Tie Transformer
six	1000/1150kVA Nonessential Unit Substation Transformers

The transfer of a 13.8kV bus between the three sources of electrical power can be either manual or automatic. Manual transfer is initiated by the operator from either the control room or the switchgear room, and automatic transfer is initiated by the action of generator or transformer protective relays. Reserve source selector switches are provided to preselect the alignment of startup transformers for buses A and B. This pre-selection of the alignment is for the fast bus transfers. When power is being supplied to a 13.8kV bus by a startup transformer, the reserve source selector switch for that bus can preselect the alternate startup transformer source. This permits a fast bus transfer to the alternate startup transformer source should the original source fail.

The control circuits of the feeders will not allow multiple power sources to be connected to either bus A or bus B except for a momentary paralleling of sources by manual transfer on station startup or shutdown.

Manual bus transfer between the sources is a live bus transfer scheme allowing the incoming source feeder circuit breaker to first close onto the energized bus, and then its interlocks cause the outgoing source feeder circuit breaker to trip when the operator releases the control switch of the incoming breaker. This transfer scheme results in no power interruption to the bus. The live transfer is supervised by a synchro-check relay permitting the completion of the transfer only if the two sources are in phase. Manual transfer is provided between any of the three power sources as preselected by the operator.

The fast bus transfer scheme from the unit auxiliary transformer 11 to the startup transformers 01 and/or 02 is further enhanced by fast acting synchrocheck relays. Opening of the 345kV breakers 34560 and 34561 during normal power operation with the electrical auxiliary systems being supplied power from the unit auxiliary transformer 11 will result in these relays monitoring the phase angle difference between the secondary voltage of the unit auxiliary transformer 11 and the startup transformer(s) secondary voltage during the fast bus transfer. Should the angle exceed 35 degrees the transfer will be blocked to prevent out of phase re-energization and the associated over-voltage stresses on the plant's electrical auxiliary system. These fast acting synchrocheck relays are also functional during the generator protective relaying delayed transfer scheme.

Automatic fast transfer of a 13.8kV bus from the unit auxiliary transformer to an available startup transformer is initiated by either generator protective relays or transformer protective relays. Transfer is made to the startup transformer which has been preselected as the reserve power source for the given 13.8kV bus by means of a selector switch in the control room or switchgear room. Automatic transfer occurs only from the normal to the reserve sources or between the two reserve power sources; the transfer from either of the startup transformers to the unit auxiliary transformer can only be done manually.

A startup transformer is available as a reserve source to a bus if:

a. Its secondary voltage is normal.

b. Its protective lockout relay is not tripped.

c. The bus feeder breaker closing DC voltage is available.

8.3.1.1.3 4160 Volt Auxiliary System

Power supply to the 4160 volt system is from two 12/16 MVA bus tie transformers which step down the voltage from 13800 volts to 4160 volts. Each bus tie transformer normally supplies one essential and one nonessential 4160 volt bus and is available as a reserve source for the other two 4160 volt buses. The capacities of the transformers and circuit breakers are sufficient to permit full station operation with one bus tie transformer out of service, providing both startup transformers are available. (Analysis has shown that the impedances of the bus tie and startup transformers are such that acceptable voltage levels can not be guaranteed for all accident scenarios with the entire station load being simultaneously supplied through a single bus tie transformer and a single startup transformer.) Each essential 4160 volt bus is provided with a fast bus transfer scheme that will transfer the bus from its normal source to an alternate source of power.

The 4160V auxiliary distribution system consists of five 4160V, 2000 amp buses (see Figure 8.3-1).

When the unit is off line with nominal loading on the buses, the startup transformer taps may be changed to maintain voltage within an acceptable range. When the unit is brought back on line, the two startup transformers' taps are reset for unit power operation.

When the unit is offline with nominal loading on the buses, the unit auxiliary transformer can be made available to supply loads by removing the generator main leads disconnecting links and changing the unit auxiliary transformer taps to maintain voltage within an acceptable range.

Two essential buses C1 and D1 provide power to engineered safety feature equipment for safe station shutdown. Each of the essential 4160V buses supplies the following loads:

Quantity		Motor HP (Nameplate)
1	Service Water Pump	600
1	High Pressure Injection Pump	600
1	Decay Heat Pump	400
1	Component Cooling Pump	400
1	Essential 4160-480V Unit Substation Transformer	1000kVA

Also, each bus supplies power to one 450 HP makeup pump motor.

In addition, a third 600 HP service water pump and a third 400 HP component cooling pump are provided. Each of these two pumps is connected to two 4.16kV Kirk Key interlocked, manually controlled transfer switching breakers. The Kirk Key interlock permits only one breaker to be closed at a time. Each breaker of a motor pair is connected to a separate essential 4.16kV bus.

Further interlocks are provided to prevent more than one component cooling pump breaker and one service water pump breaker from automatically closing and connecting to either emergency diesel generator at the same time. It should be noted that while swapping the running and spare Component Cooling pumps, both pumps are temporarily running on the same bus, and would remain on the bus if the emergency diesel generator was started. Administrative controls will alert operators to this unconventional EDG loading and to minimize the time during which two CCW pumps are connected onto one bus. Also, the sequences of aligning the pumps' 4KV breakers are administratively controlled to ensure a pump is available for auto-loading onto each essential bus.

The two 4.16kV nonessential buses C2 and D2 supply power to non-safety-related station auxiliaries indicated on Figures 8.3-1 and 8.3-2. In the event of a station blackout, bus D2 can be aligned to either essential 4.16 kV bus for the purpose of using the Station Blackout Diesel Generator (SBODG) to supply loads required for coping with a loss of all AC power.

In normal operation, the secondary winding of each bus tie transformer is connected through a 2000 amp circuit breaker to its associated nonessential 4.16kV bus. This bus then feeds the corresponding essential 4.16kV bus through a 1200 amp circuit breaker. Each essential bus can also be energized directly from the other bus tie transformer.

Transfer schemes are provided to switch each 4.16kV bus from its normal bus tie transformer to its reserve. The transfer between the two sources is done either manually, initiated by the operator at the control room, or automatically initiated by a protective relay action. Manual transfer is a live bus scheme while automatic transfer is a fast one.

The 4.16kV system is low resistance grounded. The grounding point is the neutral of each source transformer.

The attached schematic diagrams (see Figures 8.3-5 through 8.3-12) are provided to permit an evaluation of compliance with the safety criteria.

Each 4.16kV safety-related bus is provided with two levels of voltage protection. Four relays at each level function as a coincidental logic to preclude spurious trips of the offsite power source. The time delays associated with the relays are chosen so as to minimize the effect of short duration disturbances from reducing the availability of the offsite power source, to assure that the allowable time duration of a degraded voltage condition does not result in failure of safety systems or components, and to assure the starting times of equipment assumed in the accident analysis are not exceeded. The Degraded Voltage Relays automatically initiate disconnection of the offsite power source whenever the voltage setpoint and time delay have been exceeded. The Loss of Voltage Relays automatically initiates disconnection of the offsite power source, load shed the bus, and starts the diesel generator whenever the voltage setpoint and time delay have been exceeded. See Technical Specification and Technical Requirements Manual for voltage and time delay values.

Starting one reactor coolant pump or circulating water pump can result in a voltage reduction on the 4.16 KV buses because the voltage drop on the 13.8 KV buses which supply power to the pump motors is fed through to the 4.16 KV buses. In order to block the low voltage trip when these pumps are started, a push button bypass allows the degraded voltage relays to be bypassed for up to one minute during pump starts.

8.3.1.1.4 Diesel Generators

General Description:

8.3.1.1.4.1 Emergency Diesel Generators

Two redundant emergency diesel generator units, one connected to essential 4.16kV bus C1 and the other connected to essential 4.16kV bus D1, are provided as onsite standby power sources to supply their respective essential buses upon loss of the normal and the reserve power sources. Bus load shedding and isolation, bus transfer to the emergency diesel generator, and pickup of critical loads is automatic.

Each emergency diesel generator has the following ratings and characteristics:

Continuous rating	2600 kW
#2000 hr. rating	2838 kW
200 hr. rating	2946 kW
#30 minute rating	3035 kW
*Short term rating	2860 kW
Generator rating	3250 kVA
Assumed power factor	0.8

* Short-term rating is the electric power output capability that the emergency diesel generator can maintain in the service environment for two hours in any 24-hour period.

Any combination of normally connected (and operating) loads and loads that are automatically connected (and operating) following a loss of offsite power and/or LOCA will not exceed the smaller of the 2000 hour rating or 90 percent of the 30-minute rating (i.e., 3035* 0.9 = 2731.5 kW) of the emergency diesel generator, after taking into account actual expected loading (vs. rated load). Refer to Table 8.3-1 for the applicable load tabulations. (Reference Safety Guide 9, Regulatory Position C.2)

The emergency diesel generator is capable of attaining rated frequency and voltage approximately 10 seconds after the engine start signal is received.

Each of the two emergency diesel generators has the capability to:

a. Supply continuously the sum of the load on the essential 4160V bus needed to be powered at any one time.

b. Start and accelerate to rated speed in the required sequence its dedicated engineered safety features loads. At no time during the loading sequence, will the frequency and voltage decrease to less than 95 percent of nominal and 75 percent of nominal, respectively, except that during the first step in the required loading sequence, there may be a voltage dip below 75 percent of normal lasting for a few cycles due to the essential unit substation transformer excitation inrush.

During recovery from transients caused by step load increases or resulting from disconnection of largest load, the speed of the diesel engine will not exceed 75 percent of the difference between nominal speed (900 rpm) and the overspeed trip setpoint.

Each diesel will receive a starting signal when any one of the following occurs:

a. Loss of essential bus voltage

b. A safety feature actuation signal (SFAS level 2)

c. Manual start (local or remote)

d. Test signals to simulate any of the above

Any of the above conditions will initiate a start signal to the emergency diesel engine. However, except for manual synchronizing during routine testing, the essential bus will be isolated only upon loss of voltage or a bus fault, and the emergency diesel breaker will be closed only on loss of voltage without a bus fault.

Relays connected to potential transformers at the emergency diesel generator terminals will detect generator rated voltage and provide a permissive interlock for the closing of the respective generator circuit breaker. Interlocks are provided to prevent automatic closing of an emergency diesel generator breaker to an energized or faulted bus.

Emergency Operation:

Loss of essential bus voltage will be detected by the Loss of Voltage Relays. In addition, the Degraded Voltage Relays will permit continuous operation at reduced voltage conditions for a period of time not exceeding the time delay specified in Technical Specifications and the Technical Requirements Manual, after which the incoming 4.16kV essential bus source breakers will be tripped.

If loss of power is confirmed, by loss of voltage at either essential 4.16kV bus, the following will occur:

1. All bus load breakers, except the breakers supplying power to the 480V essential unit substation supply breakers and component cooling pump breakers, will be tripped.

2. Both source breakers will be tripped and the bus will be isolated.

3. The associated emergency diesel generator set will be started, if not already running.

4. When the emergency diesel generator reaches rated voltage, the corresponding emergency diesel generator breaker will close energizing the 4.16kV and 480V essential buses.

5a. In case the safety features actuation system has been tripped, the engineered safety features loads will be automatically energized according to the predetermined loading sequence given in Table 8.3-1.

5b. In case the safety features actuation system has not been tripped, the emergency diesel will be loaded manually; except that in any case, the component cooling water pumps, service water pumps, previously running makeup pump and the essential 480 volt buses will be started/energized. The loading sequence is provided in the Notes of Table 8.3-1. Also see Section 9.2.7.3 for details.

In the event of loss of power, there will be an interruption of approximately 10 seconds in power supply to the previously running component cooling pumps. The standby component cooling pump will start 10 seconds after the EDG output breaker closes.

However, there will be no effect on the diesel generator performance since each diesel is capable of operating without cooling water for three minutes at startup and for one minute at rated full load.

The diesel generators will remain on-line during this interval since the engine high temperature (high jacket water) trip of each diesel is defeated during emergency operation.

Testing:

The emergency diesel generator units have been tested according to IEEE 387. Periodic testing requirements of the emergency diesel generators are given in the Technical Specifications. Each emergency diesel generator is equipped for test purposes only with means for periodically testing, synchronizing, and loading without interrupting service. Only one emergency diesel generator is loaded at any one time. During testing, interlocks will prevent paralleling an emergency diesel generator with the auxiliary or startup transformer until the generator has been manually synchronized by the operator and the synchronism-check relay contacts are closed. Also for testing purposes, an idle start/stop feature in the diesel generator control circuit allows the diesels to be started to an idle setting via the local idle start circuit and allows for a normal stop 10-minute idle cooldown.

A normal or emergency start signal overrides this feature, with exception of the start pushbutton on C3621 (C3622). The idle start/stop feature is intended to prolong the life and reliability of the diesel generators.

Mechanical/Electrical Protection:

Each emergency diesel generator is equipped with mechanical and electrical interlocks to ensure personnel protection and to prevent or limit equipment damage. During a non-emergency diesel generator operation (for example, on-line testing) some of the following mechanical and electrical protective devices are capable of initiating a diesel generator trip. However, during an emergency operation, namely on a loss of essential bus voltage or an SFAS level 2, controls limit the diesel generator trip to generator differential relay action (87/DG), and engine overspeed (OTS). This measure is taken to minimize the possibility of the above devices needlessly preventing the diesel from operating when required, as during a DBA. However, alarms are still provided for high crankcase pressure, low lube oil pressure, high engine temperature, and electrical protective relays. The 51V-2 relay is also not bypassed which will trip the EDG output breaker due to fault on the essential bus. This relay enhances the availability of the diesel generator.

Except as modified by a loss of essential bus voltage signal or SFAS level 2, the installed protective type devices that are incorporated in the design to protect the diesel generators from exceeding operating limits are as follows:

A. Electrical Protective Relays:

Description	Function
Reverse power relay (32/DG): - provides anti-motoring protection for the diesel to preclude the danger of explosion and fire from unburned fuel.	Trip breaker
Generator ground relay (51G/DG): - provides protection for ground faults in the generator, the 4.16kV essential bus, and the cabling between the generator and the bus. It also provides ground-fault back-up protection for feeder faults.	Trip breaker
Generator differential relays (87/DG): - provide protection for faults in the zone between the generator neutral and its associated 4.16kV essential bus.	Trips engine/breaker
Voltage controlled, over current relays (51V-1/DG,51V-2/DG): - provide generator fault backup protection as well as system fault backup protection.	Trip breaker
Loss of field relay (40/DG): - provides generator protection due to loss of field.	Trip breaker
Negative phase sequence relay (461DG): - provides generator rotor overheating protection due to unbalanced faults.	Trip breaker
Over and under-voltage (27-59/DG): - alarms if generator voltage exceeds limits.	Alarm only
Voltage balance (60/DG): - senses an imbalance between the bus potential transformers and the emergency diesel generator potential transformers due to a blown fuse.	Prevent false trip by emergency diesel generator voltage controlled, over-current relays
Synchronism-check relay (25/DG): - provides generator protection from being manually loaded onto a 4160V bus out of phase.	Manual breaker permissive

B. Mechanical Protective Devices:

(Nominal Setpoints - for variances on these setpoints, see the Instrument Index Drawing M-720I)

Description	Function
High Jacket Water Temperature Switch (HJWTS) set at 205°F	Trips engine/breaker
High Crankcase Pressure Switch (CPS) - set at 1" of water	Alarm only
Low Lube Oil Pressure Switch (LOPS) - set at 20 psi	Trips engine/breaker
Engine Overspeed Trip (OTS) - set at 1035 rpm 115% speed	Trips engine/breaker
Manual Emergency Shutdown: - A manual emergency shutdown pushbutton which does not get by-passed during emergency operation is located locally at the engine control panel. This device is provided for personnel and equipment protection.	Trips engine/breaker

Essential Subsystems:

The following are descriptions of the essential subsystems for the diesels:

a. Starting air system - each of the two emergency diesel generators has a complete starting air supply system including starting air compressor, two air reservoirs (each of which has the capacity to provide 5 starts without recharging), and two sets of two starting motors in parallel, one set from each reservoir. The compressor has sufficient capacity to recharge two air reservoirs from minimum to maximum starting air pressure in not more than 30 minutes. Each air compressor will charge one of the two air reservoirs in the starting systems for each of the two emergency diesel engines. A third compressor, which can be manually aligned to act as either of the normally aligned compressors, is available when either of the other two compressors has been isolated. (Figure 9.5-8A - Diesel Generator Air Start System, and Figure 9.5-10 - Diesel Generator Day Tank Location)

b. Lubricating oil system - each diesel engine has its own independent lube oil system which is an integral part of the engine. The lube oil system consists of the following (Figure 9.5-8 - Emergency Diesel Generator Auxiliary Systems):

   1. Lube oil filtering and cooling system - this system draws oil from the engine sump through a cleanable basket strainer by means of an engine-driven scavenge pump. The oil is directed to a full flow filter, and then to an oil cooler. Thermostatically controlled engine jacket water cools and maintains the lube oil temperature automatically at the proper operating condition. The cooled oil returns to an engine-mounted strainer.

   2. Main lubrication and piston cooling systems - these systems draw oil from the oil cooler through the duplex strainer by the gear-driven pressure pump. The main lubrication oil system supplies oil pressure to all necessary moving parts of the engine. The piston cooling pump discharges oil in continuous sprays on the underside of the piston crown. All oil from these systems drains into the engine oil sump. A dipstick oil level gauge is provided, and the oil is added at the strainer.

3. Turbocharger cooling system - an independent, essentially powered, AC motor-driven turbo oil pump draws oil from the sump and delivers it to the turbocharger bearings through a replaceable cartridge filter. This pump is always kept running to provide pre-lubrication of the turbocharger bearings for starting and post-lubrication at stopping. The oil drains from the turbocharger housing into the oil sump. An alarm is actuated if sufficient oil pressure is not provided to the turbocharger bearings. An electric, DC motor-driven pump acts as a back-up to the AC turbo oil pump. The DC motor-driven pump is normally in standby (not running) but will automatically start when the discharge pressure from the AC motor-driven turbo pump drops off.

4. An essentially powered AC motor-driven circulating oil pump draws oil from the engine sump and circulates it through the main lube oil filter, the lube oil cooler, and the main lube oil gallery. This pump is always kept running to provide pre-lubrication of the engine with warm, filtered oil.

c. Jacket water cooling system - each emergency diesel engine water jacket cooling system includes a heat exchanger, expansion tank, lube oil cooler, automatic cooling water temperature regulating valve, and engine-driven water pumps. Jacket cooling water is circulated in a closed loop through the engine lube oil cooler, the engine cooling water passages, and the shell side of the raw water heat exchanger. The raw water flowing through the tube side is a part of the component cooling water system.

An electric immersion heater powered from an essential source is provided in the diesel engine jacket water system, and is controlled by a temperature switch. The immersion heater keeps both the jacket water and lube oil systems warm during standby conditions to enhance reliability and fast starting of the emergency diesel generator set. The heated water is circulated by thermo-siphoning through the lube oil cooler where the circulating oil gets heated up, and is maintained above 85°F. A low jacket water temperature alarm monitors the operation of the immersion heater. (Figure 9.5-8 - Emergency Diesel Generator Auxiliary Systems)

d. Fuel oil system - the diesel oil system includes seven days storage of fuel oil for each emergency diesel generator. This system consists of the emergency diesel generator day tank, bulk storage (week) tank, pumps, and associated piping and valves to the respective diesel generator. The oil storage tank and the fuel oil transfer system are designated as Class 1E structures within the meaning of IEEE 308. A complete description of the diesel fuel oil system is given in Subsection 9.5.4.

The fuel oil filtering system is composed of a number of devices to guarantee fuel oil purity. Before entering the suction of the engine driven fuel pump, the oil passes through a strainer which protects the pump. The oil discharged from the pump then passes through a duplex cartridge filter. The fuel supplied by the DC motor-driven, redundant fuel pump is filtered in the same manner as that supplied by the engine driven pump, except that a duplex basket strainer is used on the suction of the pump. (Figure 9.5-8 - Emergency Diesel Generator Auxiliary Systems, and Figure 9.5-10 - Diesel Generator Day Tank Location)

The factors which are used to determine that the emergency diesel generator day tank capacity is sufficient for approximately 24 hours at 110 percent full load operation are as follows:

The emergency diesel generator day tank normally stores approximately 5000 usable gallons of fuel oil, (4728 gals at the tank low level switch setpoint for starting the Transfer Pump to 5155 gallons at the tank high level switch setpoint for shutting off the Transfer Pump). At 100 percent rated load, 5000 gallons of usable fuel oil is sufficient to continue operation for approximately 25 hours. If loading is 110 percent this quantity of fuel oil is sufficient to continue operation for approximately 23 hours, assuming a reasonable increase in the fuel oil consumption rate (lbs. of fuel oil per bhp per hour) above the rate at 100 percent load. However, a low-low level alarm is established with approximately 4530 gallons usable fuel still remaining in the tank. This quantity of fuel oil can maintain full load diesel operation for approximately 23 hours or approximately 21 hours at 110 percent loads, assuming the same reasonable increase in the fuel oil consumption rate used earlier.

e. <u>Air intake and exhaust systems</u> - the air intake structure and filtering system for each diesel consists of an intake filter assembly, an intake silencer, and interconnecting piping to the diesel engine-mounted air inlet flexible connector. The filtered air then enters the impeller-end of a turbocharger where its pressure is increased for combustion and exhaust gas removal. The exhaust system consists of an engine-mounted manifold, turbine-end of the turbocharger, and inter-connecting piping to an exhaust silencer. (Figure 9.5-8A - Diesel Generator Air Start System)

The physical arrangement of the air intake and exhaust for the emergency diesel generators is shown in Figure 8.3-13 - Auxiliary Building Sections, and Figure 9.5-10 - Diesel Generator Day Tank Location. The air intake filter and intake and exhaust silencers are located outside at the roof top of the auxiliary building above the diesel rooms. Suitable enclosures are provided to protect the filter and silencers from missiles, tornadoes, snow, rain, etc. Since the air intake is located outside of the diesel building, there is no possibility of fire extinguishing agents being drawn into the air intakes. The physical separation of the intake and exhaust preclude significant recirculation of exhaust gas into the air intake.

f. <u>Excitation and voltage regulating system</u> - a solid state excitation and voltage regulating system of the series boost static regulator type, is provided for each emergency diesel generator unit. The exciter is of the static type having fast response characteristics and reliability for allowing the startup of a heavy load parallel with a running load. The voltage regulator is a static type with silicon type rectifiers and provides the necessary excitation control to maintain the adjusted generator voltage with the generator operating at loads ranging from zero up to and including its overload capacity at rated power factor and frequency. The generator reactance’s, excitation system, and regulator response time are such that adequate voltage is provided to meet automatic loading requirements in accordance with AEC Safety Guide 9. The electric power supply for field flashing will be taken from the respective station battery. Sufficient electrical instrumentation is furnished to survey the variables required for successful operation of the excitation and voltage regulation system.

Electrical instrument power supplies will be 120V AC and 125V DC from redundant essential instrument power distribution panels.

Sufficient mechanical and electrical instrumentation is provided for each emergency diesel to survey the variables required for successful operation.

The systems monitored included the starting system, lubrication system, fuel system, cooling system, combustion air system and exhaust system.

Separation/Hazards

Figure 3.6-3 indicated the physical arrangement of the diesel generators, fuel oil day tanks, and starting air system. Physical separation is provided to each diesel generator and its associated auxiliary systems. The floor drains in the two EDG rooms are interconnected, and therefore not physically separated and independent. An evaluation of this common drain design verified that no credible single event would disable both EDG units (see also Flooding in this subsection). The redundant emergency diesel generating units are located in separate, adjacent rooms in the Seismic Class I auxiliary building (also see Subsection 8.3.1.1.8). A fire wall and door are provided between the two rooms. The local control and auxiliaries for each emergency diesel generating unit are located in the same room as the diesel with which they are associated.

Missiles

Internal missiles generated by one unit will not affect the redundant unit since the walls act as missile barriers. A high crankcase pressure switch is provided which will alarm. These units are located in the auxiliary building which is protected from external missiles generated by a tornado. There are no other external missiles which can affect these units.

Fires

Each diesel generator room is protected by a pre-action sprinkler system. Water is admitted to the system through an automatically actuated valve located outside the diesel generator rooms, which is automatically activated by photoelectric smoke detectors. Pressure switches are provided. Photoelectric smoke detectors are provided for alarm. In addition, a hose station and portable fire extinguishers are provided for each room. The diesel oil day tank rooms are protected with a wet pipe, automatic sprinkler system. Flow switches are also provided. Fire walls and doors separate each diesel generator and its associated auxiliary systems.

Flooding

Four-inch drains are provided in each room to accommodate fire suppression water, fuel oil spills or leak in a diesel engine heat exchanger component cooling water line. The floor drains in these two rooms are tied together and the drainage rate is limited due to the oil interceptor that these drains connect to. Fire suppression activities that introduce water at a rate in excess of the capacity of this common drain system require that the one of the outside doors to one of the rooms be opened or suppression activities minimized to prevent flooding in both rooms. See Table 9.2-6 for a single failure analysis of the component cooling water line.

Mechanical Failures

The intake, exhaust, fuel oil, cooling water, and lube oil systems are independent systems for each diesel generator unit.

The starting air systems are interconnected. Each compressor charges one air receiver for each unit. One compressor can be lost with the redundant compressor capable of charging one air receiver for each unit. Likewise, the loss of one air receiver and its associated piping and valves will not prevent starting from the redundant air receiver. In addition, a third swing compressor can be aligned to act automatically as either of the other two compressors. Interconnecting piping between redundant starting systems is typically isolated by double valving. However, with other alignments, such as the third compressor in service, interconnecting piping between redundant starting systems is isolated minimally by a single manual valve, as can be seen in Figure 9.5-8A. Also, there are two air lines on each EDG that tap off downstream of the air start solenoid valves, pass through a check valve, and then combine into a common header for the hydraulic governor air booster servomotor. The check valves prevent air back-leakage into the other air side.

Auxiliary Support Systems

The following are Seismic Class I auxiliary systems which supply the emergency diesel generator rooms of the auxiliary building:

- Fuel Oil System: this system is fully described in Subsection 9.5.4 and 8.3.1.1.4.1. (Figure 9.5-10 - Diesel Generator Day Tank Location, and Figure 9.5-8 - Emergency Diesel Generator Auxiliary Systems)

  A Seismic Category 1, missile protected, fuel oil storage and transfer system that meets IEEE 308 requirements is provided.

- Component Cooling Water System: this system is fully described in Subsection 9.2.2. (Figure 9.2-2 - Component Cooling Water System)

  Subsection 8.3.1.1.4.1 describes, in detail, the diesel generator jacket water cooling system.

- Ventilation System: this system is described in Subsection 9.4.2.1.2.

  Subsections 9.4.2.1.2.3 and 9.4.2.1.3.3 describe, in detail, the emergency diesel generator room ventilation system.

  During the winter, heating for the emergency diesel generator rooms is supplied by means of an electric heating system which maintains a 60°F minimum temperature with an outdoor design temperature of -10°F.

  In addition, the ventilation fans in each room automatically start whenever the diesel in that room is operating. Outside air is mixed with the recirculation air, as required, to maintain design conditions in the room. The fan motors are energized from the essential 480V motor control centers to guarantee their availability.

- Station batteries: as noted in Subsection 8.3.2.1.4, some battery power has been assigned to each emergency diesel generator. This assignment is for control and field flashing, not for cranking service.

8.3.1.1.4.2 Alternate AC Source - Station Blackout Diesel Generator

The purpose of the non-class 1E 4.16kV, 2865KW Station Blackout Diesel Generator (SBODG) is to provide AC power to all systems required for coping with a Station Blackout as defined in 10CFR50.2. This alternate AC power source meets the criteria specified in Appendix B to NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiative Addressing Station Blackout at Light Water Reactors" and in Regulatory Guide 1.155, "Station Blackout."

The SBODG and support systems (auxiliaries), except the engine radiator, are located in a separate structure south of the Station within the protected area. To protect the SBODG from likely weather events which could initiate a loss of off-site power, this structure shall conform to Ohio Basic Building Code. Additionally, all cabling between this structure and the Station is routed through buried duct bank. The SBODG engine radiator is designed for outdoor installation.

Two 1200 amp circuit breakers in series connect the SBODG to the Station's nonessential 4.16 kV Bus D2. The circuit breaker which is at Bus D2 is normally closed and supplies power to SBODG auxiliaries during standby conditions. Closing the normally open 1200 amp circuit breaker which is located in the SBODG building connects the generator to Bus D2. During emergency conditions, power to the SBODG auxiliaries is supplied by the generator itself.

The SBODG is capable of supplying either of the Station's essential 4.16kV buses through nonessential Bus D2 and is available within ten minutes of the onset of Station Blackout. During an emergency, the SBODG can be manually started and loaded onto Bus D2 from the Control Room auto starting and loading is not provided. Operation of circuit breakers to make an SBODG line up to either essential bus can also be accomplished from the Control Room. The SBODG is capable of unattended operation at rated full-load for at least four hours. The SBODG has the following ratings and characteristics:

Continuous Rating	2865kW, 3580kVA
2000 Hour Peaking	3135kW, 3918kVA
Power Factor	0.8
Reactances	xd = 2.35 xd' = 0.42 xd" = 0.27

A 125V battery system is included among the SBODG auxiliaries. These batteries have sufficient capacity to maintain DC control power and diesel-generator starting and loading ability. SBODG Breaker AD213, which is normally closed, receives control power from the Station's Train 2 D.C. Distribution System.

A compressed air system is used for SBODG engine starting. The primary system components are two ASME Code VIII air receivers and two electric motor driven air compressors.

The fuel oil supply for the SBODG engine is separate from the fuel oil supply used by the Station's Emergency Diesel Generators. The SBODG fuel oil supply tank has enough capacity to provide an eight-hour supply with the generator at rated load. Four hours of fuel must be stored in this tank to meet the Site's Station Blackout duration.

The SBODG building is protected by fire protection systems.

The diesel engine cooling system is a closed loop system. Cooling is provided using a force draft radiator with engine-driven cooling water pumps.

SBODG testing follows the recommendations presented in Appendix B of NUMARC 87-00. To facilitate testing, a sync-check relay prevents paralleling the SBODG with the auxiliary transformer or either start-up transformer until the generator has been manually synchronized.

8.3.1.1.5 480V AC Auxiliary System

The station 480V AC distribution system consists of:

Two 1000kVA 4160-480V AC essential unit substations (E1 and F1) for the supply of power to the 480V AC safety loads.

Six 1000kVA, 13800-480V AC nonessential unit substations (E2, E3, F2, F3, EF4, and EF6) for the supply of power to the 480V AC normal auxiliaries.

One 1000kVA, 4160-480V AC nonessential unit substation (F7) for the supply of 480V AC to Station Auxiliaries.

One 225kVA, 4160-480V AC distribution center for supplying 480V AC power to the station blackout diesel generator auxiliaries.

Two 750kVA, 4160-480V AC lighting substations (E5 and F5) for station lighting.

One 112.5kVA, 4160-480V AC outdoor distribution center for outdoor lighting.

Two 500kVA, 4160-480V AC switchyard distribution centers for supplying 480V AC power to the switchyard.

See Figures 8.3-14 through 8.3-18.

The two 4160-480V AC essential unit substations are double ended (two transformers) with transformer secondaries wye connected and the neutral high resistance grounded. The six 13800-480V AC nonessential unit substations are double-ended (two transformers) with transformer secondaries wye connected and the neutral solidly grounded, except for transformers AE3 and BF3, which are high resistance grounded. The capacity of each transformer is sufficient to permit station operation with one transformer out of service. The two 4160-480V AC essential and four of the 13800-480V AC nonessential unit substations have a single bus; each of the remaining two 13800-480V AC nonessential unit substations has a two bus arrangement with a tie breaker between the buses.

Each 4160-480V AC essential unit substation is supplied from its corresponding 4160V AC essential bus through redundant normally closed 1200 ampere circuit breakers; one feeder is connected to the primary side of each transformer. The transformer secondary side is connected to the 480V, 1600 amp bus through a 1600 amp circuit breaker. During normal operation both of the essential 4160-480V AC unit substation transformers are energized with one transformer carrying the load and the second transformer carrying no load. Transfer from one transformer to the other is by manual control only; automatic transfer is not provided. It is possible to accomplish either a live (bus energized) or a dead (bus de-energized) transfer at the operator’s discretion (see Figures 8.3-19 through 8.3-22).

Each 13800-480V AC nonessential unit substation is supplied from alternate 13800V AC Buses A and B. Apart from the arrangement of the incoming primary feeders, four of these substations are designed to operate in the same manner as the essential substations. Each of the remaining two substations has a manual transfer scheme between the two main circuit breakers and the bus tie circuit breaker such that only two breakers can be maintained in the closed position at the same time. The bus tie breaker is normally open.

The 4160-480V AC nonessential unit substation F7 is supplied from 4160V Bus D2 through a normally closed 1200 ampere circuit breaker. The transformer secondary side is connected to the 480V AC 1600 amp bus through a 1600 amp circuit breaker.

The nonessential 225kVA 4160-480V AC distribution center consists of a 480V AC motor control center BF81 which supplies power to the station black out diesel generator (SBODG) auxiliaries. The center is fed from transformer DF8, a 4160-480V transformer through breaker BF8105. Transformer DF8 is powered through a fuse from 4160V Bus D3 by either the SBODG via breaker AD301 or from Bus D2 via AD213. The normal feed for D3 (and DF8) is from Bus D2 breaker AD213.

Each of the two lighting substations has a single bus arrangement and one transformer. The primary side of the transformer is connected to one 4.16kV AC nonessential bus. The secondary side is connected to the 1600 amp bus through a 1600 amp circuit breaker. The two lighting substation 480V AC buses are connected through a normally open tie breaker. Either transformer can supply the entire station lighting load.

An outdoor distribution center supplies 480V AC power for outdoor lighting and other miscellaneous loads. The distribution center transformer is connected to one of two alternate 4.16kV sources through a manual throw-over switch.

Two switchyard distribution centers are provided to supply the switchyard AC requirement of 480V AC and below. Each distribution center transformer is connected on the primary side to one 4.16kV AC nonessential bus.

The 480V AC system also contains approximately 70 motor control centers about two-thirds of which supply nonessential station loads, and the remainder serve engineered safety features and other safety loads. The motor control centers are supplied from the unit substations.

The equipment is arranged and switching accomplished such that the loss of any 480V bus or any single failure would deprive the station of only part of the safety-related equipment associated with that particular function. The remaining operational equipment will be adequate in these circumstances to allow the station to continue to operate and supply all safety functions (see Figures 8.3-23 and 8.3-24).

The circuit breakers shown on Figure 8.3-2 identified as being “without automatic tripping device” and described as follows.

The breakers are molded case type which have continuous current ratings equal to the frame size, but are not equipped with automatically operating over current circuit tripping elements.

The breakers are designed to function as manually operated, high capacity disconnect switches only. Normal circuit protective functions are assigned to other system breakers, i.e., those breakers with over current tripping elements.

The use of this type of breaker can be justified in the design of a Class 1E power system since, as stated previously, circuit protective functions are properly assigned to breakers equipped with automatic over current tripping elements or current limiting fused disconnect switches.

The following is a description of the design of the Class 1E electric power systems downstream of the 480V switchgear buses “E1” and ‘F1” (Figure 8.3-2), to demonstrate conformance with IEEE Standard 308-1971 and Regulatory Guide 1.6.

As noted on the revised Figure 8.3-2, all possible cross connections, except three, between buses “E1” and “F1“ and a fourth between “F1” and non-essential Bus “F7”, have been eliminated. These remaining four listed below, are designed with both electrical and manual mechanical interlocking to guarantee independence between buses “E1” and “F1” and between “F1” and “F7”; this conforms to Regulatory Guide 1.6, position 4 (d). In addition, transfer between “E1“ and “F1” and between “F1” and “F7” is non-automatic, and thus conforms to Regulatory Guide 1.6, positions 4 (a) through 4 (c).

a. Motor control center F13 is non-safety related. It has its associated incoming, non-automatic circuit breakers, BF1310 and BF1304, mechanically interlocked by a Kirk key system which precludes having both breakers in the closed position at any one time. The associated upstream motor control center normal feeder breaker, BF705, at bus “F7” is automatically tripped by an electrical interlocking contact from breaker BF1304 if breaker BF1304 is open. Similarly, the upstream motor control center alternate feeder breaker, BF113, at bus “F1” is automatically tripped by an electrical interlocking contact from breaker BF1310 if breaker BF1310 is open. Thus there is no direct interlocking between buses “F7” and “F1“. In addition, an alarm in the control room is established if a non-normal breaker alignment (based on Figure 8.3-2) is set up.

b. Motor control center EF15 has a split bus arrangement, one bus for high speed and the second for low speed operation of containment cooler fan 1-3. Kirk key type mechanical interlocking is provided between breakers BEF152 and BEF154 and between breakers BEF151 and BEF153. This prevents both paired breakers from being in the closed position at any one time. Breakers BEF151 and BEF152 are electrically interlocked with their associated upstream substation breaker BE105. In addition, breakers BEF153 and BEF154 are electrically interlocked with their associated upstream substation breaker BF105. The electrical interlocking is actuated to trip the substation breaker if either of its associated downstream breakers is open. An alarm in the control room is established if a non-normal breaker alignment (based on Figure 8.3-2) is set up.

c. Motor control center EF12C can be fed from either bus “E1“ or bus “F1“ via motor control centers E12A or F12A, respectively. Kirk key type mechanical interlocking is provided between fused disconnect switches BEF121 and BEF122 in order to preclude having both fused disconnect switches closed at the same time. Electrical interlocking is provided between fused disconnect switch BEF121 and its associated upstream, latch-in type contactor at BE1280 of motor control center E12, section E12C and between fused disconnect switch BEF122 and its associated upstream, latch-in type contactor at BF1280 of motor control center F12, section 12C. In both cases, electrical interlocking prevents contactor closing if the associated downstream fused disconnect switch is open. The electrical interlocking also trips the contactor if the downstream fused disconnect switch is opened after the contactor has been closed.

d. Motor control center EF12D can be fed from either bus “E1” or bus “F1” via motor control centers E12A or F12A. Kirk key type mechanical interlocking is provided between breakers BEF128 and BEF129 in order to preclude having both breakers closed at the same time. Electrical interlocking is provided between breaker BEF128 and its associated upstream contactor at BE1207 on MCCE12A and between breaker BEF129 and its associated contactor at BF1224 on MCCF12A. In both cases, electrical interlocking prevents contactor closing if the associated downstream breaker is open.

8.3.1.1.6 120V AC Auxiliary System

The station 120V AC system (see Figure 8.3-25) consists of:

Four essential instrument distribution panels each supplied from a 125V DC/120V AC inverter. The four essential instrument distribution panels are comprised of six physical panels, Y1, Y1A, Y2, Y2A, Y3, and Y4. The two physical panels for Channel 1, Y1, and Y1A, are administratively controlled as a single panel, identified as bus Y1. The two physical panels for Channel 2, Y2, and Y2A, are administratively controlled as a single panel, identified a bus Y2. Buses Y3 and Y4 are each comprised of a single distribution panel.

Two regulated instrument distribution panels each supplied from one 480/120V AC static voltage regulator.

Two uninterruptible instrument distribution panels each supplied from a 250V DC/120V AC inverter.

All inverters are fed from the DC power supplies as described in Subsection 8.3.2.

Each of the four 120 volt single phase, 60 Hertz essential instrument distribution panels supplies power to one of the four channels in the reactor protection system and the safety features actuation system. The essential instrument AC system is arranged so that any type of single failure or fault will not prevent the reactor protection system or safety features actuation system from performing their safety functions. There are four independent panels available, and a single failure within the system can involve only one panel. A combination of simultaneous failures or faults on any two of the channels will trip the reactor and trigger the safety actuation system.

The inverter and rectifier for channels 1, 2, 3, and 4 are equipped with a static automatic bypass switch for fault clearing capability and for maintaining power to the 120V AC essential distribution panels upon inverter failure. The alternate source for channels 1 and 3, and 2 and 4 inverters are essential 480V AC busses E1 and F1 respectively through a 480/120V AC constant voltage transformer (CVT). Although the essential CVT is available as a maintenance backup source, a non essential regulated instrumentation distribution panel is also available as an alternate source to the 120V AC distribution panel via manual transfer.

Each uninterruptible instrument distribution panel is fed from one 50kVA single phase, 60 Hertz 250V DC/120V AC inverter and supplies important non-safety related loads, as shown in Figure 8.3-25.

Each of the two regulated instrument panels is fed from one of two static voltage regulators, from a separate AC source, and supplies non-safety-related instrument and miscellaneous controls.

8.3.1.1.7 Channels

Davis-Besse Nuclear Power Station Unit No. 1 has four essential Channels 1, 2, 3, and 4.

8.3.1.1.8 Physical Arrangement of the AC Electrical System Components

The physical locations of electrical distribution system equipment are such as to minimize vulnerability of essential circuits to physical damage as a result of accidents. Redundant Class 1E distribution switchgear (both medium and low voltage), some motor control centers, and distribution panels are located in separate, rooms in the Seismic Class I auxiliary building. In two cases, where redundant Class 1E motor control centers are located within the same room, horizontal separation distances are 6 and 17 feet. The MCCs separated by 6 feet have a block wall fire barrier located approximately midway between them. The locations are as follows: (See Figures 8.3-31 through 8.3-34.)

a. The auxiliary, startup, and bus tie transformers are located out of-doors, physically separated from each other. Lightning arresters are provided for the startup transformers. All outdoor transformers are protected by automatic water spray systems to extinguish oil fires quickly and prevent the spread of fire. Fire walls are installed between transformers to minimize the exposure to fire and mechanical damage.

b. The medium voltage switchgear buses are located indoors in physically isolated rooms as follows:

   13.8kV bus A and 4.16kV buses C1 (Channel 1) and C2 are located in room 325;

   13.8kV bus B and 4.16kV buses D1 (Channel 2) and D2 are located in room 323;

   4.16kV manual transfer breakers (Channel 3) are located in room 324.

c. Low voltage switchgear room 428 contains the following:

   480V AC unit substations F1 (Channel 2) and F2;

   480V AC motor control center F12A (Channel 2);

   480V AC motor control center F14 (Channel 2);

   480V AC motor control center F15 (Channel 2);

   480V AC motor control center F16A (Channel 2);

   120V AC panel Y2 and 125V DC/120V AC inverter YV2 (Channel 2);

   120V AC panel YBU and 250V DC/120V AC inverter YVB;

   480-120V AC Constant Voltage Transformer XY2

   120V AC regulated panel YBR and 480V/120V AC static voltage regulators XYB;

480V AC lighting substation F5 (non-essential). The other 480V AC lighting substation E5 is located in the turbine building

d. Low voltage switchgear room 429 contains the following:

480V AC unit substations E1 (Channel 1) and E2;

480V AC motor control center E12A (Channel 1);

480V AC motor control center E14 (Channel 1);

480V AC motor control center E15 (Channel 1);

120V AC panel Y1 and 125V DC/120V AC inverter YV1 (Channel 1);

120V AC panel YAU and 250V DC/120V AC inverter YVA;

120V AC regulated panel YAR and 480V AC static voltage regulator XYA.

480-120V AC Constant Voltage Transformer XY1

e. Low voltage supply room 428B contains 120V AC panel Y4 and 125V DC/120V AC inverter YV4, both Channel 4.

480-120V AC Constant Voltage Transformer XY4

f. Low voltage supply room 429A contains the following:

120V AC panel Y3 and 125V DC/120V AC inverter YV3, both Channel 3;

480-120V AC Constant Voltage Transformer XY3

480V AC motor control center EF15 (Channel 3).

g. The remaining 480V AC motor control centers are located indoors in areas of electrical load concentration. Physical separation is maintained between essential motor control centers fed from redundant channels.

h. The redundant Class 1E emergency diesel generating units which serve as the standby power supplies are located in separate, adjacent rooms (318 and 319) in the Seismic Class I auxiliary building. A fire wall and door are provided between the two rooms. Starting air for each diesel is provided by independent air reservoirs, two (2) per diesel, one (1) for each set of starting motors.

The local control and auxiliaries for each emergency diesel generating unit are located in the same room as the diesel with which they are associated.

i. Four separate rooms, two on the east and two on the west side of the containment, are provided for electrical penetrations. The two rooms on each side are on different floors (see Figure 8.3-33).

Class 1E containment electrical penetrations carry only Class 1E circuits except as noted below. Redundant Class 1E containment electrical penetrations are widely dispersed around the circumference of the containment. Wherever possible, redundant circuits are run through separate penetration rooms. The center-to-center spacing between penetrations at the outside of the containment is 32 inches horizontally and 60 inches vertically. Separate penetrations are provided for power, control and instrumentation cables. For essential redundant systems in a given penetration room, penetrations are kept as far apart as possible, and in no case will they be less than 9 feet apart. Cables in the annulus space are installed as shown on Figure 8.3-34.

The minimum physical separation for redundant electrical penetrations inside the containment are listed below:

1E Channels	Distance
1 to 2	22'
1 to 3	24'
1 to 4	23'
2 to 3	10'
2 to 4	21'
3 to 4	24'

As discussed in Subsection 8.3.1.2.29, all containment electrical penetrations, regardless of circuit function assignments, are designed and tested to meet IEEE Std. 317-1971. Conax penetration assemblies were designed and tested to meet IEEE 317-1976 as modified by NRC Regulatory Guide 1.63, Revision 2. Cables which are part of Class 1E circuits are assigned to penetrations which are exclusively dedicated to Class 1E service, whereas cables which are part of non-Class 1E circuit functions are assigned to penetrations dedicated for that service. Exceptions are as follows:

1. The non-Class 1E cables that feed the motor space heaters associated with two containment cooler fans. These heater circuits are de-energized when the fans are running.

2. The cables for the Reactor Vessel Vent Line Temperature thermocouples, which are non-Class 1E circuits that utilize a penetration dedicated exclusively to Class 1E instrumentation circuits. This situation has been analyzed and found to have no adverse affect on Class 1E circuits in the same penetration.

3. The non-Class 1E cables associated with Containment Recirculation Fan 2 motor. These cables were originally Class 1E and were later downgraded to non-Class 1E. However, they physically remain with Class 1E circuits, and are considered associated Class 1E circuits. They have been evaluated and found not to present the potential to degrade the integrity of their Class 1E power supplies.

Redundant Class 1E containment electrical penetrations are widely dispersed around the circumference of the containment.

The electrical penetration assemblies are described in Subsection 3.8.2.1.10.

j. The applications, installation and routing of control, instrumentation and power cables are such as to minimize their vulnerability to damage from any source and to maintain the integrity of their respective redundant channels and/or branches.

k. All Class 1E cables are run in solid bottom trays when not in embedded conduit, exposed conduit, or wireway except for cables in the annulus space and manholes, In general, all Class 1E powercables are run in conduit except for those instances mentioned in Subsection 8.3.1.2.19.

l. The locations of redundant Class 1E actuated equipment such as pump drive motors and valve operating motors have been reviewed to ensure the minimum required functional capability despite any single design basis event or result therefrom.

8.3.1.1.9 Tests and Inspections

The AC electrical systems are designed to permit testing and inspecting the operability and functional performance of the components of the system as well as the operability of the system as a whole. Essential and safety-related systems are provided with complete redundancy to permit testing of one system while the redundant system is performing the same function. This ensures no interruption of station operation.

The 345kV circuit breakers will be inspected, maintained and tested on a routine basis. This can be accomplished without removing the generator, transformers and transmission lines from service.

Transmission line protective relaying will be tested on a routine basis. This can be accomplished without removing the transmission lines from service. Generator and unit auxiliary transformer relaying will be tested when the generator is off line. Startup transformer relaying will be tested while the transformer is off the line.

The 13800, 4160 and 480 volt circuit breakers and associated equipment may be tested while individual equipment is shut down. The circuit breakers may be placed in the test position and tested functionally. The breaker opening and closing may also be exercised. Circuit breakers and contactors for redundant or duplicated circuits may be tested in service without interfering with the operation of the unit.

Manual and automatic transfer schemes among the various power sources will be tested on a routine basis to prove the operability of the system.

The capability of the essential buses to provide power to engineered safety features components will be demonstrated as part of the surveillance requirements of the station Technical Specifications. Additionally, continuous normal operation of selected service water and component cooling pumps on the 4160V essential buses, of selected containment air cooler fans on 480V essential buses, and operation of the RPS, SFAS, and radiation monitoring systems on the 120V AC essential instrumentation buses will verify essential power availability. Emergency diesel generator availability will be verified according to Technical Specifications.

Local indication of 480V fused disconnect switch status is provided at the fused disconnect switch MCC bucket. A “status” light provides visual confirmation of a satisfactory circuit status for all 3 phases, which indicates fuse condition and disconnect switch closure.

8.3.1.1.10 Administratively Controlled Devices

Administratively controlled circuit opening devices are listed in Table 8.3-2 by device number, type and location.

8.3.1.1.11 Cross Ties Between MCC E11B and F11A

The primary and backup boron dilution flow paths each have a Train 1 and Train 2 essentially powered isolation valve in series. These four valves are:

Line	Valve	Channel	MCC	Valve Location	MCC Location
Primary Flowpath					
Auxiliary pressurizer spray	HV2735	1	E11B	Inside cont.	El. 585' Room No. 304
Auxiliary pressurizer spray	HV2736	2	F11A	Outside cont	El. 603' Room No. 427
Backup Flowpath					
Decay heat suction	HVDH11	2	F11A	Inside cont.	El. 603' Room No. 427
Decay heat suction	HVDH12	1	E11B	Inside cont.	El. 585' Room No. 304

Should one of the two redundant emergency diesel generators fail, should the 4 kV bus C1 or D1 fail, or should 480V bus E1 or F1 fail; it would be necessary to provide power to at least one of the affected two valves from the unaffected power supply. This would be accomplished by administratively utilizing the tie path between MCC F11A and MCC E11B as provided in Davis-Besse Emergency Operating Procedures (refer to Figures 8.3-23 and 8.3-24).

Interconnecting cables are designated as Channel 12 and are run in conduit dedicated exclusively for these cables.

8.3.1.1.12 Motors

All safety related Limitorque actuators shall be purchased to a specification which insures the motor will be able to perform its intended safety function with 70 percent of motor rated nameplate voltage, or, on an individual basis where the 70 percent of motor rated nameplate voltage does not apply, be purchased to a percentage of rated nameplate voltage which assures satisfactory operation under all required conditions.

While most initial purchase specifications required valve operation at 70 percent terminal voltage; in some cases subsequent evaluations have determined that required torque is greater than originally determined. In those cases operation of the valve has been established using available voltage at the Limitorque actuator's terminals, as determined by calculation.

8.3.1.2 Analysis

The station AC electrical system as described under Sections 8.2 and 8.3 ensures the following:

8.3.1.2.1 Switching

Three physically independent transmission lines are provided from the transmission network to the station switchyard minimizing power failure due to faults in the network interconnection and the associated switching (see Subsection 8.2.1.1).

8.3.1.2.2 Independent Circuits

Three independent circuits are provided to supply power to the onsite electrical distribution system, and with any two circuits in service the requirements of NRC General Design Criterion 17 are fulfilled.

8.3.1.2.3 Onsite Standby Emergency Diesel Generator Units

Two onsite standby emergency diesel generator units are provided. Independence and physical separation between the two units and between each unit and the other power sources is maintained so that no credible single event will disable more than one unit. The floor drains in the two EDG rooms are interconnected, and therefore not physically separated and independent. An evaluation of this common drain design verified that no credible single event would disable both EDG units (see also Flooding in Subsection 8.3.1.1.4.1).

8.3.1.2.4 Power Distribution System

The two engineered safety features power distribution systems are connected to different 4.16kV essential buses, and they are redundant in that completion of the starting and loading of one emergency diesel is adequate to satisfy the minimum engineered safety feature requirements.

8.3.1.2.5 DELETED

8.3.1.2.6 Parallel Operation

Parallel operation of the emergency diesel generators is not permitted.

8.3.1.2.7 Testing

During modes 1, 2, 3, or 4 an emergency diesel generator (EDG) can be tied to the grid (loaded) only if the other EDG is operable. If one EDG is inoperable during modes 1, 2, 3, or 4, the remaining operable EDG can be started for testing, but shall not be tied to the grid (loaded). In modes 5 or 6 with one EDG inoperable, the remaining operable EDG can be started and may be tied to the grid (loaded) for testing purposes. If the remaining operable EDG is loaded in modes 5 or 6, the Technical Specification requirements for the required EDG being inoperable shall be followed.

8.3.1.2.8 AC Electrical System

The station essential AC electrical system consists of two electrically isolated and physically separated load groups. Each has access to normal (unit auxiliary transformer), reserve (startup transformer), and onsite standby (emergency diesel generators) power sources.

8.3.1.2.9 Controls

Automatic and manual controls are provided to permit the following:

a. selection of the most suitable power source for the distribution system;

b. disconnecting the appropriate loads when normal and reserve sources are not available;

c. starting and loading the standby power supply.

8.3.1.2.10 Electric Power

Systems and equipment that provide electric power for the safe shutdown of the reactor are classified as Class 1E (essential) and are designed to perform their functions when subjected to any design basis event. The variation of voltage and frequency during switching of such equipment will not degrade the performance of any load to the extent of damaging the reactor coolant system or fuel rods.

8.3.1.2.11 Protection Systems

Protection systems are provided and designed to initiate automatically the operation of the appropriate equipment. Necessary protective devices are provided to isolate failed equipment and to identify the equipment that has failed. For the protection system related to the engineered safety features and essential functions, complete redundancy, independency, and inservice testability is maintained.

8.3.1.2.12 Instrumentation

Essential instrumentation, control, and power requirements are supplied by reliable, independent, and redundant sources designed to ensure that no single failure will result in loss of power to safety-related equipment.

8.3.1.2.13 Periodic Testing

All essential electrical systems are designed to permit periodic testing of the operation of individual system components with the station in operation.

8.3.1.2.14 Cables and Raceway Functions

Cable functions are divided into three categories: Power (P), Control (C), and Low Level Instrumentation (L). In addition cables are classified according to their service as essential and non-essential. Cable tray and wireway are classified according to their service as carrying essential and nonessential cables and according to their function. Conduit are only classified according to their service. Four essential channels are provided.

Essential Channels

Cables are identified with the color and by the first digit of the cable number corresponding to the channel, and the second character corresponding to the function as follows:

Channel		Function
Designation	Color	Designation
1	Green	Power (P)
2	Orange	Control (C)
3	Light Blue	Instrumentation (L)
4	Maroon	

Cable tray and wireway are identified with the label background color corresponding to the channel, and the color of the label alphanumeric identifier corresponding to the function. The first digit of the identifier indicates the channel and the second character indicates the function.

Channel		Function	
Designation	Color	Designation	Color
1	Green	Power (P)	Black
2	Orange	Control (C)	White
3	Light Blue	Instrumentation (L)	Yellow
4	Maroon		

Conduit containing essential cables are banded with the color associated with the essential channel. Scheduled conduit (excludes lighting and communication circuits) in Containment and the Auxiliary buildings have an alphanumeric identifier which is stamped on a metal tag and attached to the conduit. Function is not included in the labeling of any scheduled conduit.

Interconnections Between Essential Channels

The 2 out of 4 logic design of the NI/RPS & SFAS necessitates running interconnecting cables between control room cabinets having different essential channel designations. The identifiers are 12, 13, 14, 23, 24, and 34.

Each cable is marked with the color corresponding to the channel which is designated by the first character of the cable number. For example. cable number 12SFSP01 means that the cable runs between Channel No. 1 and Channel No. 2 cabinets and is colored green which corresponds to Channel No. 1.

The interconnecting cables between the SFAS cabinets of different channels and between the RPS cabinets of different channels are routed through raceways that are independent of any other raceway. Interconnecting cables having different identifiers do not share a common raceway once outside the cabinets. Wireways containing the interconnecting cables have the same identifier as the cables, i.e., the first two characters of the raceway number are the same as the first two characters of the cable number.

External to the SFAS/RPS cabinets physical separation is required between interconnecting cables that are prefixed with 12, 13, 14, 23, 24 or 34. Physical separation is achieved by installing the differently prefixed cables in independent raceway system. Cables having the same prefix (identifier) share the same raceway. The interconnecting cables may contact non-essential cables of any channel (A, B, or C) provided bridging does not occur. (Bridging occurs when a single non-essential cable or conductor is simultaneously bundled, routed, or formed with cables or conductors of two different essential channels.)

Raceways connected to the RPS, with the exception of those used for NI loops, do not contain voltages in excess of the isolation device circuit ratings. The NI loop cables have a working voltage of 1200V for the intermediate and power range channels and 2400V for the source range channels. These cables, however, are run entirely in their own separate conduits from the detectors to the RPS cabinets.

RPS and SFAS In-Cabinet Isolation

As discussed in Subsection 7.3.2.3, physical separation between redundant channels of the SFAS is accomplished by locating each redundant channel in a separate cabinet assembly.

Internal to the SFAS cabinets, physical separation is maintained between interconnecting cables and input sensor cables. Physical separation is required between interconnecting cables and non-essential cables where bridging could occur. All cables pass through fire stops at cable entrances/exits. Isolation is provided between trip signals in interconnecting cables and essential cables. The isolation device circuits are designed to withstand the effects of short circuits, open circuits, grounds, electrical transients and the application of AC or DC potential as listed below:

1. Analog signal isolation device circuits are capable of withstanding a maximum of 600V DC or AC peak across their output without affecting the input.

2. Digital signal isolation device circuits have a minimum dielectric strength rating of 450V AC (RMS) between the input and output signals.

The isolation device circuit includes the isolation device, internal wiring and field wiring connection terminal strips. No single failure of an isolation device circuit will compromise the operating ability of the redundant system.

Analog signal isolation devices, with individual power supplies, are provided between the sensing channel and the logic channel. Digital signal isolation devices are provided between the logic channel trip bistables and the output modules of the actuation channel.

Electrical noise transient testing was performed on the SFAS equipment during system functional testing at the vendor facility. Noise transients were generated in close proximity to all interconnecting wiring including essential and nonessential wiring. All equipment was operational with inputs and outputs simulated. It was verified that the equipment operation was not affected by the transients. The noise test report has been submitted as part of the docket under separate cover.

As a further precaution against electrical noise, particularly radio interference, no portable radio transmitters (with attached transmitting antenna) or any other radio transmitting antennae will be allowed in the control/cabinet room or cable spreading room.

A test program was implemented by TED to demonstrate the adequacy of noise rejection isolation devices and internal cable routing of the RPS and SFAS for credible electrical faults introduced from non-Class 1E systems and equipment.

An evaluation of the Station and Instrument Ground Systems at the Davis-Besse Nuclear Power Station was performed by the Lawrence Livermore National Laboratory, California.

The reactor protection system was subjected to electromagnetic, electrostatic, and noise level tests. Also, system isolation tests were performed on selected devices of the RPS. A complete test description (test parameters, schematics, equipment list, procedures, and specifications) for each test was submitted by Toledo Edison Co. Each test consisted of four basic parts: type of test, acceptance criteria, pretest values, and post-test values. After the system or device was subjected to a selected type of test, the test values were analyzed to determine if the system or device failed to meet the acceptance criteria.

The scope of the testing for the SFAS was to demonstrate that the isolation capability of the digital and analog isolation devices are not degraded to unacceptable levels following the inadvertent application of postulated electrical faults in excess of normal operating currents. Also, that due to the intermix of non-Class 1E and Class 1E signal wiring, postulated electrical faults appearing on the non-Class 1E circuitry will not produce unacceptable effects in the Class 1E circuitry by means of mutual inductance and/or capacitive coupling.

The isolation device testing consisted of testing one of each type of device used in the SFAS Class 1E to non-Class 1E circuitry, while system testing consisted of utilizing one complete channel of the SFAS.

Based on the above, the isolation noise testing performed on the RPS and SFAS was found to be acceptable.

The reactor protection system has adequately demonstrated its capability to perform the Class 1E protective functions when subjected to electrostatic, electromagnetic, isolation and noise level tests. The above tests, performed to NRC approved test methods and MIL-N-19900B as required, concluded that:

(1) no significant degradation to the Class 1E circuitry occurred as a result of the fault tests;

(2) no spurious trips or resets of the relays occurred as a result of the fault tests; and

(3) no spurious trips, resets, or reactions of the SFA system occurred as a result of the fault tests.

NRC reviewed the tests and documents submitted and issued a Safety Evaluation Report accepting the tests and results, concluding that an analysis and testing of the ground grid systems has been conducted per NRC criteria and the ground ties found in the ground grid systems which do not meet design criteria have been isolated and corrected.

As discussed in Subsection 7.2.2.1, physical separation between redundant channels of the RPS is accomplished by locating each redundant channel in a separate cabinet assembly. The cabinet assembly provides physical protection of the cabinet internal equipment from external hazards such as missiles and fire. All openings between the cable spreading room and RPS cabinets through which RPS cables pass, are sealed to prevent the passage of fire, smoke, and fumes.

Internal to the RPS cabinets, the independence of redundant channels is maintained by isolation device circuits. The isolation device circuits have been tested and analyzed to protect against short circuits, open circuits, grounds, and the application of AC or DC potential as listed below:

1. Analog signal isolation device circuits are capable of withstanding a minimum of 400V DC or AC peak across their output without affecting the input.

2. Digital signal isolation device circuits have a minimum dielectric strength rating of 480V AC RMS between the input and output signals.

The isolation device circuits include the isolation device, internal wiring, and field wiring connection terminal strips. The isolation device is an isolation amplifier for analog signals and a relay for digital signals. The isolation device circuit internal wiring and field connection terminal strips have the same characteristics (flame retardancy, maximum operating temperature, dielectric strength) as the wiring and terminal strips used internally within the cabinets for Class 1E service.

The isolation device circuits have been tested and analyzed by type tests and type analysis to establish the isolation device characteristics. The RPS isolation device circuits for Toledo Edison Davis-Besse 1 Nuclear Power Generation Station are production units of the circuits tested and analyzed by type. The isolation test report was submitted as part of the docket under separate cover.

The RPS exhibits a high degree of immunity to the effects of electromagnetic and electrostatic-induced noise on non-Class 1E signal output leads and Class 1E input leads. The immunity to noise has been established by operating experience, tests, and noise-rejection circuits. The Noise Test Report was submitted as part of the docket under separate cover.

<u>ASP In-Cabinet Isolation</u>

Physical separation between redundant channels of the Auxiliary Shutdown Panel (ASP) is accomplished by locating each redundant equipment system and its terminations in separate and independent, fully enclosed subsections of the panel. Refer to Subsection 7.4.2.5 for additional design features for the ASP.

Internal to the ASP, the separation of 1E and non-1E analog circuits is maintained by an isolation device circuit. The circuit configuration for the analog isolation in the ASP differs from the configuration used in the NI/RPS only in that the operational amplifier in the ASP is used in the non-inverted mode while the amplifiers in the NI/RPS are used in the inverted mode. The voltage isolation capabilities of the ASP configuration is very similar to that of the NI/RPS. Analysis performed on the ASP circuits has shown the same isolation capabilities as the NI/RPS.

<u>Clarification to Essential Channels of the SFAS</u>

The logic of the safety actuation Channel No. 1 requires that both the terminating relays of sensing and logic Channels No. 1 and No. 3 be de-energized to initiate the actuation of Channel

No. 1. Similarly it is required that sensing and logic Channels No. 2 and No. 4 be de-energized to initiate actuation Channel No. 2. See Subsection 7.3.1.1.2.

Approximately fifty percent of the field cable terminations of actuation Channel No.1 are made in the Channel No. 1 SFAS cabinets while the remaining field cables of actuation channel No. 1 are terminated in the Channel No. 3 SFAS cabinets. Similarly for actuation Channel No. 2, the terminating field cables are in Channel No. 2 and Channel No. 4 SFAS cabinets.

The field cables are coded by the color of the actuation channel that it serves.

Nonessential Channels

Nonessential, i.e., non-Class 1E, functions are divided into channelized categories for improving station reliability. Classifications are alphabetized as contrasted to the numerical essential channels and are designated as Channels A, B, and C.

Nonessential cables may have any mix of black, white, or yellow jackets when routed in raceways designed to carry nonessential cables. Nonessential cables that are routed in raceways designated to carry Class 1E cables are color coded, as a minimum:

1. At the exit/entrance of the shared raceway and at numbered junction boxes when the nonessential cable terminates at non-Class 1E equipment.

2. At the exit/entrance of the shared raceway, at numbered junction boxes, and at each end when the nonessential cable terminates at Class 1E equipment.

When non-essential cables are routed in raceways designated to carry essential cables (see Subsection 8.3.1.2.18), color coding is as follows:

Designation	Color
Channel A	Dark blue
Channel B	Tan
Channel C	Silver Fleck

8.3.1.2.15 Cable

Each cable is identified at each end with a cable number: the first digit indicates the channel, and the second digit indicates the function. In addition, the jacket of each essential cable is marked with the color corresponding to its channel every 5 feet (maximum) when in tray/wireway and at end points and intermediate pull points when installed in conduits.

As a minimum, cable routed in conduits is color coded at the termination points and intermediate pull points. In addition, each essential cable is identified at each end with its associated alphanumeric designation as described above.

8.3.1.2.16 Safety Feature Actuation System (SFAS) and Reactor Protection System

The Safety Features Actuation System and Reactor Protection System logic cabinets are painted in the corresponding channel colors.

8.3.1.2.17 Markers

Each tray carrying essential cables is identified with colored plastic markers at intervals averaging every fifteen (15) feet, in compliance with Paragraph 5.1.2 of Regulatory Guide 1.75 giving the tray number. The first digit of each tray number indicates the channel, and the second digit indicates the function. Where a mixture of functions occurs in a common tray or wireway (see Subsection 8.3.1.2.18, below, for cases where mixtures exist), the second digit of the tray or wireway number indicates the function of the majority of the cables in the raceways. Markers have background colors corresponding to the channel and the digit color corresponding to the function. The markers are color-coded on the basis of the majority of the cables in the raceway. Trays carrying control and instrumentation cables are amply sized to contain the required number of cables.

Each essential conduit is color coded according to channel at all entry and exit points through which the conduits are run, as well as all attach points to equipment or trays.

Control trays are those trays that contain conductors that carry continuously 10A or less at 150 volts or less.

Instrumentation trays are those trays that contain conductors that carry 50 ma or less.

8.3.1.2.18 Essential Cables

Essential cables only run in raceways specifically designated for the corresponding channel. Nonessential cables may run in raceways designed to carry essential cables; however, no nonessential cable will run in the raceways of more than one essential channel. Cables for a given function are only run in raceways designated for that function, except (1) that small motor-operated valve leads and solenoid valve leads may be classified as control cables and routed accordingly and (2) where physical limitations prevent the installation of independent raceways for a given function (a mixture of functions occurs in the following raceways: 1CJQ10, 1CJR10, 1CJS10, 3LP63D, 4LP56D, 1PGS01, and 1PGS03).

Exception (1) is allowed since the operating voltage of the control and power section of a particular valve circuit (solenoid or small motor operated valve) are the same (120 volts) and are actually derived from the same power supply. Consequently, classifying and routing the entire circuit as control is of no concern.

Exception (2) concerning raceways 1CJQ10, 1CJR10, and 1CJS10 is allowed since both 480-volt power and 120 volt control are derived from the same motor control center (MCCE11C), the lengths of raceways are very short (approximately 2 feet) and all cable contained therein has an insulation rating of 600 volts. Furthermore, these raceways are physical extensions of the MCC to the MCC crown box.

Exception (2) concerning raceways 3LP63D and 4LP56D is allowed since the control cables carry low voltages (6 volts AC and 24 volts DC) and will not generate noise within the instrumentation cable which is shielded and twisted. In addition, these voltages are well below the ratings of the analog isolation devices in the SFAS as discussed in Subsection 8.3.1.2.14.

The nonessential control cable that is run in raceways 1PGS01 and 1PGS03 is allowed since the nonessential cable does not come in contact with cables of more than one essential channel.

Furthermore, there is no safety channel violation associated with any of these exceptions.

8.3.1.2.19 Power Cables

All essential power cables are run in exposed steel or embedded nonmetallic conduit, except in the annulus space, in manholes, where physical limitations exclude the installation of conduit, and where channel separation is required in manholes. When physical limitations exist and/or channel separation in manholes is required, the power cables are run in tray or wireway. Power cable is contained in the following trays/wireways: 1CJQ10, 1CJR10, 1CJS10, 1PBM01, 1PJA01, 1PAM01, 1PAM02, 2PAM02, 3PAM01, 1PGS01, 1PGS02, and 1PGS03. Justification is as follows:

> 1CJQ10, 1CJR10, 1CJS10: The space available was insufficient to terminate all conduits destined for the various vertical stacks of MCCE11C. Short sections of tray, in lieu of cabinet extensions, were used to gather and deploy the cable to the appropriate stacks (see Subsection 8.3.1.2.18).
>
> 1PBM01, 1PJA01: Physical limitations that imposed restrictions on conduit bending radius and space limitations at the containment penetration terminal boxes prevented the installation of conduits at penetration terminal boxes P1P2MI and P1P2MX. Short sections of wireway were used to gather the cable and nest the cable to the penetrations. There is no separation conflict in this instance.
>
> 1PAM01, 1PAM02, 2PAM02, 3PAM01 (located in manhole 3001): Wireways were used to achieve channel separation, by use of a metal barrier, inside manhole 3001. Wireway was used in lieu of conduit because the need for channel separation was not apparent until after the cables were pulled.
>
> 1PGS01, 1PGS02, 1PGS03: The location of embedded conduit stub-outs with respect to the penetration terminal box, in conjunction with structural steel interferences, prevented the installation of conduit.

The embedded nonmetallic conduits are in concrete duct banks which are Seismic Class I structures. Class 1E cables of different essential channels are run in separate nonmetallic conduits encased within the duct bank and separation between these conduits is a minimum of 1-1/2 inches.

8.3.1.2.20 Routing of Class 1E Circuits

The routing of Class 1E circuits has been reviewed for exposure to potential hazards such as high-pressure piping, missiles, flammable material, and flooding (see Chapter 3). All raceways are flame retardant.

Trays carrying essential control and instrumentation cables are amply sized to preclude overfill. Control cable trays are filled to 60 percent of tray cross-sectional area or less except at tray cross fittings where the limit is 54 percent in the entering and exiting legs of the cross. The cable cross sectional area above the tray side rails is included with the cable cross-sectional area within the side rails in determining tray fill percentage. Instrumentation and control cable tray loading is permitted to the height of the side rails. At crosses, tees, and where large conduit spills into trays, the height of the fill may exceed the side rails height due to cable crossover. Where the intent of vertical cable tray separation criteria would be negated by cable exceeding the tray rail heights, the inclusion of a thermal insulating material provides the required separation. In addition, all trays are ladder type with solid bottoms. Trays passing through fire walls, floors and ceilings are provided with fire stops.

The minimum cross-sectional area of the cable tray cross fittings used is 90% of the combined cross-sectional area of the two (2) intersecting trays, and therefore, in order to maintain the 60% fill limitation within the cross fitting, limits the fill to 54% (90% of 60%) in the entering and exiting legs of the cross. In no instance is there any essential system tray cross fitting with entering or exiting legs having a cable fill in excess of 54%. The identified 54% fill limitation will be maintained for tray cross fittings' legs on essential system trays.

By not exceeding the 54% fill limit on each leg, recognizing that cables cannot terminate within a Tee, the exceeding of the 60% fill of the Tee is prevented.

Separation between trays carrying redundant Class 1E circuits is usually accomplished by locating these trays in separate rooms. However, as defined in Section 5.1.4 of Regulatory Guide 1.75, in some general plant areas, defined as areas from which potential hazards such as missiles, external fire, and pipewhip have been excluded, open top trays carrying redundant Class 1E circuits are normally separated by a minimum of 4 feet vertically (bottom to bottom) and 18 inches horizontally. These minimum distances are considered adequate, since (1) the tray system is solid bottom rather than open ventilated, and (2) cable jackets have a self-extinguishing and non-propagating flame resistance characteristic as supported by certified test results.

The cable spreading room and main control room do not contain high-energy equipment such as switchgear, power transformers (except a 30 KVA dry type lighting transformer in the cable spreading room), rotating equipment, or potential sources of missiles or pipe whip and will not be used for storing flammable material. Separation criteria for open top cable trays in the cable spreading room are the same as for the general plant areas discussed above (4 feet vertically and 18 inches horizontally).

In both the general plant area and cable spreading room, where there are conditions of either convergence of trays carrying redundant Class 1E cables or crossings of trays carrying redundant Class 1E cables, where vertical or horizontal distance cannot be maintained, solid covers, flame retardant barriers, and/or thermal insulating materials are used. The locations of these installations in the cable spreading room are shown on Figures 8.3-35, 8.3-36, and 8.3-37.

The minimum vertical separation distance of 4 feet between trays carrying redundant Class 1E cables does not exclude trays carrying non-Class 1E cables from being interposed between the trays carrying Class 1E cables. This arrangement can be justified since (1) the trays carrying non-Class 1E cables are also solid-bottom type and (2) the flame retardance of the non-Class 1E installed cable is the same as that of the Class 1E cable discussed previously with minor exceptions. The criteria are shown on Figure 8.3-38. Where such distances are not met, fire barriers are installed.

The separation criteria between trays, wireways, and conduits are as shown on Figures 8.3-39 through 8.3-42. Enclosed tray, wireway, and conduit are equated insofar as these criteria. The fire barrier details associated with Figures 8.3-39 through 8.3-42 are shown on Figures 8.3-43, 8.3-44, and 8.3-45.

The above minimum separation distances do not necessarily apply to embedded conduits carrying redundant Class 1E cables. However, they do apply at points where these embedded conduits leave the embedding material and the previously enclosed cables do not continue in exposed conduit.

Thermal blankets (Kaowool or equivalent) will be provided in all open top trays with certain exceptions (e.g., trays inside containment and other selected areas). These exceptions will be documented on controlled documents.

Design and control of the cable systems layout is in accordance with approved Design Control Procedures. Trays, wireways, and conduits carrying essential cables are clearly marked on all layout drawings, and each is reviewed and approved prior to being utilized in the field. Review has included consideration of failure of a non-seismically qualified equipment affecting both redundant channels of essential components and failure of a high energy line in the vicinity of Class 1E equipment to ensure the design criteria are not violated.

During installation, electricians are responsible for installation of the equipment and cable systems in accordance with the issued drawings using approved procedures. After installation, the system is inspected in accordance with another approved procedure and the results recorded. Any deviations from issued drawings are documented and reviewed to ensure design intent is not violated. This information is then included on final, as-built drawings.

Pulling and inspection of cable within the installed raceways is performed using similarly approved procedures and results of final inspection documented.

8.3.1.2.21 Electrical Conductors

Class 1E electrical conductors except heat trace cables have insulating materials which resist heat, moisture, radiation, and ozone. Jackets are also applied over the insulations. These jackets make the cables self-extinguishing and prevent flames from spreading. Heat trace cables are not considered here, since they are used as heating elements for piping and instrumentation rather than as system interconnections. Ground wires may be bare or covered with an insulation or jacket material. Minor amounts of PVC Cables are routed in non-essential trays in the unit.

Prototypes or actual production samples of each type construction have been tested to demonstrate that all cables will withstand the environmental conditions specified (see Table 8.3-4).

Interconnections between cabinets of the SFAS are achieved by using the same single conductors as that used within the SFAS cabinets. This wiring is supplied as a part of the SFAS equipment. It is single conductor with one layer of an insulation/jacketing of polytetrafluoroethylene material which is compatible with the environmental service conditions. The wireways in which these SFAS interconnections are run are sealed with silicone foam for additional fire retardancy as necessary.

8.3.1.2.22 Base Ampacity Ratings of Cables

Base ampacity ratings of cables are established as published in IPCEA P-46-426 and in accordance with the manufacturer’s standards. To this basic rating a grouping derating factor, also in accordance with IPCEA tables, is applied.

Credit is taken for load diversity factors where applicable.

Motor feeder power cables are selected on the basis of 100% load factor and continuously rated for 125% of the motor full load current. If exception is taken to this requirement then the basis shall be documented in an evaluation which demonstrates that the feeder cables are capable of carrying their design load under normal and emergency conditions of operation for their design life expectancy.

Power and control cables for services required to operate for extended periods after a loss of coolant accident are suitable for operation under condition of high ambient temperature, radiation, pressure, and humidity prevailing after an accident.

8.3.1.2.23 AC Power Circuits

All AC power circuits have circuit protection provided by either circuit breakers or fused disconnect switches. Fuses are also used on some AC power circuits for fault current backup protection.

Thermal overload protective devices are not used to trip any safety-related motor operated valve. The tripping contacts on the overload protective device are not connected to the coils of the valve motor's reversing starter. Many of the heaters in the overload protective devices have been replaced with shorting bars which prevent the overload device from sensing an overload condition. However, motor thermal overload devices are used to trip some safety and non-safety related motors for pumps, fans, dampers and drives.

8.3.1.2.24 Cables for Reactor Protection Systems

Essential cables for reactor protection systems and safety features actuation system equipment are installed within Seismic Class I structures. The cable installation is Q (Nuclear Safety Related) and as such is subject to quality assurance procedures to ensure that the design criteria are met through all stages of design, procurement, and installation.

8.3.1.2.25 Redundant Class 1E Instruments

Redundant Class 1E instruments are located in separate cabinets or in separate compartments of the same cabinet. When this is not feasible, physical separation of 12 inches is maintained between redundant essential channels or metal barriers and conduits, either rigid or flexible metal, are utilized for maintaining separation. The cabinets are located in plant areas which minimize potential hazards such as missiles, external fires, and pipe whip.

Redundant Class 1E sensors and their connections to the process system have been sufficiently separated to ensure that the functional capability of the protection system has been maintained despite any single design basis event or result therefrom. Sensor to sensor separation is a minimum of three (3) feet.

The main control board is located within a fire wall type control room in the Seismic Class I auxiliary building. The control room is protected from and does not contain high-energy equipment such as switchgear, power transformers, rotating equipment, or potential sources of missiles or pipe whip. The separation distance between redundant Class 1E equipment and circuits internal to the control board is a minimum of 12 inches. Barriers such as flexible or rigid metallic conduit are installed where separation distance is less than 12 inches. Wiring is flame retardant. Class 1E incoming cable and internal board wiring identification uses color coding as discussed in Subsection 8.3.1.2.14. Where common devices accommodate redundant Class 1E circuits the minimum separation is met by use of barriers.

Cable entrance to the main control board is through blockouts in the control room floor. Typically, each block out is dedicated to only one redundant Class 1E channel.

Instrument Cabinets

Blockouts for cable entrances beneath the Reactor Protection System and Safety Features Actuation System cabinets enclose cables for the various sub-logic matrices which are necessary to establish the two-out-of-four logic described in Subsection 7.3.1.1.2.

All sensor input cables to the SFAS cabinets are enclosed in either rigid or flexible metallic conduit.

Further, no single event which fails all cables passing through a particular block out can preclude proper operation of the Reactor Protection System or Safety Features Actuation System as appropriate (see Sections 7.2, 7.3 and Subsection 8.3.1.2.14).

Some sensor-to-process connections of redundant sensors have a common section of line. This is justified since failure of this connection will cause the sensors to fail in the safe position.

The locations of redundant Class 1E actuated equipment such as pump drive motors and valve operating motors have been reviewed to ensure the minimum required functional capability despite any single design basis event or result therefrom.

The main control boards have the following fire stops and separation barriers:

a. All control room vertical panels shall have the cable runs in the base of the panels enveloped with low density silicone foam up to a height level with the base of the panel.

b. All control room control consoles shall have the cable runs in the base of the consoles enveloped with low density silicone foam up to the top of the cable tray in the base of the consoles.

c. All essential cable conduits in the base of the control room cabinets and consoles shall be sealed with low density silicon foam, if the conduit end is in the base.

d. All essential cable runs in the base of the control room cabinets not in conduit shall have the cable runs coated with low density silicone foam up to the cable identification tag affixed to the cable or eight (8) inches above the base of the panel. This eight (8) inches provides the fire stops and cable separation for cable crossover between essential channels and between control panels.

e. Openings in fire barriers through which cables pass into the main control boards are closed with fire rated seals equal to the rating of the barrier. If the cable is routed to the control boards in conduit, the conduit is sealed internally as required to maintain the fire barrier rating.

f. Panel C5716

A horizontal barrier is installed to completely close the top of this vertical panel.

The center barrier extends up to the additional horizontal barrier at the top of the panel.

The center barrier is extended and completed down to the enveloped cable in the base of the panel.

A vertical barrier is installed to complete the sides of this panel, and C5716 is isolated from C5715 and the void between C5716 and C5717.

All joints in barriers and voids around cables penetrating the center barriers are sealed with silicone rubber.

g. Panel C5717

A horizontal barrier is installed to completely close the top of the vertical panel.

Vertical barriers are installed to complete the sides of this panel, and C5717 is isolated from the void between C5717 and C5716.

A readily removable barrier is installed to extend the center barrier to complete isolation between Channels 1 and 2.

h. Panel C5718

A horizontal barrier is installed to completely close the top of the vertical panel.

A vertical barrier is installed to complete panel isolation at the bottom of the vertical panel between C5717 and C5716.

i. In Panels C5715, C5716, C5717, and C5718, smoke detectors are installed to maintain fire detection now that these panels are completely isolated.

j. Barriers required by the above are made from 1/2 – inch – thick Marinite. Barriers to isolate C5717 and C5716 from the void between these panels may be installed within the void if more convenient than within the panels.

Within enclosures (control boards, instrument cabinets, distribution panels, motor control centers, etc.), non-Class 1E wiring may be routed, bundled, or formed with Class 1E wiring. The following specific criteria are used to guide the installation. Deviations from these criteria, as well as the other separation criteria, may occur. However, these deviations are documented and analyzed as a prerequisite for acceptance. The non-Class 1E with Class 1E criteria are:

a. When located in the same enclosure with essential cables, Channel A cables may be bundled, routed, or formed with Channel 1 cables. Similarly, Channel B cables may be bundled, routed, or formed with Channel 2 cables.

b. In enclosures designated for Channel 3 use, Channel A cables stay be bundled, routed, or formed with Channel 3 cables. Similarly, in enclosures designated for

Channel 4 use, Channel B cables may be bundled, routed, or formed with Channel 4 cables. However, in the specific case where Channel A is bundled, routed, or formed with Channel 3 (and conversely Channel B is bundled, routed, or formed with Channel 4), a verification is made that bridging does not exist. (Bridging occurs when a single nonessential cable or conductor is simultaneously routed, bundled, or formed with cables or conductors of two different essential channels.)

c. If an enclosure contains both Channels 1 and 3 cables, Channel A cables will preferably be run with Channel 1 cables. Similarly, if an enclosure contains both Channel 2 and 4 cables, Channel B cables will preferably be run with Channel 2 cables. However, in the specific case where Channel A is bundled, routed, or formed with Channel 3 (and conversely Channel B is bundled, routed, or formed with Channel 4), a verification is made that bridging does not exist.

d. When located in the same enclosures with essential cables, Channel A cables will not be bundled, routed, or formed with Channel 2 or 4 cables. Similarly, when located in the same enclosures with essential cables, Channel B cables will not be bundled, routed, or formed with Channel 1 or 3 cables.

e. Channel C cables will not be bundled, routed, or formed with any essential cables.

f. Any single nonessential cable will not bridge two or more essential channels within enclosures.

8.3.1.2.26 Cable Spreading Room

All cables in the cable spreading room associated with essential channels are arranged so that redundant circuits for each of the individual systems are isolated either by physical separation or by fire barriers where physical separation cannot be maintained.

8.3.1.2.27 Circuit Schedules and Connection Diagrams

Circuit schedules and connection diagrams have been prepared to give a permanent record of the routing and termination of all cables.

8.3.1.2.28 Q-List Items

All electrical equipment classified as Q (Nuclear Safety Related) have been designed in accordance with the latest codes and standards as of the date of licensing of the plant to perform under the environmental conditions required. To ensure the proper design has been accomplished and that the equipment is subsequently fabricated and installed as specified, a detailed Quality Assurance/Quality Control program has been instituted and is described in further detail in Chapter 17.

Each safety-related electrical purchase is covered by a procurement package which ensures that appropriate technical requirements and environmental conditions are applied during design of the equipment, includes any special quality control procedures to be followed by the manufacturer, and includes any required acceptance testing. The design development process is monitored so that all design additions/deletions changes are reviewed and approved prior to incorporation in the station. The manufacturing process is monitored by inspectors representing the Davis-Besse Nuclear Power Station (DBNPS) Nuclear Group with the authority to reject any non-conforming material.

The electrical installation contractor is responsible for the proper handling and installation of the electrical equipment after it arrives at jobsite. All work in relation to the receipt, handling, storage, installation, and testing of Safety Related items is performed in accordance with procedures that have been reviewed and approved by the Davis-Besse Nuclear Power Station (DBNPS) Nuclear Group or its agents prior to use. Representatives of Davis-Besse Nuclear Power Station (DBNPS) Nuclear Group monitor all phases of this work ensuring the procedures are properly followed and have the responsibility for giving final approval prior to acceptance of a complete installation.

Adequate records such as inspection and test reports are maintained to demonstrate the traceability of all Safety Related material from the time of manufacture to final installation.

8.3.1.2.29 Penetrations

The electrical penetrations are designed and tested to meet IEEE Standard 317-1971.

Conax penetration assemblies are designed and tested to meet IEEE 317-1976 as modified by NRC Regulatory Guide 1.63, Revision 2.

Short-circuit tests were performed on two prototype penetrations, as required by the above-mentioned standards, to ensure that the penetration assemblies can withstand, without loss of mechanical integrity, the maximum possible fault current vs. time conditions.

The two prototype penetrations tested were a medium-voltage penetration consisting of a unitized header 26 inches OD, 3 inches thick, with 6 modules, and a low-voltage penetration consisting of 3 x 350 kcmil in a single hole plate.

The prototype penetrations withstood the following currents for the indicated times:

	Start Asymmetric RMS Amperes	Start Symmetric RMS Amperes 3 Phase	1/4 Time Symmetric RMS Amperes 3 Phase	Number of Cycles
Medium-voltage Penetration	70,000 (C phase)	44,700	33,700	26.5
Low-voltage Penetration	41,300 (B phase)	23,400	20,400	30.5

After completion of the short-circuit tests, a leak test was performed on each prototype penetration. The results of that test met the requirements of the above-mentioned standard.

In addition, prior to the performance of the above-mentioned tests, each prototype penetration successfully passed radiation and environmental (LOCA) tests.

The electrical system design provides both primary and backup fault protection for power circuits which are energized during plant operation and are routed through electrical penetrations. Should the primary protection fail to act, the backup will act in sufficient time to preclude thermal and mechanical damage to the penetration assembly under fault conditions.

The basic philosophy of this type of protection is to provide selective tripping of circuit breakers in order to maintain maximum continuity of service by removing that section of the system where the fault has occurred. The primary protection is set to trip the breakers instantaneously under high-fault currents. In the event the primary protection or the corresponding breakers fail to act, the backup protection will respond to disconnect the affected circuit. During some high current faults the backup protection may act before or in unison with the primary protection. The tripping time of the backup protection has been set in such a way that it will trip faster with higher fault currents, i.e., it has inverse time characteristics. Diversity of 125V DC control voltage (for 13.8 kV buses A and B between source breakers and load breakers) is utilized to further assure that the backup breaker will trip if the load breaker fails due to a loss of control voltage.

The short circuit studies performed for Davis-Besse Unit I determine the maximum symmetrical short circuit current which might flow through the 13.8kV electrical penetrations. This calculated short circuit current is lower than the tested value of the medium voltage penetrations. The calculated permissible tripping time for the fault current is based on a correlation of current and time using the relationship $I_1^2 t_1 = I_2^2 t_2$. Under this fault condition the primary and secondary protection will act to preclude the damage of the penetration. This protection is adequate for the medium voltage penetrations.

Similarly, for the low voltage penetrations, the calculated maximum symmetrical short circuit current and the calculated permissible tripping time for this fault current has been determined. Under this fault current, the primary and secondary protection will act to preclude the damage of the penetration. Circuits with lower fault currents have been similarly evaluated.

The above analysis establishes the adequacy of the primary and backup protection of the electrical penetrations.

Electrical penetration assembly (EPA) terminal boxes, installed inside the containment structure are used to house the terminations of the electrical penetration assembly pigtails to their respective field cables. For circuits which are required to function in an accident environment the termination of the field cable/EPA pigtail combination is performed utilizing an environmentally qualified (Raychem) splice kit.

During a postulated accident condition, these terminal boxes are subject to a pressure rise; imploding could result. To reduce the differential pressure across the terminal box, each box is fitted with a vent hole in the bottom, proportional to the size of the box. Since the cable splicing located internal to these boxes are environmentally qualified, the vent holes do not have an adverse effect on safety.

The purpose of the electrical penetration assemblies (EPAs) is to provide continuity of electrical circuits through the containment structure, while maintaining the integrity of the containment pressure boundary. The electrical penetration assemblies consist of Conax and Amphenol modules in a header plate.

A nitrogen supply system is connected to the EPAs to monitor the leak integrity of the penetration assemblies. The nitrogen supply system consists of two separate trains, one in the west auxiliary building (electrical penetration Room 1 [Room 402]) and the other in the east auxiliary building (electrical penetration Room 2 [Room 427]). The nitrogen gas cylinders are permanently connected to the electrical penetration assemblies' header tubing to provide a continuous pressurization to a value recommended by both Amphenol and Conax and greater than containment pressure. The nitrogen pressure is checked periodically and the cylinders replaced as necessary to maintain the recommended nitrogen pressure.

The dry nitrogen serves the following functions:

a. Maintain the penetration dry during both normal and LOCA conditions.

b. Prevent leakage from the Containment Vessel interior to the environment.

c. Monitor EPA integrity. A high nitrogen consumption would indicate that an EPA might be leaking.

The following exception is taken to Regulatory Guide 1.63 :

a. IEEE 317-1971 is used instead of IEEE 317-1972. The Conax penetration assemblies meet the requirements of IEEE 317-1976 as modified by NRC Regulatory Guide 1.63, Revision 2.

The only redundant circuits which are routed through the same penetration room are the power supplies and the space heater supplies to the containment cooler fans numbers 2 and 3 in room 427.

The separation of 9 feet will preserve the integrity of the redundant circuits.

8.3.1.2.30 Cable for Class 1E Service

Each manhole (i.e., 3001 , 3004, 3005, 3006, 3020, 3041, and 3042) that accommodates cable for Class 1E service is provided with a sump and a sump pump. In addition, essential cable is suitable for direct burial service.

The insulation resistance of essential power leads passing through manholes will be tested per station procedures as part of the motor and equipment maintenance program on a periodic basis to assure cable insulation integrity over the design life of the station.

8.3.2 <u>DC Power System</u>

8.3.2.1 Description

The station DC equipment consists of two 250/125V DC motor control centers, four batteries, six battery chargers, four essential distribution panels, four 480V AC/125V DC rectifiers, and four nonessential distribution panels.

The system is designed to provide a continuous, reliable, and redundant 250/125V DC power source for control, instrumentation and DC loads required for normal operation and orderly shutdown and control of the station. The system is arranged to form two completely independent load groups as shown in Figure 8.3-25. The DC equipment is classified as Class 1E except nonessential distribution panels.

8.3.2.1.1 DC Motor Control Centers

Two redundant 250/125V DC motor control centers are provided. Each motor control center has a positive, a negative, and a neutral bus arranged to form a 250/125V DC system. Each live bus is connected to a corresponding 125 volt battery, a normal battery charger source, and a manual standby battery charger as indicated in Figures 8.3-46 and 8.3-47. The standby charger is connected to the bus through a normally open manual switch. In the event of AC power failure, the motor control center will be supplied from its respective batteries without any interruption of power.

Each of the two motor control centers supplies two 125V DC essential distribution panels, five 250V DC oil pump motors, two 250/125V DC emergency lighting feeders and one 250V DC/120V AC nonessential inverter.

DC motor control center 1 also supplies power to the motor operations of the auxiliary feed pump discharge stop valve to steam generator 1 (MV3870), the auxiliary feed pump turbine 1 main steam isolation valve (MV106) and the DC lube oil pump motor for the high-pressure injection pump 1-1 (MP197-2).

DC motor control center 2 also supplies power to the DC lube oil pump motor for the high pressure injection pump 1-2 (MP198-2).

8.3 .2.1.2 Station Batteries

Four 125V DC approximately 1500 ampere-hour, on eight hours discharge basis, lead-sold batteries are provided and arranged to form two independent 250/125V DC systems. Using 1.75 volts per cell as the minimum cell voltage each battery has the following capacity:

Amperes Rating	Discharge Time
187	8 hours
750	1 hour
1400	1 min

Each battery is maintained in a fully charged condition and is normally float charged at approximately 132 volts from its associated battery charger. Battery discharge will occur either when the DC requirements temporarily exceed the charger capacity or during a loss of a battery charger supply. Each battery is connected to one 125V DC bus of one of the two DC motor control centers as shown in Figure 8.3-25.

Design Bases

The station batteries are sized to supply the station DC and instrument AC loads for a period of one hour without AC power availability. Manual shedding of some loads is required within 30 minutes of a loss of AC power to maintain adequate voltage at all required DC loads. An age factor of at least 1.25 is applied in the station battery sizing analysis to ensure that the batteries will supply the required loads when battery capacity decreases to 80 percent of the manufacturer’s rating.

The loads on each battery are as follows: Station battery 1P supplies the loads of essential 125V DC distribution panel D1P, motor operated stop valve for Auxiliary Feed Pump 1-1 discharge to Steam Generator 1-1 (MV3870), and the lube oil pump for the HPI Pump 1-1 (MP197-2). Station battery 1N supplies the loads of essential distribution panel D1N and motor operated isolation valve for Main Steam Line 1 to Auxiliary Feed Pump Turbine 1-1 (MV106). Also batteries 1P and 1N feed the 250V DC MCC1 loads.

Similarly, station battery 2P supplies the lube oil pump for the HPI pump 1-2 (MP198-2) and essential distribution panel D2P. Station battery 2N supplies essential distribution panel D2N. Also, station batteries 2P and 2N feed the 250V DC MCC2.

The battery loads, operating requirements, and load shedding requirements during the worst case accident with no AC power available for battery chargers are detailed in the DC System Analysis.

The DC load list (contained in the DC System Analysis) establishes the one-hour duty cycle for each battery. The battery with the largest load was used in sizing the capacity and ampere rating of all four batteries. The first minute of the duty cycle includes the momentary loads and non-continuous loads that may occur at random during the one hour duty cycle. It also includes the continuous loads carried by the battery immediately following a design basis event coupled with a loss of ac power to the battery chargers. The first minute loads include the starting current for certain dc motors, the dc load current associated with operation of 13.8kV, 4.16kV, and 480V breakers, and the starting and field flashing of the emergency diesel generators.

The plate requirement which satisfies the above load cycle is a battery with ten positive plates and with performance characteristics equal to or better than a GNB model NCX-21.

8.3.2.1.3 Battery Chargers

Six static solid state battery chargers are provided. Each is rated at 480V AC, 3 phase, 60 Hertz input and has a nominal output of 125V DC. Each charger is capable of supplying all steady-state DC loads required under any condition of operation while recharging the battery to a fully charged condition over a period of 12 hours from the maximum discharge condition established in the DC System Analysis.

Technical Specification surveillance testing assures that each charger is capable of delivering the necessary current and voltage for an extended period of time to demonstrate this design capability. The six chargers are arranged into two groups. Each group consists of three chargers, two of which are supplied from one essential 480V AC motor control center and constitute the normal DC supply to both live buses of the corresponding DC motor control center. The third charger is provided as a standby source and is supplied from a separate 480V AC bus on the same essential channel. The third charger can be manually switched to supply either live bus on the given DC motor control center. Each charger has a circuit breaker in its AC power incoming feeder and a fused disconnect switch in DC power output circuit for isolating the charger.

8.3.2.1.4 Essential 125V DC Panels

Four redundant 125V DC panels are provided, as a part of essential power systems, to supply 125V DC power to safety-related loads. The four panels are designated D1P, D2P, D1N, and D2N, and supply DC loads as follows:

a. Essential DC panel D1P (Channel 1) supplies:

   1. Essential safety features actuation system solenoid valves (Channel 1)

   2. 480 Volt essential unit substation Bus E1

   3. 4.16kV essential switchgear Bus C1

4. 120V AC essential inverter YV1 through a coupling diode
5. Emergency diesel generator 1-1
6. Nonessential DC panel DAP
7. Radiation sampling system solenoid valves
8. Relay cabinets for: 120/240 VAC System: Reactor Coolant Pump: and SFRCS
9. Auxiliary Feedwater Pump Turbine 1-1 control circuits
10. Component Cooling Water Pump and Emergency Ventilation System flow indicators
11. Control Rod Drive shunt trip breaker B
12. 4160 Volt essential transfer switchgear CD

b. Essential DC panel D2P (Channel 2) supplies:

1. Essential safety features actuation system solenoid valves (Channel 2)
2. 480 Volt essential unit substation Bus F1
3. 4160 Volt essential switchgear Bus D1
4. 120V AC essential inverter YV2 through a coupling diode
5. Emergency diesel generator 1-2
6. Nonessential DC panel DBP
7. Radiation sampling system solenoid valves CH-2
8. Relay cabinets for: 120/240 VAC; Reactor Coolant System; Reactor Coolant Pump; SFRCS
9. Auxiliary Feedwater Pump Turbine 1-2 control circuits
10. Component Cooling Water and Emergency Ventilation System flow indicators
11. Control Rod Drive shunt trip breaker A
12. Motor Driven Feedwater Pump control valve position controller
13. 4160 Volt essential transfer switchgear CD

c. Essential DC panel D1N (Channel 3) supplies:

1. 480 Volt essential unit substation Bus E1 (alternate source)
2. 4.16kV essential switchgear C1 (alternate source)
3. 120V AC essential inverter YV3 through a coupling diode
4. Emergency diesel generator 1-1 (alternate source)
5. Nonessential panel DAN
6. Reactor Coolant Pump relay cabinet
7. Motor Driven Feedwater Pump control valve position controller
8. Control Rod Drive shunt trip breaker D

d. Essential DC panel D2N (Channel 4) supplies:

1. 480 Volt essential unit substation Bus F1 (alternate source)
2. 4.16kV essential switchgear D1 (alternate source)
3. 120V AC essential inverter YV4 through a coupling diode
4. Emergency diesel generator 1-2 (alternate source)
5. Nonessential DC panel DBN
6. Reactor Coolant System and Reactor Coolant Pump relay cabinets
7. RC2A PROV solenoid
8. Control Rod Drive shunt trip breaker C

Each essential panel is fed normally from one DC motor control center with a manually switched reserve supply from the second DC motor control center as shown in Figure 8.3-25.

Four 125V DC nonessential panels are provided. Each supplies DC loads as indicated on Figure 8.3-25.

8.3.2.1.5 Rectifiers

Four rectifiers are provided to supply normal DC power to the four essential inverters. Each rectifier output is connected in parallel with the DC panel reserve supply to the inverter and is rated at 480V AC, 3-phase, 60 Hertz input, 125V DC nominal output. The output voltage is maintained at least 3 volts higher than the station battery voltage, which reverse-biases a coupling diode to prevent current flow from the reserve supply, and to prevent back-feeding the DC system. The failure of the rectifier Ac source and/or of the rectifier itself will forward bias the coupling diode, and cause the battery and/or battery charger to become the DC source to the essential inverter with no power interruption.

Channel 1 and 3 rectifiers are fed from a Channel 1 essential 480V AC motor control center, while Channel 2 and 4 rectifiers are fed from a Channel 2 essential 480V AC motor control center.

8.3.2.1.6 Monitoring and Surveillance

Instrumentation, relays and indicators are provided locally and at the main control board to monitor the status of the DC system equipment.

The locally mounted instruments are:

a. On each motor control center:

   1. DELETED

   2. Two 125V DC ammeters 800-0-800 ampere each to read battery current flow.

   3. Two DC voltmeters — relays each connected to a separate bus and set to alarm in the control room at an under-voltage or an overvoltage.

   4. One ground detector to alarm in case any of the three buses is grounded.

   5. Two directional current relays with time delay to alarm battery discharge.

b. On each battery charger:

   1. One under-voltage relay on the input side set to alarm when battery charger input voltage drops below the design capability of the battery chargers.

   2. One under-voltage alarm relay on the output side.

   3. One DC ammeter.

   4. One DC voltmeter.

   5. One Over Temperature alarm relay.

   6. One Fan Failure alarm relay.

   7. One Charger Failure alarm relay.

c. On each 125V DC essential panel:

   1. One under voltage alarm relay.

   2. One indicating light, indicating low voltage DC.

The main control board mounted instruments are:

a. Four DC ammeters 800-0-800 amperes indicating each battery output current.

b. Two DC voltmeters 0-300V each to measure motor control center bus voltage.

c. Four DC voltmeters 0-150V one for each essential 125V DC panel.

d. Eight indicating lights, two for each essential 125V DC panel; one indicates the status of the normal feed switches, and the second indicates the status of the alternate feed switches.

e. Four indicating lights; each indicates the status of the DC motor control center disconnect switches associated with the standby battery chargers.

f. Four indicating lights; each indicates the status of the feed switch from each essential 125V DC panel to the respective essential inverter.

8.3.2.1.7 Physical Arrangement of DC Electrical System Components

DC distribution system components are arranged and located in areas to minimize their vulnerability to physical damage as a result of accidents.

Battery chargers as well as the other listed equipment (below) for the Class 1E batteries are located in separate fire wall type rooms adjacent to their associated batteries.

Low voltage Switchgear Room 428 contains the following:

a. DC motor control center 2

b. Battery chargers DBC2P, DBC2N, and DBC2PN

c. Essential distribution panels D2P (Channel 2)

d. Distribution panels DBP and DBN

Low voltage Supply Room 428B contains essential distribution panel D2N (Channel 4)

Low voltage Switchgear Room 429 contains the following:

a. DC motor control center 1

b. Battery chargers DBC1P, DBC1N, and DBC1PN

c. Essential distribution panel D1P (Channel 1)

d. Distribution panels DAN an DAP

Low Voltage Supply Room 429A contains essential distribution panel D1N (Channel 3).

Low Voltage Battery Room 429B contains 125 volt batteries 1P and 1N, and Room 428A contains batteries 2P and 2N. In each room the two 125 volt batteries are mounted on two racks separated by an aisle approximately 5 feet wide.

The Class 1E batteries are located in separate battery rooms in the Seismic Class I auxiliary building. Each battery room has fire walls and is served by an independent Class 1E ventilation system. Air flow alarm is provided in the Control Room to assure that hydrogen buildup is prevented in the battery rooms.

8.3.2.1.8 (TEXT DELETED HERE AND PLACED IN 8.2.1.3)

8.3.2.1.9 Tests and Inspection

The ungrounded DC system has detectors to indicate when there is a ground existing on any portion of the system. A ground on one portion of the DC system will not cause any equipment to malfunction. Grounds will be located by logical isolation of individual circuits connected to the faulted system while taking the necessary precautions to maintain the integrity of the essential bus supplies.

The station batteries are under continuous automatic charging and will be inspected and checked on a routine basis while the unit is in service according to the surveillance requirements of Technical Specifications.

8.3.2.1.10 Administratively Controlled Devices

Administratively controlled circuit opening devices are listed in Table 8.3-3 by device number, type and location.

8.3.2.2 Analysis

Analysis of the station DC system described in Subsection 8.3.2.1 is given in the following subsections.

8.3.2.2.1 DC System

The DC system provides continuous DC power source to essential instrument, safety features systems, and necessary control systems regardless of auxiliary electrical system conditions. The system is designed to permit periodic testing of individual components as well as the system as a whole during station operation.

8.3.2.2.2 Reliability

The reliability of the system is increased by providing redundancy of equipment and circuits.

8.3.2.2.3 250V DC System

The 250V DC system consists of two independent load groups. A failure in one group will not affect the other.

8.3.2.2.4 125V DC Control Panel Boards

Four separate 125V DC control panel boards are provided. Each panel is supplied by redundant feeders from both 250/125V DC buses through manual throw-over switches to prevent any DC panel from being supplied from more than one battery at a time. These DC panels provide DC instrument and control power as necessary for proper functioning of the unit.

8.3.2.2.5 Station DC System

The station DC system is arranged so that a single fault within the system will not prevent the reactor protective system, engineered safety feature control system, and the engineered safety features from performing their safety functions. The batteries are mounted on Seismic Class I racks, installed in separate rooms within a Seismic Class I structure, and separated by fire walls to minimize the possibility of simultaneous damage to both batteries.

8.3.2.2.6 Battery Chargers

The battery chargers are designed to prevent the AC source from becoming a load on the battery due to a power feedback as a result of the loss of AC power to the chargers. This preserves the battery.

8.3.2.2.7 Design Criteria for Cables and Raceway

The design criteria for cables and raceways routing, loading, sizing. and marking are identical to those described under Subsection 8.3.1.2.

8.3.2.2.8 Redundancy in DC Control Power

Redundancy is maintained in the DC control power supply to the 13800, 4160, 480 volt AC systems by providing two DC control feeders for each separate bus or appropriate group of circuit breakers. Each feeder is supplied from a separate 125V DC battery.

8.3.2.2.9 (TEXT DELETED HERE AND PLACED IN 8.2.1.4)

8.3.2.2.10 Quality Assurance Procedure

A quality assurance procedure identical to that described under AC system (Subsection 8.3.1.2) ensures that the design criteria through all stages of design, procurement and installation are met.

8.3.2.2.11 Drawings

Section 1.6 provides a cross reference between USAR figures and electrical control drawings.

BUS	BKR	EQUIPMENT DESCRIPTION	O/N	LOAD	CONTINUOUS RATING HP/KVA	OPERATING LOAD %	KW AT % LOAD	kvar AT % LOAD	LOCA WITH LOOP – SEQUENCER STEP LOADING: STEP I (SEE NOTE 1)	STEP Ia	STEP II	STEP III	STEP IV	STEP V	MANUAL LOADING	REMARKS	LOOP ONLY: LOOP1 (SEE NOTE 22 & 23)	LOOP2 (SEE NOTE 24)	LOOP3 (SEE NOTE 25)	MANUAL LOADING	LOADS ADDED THRU BACK FEEDING BUS (SEE NOTE 6)	REMARKS
4160V SWGR C1	AC113	COMPONENT COOLING WATER PUMP 1	O	MP0431	400	90	285.30	167.80	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
C1	AC108	COMPONENT COOLING WATER PUMP 3	O	MP0433	400	0	0.00	0.00								NOTE 20						SPARE
C1	AC111	HIGH PRESS. INJ PUMP 1	O	MP0581	600	117	561.10	271.80			ON	ON	ON	ON	ON							
C1	AC112	DECAY HEAT PUMP 1	O	MP0421	400	105	323.5	121.8				ON	ON	ON	ON							
C1	AC107	SERVICE WATER PUMP 1	O	MP0031	600	100	482.2	273.3					ON	ON	ON				ON	ON	ON	
C1	AC109	SERVICE WATER PUMP 3	O	MP0033	600	0	0.00	0.00								NOTE 20						SPARE
C1	AC105	MAKE-UP PUMP 1 (NOTE 26)	N	MP371A	450	124/90	444.6/322.7	183.7/168.9		ON	ON					SEE NOTE 2 AND NOTE 10		ON	ON	ON	ON	(SEE NOTE 2)
C2	AC201	B.U. SERVICE WATER PUMP	N	MP180	600	0	0.00	0.00														TWO SPEED MOTOR
C2	AC211	LIGHTING DIST PANEL E5	N	CE5	283 KVA	0	0.00	0.00														
C2	AC211	SWITCHYARD FEEDER	N	1-1	160 KVA	0	0.00	0.00														
D2	AD210	MOTOR DRIVEN FEEDWATER PUMP	N	MP2410	800	98	620.10	323.80													ON	
D2	AD201	STATION AIR COMPRESSOR	N	MC1400	382	81	243.9	184.7													ON	
D2	BDCL	TRANSF. BD CORE LOSS. NOTE 21	N	ABD02	31.2 KVA	100	18.89	24.82													ON	
480V LC BUS E1	BE111	CONTAINMENT SPRAY PUMP 1	O	MP0561	200	110	171.2	79.76						ON	ON							
F7	BF703	EMER INSTRUMENT AIR COMPRESSOR	N	MC1390	200	100	156.80	81.21													ON	
BUS F7	BF703	EMER.INSTR.AIR COMPRESSOR AUX OIL PUMP	N	MP261	2	100	1.95	1.21													ON	
F7	BDF7	TRANSF. DF7 TOTAL LOSS. NOTE 21	N	DF7CL	26 KVA	100	3.70	25.74													ON	
480V MCC E1	BCE11	XFMR CE1-1 CORE LOSS. NOTE 21		CE1-1CL	13	100	2.00	12.84	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E1	BCE12	XFMR CE1-2 CORE LOSS. NOTE 21		CE1-2CL	13	100	2.00	12.84	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E11A	BE1102	H_2 DILUTION SYSTEM BLOWER 1	O	MC0621	20	0	0.00	0.00								SEE NOTE 8						
E11A	BE1115	ECCS SUMP 1-1 PUMP 1A	O	MP891A	5.9	100	4.54	2.81							ON							
E11A	BE1116	ECCS SUMP 1-1 PUMP 1B	O	MP891B	7.9	0	0.00	0.00														
E11A	BE1117	ECCS SUMP 1-1 PUMP 3A	O	MP893A	7.9	100	5.96	3.69							ON							
E11A	BE1118	ECCS SUMP 1-1 PUMP 3B	O	MP893B	5.9	0	0.00	0.00														
E11A	BE1123	CTMT ISO VLV PEN 72A	O	MV2001	0.33	0	0.00	0.00														
E11A	BE1124	CTMT ISO VLV PEN 74A	O	MV2003	0.13	0	0.00	0.00														
E11A	BE1121	DHP 1 SUCT VLV FRM BWST	O	MV2733	3.90	100	3.46	4.38				ON	ON	ON								
E11A	BE1170	CTMT H2 PURGE OUT ISO VLV 1	O	MV5038	0.33	100	0.26	0.57	ON	ON	ON	ON	ON	ON								
E11A	BE1113	H2 DILUTION SYS 1-1 CTMT ISO VLV	O	MV5090	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11A	BE1104	ECCS RM 105 HVAC ISO VLV 1	O	MV5439	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11A	BE1107	ECCS RM 105 HVAC ISO VLV 2	O	MV5440	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11A	BE1106	LOW PRESSURE INJECTION 1 VLV	O	MVDH1B	12.8	0	0.00	0.00														
E11A	BE1157	BWST OUT VLV B	O	MVDH7B	1.00	100	1.14	1.73	ON	ON	ON	ON	ON	ON								
E11A	BE1112	CTMT EMER SUMP OUT VLV	O	MVDH9B	1.00	100	1.14	1.73	ON	ON	ON	ON	ON	ON								
E11A	BE1103	HIGH PRESSURE INJECTION 1-1 VLV	O	MVHP2C	1.00	100	1.14	1.73			ON	ON	ON	ON								
E11A	BE1105	HIGH PRESSURE INJECTION 1-2 VLV	O	MVHP2D	1.00	100	1.14	1.73			ON	ON	ON	ON								
E11A	BE1125	MU FILTER 1 INLET VALVE	O	MVMU12A	0.13	0	0.00	0.00														
E11A	BE1109	DEMINERALIZED WATER STOP VLV	O	MVMU40	0.13	0	0.00	0.00														
E11A	BE1129	PRZR SPRAY ISO VLV	O	MVRC10	1.00	0	0.00	0.00														
E11B	BE1169	CONTAINMENT RECIRC FAN 1	O	MC0561	50	99	38.09	23.93							ON	NOT SAFETY RELATED						NOT SAFETY RELATED
E11B	BE1173	CC OUT ISO VLV 1 FROM CTMT	O	MV1407A	0.70	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
E11B	BE1176	CC IN ISO VLV 1 TO CTMT	O	MV1411A	0.70	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
E11B	BE1158	CC IN ISO VLV 1 TO CRD	O	MV1567A	0.66	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
E11B	BE1108	CTMT NORMAL SUMP ISO VLV	O	MV2012-A	0.66	100	4.03	1.59	ON	ON	ON	ON	ON	ON								
E11B	BE1181	RC PRZR SMPL VLV 1	O	MV240A	0.13	100	0.26	0.25	ON	ON	ON	ON	ON	ON								
E11B	BE1155	PRZR SPRAY LINE ISO VLV	O	MV2735	0.13	0	0.00	0.00														
E11B	BE1162	CF TK 1 ISO VLV	O	MVCF1B	10.30	0	0.00	0.00														
E11B	BE1163	CF TK 1 SMPL VLV	O	MVCF2B	0.33	0	0.00	0.00														
E11B	BE1165	CF TK 1 VENT VLV	O	MVCF5B	0.33	0	0.00	0.00														
E11B	BE1183	DH REMOVAL SUC LINE VLV	O	MVDH12	9.80	0	0.00	0.00														
E11B	BE1171	LETDOWN CLRS OUT VLV	O	MVMU2A	0.66	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
E11B	BE1172	LETDOWN CLRS IN VLV	O	MVMU2B	1.00	0	0.00	0.00														
E11B	BE1174	RCP 2-1 SEAL RET LINE VLV	O	MVMU59A	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11B	BE1175	RCP 2-2 SEAL RET LINE VLV	O	MVMU59B	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11B	BE1177	RCP 1-1 SEAL RET LINE VLV	O	MVMU59C	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11B	BE1178	RCP 1-2 SEAL RET LINE VLV	O	MVMU59D	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11C	BE1154	C.C. PUMP ROOM VENT FAN 1	O	MC0751	7.50	100	6.25	4.54	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E11C	BE1186	HYDROGEN RECOMBINER	N	NC3801	64.5 KVA	0	0.00	0.00								SEE NOTE 8						
E11C	BE1168	CONTAINMENT LTG TRANS. (L39D1)	N	X39D1	45 KVA	0	0.00	0.00								SEE NOTE 16						(SEE NOTE 16)
E11C	BE1167	CONTAINMENT LTG TRANS. (L79D3)	N	X79D3	30 KVA	0	0.00	0.00								SEE NOTE 16						(SEE NOTE 16)
E11C	BE1167	CONTAINMENT LTG TRANS. (L79D4)	N	X79D4	30 KVA	0	0.00	0.00								SEE NOTE 16						(SEE NOTE 16)
E11C	BE1142	CTMT AIR CLR 1-1 IN ISO VLV	O	MV1366	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON			ON	ON	ON			
E11C	BE1156	CS PMP 1 HDR VLV	O	MV1530	1.00	100	1.14	1.73	ON	ON	ON	ON	ON	ON								
E11C	BE1137	CTRM VAC RELIEF VLV	O	MV5070	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11C	BE1138	CTMT VAC RELIEF VLV	O	MV5071	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11C	BE1139	CTMT VAC RELIEF VLV	O	MV5072	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11C	BE1140	CTMT VAC RELIEF VLV	O	MV5073	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11C	BE1141	CTMT VAC RELIEF VLV	O	MV5074	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11C	BE1144	CTRL RM EMER VENT FAN 1 IN VLV	O	MV5261A	0.33	0	0.00	0.00														
E11C	BE1159	MN FW 1 ISO VLV	O	MV612	39.40	100	33.72	18.20	ON	ON	ON	ON	ON	ON								
E11D	BE1191	RC MU PMP 1 MAIN OIL PUMP	O	MP371B	1	100	1.21	0.91	ON	ON	ON	ON	ON	ON			ON	ON	ON	ON	ON	
E11D	BE1192	RC MU PMP 1 AUX GEAR LUBE OIL PMP	A	MP371D	3	100	2.78	2.34				ON	ON	ON			ON	ON	ON			
E11D	BE1190	BATTERY CHARGER 1PN	O	DBC1PN	74.6 KVA	84	43.86	44.76								SPARE (SEE NOTE 3)						SPARE (SEE NOTE 3)
E11D	BE1185	BORIC ACID PUMP 1	N	MP0381	5	0	0.00	0.00														
E11D	BE1188	BORIC ACID ADD TANK 1 HTR1	N	WE7711	7.50 KVA	100	7.50	0.00							ON					ON	ON	
E11D	BE1189	BORIC ACID ADD TANK 1 HTR2	N	WE7712	7.50 KVA	100	7.50	0.00							ON					ON	ON	
E11D	BE1197	CTRM EMER VENT SYS VACUUM PMP 1	O	MRE5327	1.50	100	1.47	1.68							ON					ON	ON	
E11D	BE1199	CC CRD BOOSTER PUMP 1 SUCT VLV	O	MV1328	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E11D	BE1126	DH NORMAL SUCT LINE 1 ISO VLV	O	MV1517	7.80	0	0.00	0.00														
E11D	BE1161	CC WTR TO LINE A VLV	O	MV2645	1.60	0	0.00	0.00														
E11D	BE1133	CTMT H2 PURGE FAN 1 "SW" IN VLV	O	MV5067	0.125	0	0.00	0.00														
E11D	BE1127	RC MU PUMP SUCTION VLV	N	MV64050	0.33	0	0.00	0.00														
E11D	BE1147	MU PUMPS DISCHARGE CROSS CONN LINE ISO VLV	O	MV6409	0.70	0	0.00	0.00														
E11D	BE1194	CTMT ISOLATION VLV	O	MV64210	0.70	0	0.00	0.00														
E11D	BE1195	DH REMOVAL CLR 1 OUT XOVER	O	MV831	1.00	0	0.00	0.00														
E11E	BE1146	AFPI DISCH TO SG2	O	MV3869	2.6	100	6.08	3.77	ON	ON	ON	ON	ON	ON								
E11E	BE1148	CTRM EMER SYS STAND BY COND UNIT 1	O	MV49060	0.17	100	0.22	0.17	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E11E	BE1160	SG 1 AFW ISO VLV	O	MV608	4 HP	0	0.00	0.00														
E11E	BE1145	CTMT ISO VLV PEN 73	O	MV6458	0.33	0	0.00	0.00														
E11E	BE1187	LPI-HPI CROSS CONN ISO VLV 1	O	MVDH64	0.33	0	0.00	0.00														
E12A	BE1209	CTRM ROOM EMER VENT SYS FAN 1	O	MC0211	5	100	4.81	2.98							ON					ON	ON	
E12A	BE1219	EMER VENT FAN 1	O	MC0301	15	100	12.20	8.26	ON	ON	ON	ON	ON	ON	ON							
E12A	BE1222	AFP ROOM VENT FAN 1	O	MC0731	7.50	100	6.31	4.73	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12A	BE1216	CNTR ROOM EMER SYS CONDENSING UNIT 1	O	MS3311	10	100	15.62	11.31							ON					ON	ON	
E12A	BE1201	CTRM EMER SYS STANDBY COND UNIT 1	O	MS0611	7.50	100	6.74	5.28							ON					ON	ON	
E12A	BE1233	BATTERY CHARGER 1P	O	DBC1P	74.6 KVA	84	43.86	44.76	ON	ON	ON	ON	ON	ON	ON	(SEE NOTE 3a)	ON	ON	ON	ON	ON	(SEE NOTE 3a)
E12A	BE1235	BATTERY CHARGER 1N	O	DBC1N	74.6 KVA	84	43.86	44.76	ON	ON	ON	ON	ON	ON	ON	(SEE NOTE 3a)	ON	ON	ON	ON	ON	(SEE NOTE 3a)
E12A	BE1217	LOW VOLTAGE SWGR ROOM VENT FAN	O	MC0711	2	100	1.80	2.03	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12A	BE1220	ESSENTIAL RECTIFIER CHANNEL 1	O	YRF1	20.00 KVA	65	10.40	7.80	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12A	BE1221	ESSENTIAL RECTIFIER CHANNEL 3	O	YRF3	20.00 KVA	65	10.40	7.80	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12A	BE1213	PRZR HEATER 1	N	WHB1	42.00 KVA	100	42.00	0.00								(SEE NOTE 11)				ON	ON	
E12A	BE1214	PRZR HEATER 2	N	WHB2	42.00 KVA	100	42.00	0.00								(SEE NOTE 11)				ON	ON	
E12A	BE1215	PRZR HEATER 3	N	WHB3	42.00 KVA	100	42.00	0.00								(SEE NOTE 11)				ON	ON	
E12A	BE1237	EMER VENTL FAN IN DAMPER #1	O	MC5017	0.33	100	0.26	0.57	ON	ON												
E12A	BE1238	EMERGENCY VENT SYSTEM CROSS TIE DUCTWORK DAMPER	O	MC5056	0.33	0	0.00	0.00														
E12A	BE1218	AFP 1 SUCT VLV	O	MV1382	0.65	0	0.00	0.00														
E12A	BE1232	CTRM EMER CNDS UNIT 1 VLV	O	MV2927	0.13	0	0.00	0.00														
E12A	BE1239	FUEL HANDLING AREA BYPASS VLV	O	MV5024	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
E12A	BE1226	CC WTR DISCH LINE 1 ISO VLV	O	MV5095	2.60	0	0.00	0.00														
E12A	BE1227	CC WTR INTAKE LINE 1 ISO VLV	O	MV5097	1.60	0	0.00	0.00														
E12A	BE1240	LOW VOLTAGE SWGR RM 429 VENT 2	O	MV5305A	0.33	0	0.00	0.00														
E12A	BE1241	LOW VOLTAGE SWGR RM 429 VENT	O	MV5305B	0.125	0	0.00	0.00														
E12A	BE1208	BATTERY ROOM 429B TO ATM DPR	O	MV5597	0.166	100	0.22	0.17	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	

NOTES

1. LOADS INDICATED IN STEP 1 ARE THOSE THAT START AS SOON AS THE EMERGENCY DIESEL GENERATOR (EDG) BREAKER CLOSES. THESE LOADS CONSIST OF NORMALLY OPERATING OR INTERMITTENT LOADS NOT SHED BY UV SIGNAL OR LOADS THAT RECEIVE A SFAS SIGNAL AND ARE NOT BLOCKED BY THE SEQUENCER.
2. IF MU PUMP WAS RUNNING ON THIS TRAIN PRIOR TO LOSS OF OFFSITE POWER (LOOP) IT WILL BE SHED BY UV RELAYS AND START BY TIME DELAY RELAY 2.5 SECONDS (STEP IA) AFTER THE EDG OUTPUT BREAKER CLOSES. MU PUMP WILL BE TRIPPED AUTOMATICALLY IN STEP 3 WHEN DH PUMP IS STARTED BY SFAS FOLLOWING A LOOP.
3. SWING CHARGER IS NOT NORMALLY IN SERVICE. IT CAN BE PLACED IN SERVICE MANUALLY IF 1P OR 1N IS NOT AVAILABLE. DURING BATTERY CHARGER SURVEILLANCE TESTING, ALL THREE BATTERY CHARGERS (1N, 1P, 1PN - TWO OPERATING AT THEIR STEADY-STATE AND ONE AT ITS TESTING LOAD) ARE IN SERVICE PRIOR TO AN EVENT (LOOP OR LOOP WITH LOCA). THE LOAD VALUE REPRESENTS THE SWING CHARGER PLACED IN SERVICE MANUALLY AS 1P OR 1N.

3a. C-EE-015.03-008, ATTACHMENT 5, ESTABLISHES THE CONTINUOUS RATING (74.6 kVA) AND OPERATING LOAD PERCENTAGE (84%) FOR THE CONTINUOUS STEADY-STATE LOAD OF THE BATTERY CHARGERS. THE kW AND kvar ARE CALCULATED BASED UPON THE PERCENTAGE LOADING.

4. DELETED
5. DELETED
6. REQUIRES SPECIAL BUS ALIGNMENT.
7. DELETED
8. THE CONTAINMENT HYDROGEN DILUTION SYSTEM (CHD) IS INITIATED APPROXIMATELY 21 DAYS POST LOCA AND REQUIRES MANUAL LOADING ON EDG1-1. THE HYDROGEN RECOMBINER (NC3801) IS A BACKUP TO THE CHD SYSTEM. IF REQUIRED, THE SYSTEM IS MANUALLY LOADED ON TO EDG1-1 APPROXIMATELY 100 DAYS POST LOCA.
9. DELETED
10. DURING A LOCA, MAKE-UP PUMPS ARE MODELED AT RUN-OUT (560 bhp). THESE PUMPS ARE AT LOWER OUTPUT DURING A LOOP ONLY EVENT. THE SECOND LOAD VALUE IN EACH COLUMN REPRESENTS THE LOOP LOADING OF THE PUMPS.
11. FOR LOCA/LOOP THE LOADS LISTED ASSUME A LARGE LOCA. FOR A LARGE LOCA THE ESSENTIAL PRESSURIZER HEATERS WILL NOT REMAIN ENERGIZED. ONLY FOR VERY SMALL LOCA'S WILL HEATERS REMAIN ENERGIZED, IN WHICH CASE OTHER LARGER LOADS SUCH AS CTMT SPRAY PUMPS WILL NOT BE PRESENT.
12. DELETED
13. THE MAGNITUDES OF THE LOADS FED FROM BUSSES C2 AND D2 ARE PROVIDED AS INFORMATION TO THE OPERATOR IN THE EVENT THAT THEY ARE BACKFED. BEFORE THESE LOADS CAN BE ADDED, HOWEVER, THE OPERATOR MUST VERIFY THAT THEIR ADDITION WILL NOT OVERLOAD THE EDG.
14. DURING EDG OPERATION, ONCE THE JACKET WATER TEMPERATURE REACHES 155°F, THE EDG IMMERSION HEATERS WILL DEENERGIZE.
15. DELETED
16. CONTAINMENT LIGHTING TRANSFORMERS ARE NOT INCLUDED IN THE TOTAL LOAD BECAUSE THEY ARE REQUIRED TO BE DEENERGIZED DURING CTMT CLOSEOUT.
17. THERE IS NORMALLY ONLY ONE RUNNING COMPONENT COOLING WATER (CCW) PUMP. WHILE SWAPPING THE RUNNING AND SPARE PUMPS, TWO CCW PUMPS ARE TEMPORARILY RUNNING ON THE SAME BUS, AND WOULD REMAIN ON THE BUS IF THE EDG WAS STARTED. THIS TABLE ACCOUNTS FOR ONLY ONE CCW PUMP BECAUSE PROCEDURES DIRECT THE OPERATORS TO LIMIT THE AMOUNT OF TIME THAT TWO CCW PUMPS ARE CONNECTED TO THE SAME BUS DUE TO EDG LOADING CONCERNS.
18. DELETED
19. DELETED
20. MP0033 AND MP0433 CAN BE OPERATED IN PLACE OF MP0031 AND MP0431, RESPECTIVELY. THE MP0031 AND MP0431 PUMPS ARE SELECTED AS RUNNING BECAUSE THEY RESPRESENT THE MOST CONSERVATIVE LOAD.
21. TRANSFORMER CORE LOSSES ARE LISTED ON THE TABLE FOR PURPOSE OF REPRESENTING TOTAL DIESEL GENERATOR LOAD. THE IDENTIFICATION NUMBERS LISTED UNDER "BKR" AND "LOAD" FOR TRANSFORMER CORE LOSSES ARE FICTITIOUS AND DO NOT EXIST IN THE PLANT OR IN SAP.
22. "LOOP 1" CONSISTS OF THE LOADS THAT ARE ADDED TO THE EDG WHEN THE EDG OUTPUT BREAKER CLOSES FOLLOWING A LOOP EVENT.
23. IF THE RUNNING CCW PUMP WAS ON THIS TRAIN PRIOR TO THE LOOP-ONLY EVENT, IT WILL RESTART WHEN THE EDG OUTPUT BREAKER CLOSES (LOOP 1). IF THE MU PUMP WAS RUNNING ON THIS TRAIN PRIOR TO THE LOOP-ONLY EVENT, IT WILL BE SHED BY UV RELAYS AND START 2.5 SECONDS AFTER THE EDG OUTPUT BREAKER CLOSES.
24. "LOOP 2" OCCURS TEN (10) SECONDS AFTER THE EDG OUTPUT BREAKER CLOSES. IF THE CCW PUMP ASSOCIATED WITH THIS TRAIN IS IN STANDBY PRIOR TO THE LOOP-ONLY EVENT, IT WILL START DURING LOOP 2. THE EDG AIR COMPRESSOR #1 WILL START 20 SECONDS AFTER THE EDG OUTPUT BREAKER CLOSES FOLLOWING A LOOP EVENT.
25. "LOOP 3" OCCURS TWENTY-ONE (21) SECONDS AFTER THE EDG OUTPUT BREAKER CLOSES. THE SW PUMP STARTS IN LOOP 3.
26. MAKE-UP PUMP MOTOR #1 IS QUALITY CLASS Q FOR EMERGENCY FEED AND BLEED COOLING. THE SCENARIO IS OUTSIDE THE BOUNDS OF FORMAL DESIGN BASIS EVENTS DESCRIBED IN THE UFSAR; HOWEVER, THE APPROPRIATE QUALITY CLASS IS ANALYTICALLY CONSIDERED.

GENERAL NOTE

SUPPORTING DOCUMENTATION FOR LOAD SEQUENCING AND ON/OFF DETERMINATION, AS WELL AS FOR LOAD VALUES, IS DOCUMENTED IN CALCULATION C-EE-015.003-008. DISPLAYED LOAD VALUES FOR MOTORS ARE CALCULATED WITH CONSIDERATION TO MOTOR EFFICIENCY AND POWER FACTOR BY ETAP POWERSTATION. THE SUMMARIZED TOTAL LOAD ON THE EMERGENCY DIESEL GENERATOR TAKES IN TO ACCOUNT SYSTEM LOSSES, INCLUDING 4KV AND 480V POWER CABLE LOSSES AND IS NOT DERIVED FROM THE ADDITION OF KILOWATTS AND KILOVARS IN THE COLUMNS LISTED.

REFERENCE DRAWINGS

E-3	4.16KV ONE LINE DIAGRAM
E-4 SH.1	480V UNIT SUB STA ONE LINE DIAGRAM
E-5 SH.2	480V MCC (NON ESS) ONE LINE DIAGRAM
E-6 SH.1 - 5	480V MCC (ESS) ONE LINE DIAGRAM
E-9	240 VAC AND 120 VAC MCC'S (ESS) ONE LINE DIAGRAM
E-17B	SFAS ACTIVATED EQUIPMENT TABULATION

DAVIS-BESSE NUCLEAR POWER STATION

EMERGENCY DIESEL GENERATOR 1-1
LOADING TABLE
E-1042 SH.1

TABLE 8.3-1

REVISION 32

SEPTEMBER 2018

DB 03-29-18 DFN=1:/ELEC/E1042SH1.DGN

BUS	BKR	EQUIPMENT DESCRIPTION	O/N	LOAD	CONTINUOUS RATING	OPERATING LOAD	KW AT % LOAD	KVAR AT % LOAD	LOCA WITH LOOP: SEQUENCER STEP LOADING								LOOP ONLY					
					HP/KVA	%			STEP I (SEE NOTE 1)	STEP Ia	STEP II	STEP III	STEP IV	STEP V	MANUAL LOADING	REMARKS	LOOP1 (SEE NOTE 22 & 23)	LOOP2 (SEE NOTE 24)	LOOP3 (SEE NOTE 25)	MANUAL LOADING	LOADS ADDED THRU BACK FEEDING BUS (SEE NOTE 6 ON SH.1)	REMARKS
480V MCC																						
E12B	BE1255	EMER D.G. ROOM 1 VENT FAN 1	O	MC0251	7.50	100	8.67	5.37	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12B	BE1256	EMER D.G. ROOM 1 VENT FAN 2	O	MC0252	7.50	100	8.67	5.37	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12B	BE1257	FIRE PUMP D.O. TRANSFER PUMP 1	N	MP0061	3	0	0.00	0.00														
E12B	BE1267	FUEL OIL BOOSTER PUMP 1	N	MP1591	3	0	0.00	0.00														
E12B	BE1270	LTG. TRANSFER D.O. PUMP HSE.	N	X3021	9.00 KVA	37	3.00	1.45	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12B	BE1269	D.O. PUMP HSE. ELEC. UNIT HTR.1	N	WE1091	4.00 KVA	100	4.00	0.00	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12B	BE1258	EMER DG 1 IMMERSION HTR.	O	C3621	15.00 KVA	100	15.00	0.00	ON	ON	ON	ON	ON	ON		SEE NOTE 14	ON	ON	ON			(SEE NOTE 14)
E12B	BE1261	EMER DG 1 SOAK-BACK PUMP	O	MP1471	1	100	0.90	1.04	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12B	BE1285	BATTERY ROOM VENT FAN 1-1	O	MC0781	1	100	0.95	1.28	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12B	BE1289	EDG 1-1 AC TURBO OIL PUMP	N	MP147-3	0.75	100	0.74	0.83	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12B	BE1268	DEISEL OIL PUMP HOUSE SUMP 1-1 PMPA	N	MP173-A	0.50	100	0.73	0.55	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12B	BE1271	SG2 TO AFPI ISO VLV	O	MV106A	2.60	100	2.79	2.84	ON	ON	ON	ON	ON	ON			ON	ON	ON			
E12B	BE1259	120VAC MCC YE1 LOAD	O	YE1	2.00 KVA	100	1.60	1.20	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12C	BE1274	S.W. PUMP STRAINER 1	O	MF0151	1	100	0.96	0.72	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12C	BE1212	S.W. PUMP VENT. FAN 1	O	MC9901	10	100	8.26	6.89	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12C	BE1205	S.V. PUMP VENT. FAN 2	O	MC9902	10	100	9.01	8.56	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12C	BE1275	SW PMP STRNR 1 DRN VLV	O	MV1379	0.33	0	0.00	0.00														
E12C	BE1277	SW ISO VLV TO CLNG WTR	O	MV1399	0.70	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
E12C	BE1281	SW TO INTAKE STRUCTURE VLV	O	MV2929	0.66	0	0.00	0.00														
E12C	BE1282	SW TO CLNG TWR MU VLV	O	MV2931	1.00	0	0.00	0.00														
E12D	BE1203	TRAVELLING SCREEN AREA EXHAUST FAN	N	MC0100	7.50	100	6.57	3.74	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12D	BE1204	BACK UP SERVICE WATER PUMP STRAINER	N	MF15401	0.75	100	0.74	0.89							ON					ON	ON	
E12D	BE1206	BACK UP SERVICE WATER STRAINER DISH VLV	N	MV4690	0.33	0	0.00	0.00														
E12E	BE1292	ECCS ROOM 105 COOLER FAN 4	O	MC0314	7.50	100	7.99	4.95							ON							
E12E	BE1293	ECCS ROOM 105 COOLER FAN 5	O	MC0315	7.50	100	7.99	4.95							ON							
E12E	BE1296	HPI PUMP 1-1 AC LUBE OIL PUMP	O	MP1971	1	100	0.95	0.94			ON	ON	ON	ON	ON							
E12E	BE1294	SG 1 DRN VLV	O	MV611	0.67	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
E12E	BE1295	MU PMP 1-1 DISCH VLV	O	MV6419	0.70	0	0.00	0.00														
E12E	BE1286	HIGH PRESSURE IN. PMP 1 MIN RECIRC LINE ISO VLV	O	MVHP32	0.70	0	0.00	0.00														
E12F	BE1298	D.G. FUEL OIL TRANSFER PUMP	O	MP1951	2.0	100	1.56	0.96	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E12F	BE1299	EMER. D.G. AIR COMPRESSOR 1	N	MC0111	10	100	8.66	7.40						ON		NON SAFETY RELATED		ON	ON			NON SAFETY RELATED
E14	BE1401	CONTAINMENT AIR COOLER FAN 1- HS	O	MC0011	150.00	87	104.90	79.52												ON	ON	
E14	BE1401	CONTAINMENT AIR COOLER FAN 1- LS	O	MC0011	40.00	100	34.21	49.96						ON	ON							
E16A	BE1611	STA.VENT.NORM.RANGE RAD.MON. RE4598AA PUMP	O	MP274-1	0.5	100	0.37	0.40	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E16A	BE1612		O													SPARE						SPARE
E16A	BE1615	HVAC FOR ROOMS 392 & 434	N	BSW220X	53.98 KVA	100	48.58	23.53	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E16A	BE1616	ISOLIMITER (CONSTANT VOLTAGE XFMR) XY1	O	XY1	13.34 KVA	100	2.00	13.19	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E16A	BE1617	ISOLIMITER (CONSTANT VOLTAGE XFMR) XY3	O	XY3	13.34 KVA	100	2.00	13.19	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E16B	BE1613	CTNT ATM NORM RANGE RAD MON RE4597AA PUMP	O	MP273-1/2	0.5	100	0.37	0.40	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
E16B	BE1614		O													SPARE						SPARE
E16B	BE1602	RC PRZR PWR RLF SHUTOFF VLV	O	MVRC11	1.33	0	0.00	0.00														
EF12C	BEF123	JOCKEY FIRE PUMP	N	MP0060	5	100	4.51	2.55	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
EF12C	BEF124	SW PUMP STRAINER 3	O	MF0153	1	0	0.00	0.00								SPARE						SPARE
EF12C	BEF125	SW PMP STRNR 3 DRN VLV	O	MV1381	0.33	0	0.00	0.00														
EF12D	BEF129	CTNT AIR COOLER 1-3 ISOLATION VLV	O	MV1368	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON			ON	ON	ON			
EF15	BEF151	CONTAINMENT AIR COOLER FAN 3- HS	O	MC0013	150.00	0	0.00	0.00								SPARE						SPARE
EF15	BEF152	CONTAINMENT AIR COOLER FAN 3- LS	O	MC0013	40.00	0	0.00	0.00								SPARE						SPARE
F13	BF1315	BA ADD TANK ROOM SEC. SPACE HTR.	N	VE0802	39 KVA	100	39	0.00													ON	
F13	BF1305	BA LINES HEAT TRACING SEC. SYST	N	BASSW	113.00 KVA	62	70.06	0.00													ON	
F13	BF1316	TURBINE GENERATOR GEAR OIL PUMP	N	MP0200	30	100	25.14	16.69													ON	
F13	BF1318	TURBINE GENERATOR TURN. GEAR	N	MK0082	60	100	54.18	33.58													ON	
F13	BF1319	TURBINE BEARING OIL LIFT PUMP 1	N	MP0251	5	100	4.47	3.58													ON	
F13	BF1320	TURBINE BEARING OIL LIFT PUMP 2	N	MP0252	5	100	4.47	3.58													ON	
F13	BF1321	TURBINE BEARING OIL LIFT PUMP 3	N	MP0253	5	100	4.47	3.58													ON	
F13	BF1322	TURBINE BEARING OIL LIFT PUMP 4	N	MP0254	5	100	4.47	3.58													ON	
F13	BF1323	TURBINE BEARING OIL LIFT PUMP 5	N	MP0255	5	100	4.47	3.58													ON	
F13	BF1324	TURBINE BEARING OIL LIFT PUMP 6	N	MP0256	5	100	4.47	3.58													ON	
F13	BF1302	EMER. INST. AIR DRYER CONTROL PANEL	N	C3405	0.2 KVA	100	0.16	0.12													ON	
F71	BF7105	EIAC CLOSED COOLING LOOP FAN 1	N	MC1431	3	100	2.52	1.96													ON	
F71	BF7105	EIAC CLOSED COOLING LOOP FAN 2	N	MC1432	3	100	2.52	1.96													ON	
F71	BF7114	MDFP AUX LUBE OIL PUMP	N	MP242-1	0.75	100	0.69	0.61													ON	
F71	BF7105	EMER INST AIR CLOSED COOLING LOOP PUMP 1	N	MP2601	7.50	100	6.52	2.37													ON	
F71	BF7105	EMER INST AIR CLOSED COOLING LOOP PUMP 2	N	MP2602	7.50	100	6.52	2.37													ON	
F71	BF7117	XFMR FOR PNL Y3401	N	X3402	30.00 KVA	0	0.00	0.00														
F71	BF7118	XFMR FOR RECEPT. RM 3348 AIR COND. RECEPT.	N	X3403	15.00 KVA	100	12.00	9.00													ON	
F81	BF8102	DBCSBOP BATTERY CHARGER	N	DBCSBOP	2.40 KVA	100	1.92	1.44													ON	
F81	BF8105	XFMR DF8 CORE LOSS. NOTE 21		DF8CL	6.00 KVA	100	0.80	5.95													ON	
F81	BF8101	DG IMMERSION HEATER	N	DGIH	15.00 KVA	100	15.00	0.00								(SEE NOTE 14)					ON	(SEE NOTE 14)
F81	BF8118	FUEL OIL TANK RM UNIT HTR	N	E207	5.00 KVA	0	0.00	0.00														
F81	BF8113	VENT FAN	N	MC152A	5	100	4.39	2.12													ON	
F81	BF8114	VENT FAN	N	MC152B	5	0	0.00	0.00														
F81	BF8112	VENT FAN	N	MC153	1.00	100	1.02	0.88													ON	
F81	BF8108	AIR COMPRESSOR	N	MC430A	10.00	0	0.00	0.00														
F81	BF8109	AIR COMPRESSOR	N	MC430B	10.00	0	0.00	0.00														
F81	BF8110	RADIATOR FAN	N	ME211A	15.00	0	0.00	0.00														
F81	BF8111	RADIATOR FAN	N	ME211B	15.00	0	0.00	0.00														
F81	BF8115	SUMP PUMP	N	MP279A	0.75	0	0.00	0.00														
F81	BF8116	SUMP PUMP	N	MP279B	0.75	0	0.00	0.00														
F81	BF8107	DEISEL GEN TURBO LUBE OIL PUMP	N	MP280A	0.75	100	0.72	0.96													ON	
F81	BF8106	DEISEL SOAK-BACK PUMP	N	MP280B	1.00	100	0.92	1.10													ON	
F81	BF8103	480 VAC RECEPTACLE	N	ZR3011	50.00 KVA	0	0.00	0.00														
F81	BF8104	480 VAC RECEPTACLE	N	ZR3012	50.00 KVA	0	0.00	0.00														
F81	BF8117	X3052 LTG TRANSF	N	X3052	50.00 KVA	38	17.10	8.28													ON	
240V MCC																						
YE2	YE201	CTNT AIR SAMPLER ISOLATION VLV MOTOR	O	MV5011A	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YE2	YE202	MOTOR FOR CTNT AIR COOLER NO 3 WATER INLET VLV	O	MV5011B	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YE2	YE203	CTNT H2 ANALYZER SAMPLE LINE #1 INLET VALVE	O	MV5011C	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YE2	YE204	CTNT AIR SAMPLER ISOLATION VALVE	O	MV5011D	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YE2	YE205	CTNT AIR SAMPLER RET PENT 43 VLV MOTOR	O	MV5011E	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YE2	YE212	CC WATER PUMP ROOM VENT FAN ROOM INLET DAMPER	O	MV5443C	0.17	100	0.17	0.13	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
YE2	YE206	XFMR YE2B LOAD	O	YE2B	2.00 KVA	100	1.60	1.20	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	

DIESEL RATING

RATED OUTPUT 2600KW CONTINUOUS

OVERLOAD OUTPUT 2860KW ANY 2 HOURS OUT OF 24

2838KW FOR 2000 HOURS

2946KW FOR 200 HOURS

3035KW FOR ½ HOUR

DAVIS-BESSE NUCLEAR POWER STATION

EMERGENCY DIESEL GENERATOR 1-1
LOADING TABLE
E-1042 SH.2

TABLE 8.3-1

REVISION 32

SEPTEMBER 2018

DB 11-20-17 DFN:I:/ELEC/E1042SH2.DGN

BUS	BKR	EQUIPMENT DESCRIPTION	O/N	LOAD	CONTINUOUS RATING HP/KVA	OPERATING LOAD %	KW AT % LOAD	kvar AT % LOAD	LOCA WITH LOOP – SEQUENCER STEP LOADING: STEP I (SEE NOTE 1)	STEP Ia	STEP II	STEP III	STEP IV	STEP V	MANUAL LOADING	REMARKS	LOOP ONLY: LOOP1 (SEE NOTE 22 & 23)	LOOP2 (SEE NOTE 24)	LOOP3 (SEE NOTE 25)	MANUAL LOADING	LOADS ADDED THRU BACK FEEDING BUS (SEE NOTE 6)	REMARKS
4160V SWGR																						
D1	AD113	COMPONENT COOLING WATER PUMP 2	O	MP0432	400	90	285.30	167.80	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
D1	AD108	COMPONENT COOLING WATER PUMP 3	O	MP0433	400	0	0.00	0.00								NOTE 20						SPARE
D1	AD111	HIGH PRESSURE INJECTION PUMP 2	O	MP0582	600	117	561.1	271.8			ON	ON	ON	ON	ON							
D1	AD112	DECAY HEAT PUMP 2	O	MP0422	400	105	333.20	171.30				ON	ON	ON	ON							
D1	AD107	SERVICE WATER PUMP 2	O	MP0032	600	97	467.60	268.00					ON	ON	ON				ON	ON	ON	
D1	AD109	SERVICE WATER PUMP 3	O	MP0033	600	0	0.00	0.00								NOTE 20						SPARE
D1	AD105	MAKE-UP PUMP 2	N	MP372A	450	124/96	433.4/335.6	138.1/134.3		ON	ON					SEE NOTE #2 AND NOTE 10		ON	ON	ON	ON	(SEE NOTE 2)
D2	AD210	MOTOR DRIVEN FEED WATER PUMP	N	MP2410	800	98	620.10	323.80													ON	
D2	ABDD2	TRANSF. BD CORE LOSS. NOTE 21	N	BDCL	31.2 KVA	0	0.00	0.00													ON	
480V LC																						
BUS F1	BF111	CONTAINMENT SPRAY PUMP 2	O	MP0562	200	110	175.5	83.48						ON	ON							
BUS F7	BF703	EMER. INSTR. AIR COMPRESSOR C139	N	MC1390	200	100	156.36	80.97													ON	
BUS F7	BF703	EMER.INSTR.AIR COMPRESSOR C139 AUX OIL PUMP	N	MP261	2	100	1.95	1.21													ON	
F7	BDF7	TRANSF. DF7 CORE LOSSES. NOTE 21	N	DF7CL	26.00 KVA	100	3.70	25.74													ON	
480V MCC																						
F1	BDF11	XFMR DF1-1 CORE LOSS. NOTE 21		DF1-1CL	13.00 KVA	100	2.00	12.84	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F1	BDF12	XFMR DF1-2 CORE LOSS. NOTE 21		DF1-2CL	13.00 KVA	100	2.00	12.84	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F11A	BF1115	CONTAINMENT LTG. TRANSF(LT9D1)	N	XT9D1	30.00 KVA	0	0.00	0.00								SEE NOTE 16						(SEE NOTE 16)
F11A	BF1115	CONTAINMENT LTG. TRANSF(LT9D2)	N	XT9D2	30.00 KVA	0	0.00	0.00								SEE NOTE 16						(SEE NOTE 16)
F11A	BF1112	CC PUMP ROOM VENT. FAN 2	O	MC0752	7.50	100	6.31	4.73	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F11A	BF1114	CONTAINMENT LTG. TRANSF. (L49D1)	N	X49D1	45.00 KVA	0	0.00	0.00								SEE NOTE 16						(SEE NOTE 16)
F11A	BF1116	CONTROL ROOM & AUX.BLDG.LTG.TRANSF.	N	X57D1	30.00 KVA	98	26.46	12.82	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F11A	BF1149	CONTROL ROOM EMER.VENT.SYSTEM FAN 2	O	MC0212	5	100	4.24	3.24							ON					ON	ON	
F11A	BF1113	CONTAINMENT RECIRC. FAN 2	N	MC0562	50	99	41.82	23.89							ON	NOT SAFETY RELATED						NOT SAFETY RELATED
F11A	BF1131	CTRM. EMER. SYST. CONDENSING UNIT 2	O	MS3321	10	100	15.62	11.31							ON					ON	ON	
F11A	BF1102	CTRM. EMER. VENT. SYST. VACUUM PUMP 1-2	O	MRE5328	1.50	100	1.47	1.68							ON					ON	ON	
F11A	BF1109	H2 DILUTION SYSTEM BLOWER 2	O	MC0622	20	0	0.00	0.00								SEE NOTE 8						
F11A	BF1124	AFPT 2 MN STM IN ISO VLV	O	MV107	2.60	100	2.79	2.84	ON	ON	ON	ON	ON	ON			ON	ON	ON			
F11A	BF1133	CC CRD BSTR PUMP 1-2 SUCT VLV	O	MV1338	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
F11A	BF1140	RCS SFAS CH1 CTMT PRESS. SW. I.V.	O	MV2000	0.33	0	0.00	0.00														
F11A	BF1144	CTMT ISO VLV PENT. 73A	O	MV2002	0.13	0	0.00	0.00														
F11A	BF1126	PRZR VAP SMPL LINE VLV MTR FOR VLV OP	O	MV239A	0.13	0	0.00	0.00														
F11A	BF1127	PRZR LQD. SMPL LINE VLV	O	MV239B	0.13	0	0.00	0.00														
F11A	BF1128	PRZR SMPLE LINE ISOLATION VLV	O	MV240B	0.33	100	0.26	0.57	ON	ON	ON	ON	ON	ON								
F11A	BF1125	PRESSURIZER SPRAY LINE ISOLATION VALVE	O	MV2736	0.33	0	0.00	0.00														
F11A	BF1132	CTRM EMER CNDS UNIT 2 VLV	O	MV2928	0.13	0	0.00	0.00														
F11A	BF1103	CTRL RM EMER SYS STAND BY COND UNIT 2	O	MV4907	0.16	100	0.22	0.17	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F11A	BF1110	H2 DILUTION SYSTEM 1-2 CTMT ISOLATION VALVE MOTOR	O	MV5065	0.33	100	0.26	0.57	ON	ON	ON	ON	ON	ON								
F11A	BF1180	CTMT VCM RELIEF VLV MOTOR	O	MV5075	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
F11A	BF1181	CTMT VCM RELIEF VLV	O	MV5076	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
F11A	BF1182	CTMT VCM RELIEF VLV 3	O	MV5077	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
F11A	BF1183	CTMT VCM RELIEF VLV	O	MV5078	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
F11A	BF1184	CTMT VCM RELIEF VLV MOTOR	O	MV5079	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
F11A	BF1106	CC WATER DISCHARGE LINE 2 ISO VLV	O	MV5096	2.60	0	0.00	0.00														
F11A	BF1119	CC WATER IN LINE 2 ISO VLV	O	MV5098	1.60	0	0.00	0.00														
F11A	BF1118	SG #2 AUX FD WATER ISOLATION VLV	O	MV599	4.00	0	0.00	0.00														
F11A	BF1111	SG #2 DRAIN LINE ISOLATION VLV	O	MV603	0.67	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
F11A	BF1108	CTMT ISO VLV	O	MV6422	0.70	0	0.00	0.00														
F11A	BF1120	CF TANK 1-2 ISO VLV MOTOR	O	MVCF1A	10.50	0	0.00	0.00														
F11A	BF1121	CF TANK 1-2 SAMPLE/BLEED LINE VALVE MOTOR	O	MVCF2A	0.33	0	0.00	0.00														
F11A	BF1123	CF TANK 1-2 VENT VALVE	O	MVCF5A	0.33	0	0.00	0.00														
F11A	BF1130	RCS TO DECAY HEAT SYSTEM ISO VLV	O	MVDH11	9.80	0	0.00	0.00														
F11B	BF1188	MAIN STM LINE 1 TO AFP TURBINE 1-2	O	MV107A	2.60	100	2.79	2.84	ON	ON	ON	ON	ON	ON			ON	ON	ON			
F11B	BF1158	CC WATER OUT ISO VLV 2 FROM CTMT	O	MV1407B	0.70	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
F11B	BF1159	CC WATER TO CTMT ISO VLV	O	MV1411B	0.70	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
F11B	BF1147	CTMT SPRAY PUMP 2 OUT VLV	O	MV1531	1.00	100	1.14	1.73	ON	ON	ON	ON	ON	ON								
F11B	BF1176	CC WATER TO CRD COOLER INLET VLV	O	MV1567B	0.66	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
F11B	BF1138	CTMT NORMAL SUMP IS VLV	O	MV2012-B	0.66	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
F11B	BF1186	CTRL RM EMER VENT FAN 2 IN VLV	O	MV5262A	0.33	0	0.00	0.00														
F11B	BF1160	CONTAINMENT/ANNULUS O/P ISO VLV	O	MV624B	0.33	0	0.00	0.00														
F11B	BF1148	BWST LINE OUT VLV A	O	MVDH7A	1.00	100	1.14	1.73	ON	ON	ON	ON	ON	ON								
F11C	BF1167	RC M.U. PUMP 2 MAIN OIL PUMP	O	MP372B	1	100	1.21	0.91	ON	ON	ON	ON	ON	ON			ON	ON	ON	ON	ON	
F11C	BF1168	RC M.U. PUMP 2 GEAR LUBE OIL PUMP	N	MP372D	3	100	2.78	2.34				ON	ON	ON			ON	ON	ON			
F11C	BF1177	AFP2 SUCTION VLV	O	MV1383	0.65	0	0.00	0.00														
F11C	BF1129	DH NORMAL SUCTION LINE 2 ISO VLV MOTOR	O	MV1518	7.80	0	0.00	0.00														
F11C	BF1134	DH PMP 2 SUCT VLV FRM BWST	O	MV2734	3.90	100	3.46	4.38				ON	ON	ON								
F11C	BF1151	CTMT H2 PURGE OUT ISO VLV 2	O	MV5037	0.33	100	0.32	0.64	ON	ON	ON	ON	ON	ON								
F11C	BF1136	LOW PRESS INJECT VLV 2 MOTOR	O	MVDH1A	12.80	0	0.00	0.00														
F11C	BF1139	HPI 2-1 VALVE MOTOR	O	MVHP2A	1.00	100	1.14	1.73			ON	ON	ON	ON								
F11C	BF1141	HPI 2-2 VALVE MOTOR	O	MVHP2B	1.00	100	1.14	1.73			ON	ON	ON	ON								
F11D	BF1145	HYDROGEN PURGE SYSTEM FILTER	O	WF60	2.00 KVA	0	0.00	0.00														
F11D	BF1172	BA ADD. TANK 2 HTR. 2	N	WET722	7.50 KVA	100	7.50	0.00							ON	SEE NOTE 8				ON		
F11D	BF1169	BA PUMP 2	N	MP0382	5	0	0.00	0.00														
F11D	BF1171	BA ADD. TANK 2 HTR. 1	N	WET721	7.50 KVA	100	7.50	0.00							ON					ON		
F11D	BF1187	BATTERY CHARGER 2PN	O	DBC2PN	74.6 KVA	84	43.86	44.76								SPARE (SEE NOTE 3)						SPARE (SEE NOTE 3)
F11D	BF1157	ECCS RM.113 CLR. FAN 3	O	MC0313	2	100	1.83	1.66							ON							
F11D	BF1153	ECCS SUMP PUMP 2A	O	MP892A	7.90	100	5.96	3.69							ON							
F11D	BF1154	ECCS SUMP PUMP 2B	O	MP892B	7.90	0	0.00	0.00														
F11D	BF1161	CC AUX BLDG TO LINE 2 ISO	O	MV2649	1.60	0	0.00	0.00														
F11D	BF1164	CTMT H2 PURGE FAN 2 SW IN VLV	O	MV5068	0.125	0	0.00	0.00														
F11D	BF1178	RM 115 HVAC ISO VLV	O	MV5441	0.13	100	0.18	0.31	ON	ON	ON	ON	ON	ON								
F11D	BF1179	RM 115 HVAC ISO VLV 2	O	MV5442	0.13	100	0.24	0.37	ON	ON	ON	ON	ON	ON								
F11D	BF1117	MAIN FD WATER 2 ISO VLV MOTOR	O	MV601	39.40	100	33.72	18.20	ON	ON	ON	ON	ON	ON								
F11D	BF1185	DECAY HEAT 1-2 OTLT CC VLV	O	MV830	1.00	0	0.00	0.00														
F11D	BF1142	CTMT EMER SUMP OUT VLV	O	MVDH9A	1.00	100	1.14	1.73	ON	ON	ON	ON	ON	ON								
F11D	BF1107	MU FLT 2 IN VLV	O	MVMU12B	0.13	0	0.00	0.00														
F11E	BF1192	ECCS RM.115 COOLER FAN 1	O	MC0311	7.50	100	7.31	4.53							ON							
F11E	BF1193	ECCS RM.115 COOLER FAN 2	O	MC0312	7.50	100	7.99	4.95							ON							
F11E	BF1195	LPI-HPI CROSS CONN ISO VLV 2	O	MVDH63	0.33	0	0.00	0.00														
F11E	BF1194	HPI PUMP 1-2 MIN RECIRC ISO VLV	O	MVHP31	0.70	0	0.00	0.00														
F11F	BF121	10KVA DIST XFMR	N	X1708	10KVA	63	5.04	3.78	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12A	BF1230	DIES.GEN.FUEL OIL STOR. & TRANSF. PUMP	O	MP1952	2.00	100	1.56	0.96	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12A	BF1229	CTRM.EMER.SYST.STANDBY COND.UNIT 2	O	MS0612	7.50	100	6.74	5.28							ON					ON	ON	
F12A	BF1205	AFP ROOM VENT. FAN 2	O	MC0732	7.50	100	6.68	4.49	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12A	BF1204	LOW VOLT. SWGR. RM. VENT. FAN 2	O	MC0133	10	100	8.74	5.41	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12A	BF1203	EMER. VENT FAN 2	O	MC0302	15	100	12.20	8.26	ON	ON	ON	ON	ON	ON	ON							
F12A	BF1209	BATTERY CHARGER 2P	O	DBC2P	74.6 KVA	84	43.86	44.76	ON	ON	ON	ON	ON	ON	ON	(SEE NOTE 3a)	ON	ON	ON	ON	ON	(SEE NOTE 3a)
F12A	BF1212	BATTERY CHARGER 2N	O	DBC2N	74.6 KVA	84	43.86	44.76	ON	ON	ON	ON	ON	ON	ON	(SEE NOTE 3a)	ON	ON	ON	ON	ON	(SEE NOTE 3a)
F12A	BF1220	RECTIFIER CHANNEL 2	O	YRF2	20.00 KVA	65	10.40	7.80	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12A	BF1221	RECTIFIER CHANNEL 4	O	YRF4	20.00 KVA	65	10.40	7.80	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12A	BF1231	HPI PUMP 2 AC LUBE OIL PUMP	O	MP1981	1	100	0.95	0.94			ON	ON	ON	ON	ON							
F12A	BF1213	PRZR HEATER	N	WLB11	42.00 KVA	100	42.00	0.00								(SEE NOTE 11)				ON	ON	
F12A	BF1214	PRZR HEATER	N	WLB12	42.00 KVA	100	42.00	0.00								(SEE NOTE 11)				ON	ON	
F12A	BF1215	PRZR HEATER	N	WLB13	42.00 KVA	100	42.00	0.00								(SEE NOTE 11)				ON	ON	
F12A	BF1218	EMER. VENTL. FAN IN DAMPER 2	O	MC5018	0.33	100	0.26	0.57	ON	ON												
F12A	BF1225	EMERGENCY VENT SYSTEM CROSS TIE DUCTWORK DAMPER	O	MC5057	0.33	0	0.00	0.00														
F12A	BF1223	CTMT AIR COOLER 2 SW IN ISOLATION VLV	O	MV1367	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON			ON	ON	ON			
F12A	BF1227	RCS LETDOWN COOLER #1 CCW I. VLV	O	MV1409	0.33	0	0.00	0.00														
F12A	BF1228	RCS LETDOWN VLV 2 CCW INTAKE VLV	O	MV1410	0.33	0	0.00	0.00														
F12A	BF1285	PRZR SAMPLE LN TO CTMT VENT HEADER VLV	O	MV200	0.13	0	0.00	0.00														
F12A	BF1201	AFP 1-2 TO SG 1-1 STP VLV	O	MV3871	2.6	100	6.08	3.77	ON	ON	ON	ON	ON	ON								
F12A	BF1226	EVS TO SPENT FUEL POOL "X" CONNECT DMPR	O	MV5025	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
F12A	BF1239	LOW VOLTAGE SWGR RM 428 VENT MOTOR	O	MV5314A	0.33	0	0.00	0.00														
F12A	BF1210	BATTERY ROOM 429A TO ATM DAMPER	O	MV5598	0.166	100	0.17	0.12	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12A	BF1208	MU PUMP DISCH CROSS CONNECT LINE ISO VLV	O	MV6408	0.70	0	0.00	0.00														
F12A	BF1237	C LETDOWN COOLER 1-1 INLET VLV OPERATOR	O	MVMU1A	1.00	0	0.00	0.00														
F12A	BF1238	LETDOWN COOLER 1-2 IN VLV	O	MVMU1B	1.00	0	0.00	0.00														

NOTES

1. LOADS INDICATED IN STEP 1 ARE THOSE THAT START AS SOON AS THE EMERGENCY DIESEL GENERATOR (EDG) BREAKER CLOSES. THESE LOADS CONSIST OF NORMALLY OPERATING OR INTERMITTENT LOADS NOT SHED BY UV SIGNAL OR LOADS THAT RECEIVE A SFAS SIGNAL AND ARE NOT BLOCKED BY THE SEQUENCER.
2. IF MU PUMP WAS RUNNING ON THIS TRAIN PRIOR TO LOSS OF OFFSITE POWER (LOOP) IT WILL BE SHED BY UV RELAYS AND START BY TIME DELAY RELAY 2.5 SECONDS (STEP 1A) AFTER THE EDG OUTPUT BREAKER CLOSES. MU PUMP WILL BE TRIPPED AUTOMATICALLY IN STEP 3 WHEN DH PUMP IS STARTED BY SFAS FOLLOWING A LOOP.
3. SWING CHARGER NOT NORMALLY IN SERVICE. IT CAN BE PLACED IN SERVICE MANUALLY IF 2P OR 2N IS NOT AVAILABLE. DURING BATTERY CHARGER SURVEILLANCE TESTING. ALL THREE BATTERY CHARGERS (2N,2P,2PN- TWO OPERATING AT THEIR STEADY-STATE AND ONE AT ITS TESTING LOAD) ARE IN SERVICE PRIOR TO AN EVENT (LOOP OR LOOP WITH LOCA). THE LOAD VALUE REPRESENTS THE SWING CHARGER PLACED IN SERVICE MANUALLY AS 2P OR 2N.

3a. C-EE-015.03-008, ATTACHMENT 5, ESTABLISHES THE CONTINUOUS RATING (74.6 KVA) AND OPERATING LOAD PERCENTAGE (84%) FOR THE CONTINUOUS STEADY-STATE LOAD OF THE BATTERY CHARGERS. THE KW AND KVAR ARE CALCULATED BASED UPON THE PERCENTAGE LOADING.

4. DELETED
5. DELETED
6. REQUIRES SPECIAL BUS ALIGNMENT.
7. DELETED
8. THE CONTAINMENT HYDROGEN DILUTION SYSTEM (CHD) IS INITIATED APPROXIMATELY 21 DAYS POST LOCA AND REQUIRES MANUAL LOADING ON EDG1-2. THE HYDROGEN PURGE SYSTEM (WF60) IS A BACKUP TO THE CHD SYSTEM. IF REQUIRED, THE SYSTEM IS MANUALLY ACTUATED APPROXIMATELY 110 DAYS POST LOCA.
9. DELETED
10. DURING A LOCA, MAKE-UP PUMPS ARE MODELED AT RUN-OUT (560 bhp). THESE PUMPS ARE AT LOWER OUTPUT DURING A LOOP ONLY EVENT. THE SECOND LOAD VALUE IN EACH COLUMN REPRESENTS THE LOOP LOADING OF THE PUMPS.
11. FOR LOCA/LOOP THE LOADS LISTED ASSUME A LARGE LOCA. FOR A LARGE LOCA THE ESSENTIAL PRESSURIZER HEATERS WILL NOT REMAIN ENERGIZED. ONLY FOR VERY SMALL LOCA'S WILL HEATERS REMAIN ENERGIZED, IN WHICH CASE OTHER LARGER LOADS SUCH AS CTMT SPRAY PUMPS WILL NOT BE PRESENT.
12. DELETED
13. THE MAGNITUDES OF THE LOADS FED FROM BUSSES C2 AND D2 ARE PROVIDED AS INFORMATION TO THE OPERATOR IN THE EVENT THAT THEY ARE BACKFED. BEFORE THESE LOADS CAN BE ADDED, HOWEVER, THE OPERATOR MUST VERIFY THAT THEIR ADDITION WILL NOT OVERLOAD THE EDG.
14. DURING EDG OPERATION, ONCE THE JACKET WATER TEMPERATURE REACHES 155°F, THE EDG IMMERSION HEATERS WILL DEENERGIZE.
15. DELETED
16. CONTAINMENT LIGHTING TRANSFORMERS ARE NOT INCLUDED IN THE TOTAL LOAD BECAUSE THEY ARE REQUIRED TO BE DEENERGIZED DURING CTMT CLOSEOUT.
17. THERE IS NORMALLY ONLY ONE RUNNING COMPONENT COOLING WATER (CCW) PUMP. WHILE SWAPPING THE RUNNING AND SPARE PUMPS, TWO CCW PUMPS ARE TEMPORARILY RUNNING ON THE SAME BUS, AND WOULD REMAIN ON THE BUS IF THE EDG WAS STARTED. THIS TABLE ACCOUNTS FOR ONLY ONE CCW PUMP BECAUSE PROCEDURES DIRECT THE OPERATORS TO LIMIT THE AMOUNT OF TIME THAT TWO CCW PUMPS ARE CONNECTED TO THE SAME BUS DUE TO EDG LOADING CONCERNS.
18. DELETED
19. DELETED
20. MP0033 AND MP0433 CAN BE OPERATED IN PLACE OF MP0031 AND MP0431, RESPECTIVELY. THE MP0031 AND MP0431 PUMPS ARE SELECTED AS RUNNING BECAUSE THEY RESPRESENT THE MOST CONSERVATIVE LOAD.
21. TRANSFORMER CORE LOSSES ARE LISTED ON THE TABLE FOR PURPOSE OF REPRESENTING TOTAL DIESEL GENERATOR LOAD. THE IDENTIFICATION NUMBERS LISTED UNDER "BKR" AND "LOAD" FOR TRANSFORMER CORE LOSSES ARE FICTITIOUS AND DO NOT EXIST IN THE PLANT OR IN SAP.
22. "LOOP 1" CONSISTS OF THE LOADS THAT ARE ADDED TO THE EDG WHEN THE EDG OUTPUT BREAKER CLOSES FOLLOWING A LOOP EVENT.
23. IF THE RUNNING CCW PUMP WAS ON THIS TRAIN PRIOR TO THE LOOP-ONLY EVENT, IT WILL RESTART WHEN THE EDG OUTPUT BREAKER CLOSES (LOOP 1). IF THE MU PUMP WAS RUNNING ON THIS TRAIN PRIOR TO THE LOOP-ONLY EVENT, IT WILL BE SHED BY UV RELAYS AND START 2.5 SECONDS AFTER THE EDG OUTPUT BREAKER CLOSES.
24. "LOOP 2" OCCURS TEN (10) SECONDS AFTER THE EDG OUTPUT BREAKER CLOSES. IF THE CCW PUMP ASSOCIATED WITH THIS TRAIN IS IN STANDBY PRIOR TO THE LOOP-ONLY EVENT, IT WILL START DURING LOOP 2. THE EDG AIR COMPRESSOR #2 WILL START 20 SECONDS AFTER THE EDG OUTPUT BREAKER CLOSES FOLLOWING A LOOP EVENT.
25. "LOOP 3" OCCURS TWENTY-ONE (21) SECONDS AFTER THE EDG OUTPUT BREAKER CLOSES. THE SW PUMP STARTS IN LOOP 3.
26. MAINTAIN MCC F13 ALIGNMENT TO NORMAL SOURCE UNIT SUB F7 UNLESS FORMALLY EVALUATED IN C-EE-015-03-008 AS ACCEPTABLE. THE LOAD WILL BE ON THROUGHOUT ENTIRE EDG LOOP/LOCA AND LOOP ONLY SEQUENCES, OR CAN BE MANUALLY LOADED ON WHEN AN ALTERNATE ALIGNMENT HAS BEEN EVALUATED IN C-EE-015.03-008 AS ACCEPTABLE.

GENERAL NOTE

SUPPORTING DOCUMENTATION FOR LOAD SEQUENCING AND ON/OFF DETERMINATION, AS WELL AS FOR LOAD VALUES, IS DOCUMENTED IN CALCULATION C-EE-015.003-008. DISPLAYED LOAD VALUES FOR MOTORS ARE CALCULATED WITH CONSIDERATION TO MOTOR EFFICIENCY AND POWER FACTOR BY ETAP POWERSTATION. THE SUMMARIZED TOTAL LOAD ON THE EMERGENCY DIESEL GENERATOR TAKES IN TO ACCOUNT SYSTEM LOSSES, INCLUDING 4KV AND 480V POWER CABLE LOSSES AND IS NOT DERIVED FROM THE ADDITION OF KILOWATTS AND KILOVARS IN THE COLUMNS LISTED.

REFERENCE DRAWING

E-3	4.16KV ONE LINE DIAGRAM
E-4 SH.2	480V UNIT SUB STA ONE LINE DIAGRAM
E-5 SH.2	480V MCC (NON ESS) ONE LINE DIAGRAM
E-6 SH.2 - 5	480V MCC (ESS) ONE LINE DIAGRAM
E-9	240 VAC AND 120 VAC MCC'S (ESS) ONE LINE DIAGRAM
E-17B	SFAS ACTIVATED EQUIPMENT TABULATION

DAVIS-BESSE NUCLEAR POWER STATION

EMERGENCY DIESEL GENERATOR 1-2 LOADING TABLE

E-1043 SH.1

TABLE 8.3-1

REVISION 32

SEPTEMBER 2018

DB 11-20-17 DFN=I:/ELEC/E1043SH1.DGN

BUS	BKR	EQUIPMENT DESCRIPTION	O/N	LOAD	CONTINUOUS RATING HP/KVA	OPERATING LOAD %	KW AT % LOAD	KVAR AT % LOAD	LOCA WITH LOOP — SEQUENCER STEP LOADING: STEP I (SEE NOTE 1)	STEP Ia	STEP II	STEP III	STEP IV	STEP V	MANUAL LOADING	REMARKS	LOOP ONLY: LOOP1 (SEE NOTE 22 & 23)	LOOP2 (SEE NOTE 24)	LOOP3 (SEE NOTE 25)	MANUAL LOADING	LOADS ADDED THRU BACK FEEDING BUS (SEE NOTE 6 ON SH.1)	REMARKS
480V MCC																						
F12B	BF1255	EMER. DG. ROOM 2 VENT FAN 3	O	MC0253	7.50	100	8.67	5.37	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12B	BF1256	EMER. DG. ROOM 2 VENT FAN 4	O	MC0254	7.50	100	9.26	5.74	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12B	BF1267	FUEL OIL BOOSTER PUMP	N	MP1592	3	0	0.00	0.00														
F12B	BF1259	BATTERY ROOM VENT. FAN 2	O	MC0782	1	100	1.05	1.53	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12B	BF1269	DIES.OIL PUMP HSE.ELECT.UNIT HTR. 2	N	WE1092	4.00 KVA	100	4.00	0.00	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12B	BF1258	EMER. D. G. 2 IMMERSION HTR.	O	C3622	15.0 KVA	100	15.00	0.00	ON	ON	ON	ON	ON	ON		SEE NOTE 14	ON	ON	ON			(SEE NOTE 14)
F12B	BF1263	EMER. D. G. AIR COMPRESSOR 2	N	MC0112	10	100	10.21	5.4						ON		NON SAFETY RELATED		ON	ON			NON SAFETY RELATED
F12B	BF1261	EMER. D. G. 2 SOAK-BACK PUMP	O	MP1472	1	100	0.90	1.04	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12B	BF1257	FIRE PUMP D. O. TRANSFER PUMP 2	N	MP0082	3	0	0.00	0.00														
F12B	BF1289	EDG 1-2 AC TURBO OIL PUMP	N	MP147-4	0.75	100	0.74	0.83	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12B	BF1268	DEISEL OIL PUMP HOUSE SUMP PUMP 1-1B	N	MP173-B	0.50	100	0.73	0.55	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12B	BF1262	AFP 1-2 TO SG STP VLV OPER	O	MV3872	2.60	100	6.08	3.77	ON	ON	ON	ON	ON	ON								
F12B	BF1260	PRESSURIZER 1 SPRAY VLV MOTOR	N	MVRC2	1.00	0	0.00	0.00														
F12B	BF1270	120VAC MCC YF1 LOAD	O	YF1	2.00 KVA	100	1.60	1.20	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12C	BF1274	SERVICE WATER PUMP STRAINER 2	O	MF0152	1	100	0.96	0.72	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12C	BF1275	SER. WTR PUMP STRAINER 2 DRAIN VLV	O	MV1380	0.33	0	0.00	0.00														
F12C	BF1277	SW ISOLATION VLV TO COOLING WATER	O	MV1395	0.70	100	0.80	1.47	ON	ON	ON	ON	ON	ON								
F12C	BF1281	SW DISCHARGE TO INTAKE FOREBAY	O	MV2930	1.00	0	0.00	0.00														
F12C	BF1282	SW TO COLLECTION BASIN VLV	O	MV2932	1.00	0	0.00	0.00														
F12D	BF1211	SW PUMP VENT. FAN 3	O	MC9903	10	111	9.19	6.91	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F12D	BF1236	SW PUMP VENT. FAN 4	O	MC9904	10	100	8.26	6.89	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F13	BF1315	BA ADD. TK. ROOM SEC. SPACE HTR.	N	WE0802	39 KVA	100	39	0.00								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1305	BA LINES HEAT TRACING SEC. SYSTEM	N	BASSW	113.00 KVA	62	70.06	0.00								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1316	TURBINE GENERATOR GEAR OIL PUMP	N	MP0200	30	100	25.14	16.89								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1318	TURBINE GENERATOR TURN. GEAR	N	MK0082	60	100	54.18	33.58								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1319	TURBINE BEARING OIL LIFT PUMP 1	N	MP0251	5	100	4.47	3.58								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1320	TURBINE BEARING OIL LIFT PUMP 2	N	MP0252	5	100	4.47	3.58								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1321	TURBINE BEARING OIL LIFT PUMP 3	N	MP0253	5	100	4.47	3.58								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1322	TURBINE BEARING OIL LIFT PUMP 4	N	MP0254	5	100	4.47	3.58								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1323	TURBINE BEARING OIL LIFT PUMP 5	N	MP0255	5	100	4.47	3.58								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1324	TURBINE BEARING OIL LIFT PUMP 6	N	MP0256	5	100	4.47	3.58								(SEE NOTE 26)					ON	(SEE NOTE 26)
F13	BF1302	EMER. INST. AIR DRYER CONTROL PANEL	N	C3405	0.2 KVA	100	0.16	0.12								(SEE NOTE 26)					ON	(SEE NOTE 26)
F14	BF1401	CONTAINMENT AIR COOLER FAN 2 - HS	O	MC0012	150	87	104.90	79.52												ON	ON	
F14	BF1401	CONTAINMENT AIR COOLER FAN 2 - LS	O	MC0012	40	100	34.21	49.96						ON	ON							
EF15	BEF153	CONTAINMENT AIR COOLER FAN 3 - HS	O	MC0013	150	0	0.00	0.00								SPARE						SPARE
EF15	BEF154	CONTAINMENT AIR COOLER FAN 3 - LS	O	MC0013	40	0	0.00	0.00								SPARE						SPARE
F16A	BF1622	STA.VENT.NORM RANGE RAD.MON.RE4598BA PUMP	O	MP274-3	0.5	100	.37	.40	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F16A	BF1623		O													SPARE						SPARE
F16A	BF1617	RC MU PUMP SUCTION VALVE MOTOR	O	MV3971	0.33	0	0.00	0.00														
F16A	BF1616	OP TO BYPASS VLV IN THE MU32 MFLW LINE	O	MV6420	0.70	0	0.00	0.00														
F16A	BF1624	ISOLIMITER (CONSTANT VOLTAGE XFMR) XY2	O	XY2	13.34 KVA	100	2.00	13.19	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F16A	BF1625	ISOLIMITER (CONSTANT VOLTAGE XFMR) XY4	O	XY4	13.34 KVA	100	2.00	13.19	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F16B	BF1609		O													SPARE						SPARE
F16B	BF1610	CTMT ATM RAD MON RE4597BA PUMP	O	MP273-3/4	.5	100	.37	.40	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
F71	BF7105	EIAC CLOSED COOLING LOOP FAN 1	N	MC1431	3.00	100	2.52	1.96													ON	
F71	BF7105	EIAC CLOSED COOLING LOOP FAN 2	N	MC1432	3.00	100	2.52	1.96													ON	
F71	BF7114	MOFP AUX LUBE OIL PUMP	N	MP242-1	0.75	100	0.69	0.61													ON	
F71	BF7105	EMER INST AIR CLOSED COOLING LOOP PUMP 1	N	MP2601	7.50	100	6.52	2.37													ON	
F71	BF7105	EMER INST AIR CLOSED COOLING LOOP PUMP 2	N	MP2602	7.50	100	6.52	2.37													ON	
F71	BF7117	XFMR FOR PNL Y3401	N	X3402	30.00 KVA	33.33	8.00	6.00													ON	
F71	BF7118	XFMR FOR RECEPT. RM 334B	N	X3403	15.00 KVA	66.67	8.00	6.00													ON	
F81	BF8102	DBCSBOP BATTERY CHARGER	N	DBCSBOP	2.40 KVA	100	1.92	1.44													ON	
F81	BF8105	XFMR DF8 CORE LOSS		DF8CL	6.00 KVA	100	0.80	5.95													ON	
F81	BF8101	DG IMMERSION HEATER	N	DGIH	15.00 KVA	100	15.00	0.00								(SEE NOTE 14)					ON	(SEE NOTE 14)
F81	BF8118	FUEL OIL TANK RM UNIT HTR	N	E207	5.00 KVA	0	0.00	0.00														
F81	BF8113	VENT FAN	N	MC152A	5	100	4.39	2.13													ON	
F81	BF8114	VENT FAN	N	MC152B	5	0	0.00	0.00														
F81	BF8112	VENT FAN	N	MC153	1.00	100	1.02	0.88													ON	
F81	BF8108	AIR COMPRESSOR	N	MC430A	10.00	0	0.00	0.00														
F81	BF8109	AIR COMPRESSOR	N	MC430B	10.00	0	0.00	0.00														
F81	BF8110	RADIATOR FAN	N	ME211A	15.00	0	0.00	0.00														
F81	BF8111	RADIATOR FAN	N	ME211B	15.00	0	0.00	0.00														
F81	BF8115	SUMP PUMP	N	MP279A	0.75	0	0.00	0.00														
F81	BF8116	SUMP PUMP	N	MP279B	0.75	0	0.00	0.00														
F81	BF8107	DEISEL GEN TURBO LUBE OIL PUMP	N	MP280A	0.75	100	0.72	0.96													ON	
F81	BF8106	DEISEL SOAK-BACK PUMP	N	MP280B	1.00	100	0.92	1.10													ON	
F81	BF8103	480 VAC RECEPTACLE	N	ZR3011	50.00 KVA	0	0.00	0.00														
F81	BF8104	480 VAC RECEPTACLE	N	ZR3012	50.00 KVA	0	0.00	0.00														
F81	BF8117	X3052 LTG TRANSF	N	X3052	50.00 KVA	38	17.10	8.28													ON	
EF12C	BEF123	JOCKEY FIRE PUMP	N	MP0060	5	100	4.51	2.55	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
EF12C	BEF124	SW PUMP STRAINER 3	O	MF0153	1	0	0.00	0.00								SPARE						SPARE
EF12C	BEF125	SW PMP STRNR 3 DRN VLV	O	MV1381	0.33	0	0.00	0.00														
EF12D	BEF129	CTMT AIR COOLER 1-3 ISOLATION VLV	O	MV1368	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON			ON	ON	ON			
4160 SWGR CONT.																						
D2	AD201	STATION AIR COMPRESSOR	N	MC1400	382	81	243.9	184.7													ON	
D2	AD208	AUX. BOILER F.D. FAN	N	MC0410	300/75	0	0.00	0.00														
D2	AD211	LIGHTING SUB TRANSFORMER	N	DF5	283.00 KVA	0	0.00	0.00														
D2	AD211	SWITCHYARD FEEDER	N	1-2	100.00 KVA	0	0.00	0.00														
240V MCC																						
YF2	YF201	CTMT ANALYZER SAMPLE LINE #4 IN VLV OP	O	MV5010A	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YF2	YF202	CTMT ANALYZER SAMPLE LINE #2 IN VLV MTR OP	O	MV5010B	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YF2	YF203	CTMT AIR SAMPLE ISO VLV MOTOR	O	MV5010C	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YF2	YF204	CTMT AIR SAMPLE ISO VLV	O	MV5010D	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YF2	YF205	H2 ANALYZER #2 DISCHARGE VLV OP	O	MV5010E	0.33	100	0.31	0.47	ON	ON	ON	ON	ON	ON								
YF2	YF212	CC PUMP ROOM VENT FAN 2 RM INLET DAMPER	O	MV5444C	0.17	100	0.17	0.13	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	
YF2	YF208	XFMR YF28 LOAD		YF28	2.00 KVA	100	1.60	1.20	ON	ON	ON	ON	ON	ON	ON		ON	ON	ON	ON	ON	

DIESEL RATING

RATED OUTPUT 2600KW CONTINUOUS

OVERLOAD OUTPUT 2860KW ANY 2 HRS. OUT OF 24

2838KW FOR 2000 HOURS

2946KW FOR 200 HOURS

3035KW FOR ½ HOUR

NOTES

FOR NOTES-LEGEND & REFERENCE DRAWINGS SEE SHEET 1.

DAVIS-BESSE NUCLEAR POWER STATION

EMERGENCY DIESEL GENERATOR 1-2 LOADING TABLE

E-1043 SH.2

TABLE 8.3-1

REVISION 32

SEPTEMBER 2018

DB 05-08-18 DFN=I:/ELEC/E1043SH2.DGN

TABLE 8.3-2

Administratively Controlled Circuits (AC)

	DEVICE NO.	DEVICE TYPE	DEVICE LOCATION	TYPE OF OPERATION
ITEM 1	CBY305	Circuit Breaker	Panel Y3	Kirk Key
	CBY105	Circuit Breaker	Panel Y1	
ITEM 2	CBY405	Circuit Breaker	Panel Y4	Kirk Key
	CBY205	Circuit Breaker	Panel Y2	
ITEM 3	Y101/YAR04	Transfer Switch	Panel Y1/YAR	SPDT
ITEM 4	Y101A/YAR06	Transfer Switch	Panel Y1A/YAR	SPDT
ITEM 5	Y201/YBR04	Transfer Switch	Panel Y2/YBR	SPDT
ITEM 6	Y201A/YBR06	Transfer Switch	Panel Y2A/YBR	SPDT
ITEM 7	Y301/YAR05	Transfer Switch	Panel Y3/YAR	SPDT
ITEM 8	Y401/YBR05	Transfer Switch	Panel Y4/YBR	SPDT
ITEM 9	BE F154 BE F152	Non Automatic Circuit Breaker	MCC EF15	Kirk Key
	BE F153	Circuit Breaker	MCC EF15	Kirk Key
	BE F151	Non Automatic Circuit Breaker		
ITEM 10	BE F121 BE F122	Circuit Breaker	MCC EF12C	Kirk Key
ITEM 11	BE F128 BE F129	Non Automatic Circuit Breaker	MCC EF12D	Kirk Key
ITEM 12	BF 1310 BF 1304	Non Automatic Circuit Breaker	MCC F13	Kirk Key
ITEM 13	AC108, AD108 AC113, AD113	Circuit Breaker	4160 V Swgr. C1, D1	Insert or Withdraw Breaker
	ACD2, ACD3	Non Automatic Circuit Breaker	Transfer Swgr. CD	Open or Close with Kirk Key Interlock
ITEM 14	BE1168/BE2238	Circuit Breaker	MCC E11C/E22A	Kirk Key
ITEM 15	BE1167/BE2237	Circuit Breaker	MCC E11C/E22A	Kirk Key
ITEM 16	BF1114/BF6204	Circuit Breaker	MCC F11A/F62	Kirk Key
ITEM 17	BF1115/BF6205	Circuit Breaker	MCC F11A/F62	Kirk Key
ITEM 18	ACD4, ACD5	Non Automatic Circuit Breaker	Transfer Swgr. CD	Kirk Key

TABLE 8.3-3

Administratively Controlled Circuits (DC)

	DEVICE NO.	DEVICE TYPE	DEVICE LOCATION	TYPE OF OPERATION
ITEM 1	D1P02 D1P01	Disconnect Switch	Panel D1P	Sliding Bar
	D201	Disconnect Switch 400 A Fuse	DC MCC2 DC MCC2	Open Remove
ITEM 2	D1N02 D1N01	Disconnect Switch	Panel D1N	Sliding Bar
	D232	Disconnect Switch 400 A Fuse	DC MCC2 DC MCC2	Open Remove
ITEM 3	D2P02 D2P01	Disconnect Switch	Panel D2P	Sliding Bar
	D102	Disconnect Switch 400 A Fuse	DC MCC1 DC MCC1	Open Remove
ITEM 4	D2N02 D2N01	Disconnect Switch	Panel D2N	Sliding Bar
	D133	Disconnect Switch 400 A Fuse	DC MCC1 DC MCC1	Open Remove
ITEM 5	D1N05 D1P05	Circuit Breaker Circuit Breaker	Panel D1N Panel D1P	Kirk Key
ITEM 6	D1N07 D1P07	Circuit Breaker Circuit Breaker	Panel D1N Panel D1P	Kirk Key
ITEM 7	D1N09 D1P09	Circuit Breaker Circuit Breaker	Panel D1N Panel D1P	Kirk Key
ITEM 8	D2N05 D2P05	Circuit Breaker Circuit Breaker	Panel D2N Panel D2P	Kirk Key
ITEM 9	D2N07 D2P07	Circuit Breaker Circuit Breaker	Panel D2N Panel D2P	Kirk Key
ITEM 10	D2N09 D2P09	Circuit Breaker Circuit Breaker	Panel D2N Panel D2P	Kirk Key
ITEM 11	43DC/HA01 43DC/HAAC	Transfer Switch Transfer Switch	HA01 HAAC	DPDT DPDT
ITEM 12	43DC/HB01 43DC/HB14	Transfer Switch Transfer Switch	HB01 HB14	DPDT DPDT
ITEM 13	B302 B303	Circuit Breaker Circuit Breaker	DBC1PN DBC1PN	Kirk Key
ITEM 14	B302 B303	Circuit Breaker Circuit Breaker	DBC2PN DBC2PN	Kirk Key

TABLE 8.3-4

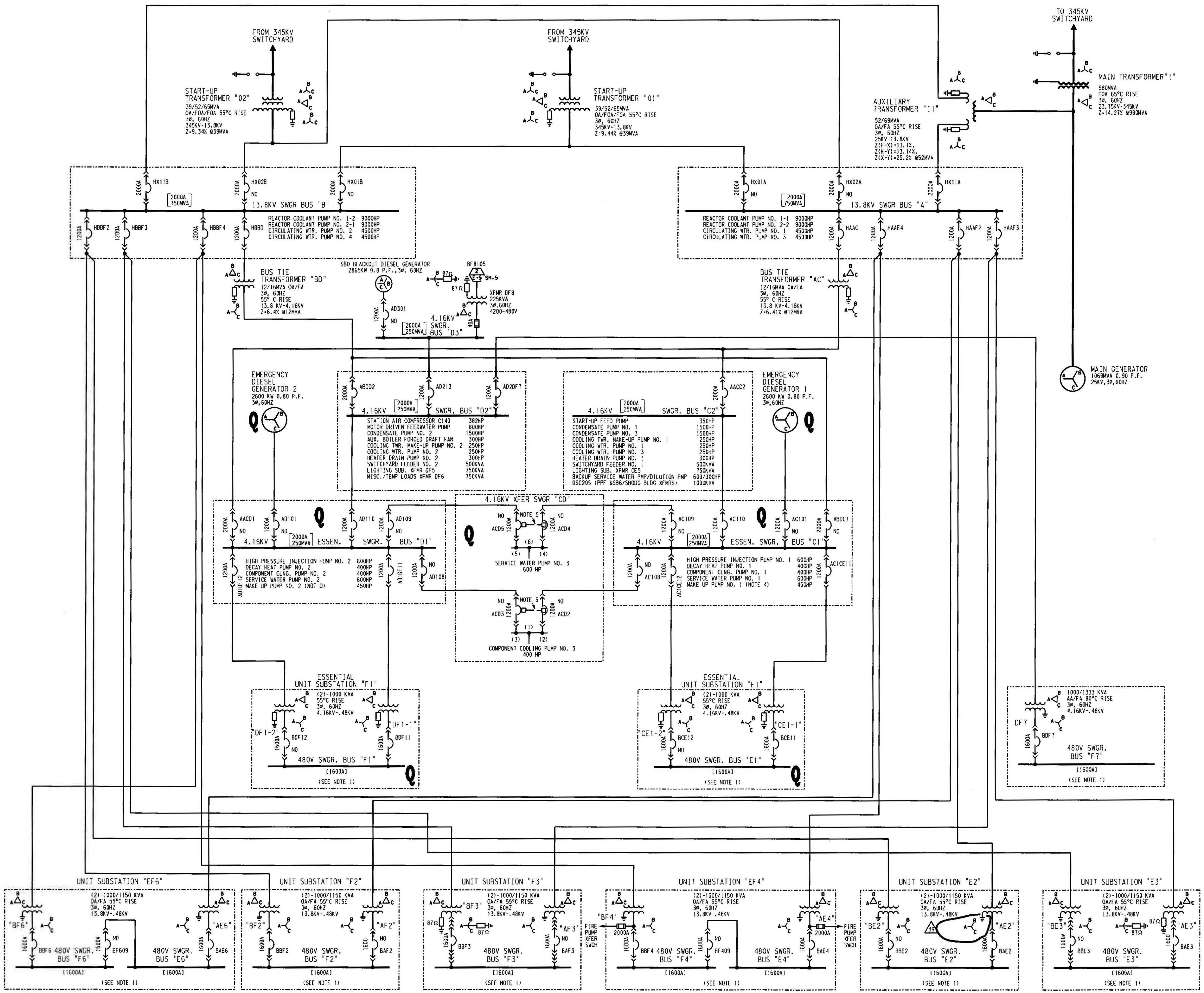
Environmental Requirements for Class 1E Cable

WITHIN SECONDARY SHIELD WALL	TEMPERATURE	HUMIDITY	PRESSURE	RADIATION	CHEMICAL	SUPPLIER**
DBA	287 °F	100% RH	40 psig – 1 Week	10^8 RAD Total	2800 PPM Borated Water 1-Week***	BIW
NORMAL	122 °F	100% RH	±0.5 psig	3.5 x 10^7 RAD Total	None	
WITHIN PRIMARY CONTAINMENT						
DBA	287 °F	100% RH	40 psig – 1 Week	10^8 RAD Total	2800 PPM Borated Water 1-Week***	KERITE, BIW
NORMAL	122 °F	70% RH	0.0 psig	3.5 x 10^7 RAD Total	None	
WITHIN AUXILIARY BUILDING						
DBA	122 °F	100% RH	0.0 psig	3.5 x 10^7 RAD Total*	None	OKONITE,
NORMAL	122 °F	100% RH	0.0 psig	3.5 x 10^7 RAD Total*	None	KERITE, BIW, CCC
OUTSIDE ENVIRONMENT						
DBA	Same requirement as within Auxiliary Building					OKONITE,
NORMAL	Same requirement as within Auxiliary Building					KERITE, BIW

* Requirements are not applicable to interconnecting cable between SFAS Cabinets which will withstand 10^4 RAD. The dose in the Cable Spreading Room and the Control Room will not exceed 5 RAD over 40 years of normal operation plus 5 RAD during the DBA.

** Suppliers are listed for historical information only. Other suppliers may be used as long as requirements are met.

*** For pH Control reference Section 9.3.3.2



NOTES

1. FOR 480V ELECTRICAL SYSTEM ONE LINE DIAGRAM SEE SHEET 2 OF THIS DWG.
2. BUS RATINGS ARE INDICATED THUS [2000A].
3. FOR STATION DISTRIBUTION TRANSFORMER TAP SETTINGS SEE SHEET 3 OF THIS DWG.
4. MAKE UP PUMP MOTOR #1 IS NEEDED FOR 'EMERGENCY FEED AND BLEED COOLING'. CERTAIN CONTROL COMPONENTS ARE DESIGNATED AS QUALITY CLASS AQ, REFER TO INTRA-COMPANY MEMORANDUM NEN 91-10215 "FEED AND BLEED SYSTEM DESIGN CRITERIA" FOR FURTHER DETAILS.
5. KIRK KEY INTERLOCK PREVENTS BREAKER CLOSURE IF INTERLOCKING BREAKER IS CLOSED.

REFERENCE DRAWINGS

E-2 25KV & 13.8KV METERING & RELAYING ONE LINE DIAGRAM

E-3 4.16KV METERING & RELAYING ONE LINE DIAGRAM

E-4 480V UNIT SUBSTATION ONE LINE DIAGRAMS

DAVIS-BESSE NUCLEAR POWER STATION

AC ELECTRICAL SYSTEM ONE-LINE DIAGRAM

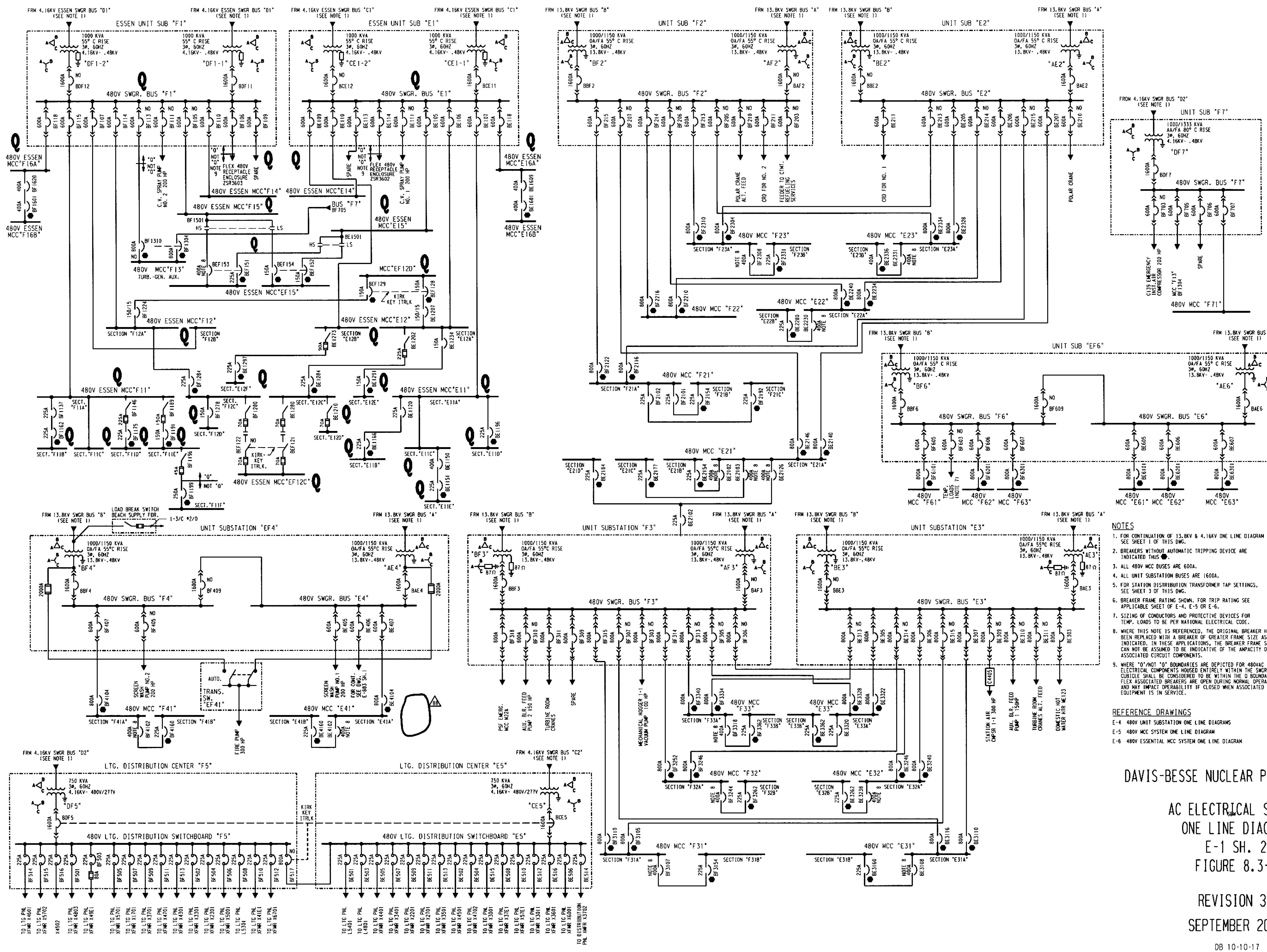
E-1, SH.1

FIGURE 8.3-1

REVISION 31

OCTOBER 2016

DB 03-18-16 DFN=I:/ELEC/E1SH1.DGN



NOTES

1. FOR CONTINUATION OF 13.8KV & 4.16KV ONE LINE DIAGRAM SEE SHEET 1 OF THIS DWG.
2. BREAKERS WITHOUT AUTOMATIC TRIPPING DEVICE ARE INDICATED THUS ●.
3. ALL 480V MCC BUSES ARE 600A.
4. ALL UNIT SUBSTATION BUSES ARE 1600A.
5. FOR STATION DISTRIBUTION TRANSFORMER TAP SETTINGS, SEE SHEET 3 OF THIS DWG.
6. BREAKER FRAME RATING SHOWN. FOR TRIP RATING SEE APPLICABLE SHEET OF E-4, E-5 OR E-6.
7. SIZING OF CONDUCTORS AND PROTECTIVE DEVICES FOR TEMP. LOADS TO BE PER NATIONAL ELECTRICAL CODE.
8. WHERE THIS NOTE IS REFERENCED, THE ORIGINAL BREAKER HAS BEEN REPLACED WITH A BREAKER OF GREATER FRAME SIZE AS INDICATED. IN THESE APPLICATIONS, THE BREAKER FRAME SIZE CAN NOT BE ASSUMED TO BE INDICATIVE OF THE AMPACITY OF ASSOCIATED CIRCUIT COMPONENTS.
9. WHERE "O"/NOT "O" BOUNDARIES ARE DEPICTED FOR 480VAC SWGR, ELECTRICAL COMPONENTS HOUSED ENTIRELY WITHIN THE SWGR CUBICLE SHALL BE CONSIDERED TO BE WITHIN THE O BOUNDARY. FLEX ASSOCIATED BREAKERS ARE OPEN DURING NORMAL OPERATION AND MAY IMPACT OPERABILITY IF CLOSED WHEN ASSOCIATED BUS EQUIPMENT IS IN SERVICE.

REFERENCE DRAWINGS

E-4 480V UNIT SUBSTATION ONE LINE DIAGRAMS
E-5 480V MCC SYSTEM ONE LINE DIAGRAM
E-6 480V ESSENTIAL MCC SYSTEM ONE LINE DIAGRAM

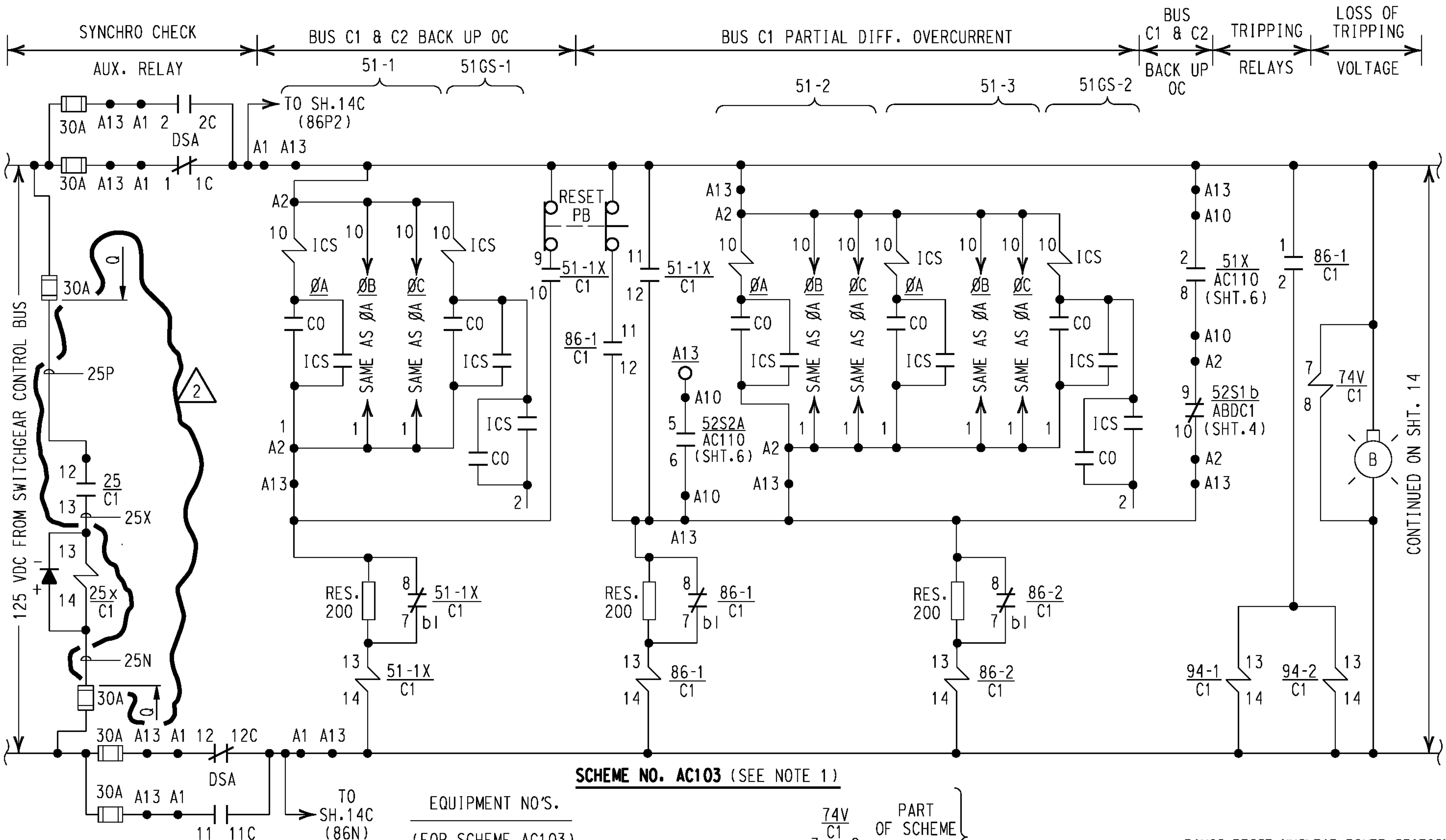
DAVIS-BESSE NUCLEAR POWER STATION

AC ELECTRICAL SYSTEM ONE LINE DIAGRAM E-1 SH. 2

FIGURE 8.3-2

REVISION 32
SEPTEMBER 2018

DB 10-10-17 DFN=I:/ELEC/E1SH2.DGN



SCHEME NO. AC103 (SEE NOTE 1)

EQUIPMENT NO'S.

(FOR SCHEME AC103)

A13-AC103C
A1 -AC101
A2 -ABDC1
A10-AC110

74V C1 3 9 AL AL1 PART OF SCHEME COT131 SH.21

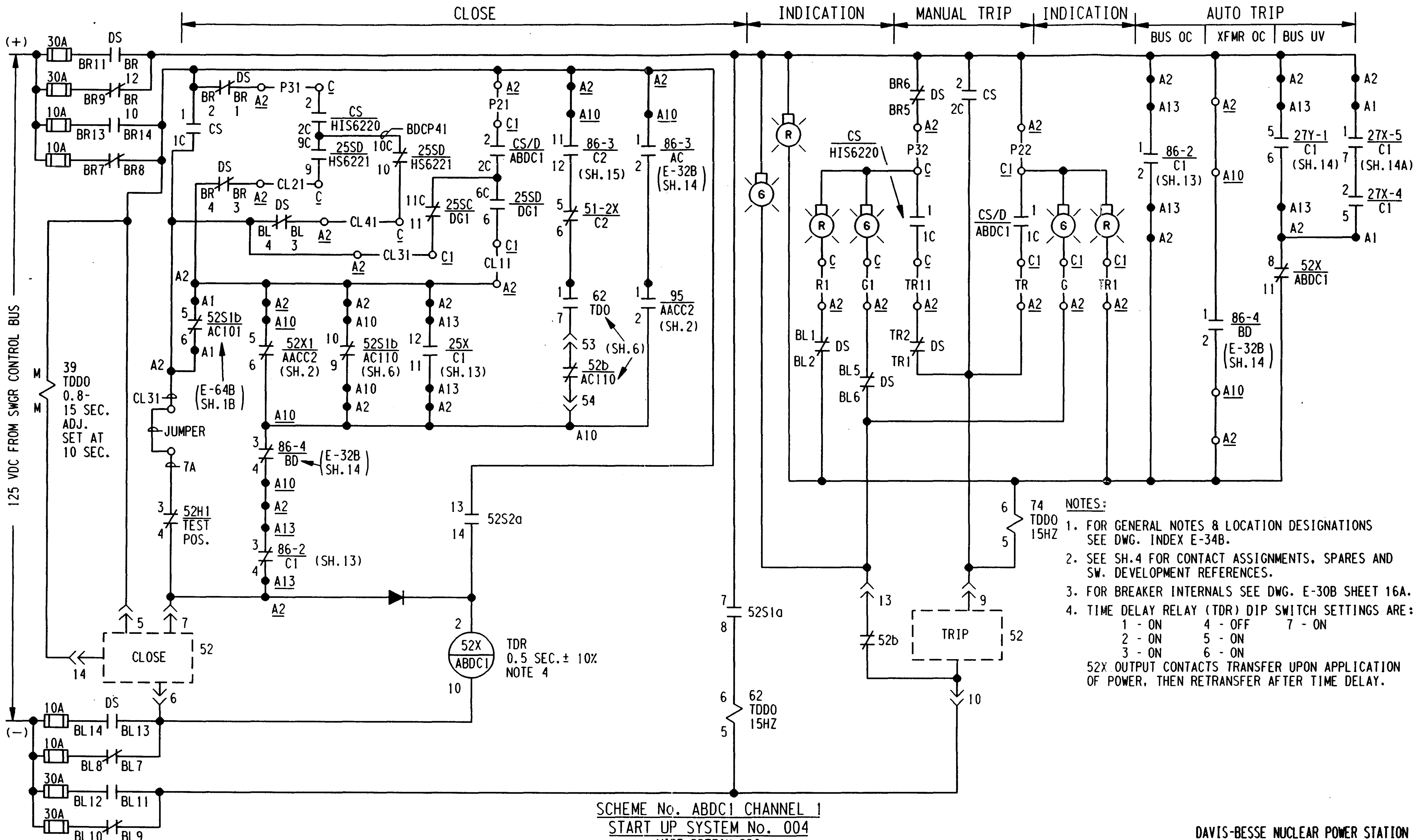
NOTES:

1. FOR SCHEME NO.AD103, BUS D1, TRIPPING LOCKOUT & SYNCHRO CHECK RELAY LISTINGS SEE SHT.13.
2. FOR DISCONNECT SWITCH DSA DETAILS SEE DWG. E-30B SHT.20, FIG.5.

DAVIS-BESSE NUCLEAR POWER STATION
4.16 KV FEEDER BREAKER
BUS C1 TRIPPING AND LOCKOUT
AND SYCHRO CHECK RELAYS
E-34B SH. 13A
FIGURE 8.3-4
REVISION 28
DECEMBER 2010

DB 11-15-10

DFN=F/SCHEME/E34BSH4.DGN

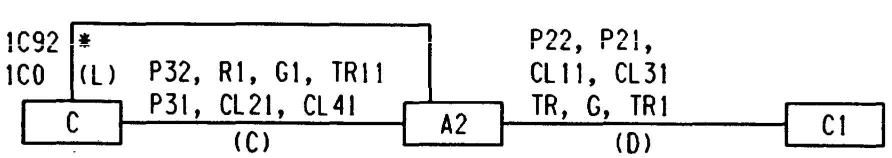


NOTES:
1. FOR GENERAL NOTES & LOCATION DESIGNATIONS SEE DWG. INDEX E-34B.
2. SEE SH.4 FOR CONTACT ASSIGNMENTS, SPARES AND SW. DEVELOPMENT REFERENCES.
3. FOR BREAKER INTERNALS SEE DWG. E-30B SHEET 16A.
4. TIME DELAY RELAY (TDR) DIP SWITCH SETTINGS ARE:

1 - ON	4 - OFF	7 - ON
2 - ON	5 - ON	
3 - ON	6 - ON	

52X OUTPUT CONTACTS TRANSFER UPON APPLICATION OF POWER, THEN RETRANSFER AFTER TIME DELAY.

SCHEME No. ABDC1 CHANNEL 1
START UP SYSTEM No. 004
WIRE PREFIX BDC



BLOCK DIAGRAM
SCHEME No. ABDC1

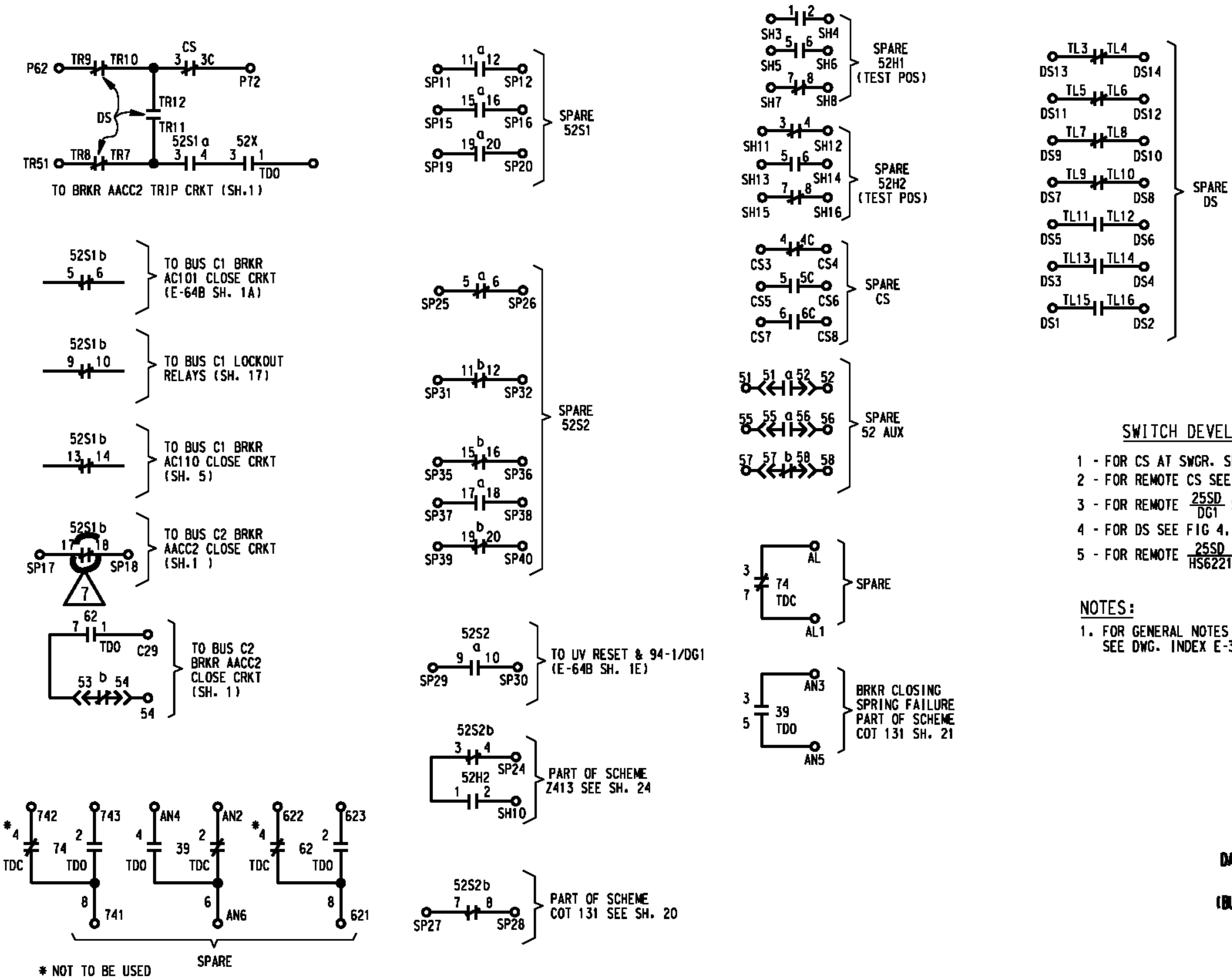
* SEE DWG. 7749 E-22 SH.1 FOR CONNECTIONS

EQUIPMENT NUMBERS

A2 - ABDC1	A9 - AACC2
C - C5715	A10 - AC110
C1 - C3615	A23 - AC203
HA - HAAC	A13 - AC103
HB - HBBD	A1 - AC101

DAVIS-BESSE NUCLEAR POWER STATION
4.16 KV FEEDER BREAKER
(BUS TIE XFMR BRKR. ABDC1 CONTROL),
SHEET 1
E-34B SH. 3
FIGURE 8.3-5

REVISION 21
NOVEMBER 1998



SWITCH DEVELOPMENT REFERENCE

1 - FOR CS AT SWGR. SEE FIG 2, SH 9A, DWG E-30B
2 - FOR REMOTE CS SEE FIG 3, SH 9, DWG E-30B
3 - FOR REMOTE $\frac{25SD}{DG1}$ SEE FIG 4, SH 9A, DWG E-30B
4 - FOR DS SEE FIG 4, SH 10, DWG E-30B
5 - FOR REMOTE $\frac{25SD}{HS6221}$ SEE FIG 1, SH 10, DWG E-30B

NOTES:

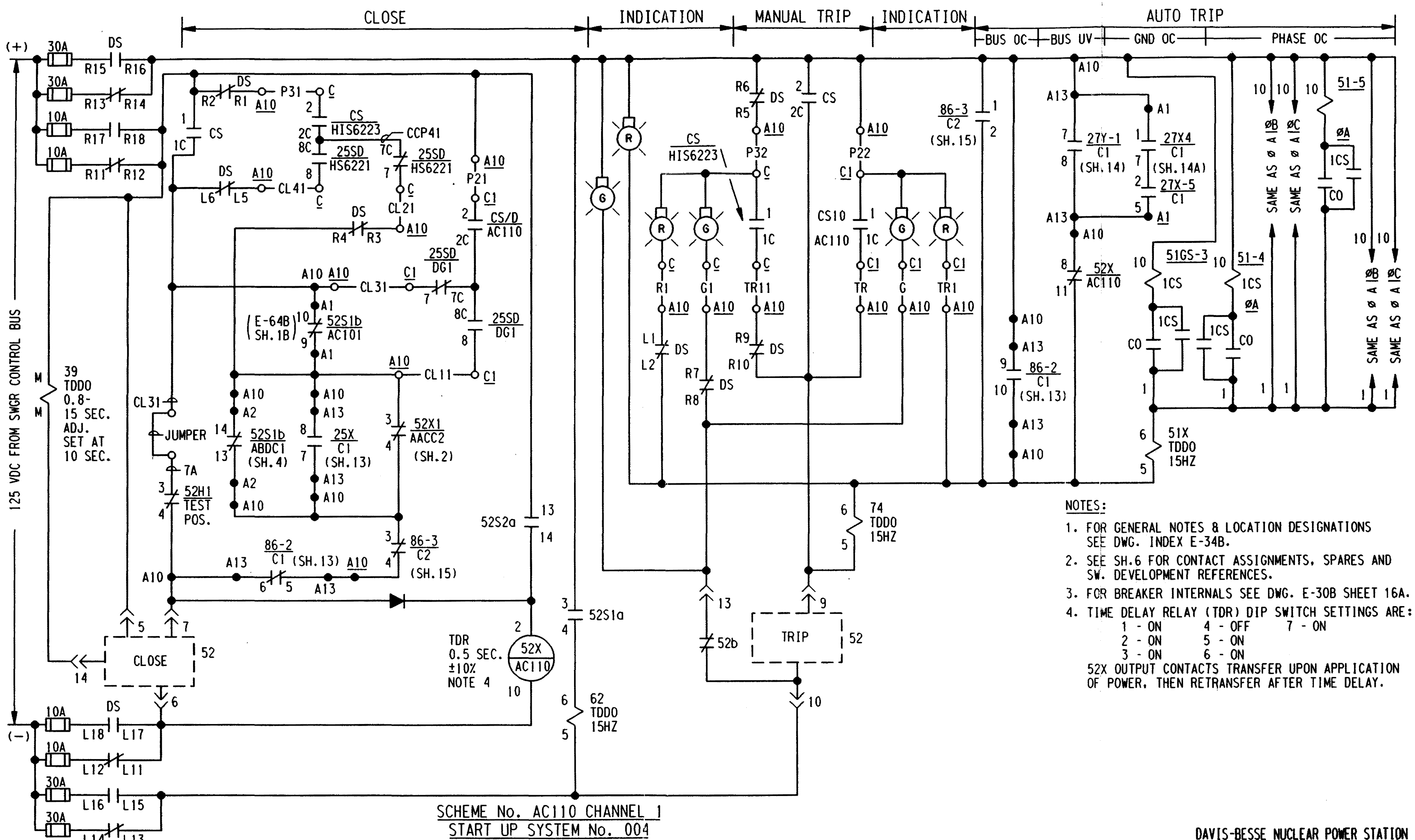
1. FOR GENERAL NOTES & LOCATION DESIGNATIONS SEE DWG. INDEX E-34B.

DAVIS-BESSE NUCLEAR POWER STATION
4.16 KV FEEDER BREAKER
(BUS TIE XFMR BRKR, ABDC1 CONTROL),
SHEET 2
E-34B SH. 4
FIGURE 8.3-6

REVISION 29
DECEMBER 2012

DB 05-22-12

DFN=F/SCHEME/E34BSH4.DGN



SCHEME No. AC110 CHANNEL 1

START UP SYSTEM No. 004

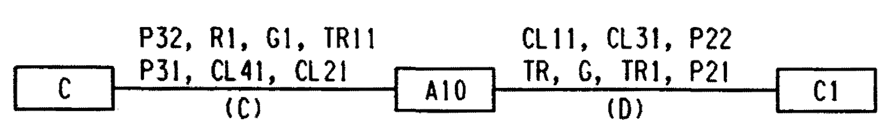
WIRE PREFIX CC

NOTES:

1. FOR GENERAL NOTES & LOCATION DESIGNATIONS SEE DWG. INDEX E-34B.
2. SEE SH.6 FOR CONTACT ASSIGNMENTS, SPARES AND SW. DEVELOPMENT REFERENCES.
3. FOR BREAKER INTERNALS SEE DWG. E-30B SHEET 16A.
4. TIME DELAY RELAY (TDR) DIP SWITCH SETTINGS ARE:

1 - ON	4 - OFF	7 - ON
2 - ON	5 - ON	
3 - ON	6 - ON	

52X OUTPUT CONTACTS TRANSFER UPON APPLICATION OF POWER, THEN RETRANSFER AFTER TIME DELAY.



BLOCK DIAGRAM

SCHEME No. AC110

EQUIPMENT NUMBERS

A10	- AC110	A13	- AC103
C	- C5715	A1	- AC101
C1	- C3615	A2	- ABDC1

DAVIS-BESSE NUCLEAR POWER STATION

4.16 KV FEEDER BREAKER

(BUS C1 & C2 TIE BRKR. AC110 CONTROL),

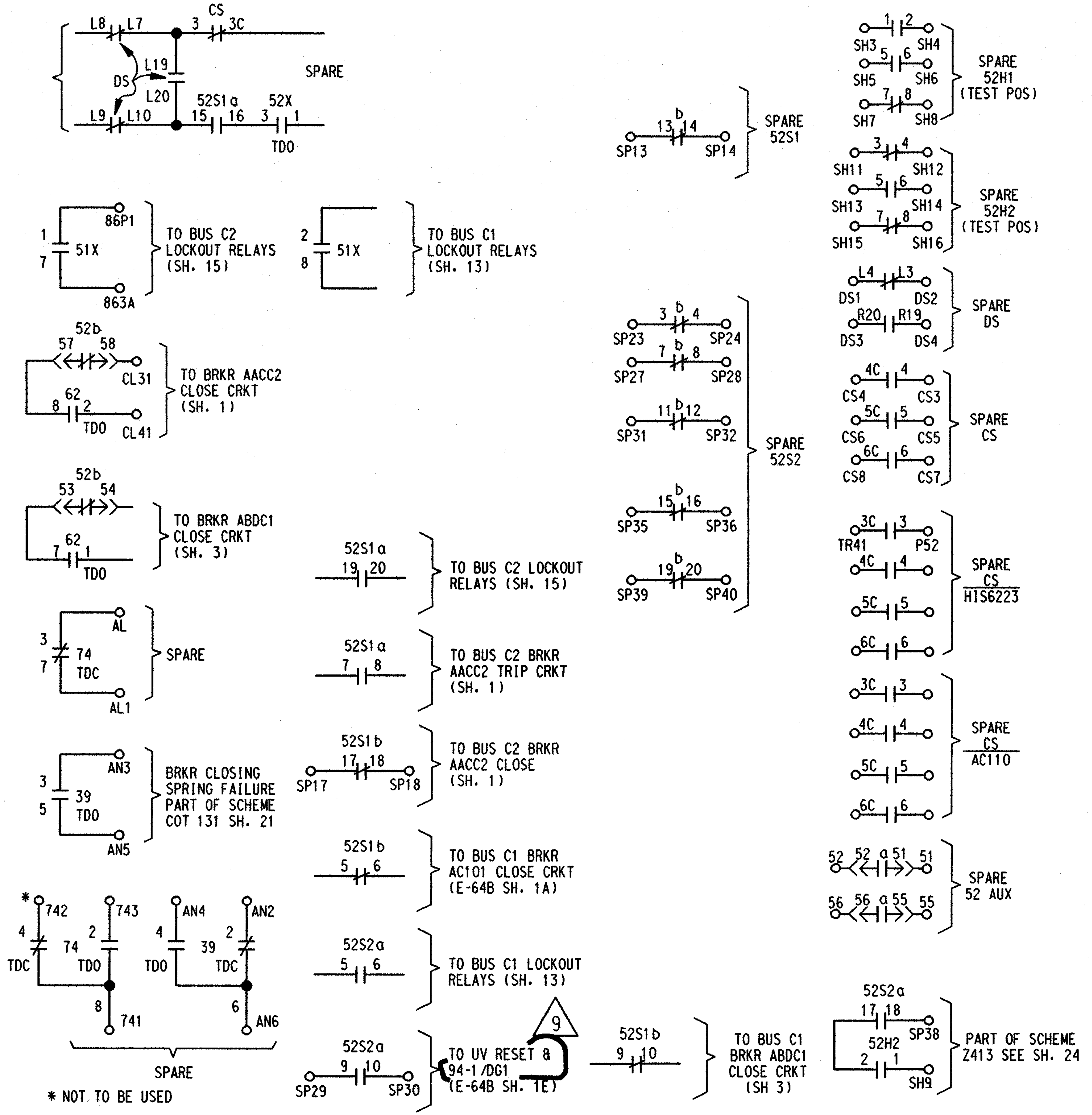
SHEET 1

E-34B SH. 5

FIGURE 8.3-7

REVISION 21

NOVEMBER 1998



SWITCH DEVELOPMENT REFERENCE

1 - FOR CS AT SWGR, SEE FIG 2, SH 9A, DWG E-30B
2 - FOR REMOTE CS, SEE FIG 3, SH 9, DWG E-30B
3 - FOR REMOTE 25SD SEE FIG 4, SH 9A, DWG E-30B
4 - FOR DS SEE FIG 5, SH 10, DWG E-30B
5 - FOR REMOTE $\frac{25SD}{HS6221}$ SEE FIG 1, SH 10, DWG E-30B

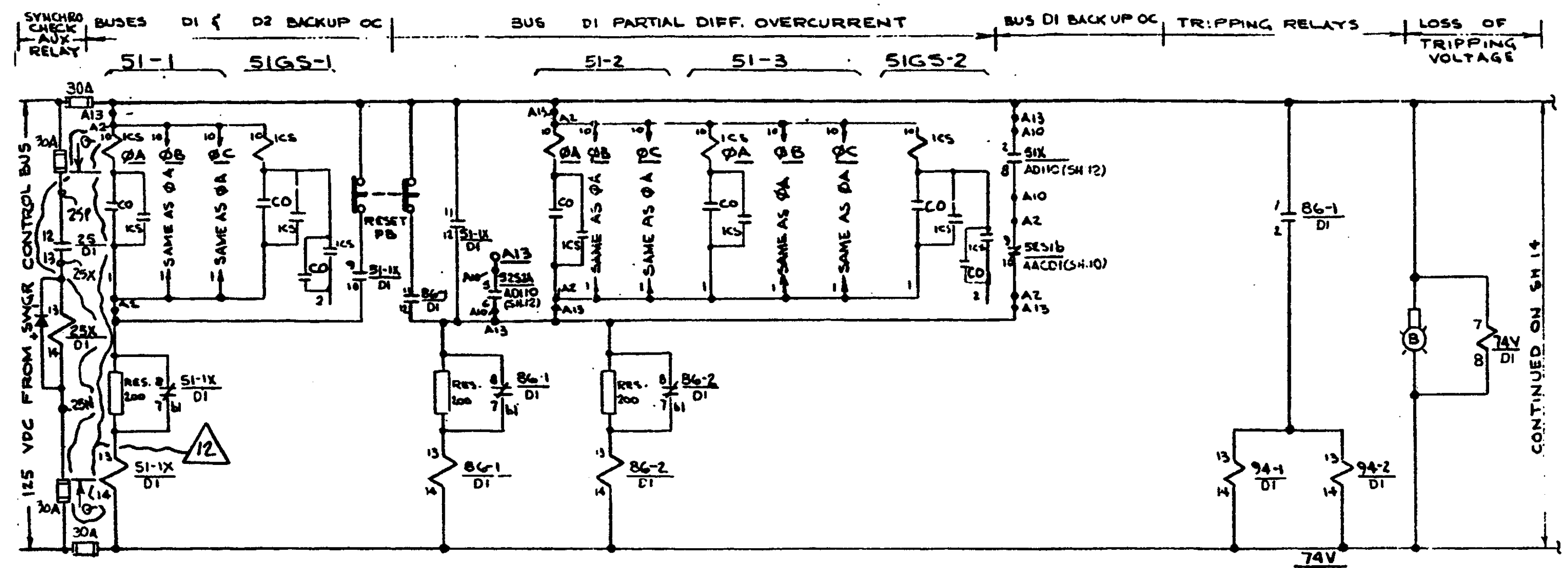
NOTES:

1. FOR GENERAL NOTES & LOCATION DESIGNATIONS SEE DWG. INDEX E-34B.

DAVIS-BESSE NUCLEAR POWER STATION
4.16 KV FEEDER BREAKER
(BUS C1 & C2 TIE BRKR. AC110 CONTROL),
SHEET 2
E-34B SH. 6
FIGURE 8.3-8

REVISION 27
JUNE 2010

DB 05-18-10 DFN=F/SCHEME/E34BSH6.DGN



SCHEME Nº AD103 (SEE NOTE 2)

51-1X C1(D1)

CONTACT	FUNCTION	DWG REF
1-2	ITRLK 86-1 C1(D1) 86-2 C1(D1)	(SH15)
3-4	SPARE	
5-6	ITRLK BRKR AACC2 (ABDD2)	SH 1 (7)
7-8 b1	RESISTOR BY PASS	THIS SH
9-10	ITRLK PB RESET	THIS SH
11-12	OPERATE 86-1 C1(D1) 86-2 C1(D1)	THIS SH

86-1 C1(D1)

CONTACT	FUNCTION	DWG REF
1-2	OPERATE 94-1 C1(D1) 94-2 C1(D1)	THIS SH
3-4	ALARM C1(D1)TRBL	THIS SH.
5-6	LOCKOUT BRKR AC101 (AD101)	E-648 SH 1A 12A
7-8 b1	RESISTOR BY PASS	THIS SH
9-10	TRIP BRKR AC101 (AD101)	E-648 SH 1A 2A
11-12	ITRLK PB RESET	THIS SH

86-2 C1(D1)

CONTACT	FUNCTION	DWG REF
1-2	TRIP BRKR ABDC1 (AACD1)	SH 3 (9)
3-4	LOCKOUT BRKR ABDC1 (AACD1)	SH 3 (9)
5-6	LOCKOUT BRKR AC110 (AD110)	SH 5 (11)
7-8 b1	RESISTOR BY PASS	THIS SH
9-10	TRIP BRKR AC110 (AD110)	SH 5 (11)
11-12	ITRLK BRKR AACC2 (ABDD2)	SH 1 (7)

94-1 C1(D1)

CONTACT	FUNCTION	DWG REF
1-2	TRIP BRKR AC108 (AD108)	E-50B SH 4E (4B)
3-4	TRIP BRKR AC107 (AD107)	E-46D SH 6B (6D)
5-6	SPARE	
7-8	TRIP BRKR AC1CL12 (AD1DF11)	SH 16
9-10	TRIP BRKR AC105 (AD105)	E-493 SH.18
11-12	TRIP BRKR AC1CE11 (AD1DF12)	SH 16

25X C1(D1)

CONTACT	FUNCTION	DWG REF
1-2	SPARE	
3-4	SPARE	
5-6	SPARE	
7-8	CLOSE ITRLK BRKR AC110 (AD110)	SH 5 (11)
9-10	CLOSE ITRLK BRKR AACC2 (ABDD2)	SH 1 (7)
11-12	CLOSE ITRLK BRKR ABDC1 (AACD1)	SH 3 (9)

94-2 C1(D1)

CONTACT	FUNCTION	DWG REF
1-2	SPARE	
3-4	TRIP BRKR AC113 (AD113)	E-50B SH 3C (3B)
5-6	SPARE	
7-8	TRIP BRKR AC112 (AD112)	E-52B SH 6B (6D)
9-10	TRIP BRKR AC111 (AD111)	E-52B SH 5B (5D)
11-12	TRIP BRKR AC109 (AD109)	E-48B SH 11B 11F

74V D1 3-9 AL ALI PART OF SCHEME COT 531 SH.21

743 742 4 2 74V C1(D1) 10 741 SPARE

3 4 86-1 C1(D1) BUS C1(D1) TRBL [Q414] (IS 6519) ([Q417] (IS 6520)) SEE DWG E746

* SEE DWG 7749-E-22 SH 1 (SH 2) FOR SYNCHRONIZING DETECTION CRKTS

NOTES
1. FOR GENERAL NOTES & LOCATION DESIGNATIONS SEE DWG INDEX E-34B
2. FOR SCHEME AC103, BUS C1, SEE DWG E-34B SH 13A.

EQUIPMENT NUMBERS FOR SCHEME AD103
A13 - AD103
A2 - AACD1
A10 - AD110

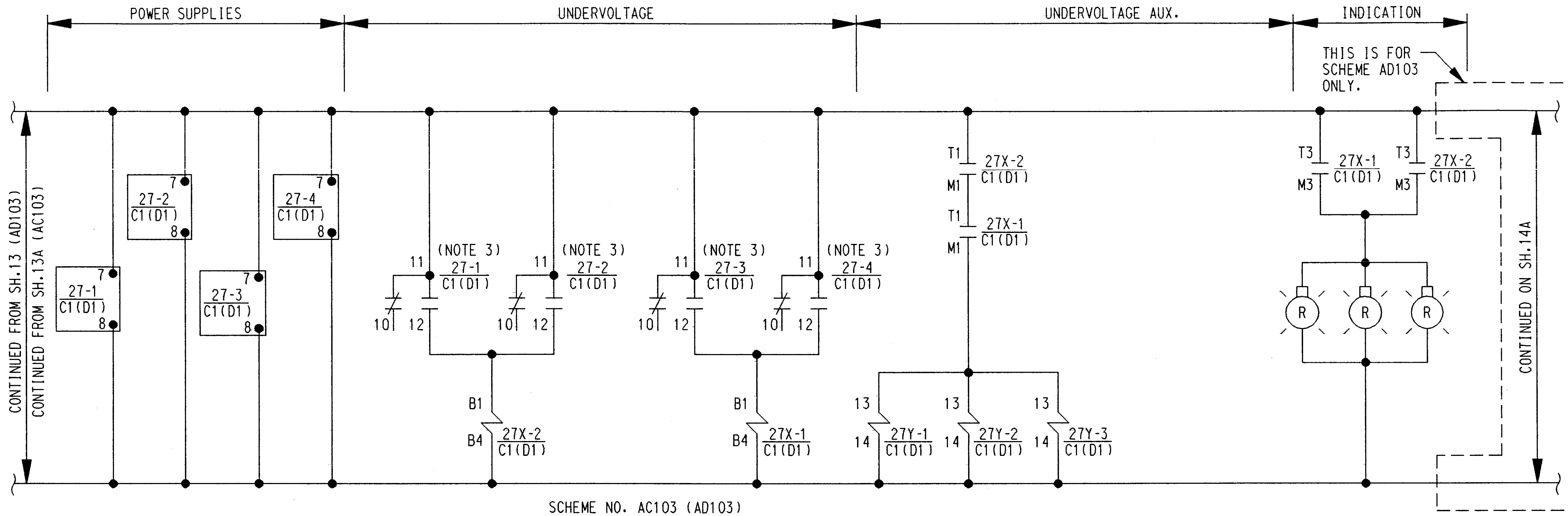
DAVIS-BESSE NUCLEAR POWER STATION

4.16KV FEEDER BREAKER ESSENTIAL BUSES TRIP, LOCKOUT AND SYNCHRO-CHECK RELAYS, SHEET 1

E34B SH. 13

FIGURE 8.3-9

REVISION 18
OCTOBER 1993



SCHEME NO. AC103 (AD103)

27Y-1 C1(D1)

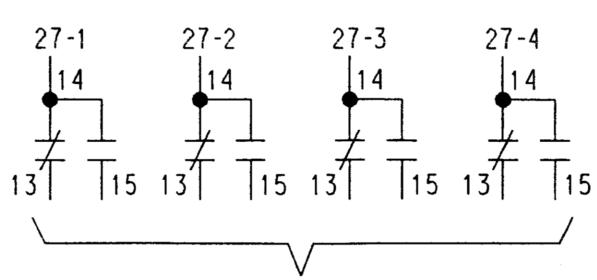
CONTACTS	FUNCTION	DWG. REF.
1, 2	SPARE	THIS SH.
3, 4	OPERATE 27X-6 C1(D1) RELAY	SH.14A
5, 6	TRIP ITRLK BRKR ABDC1 (AACD1)	SH.(3) 9
7, 8	TRIP ITRLK BRKR AC110 (AD110)	SH.5 (11)
9, 10	SFAS SEQUENCER CH.1(CH.2)	E-64B SH.17
11, 12	SPARE	

27Y-2 C1(D1)

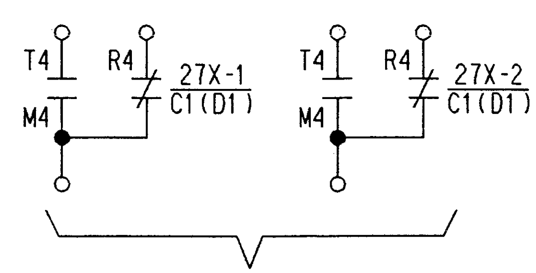
CONTACTS	FUNCTION	DWG. REF.
1, 2	SPARE	THIS SH.
3, 4	SPARE	12
5, 6	TRIP ITRLK BRKR AC105 (AD105)	E-49B SH 1B
7, 8	TRIP ITRLK BRKR AC111 (AD111)	E-52B SH.5B
9, 10	TRIP ITRLK BRKR AC112 (AD112)	E-52B SH.6B
11, 12	SFAS SEQUENCER CH.3(CH.4)	E-64B SH.17

27Y-3 C1(D1)

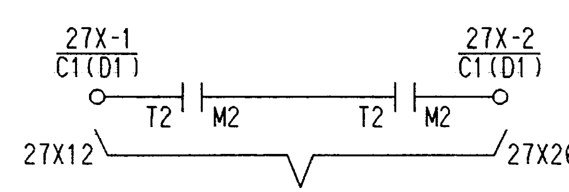
CONTACTS	FUNCTION	DWG. REF.
1, 2 / 1, 2	SPARE	
3, 4	TRIP ITRLK BRKR AC109 (AD109)	E-48B SH.11B
5, 6	SPARE	
7, 8	TRIP ITRLK BRKR AC107 (AD107)	E-48B SH.6B
9, 10	SPARE	THIS SH.
11, 12	SPARE	



SPARE



RELAY TEST, TS1-4/C1(D1)
(SEE E-204B SHT.1, FOR C1)
(SEE E-206B SHT.1, FOR D1)



BUS C1(D1) AUX.
UNDER VOLTAGE RELAYS
E-64B SH.1E(2E)

NOTES:

1. FOE GENERAL NOTES & LOCATION DESIGNATIONS SEE DWG. INDEX E-34B.
2. FOR $\frac{TS}{UV}$ DEVELOPMENT, SEE DWG. E-30B, SH.11, FIG.6 AND FOR CONTACT FUNCTIONS SEE DWG. E-34B SH.14B.
3. SEE DRAWING E-22, SH.1(2) FOR RELAYS 27-1, 27-2, 27-3 & 27-4.

DAVIS-BESSE NUCLEAR POWER STATION

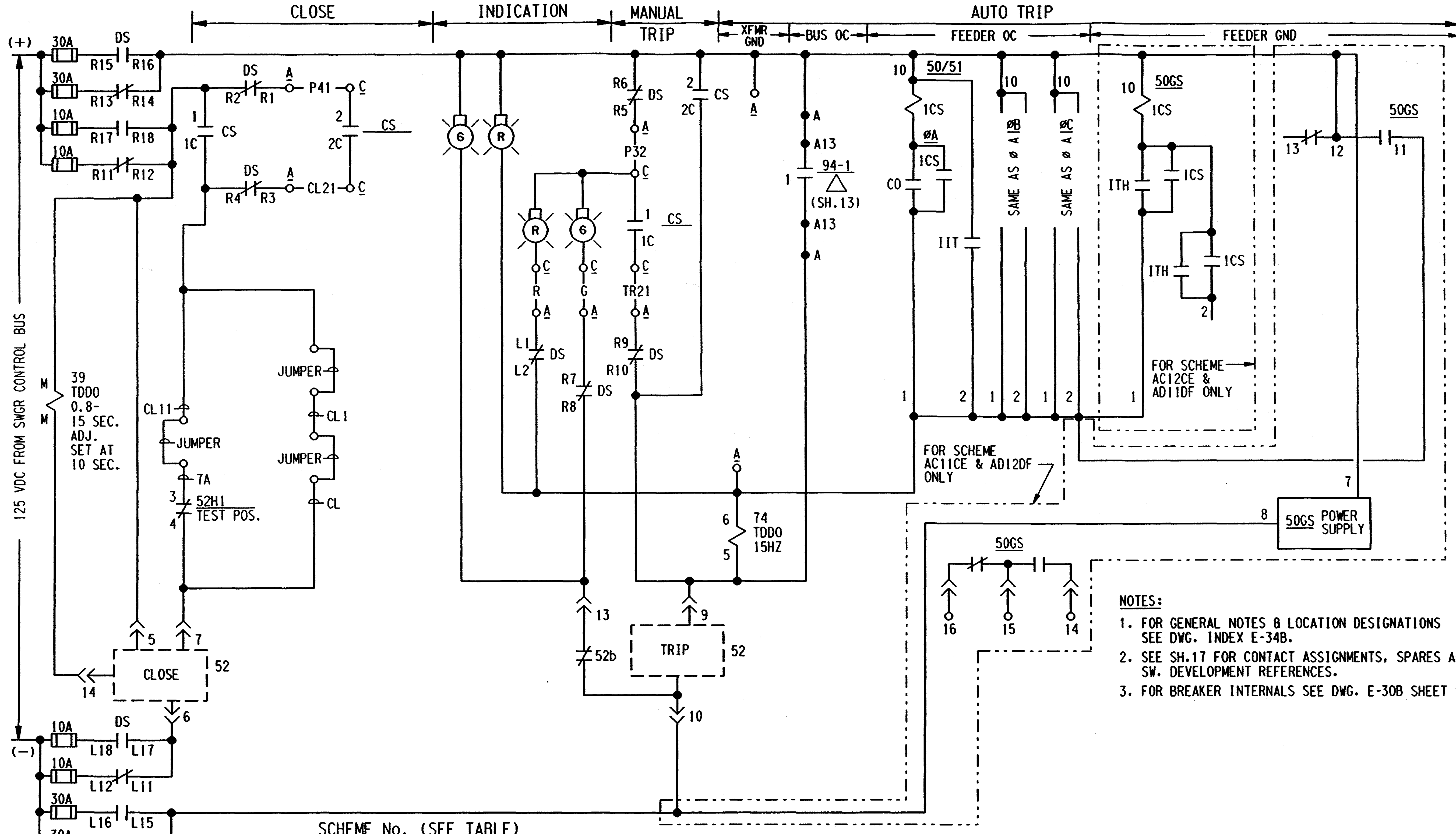
4.16KV FEEDER BREAKER-BUS C1 (D1)
VOLTAGE AND AUX RELAYS
E-34B SH. 14
FIGURE 8.3-10

Q

REVISION 25
JUNE 2006

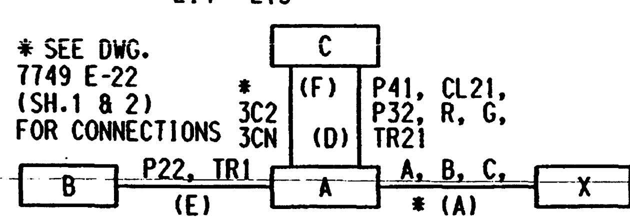
12/3/03

DB 05-01-06 DFN F:/SCHEME/E34BS14.DGN



SCHEME No. (SEE TABLE)

SCHEME NO.	UNIT SUBSTA. NO.	START UP SYS.	CH.	WIRE PREFIX	⬡	□	94-1 △	94-3 △	EQUIPMENT NUMBERS A	C	B	X	A13
AC11CE	E1	005	1	X1E	HIS6226		11 C1 12	3 C1 4	AC1CE11	C5715		XCE11	AC103
AC12CE	E1	005	1	X2E	HIS6227		7 C1 8	1 C1 2	AC1CE12	C5715		XCE12	AC103
AD11DF	F1	005	2	X1F	HIS6237		7 D1 8	1 D1 2	AD1DF11	C5715		XDF11	AD103
AD12DF	F1	005	2	X2F	HIS6236		11 D1 12	3 D1 4	AD1DF12	C5715		XDF12	AD103



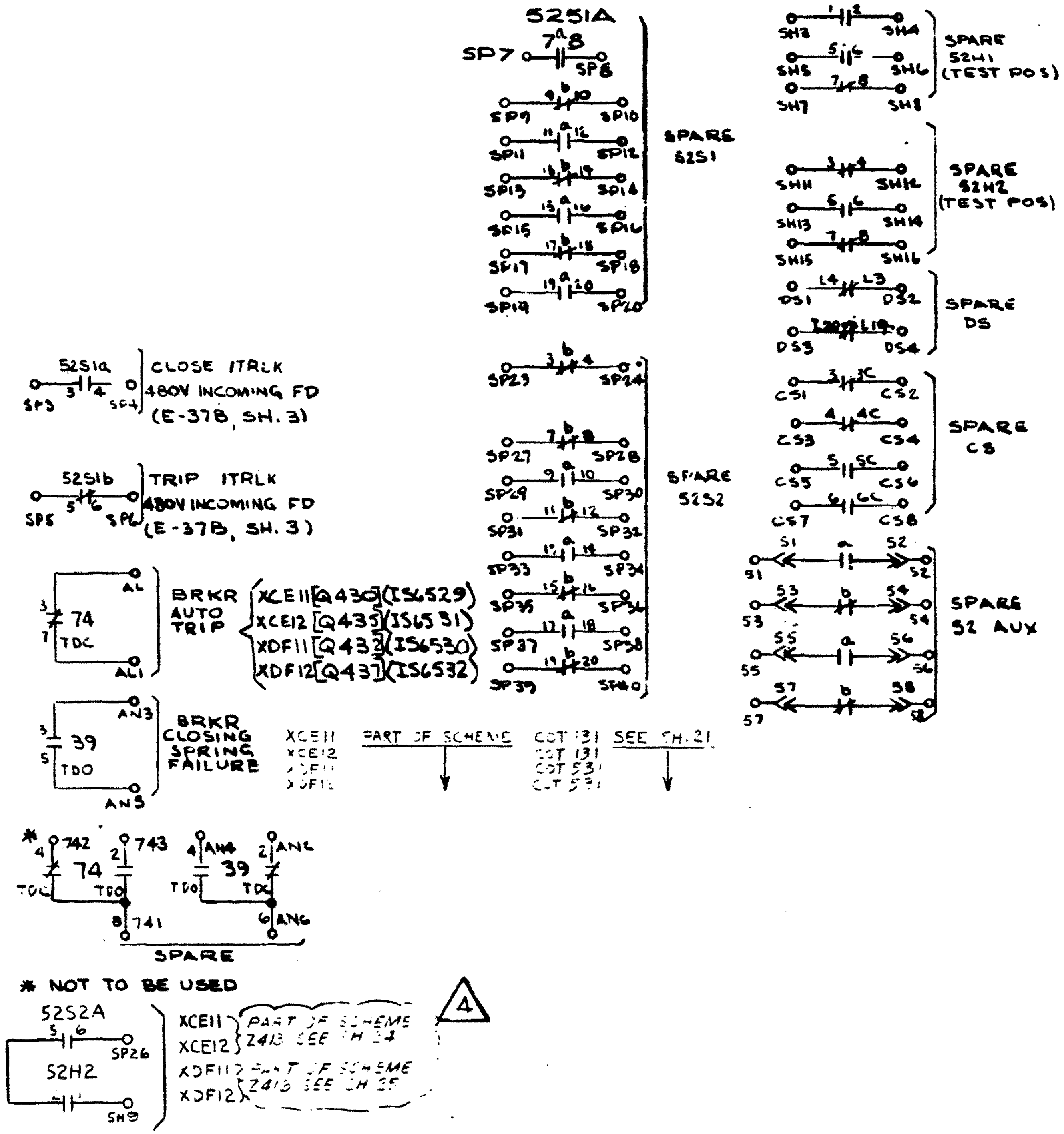
BLOCK DIAGRAM

NOTES:

1. FOR GENERAL NOTES & LOCATION DESIGNATIONS SEE DWG. INDEX E-34B.
2. SEE SH.17 FOR CONTACT ASSIGNMENTS, SPARES AND SW. DEVELOPMENT REFERENCES.
3. FOR BREAKER INTERNALS SEE DWG. E-30B SHEET 16A.

DAVIS-BESSE NUCLEAR POWER STATION
4.16 KV FEEDER BREAKER ESSENTIAL UNIT SUBSTATIONS E1 & F1 CONTROL
SHEET 1
E-34B SH. 16
FIGURE 8.3-11

REVISION 23
NOVEMBER 2002



DWG E-30B
SWITCH DEVELOPMENT REFERENCE

1- FOR CS AT SWGR, SEE FIG 2, SH 9A, DWG E-30B
2- FOR REMOTE CS, SEE FIG 1, SH 9, DWG E-30B
3- FOR DS, SEE FIG 5, SH 10, DWG E-30B

NOTES
1 - FOR GENERAL NOTES & LOCATION DESIGNATIONS SEE DWG INDEX E-34B

DAVIS-BESSE NUCLEAR POWER STATION

4.16kV FEEDER BREAKER - ESSENTIAL UNIT SUBSTATIONS
E1 AND F1 CONTROL, SHEET 2

E34B SH. 17

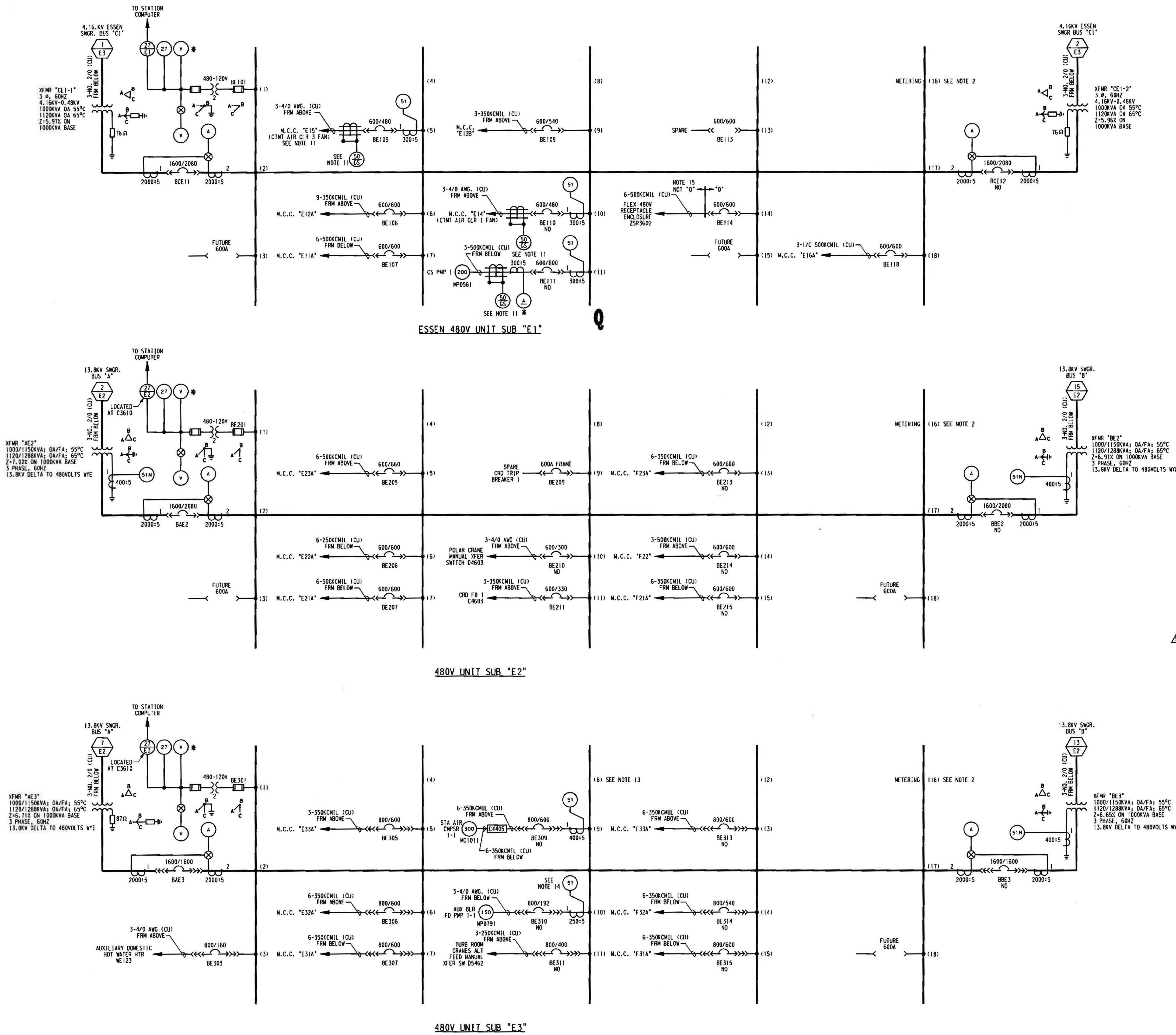
FIGURE 8.3-12

REVISION 9
JULY 1989

Removed in Accordance with RIS 2015-17

DAVIS-BESSE NUCLEAR POWER STATION
AUXILIARY BUILDING SECTIONS
FIGURE 8.3-13

REVISION 29
DECEMBER 2012



RELAY AND INSTRUMENT TABLE

DEVICE	DESCRIPTION	FUNCTION
A	AMMETER	
V	VOLTMETER	
⊗	TRANSFER SWITCH	
27	UNDERVOLTAGE RELAY	REMOTE ALARM
51N	NEUTRAL OC RELAY	TRIP CORRESPONDING HIGH SIDE FEEDER BREAKER
50/GS	GROUND SENSOR RELAY	REMOTE ALARM
51	OVERCURRENT RELAY	ALARM MOTOR OVERLOAD
A	AMMETER W/5:0.02 A AUX. CT.	

NOTES

1. COMPARTMENT NUMBERS ARE IN PARENTHESIS.
2. ALL RELAYS AND INSTRUMENTS TO BE LOCATED IN COMPARTMENTS (1) AND (16).
3. DELETED
4. INSTRUMENTS NOTED WITH ASTERISK (*) ARE LOCATED IN THE (REMOTE) CONTROL ROOM.
5. CIRCUIT BREAKER FRAME SIZE AND TRIP RATING FOR THE TRIP UNIT ARE SHOWN AS FOLLOWS:

   600/300

   FRAME SIZE — LONG-TIME DELAY PICKUP SETTING OF TRIP DEVICE
6. CABLE SIZES ARE BASED ON THE REQUIRED AMPACITY TAKING INTO ACCOUNT THE DERATING FACTORS ACCORDING TO THE ROUTING OF THE CABLE IN DUCTS, CONDUIT OR/AND TRAYS.
7. ALL FUSES ARE TO BE SHAWMUT AMPTRAP FORM 600 CURRENT LIMITING FUSES.
8. DELETED
9. BUS INCOMING & TIE BREAKERS ARE EQUIPPED WITH "POWER SENSOR" TYPE PS1-A OVERCURRENT TRIP DEVICES.
10. FEEDER BREAKERS ARE EQUIPPED WITH "SST" OVERCURRENT TRIP DEVICE WITH INTEGRAL GROUND FAULT PROTECTION ELEMENT.
11. FACE OF 50GS RELAYS ARE LABELED "NOT USED PER FCR 79-223". THE RELATED CT'S ARE SHORTED AT TERMINAL BLOCK.
12. DELETED
13. COMPARTMENT 8 OF UNIT SUB E3 CONTAINS SMOKE DETECTOR DS8600; COMPARTMENT 8 OF UNIT SUB F3 CONTAINS SMOKE DETECTOR DS8601.
14. THESE TYPE 51 RELAYS DO NOT HAVE ALARMING FUNCTIONS CONNECTED (BE310 AND BF310 ONLY, REF. ECP 09-0177-001)

50

15. WHERE "Q"/NOT "Q" BOUNDARIES ARE DEPICTED FOR 480VAC SWGR, ELECTRICAL COMPONENTS HOUSED ENTIRELY WITHIN THE SWGR CUBICLE SHALL BE CONSIDERED TO BE WITHIN THE Q BOUNDARY. FLEX ASSOCIATED BREAKERS ARE OPEN DURING NORMAL OPERATION AND MAY IMPACT OPERABILITY IF CLOSED WHEN ASSOCIATED BUS EQUIPMENT IS IN SERVICE.

REFERENCE DRAWINGS

E-1 AC ELECTRICAL SYSTEM ONE LINE DIAGRAM

E-2 MAIN ONE LINE DIAGRAM

E-3 4.16KV ONE LINE DIAGRAM

E-5 480V MCC SYSTEM ONE LINE DIAGRAM

E-6 480V ESSENTIAL MCC SYSTEM ONE LINE DIAGRAM

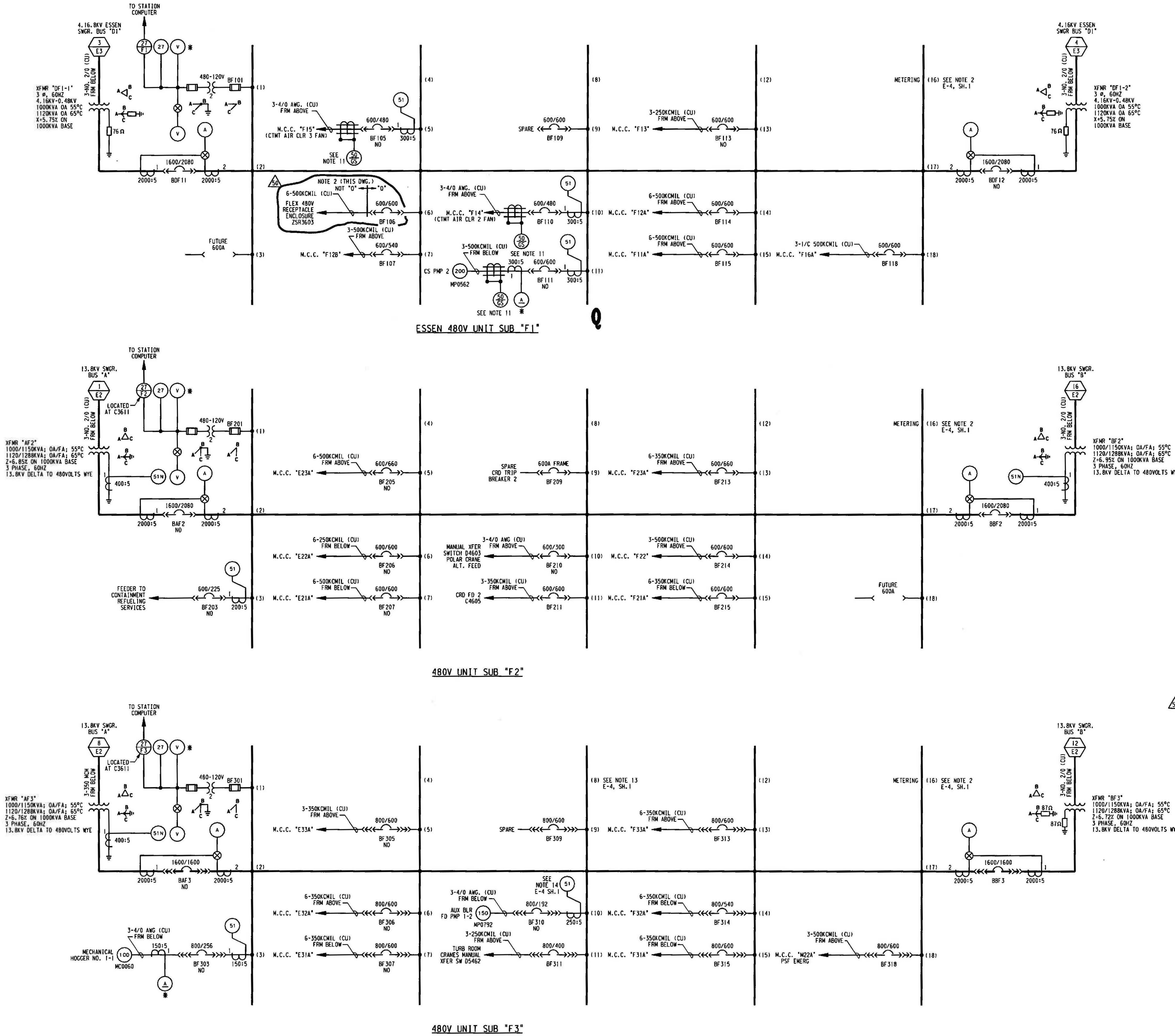
DAVIS-BESSE NUCLEAR POWER STATION

"E" BUSES 480V UNIT SUBSTATIONS
ONE-LINE DIAGRAM
E-4, SH.1
FIGURE 8.3-14

REVISION 31

OCTOBER 2016

DB 09-06-16 DFN=1:/ELEC/E4SH1.DGN



NOTES

1. FOR NOTES,LEGEND AND REFERENCE DRAWINGS SEE DWG. E-4 SHEET 1.
2. WHERE "Q"/NOT "Q" BOUNDARIES ARE DEPICTED FOR 480VAC SWGR, ELECTRICAL COMPONENTS HOUSED ENTIRELY WITHIN THE SWGR CUBICLE SHALL BE CONSIDERED TO BE WITHIN THE Q BOUNDARY. FLEX ASSOCIATED BREAKERS ARE OPEN DURING NORMAL OPERATION AND MAY IMPACT OPERABILITY IF CLOSED WHEN ASSOCIATED BUS EQUIPMENT IS IN SERVICE.

DAVIS-BESSE NUCLEAR POWER STATION

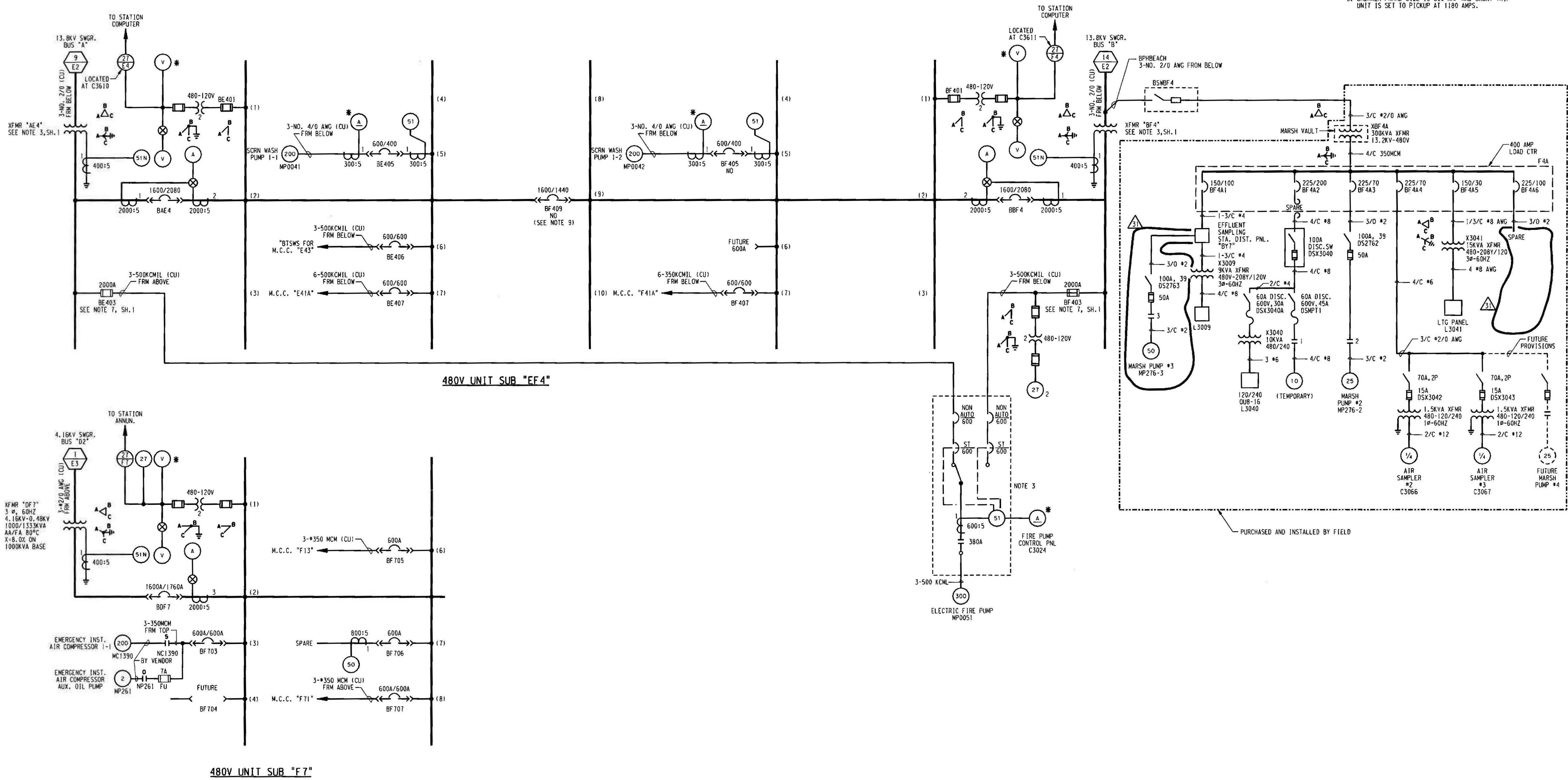
"F" BUSES 480V UNIT SUBSTATIONS
ONE-LINE DIAGRAM
E-4, SH.2
FIGURE 8.3-15

REVISION 31
OCTOBER 2016

DB 09-06-19 DFN=I:/ELEC/E4SH2.DGN

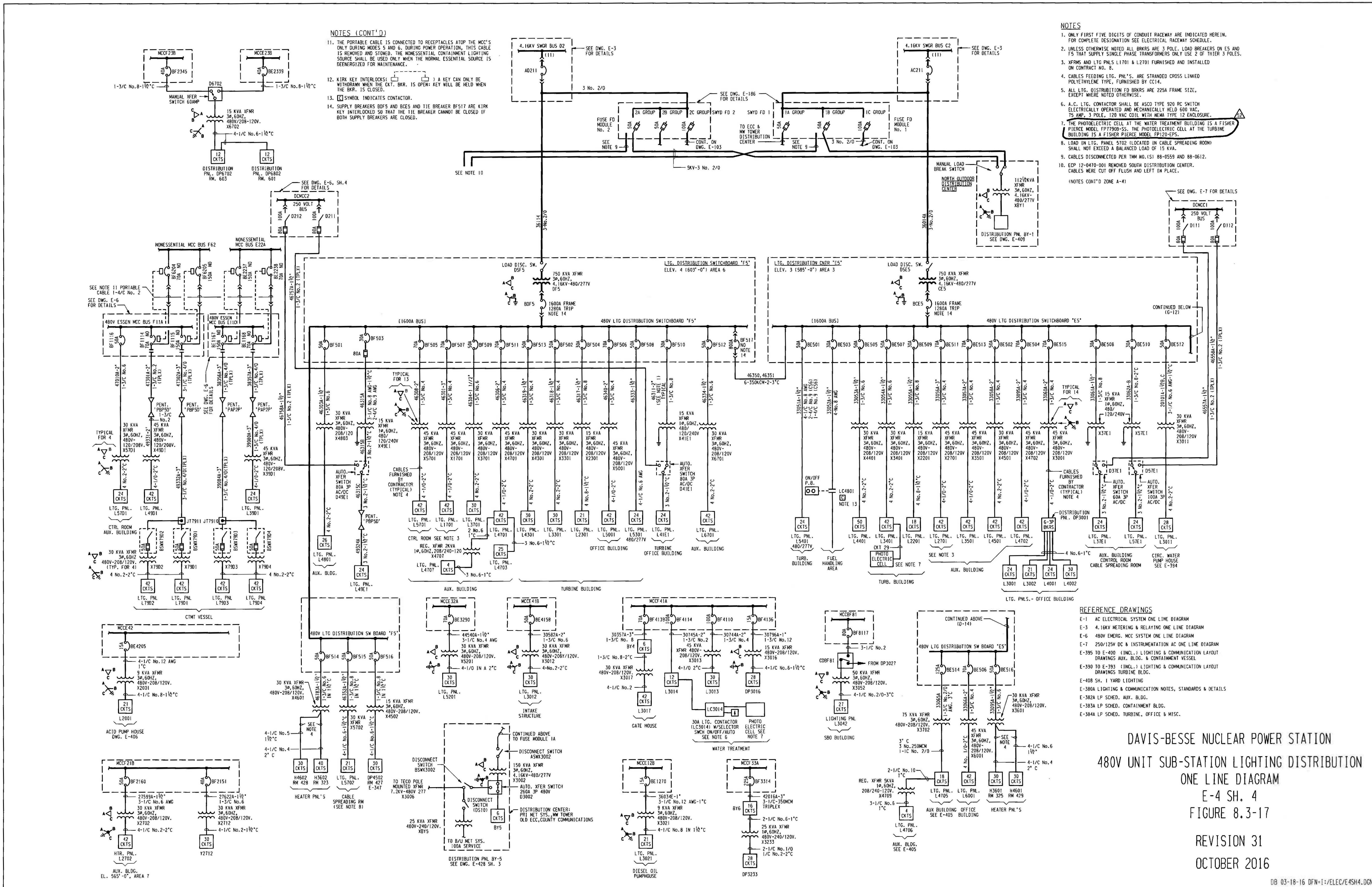
NOTES

1. FOR MARSH VAULT TRANSFORMER TAP SETTINGS SEE DWG. E-1 SH.3.
2. FOR ADDITIONAL NOTES, LEGEND AND REFERENCE DRAWINGS SEE DWG. E-4 SHEET 1.
3. BREAKER FRAME SIZE IS 600 AMP AND SHUNT TRIP UNIT IS SET TO PICKUP AT 1180 AMPS.



DAVIS-BESSE NUCLEAR POWER STATION
WATER TREATMENT & TURBINE BLDG.
480V UNIT SUB-STATION
ONE LINE DIAGRAM
E-4 SH. 3
FIGURE 8.3-16
REVISION 31
OCTOBER 2016

DB 03-18-16 DFN=I:/ELEC/E4SH4.DGN



NOTES

1. ONLY FIRST FIVE DIGITS OF CONDUIT RACEWAY ARE INDICATED HEREIN. FOR COMPLETE DESIGNATION SEE ELECTRICAL RACEWAY SCHEDULE.
2. UNLESS OTHERWISE NOTED ALL BRKRS ARE 3 POLE. LOAD BREAKERS ON E5 AND F5 THAT SUPPLY SINGLE PHASE TRANSFORMERS ONLY USE 2 OF THIER 3 POLES.
3. XFRMS AND LTG PNLS L1701 & L2701 FURNISHED AND INSTALLED ON CONTRACT NO. 8.
4. CABLES FEEDING LTG. PNL'S. ARE STRANDED CROSS LINKED POLYETHYLENE TYPE, FURNISHED BY CC14.
5. ALL LTG. DISTRUBITION FD BRKRS ARE 225A FRAME SIZE, EXCEPT WHERE NOTED OTHERWISE.
6. A.C. LTG. CONTACTOR SHALL BE ASCO TYPE 920 RC SWITCH ELECTRICALLY OPERATED AND MECHANICALLY HELD 600 VAC, 75 AMP, 3 POLE, 120 VAC COIL WITH NEMA TYPE 12 ENCLOSURE.
7. THE PHOTOELECTRIC CELL AT THE WATER TREATMENT BUILDING IS A FISHER PIERCE MODEL FP7790B-SS. THE PHOTOELECTRIC CELL AT THE TURBINE BUILDING IS A FISHER PIERCE MODEL FP120-EPS. 52
8. LOAD IN LTG. PANEL 5702 (LOCATED IN CABLE SPREADING ROOM) SHALL NOT EXCEED A BALANCED LOAD OF 15 KVA.
9. CABLES DISCONNECTED PER TMM NO.(S) 88-0559 AND 88-0612.
10. ECP 12-0470-001 REMOVED SOUTH DISTRIBUTION CENTER. CABLES WERE CUT OFF FLUSH AND LEFT IN PLACE.

(NOTES CONT'D ZONE A-4)

NOTES (CONT'D)

11. THE PORTABLE CABLE IS CONNECTED TO RECEPTACLES ATOP THE MCC'S ONLY DURING MODES 5 AND 6. DURING POWER OPERATION, THIS CABLE IS REMOVED AND STOWED. THE NONESSENTIAL CONTAINMENT LIGHTING SOURCE SHALL BE USED ONLY WHEN THE NORMAL ESSENTIAL SOURCE IS DEENERGIZED FOR MAINTENANCE.
12. KIRK KEY INTERLOCKS( ) A KEY CAN ONLY BE WITHDRAWN WHEN THE CKT. BKR. IS OPEN: KEY WILL BE HELD WHEN THE BKR. IS CLOSED.
13. $\boxed{C}$ SYMBOL INDICATES CONTACTOR.
14. SUPPLY BREAKERS BDF5 AND BCE5 AND TIE BREAKER BF517 ARE KIRK KEY INTERLOCKED SO THAT THE TIE BREAKER CANNOT BE CLOSED IF BOTH SUPPLY BREAKERS ARE CLOSED.

REFERENCE DRAWINGS

E-1	AC ELECTRICAL SYSTEM ONE LINE DIAGRAM
E-3	4.16KV METERING & RELAYING ONE LINE DIAGRAM
E-6	480V EMERG. MCC SYSTEM ONE LINE DIAGRAM
E-7	250/125V DC & INSTRUMENTATION AC ONE LINE DIAGRAM
E-395	TO E-400 (INCL.) LIGHTING & COMMUNICATION LAYOUT DRAWINGS AUX. BLDG. & CONTAINMENT VESSEL
E-390	TO E-393 (INCL.) LIGHTING & COMMUNICATION LAYOUT DRAWINGS TURBINE BLDG.
E-408	SH. 1 YARD LIGHTING
E-380A	LIGHTING & COMMUNICATION NOTES, STANDARDS & DETAILS
E-382A	LP SCHED. AUX. BLDG.
E-383A	LP SCHED. CONTAINMENT BLDG.
E-384A	LP SCHED. TURBINE, OFFICE & MISC.

DAVIS-BESSE NUCLEAR POWER STATION

480V UNIT SUB-STATION LIGHTING DISTRIBUTION ONE LINE DIAGRAM

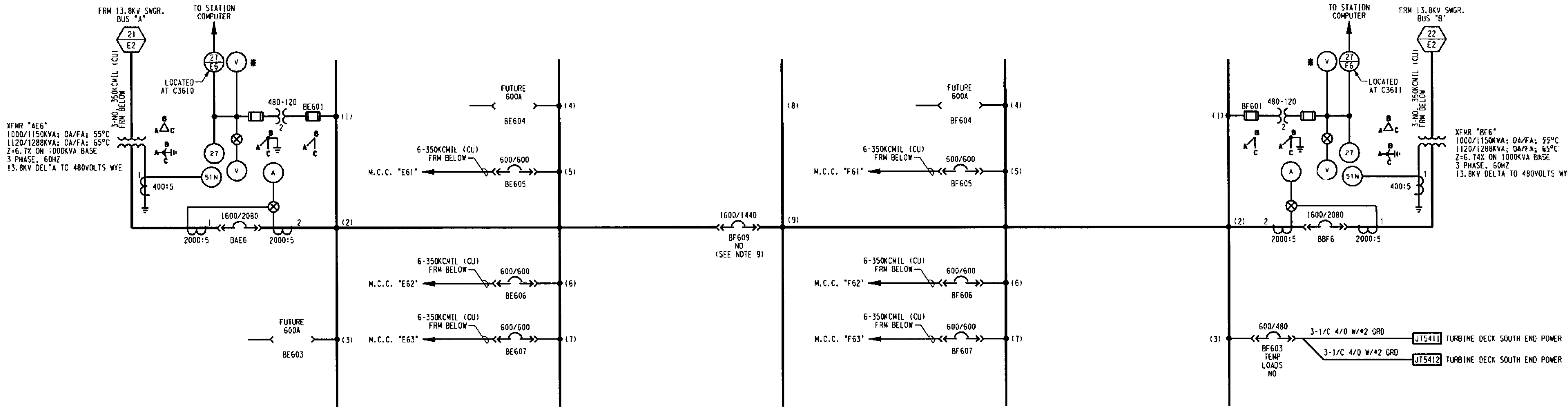
E-4 SH. 4

FIGURE 8.3-17

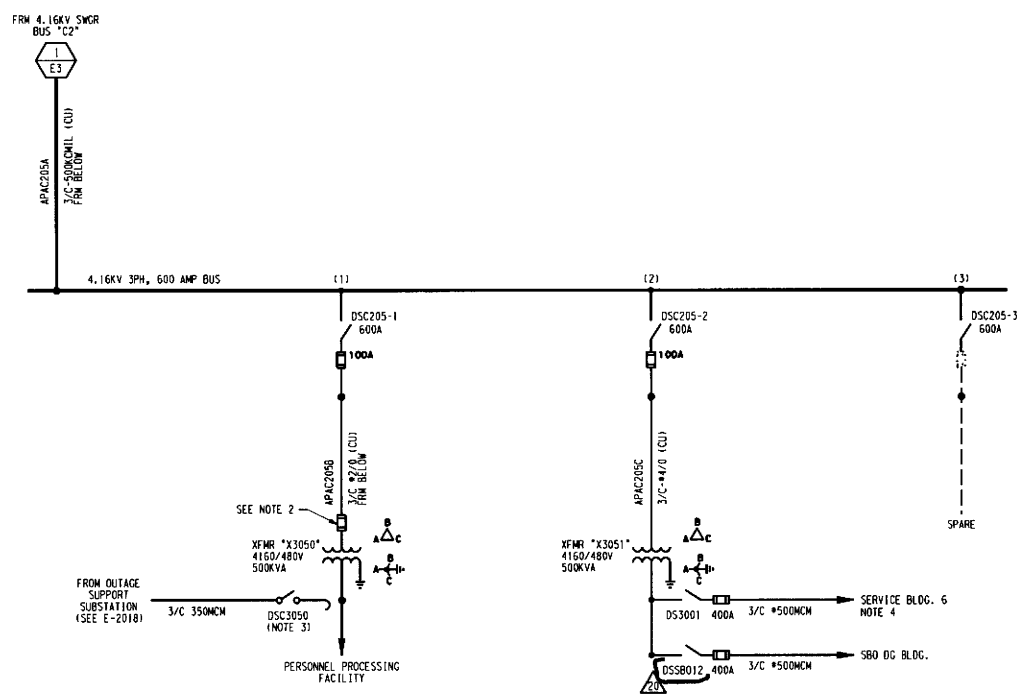
REVISION 31

OCTOBER 2016

DB 03-18-16 DFN=I:/ELEC/E4SH4.DGN



480V UNIT SUB "EF6"



4.16KV DISCONNECT DSC205

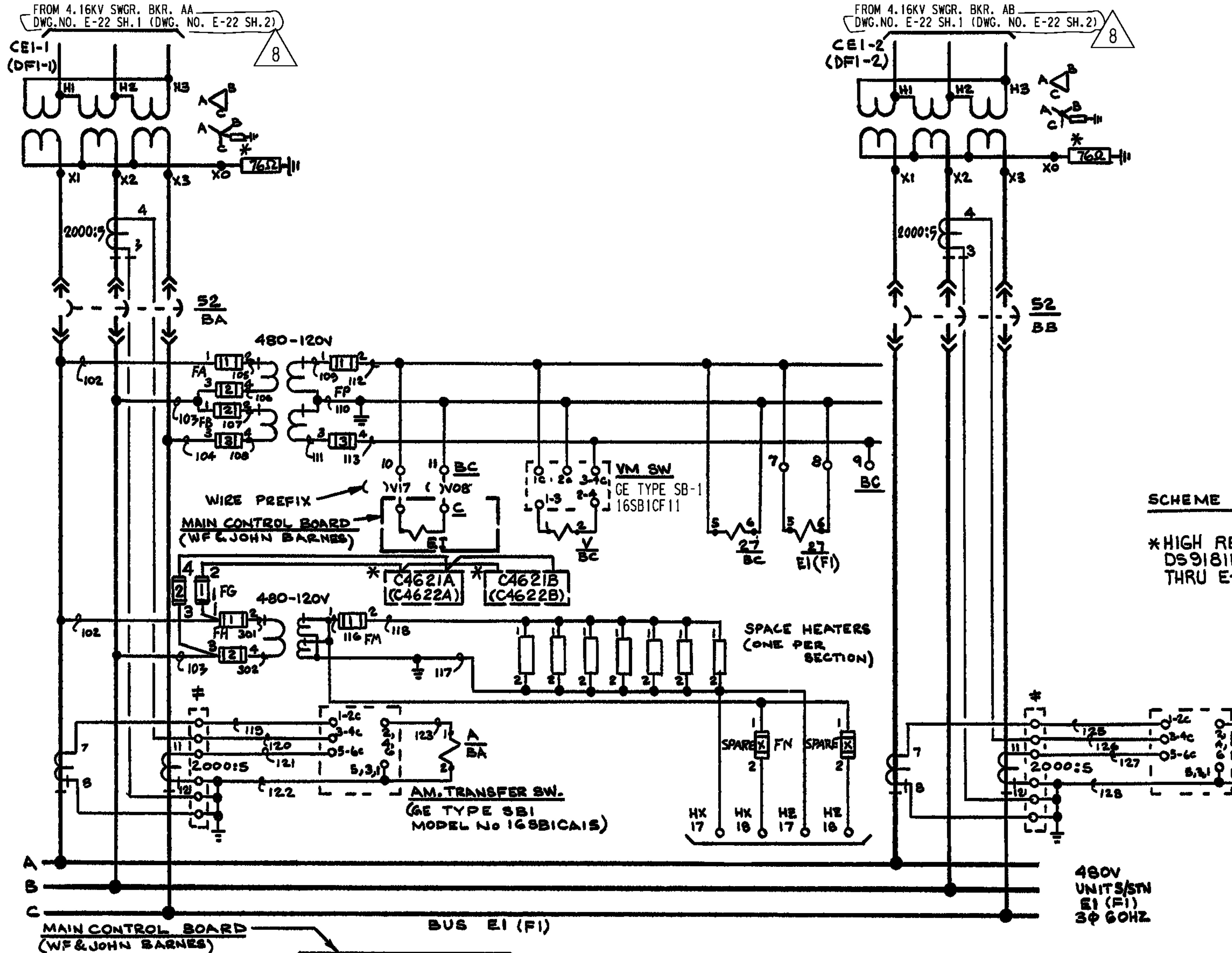
NOTES

1. FOR ADDITIONAL NOTES,LEGEND AND REFERENCE DRAWINGS SEE DWG. E-4 SHEET 1.
2. FIELD SHOULD REPLACE EXISTING 100 AMP (MCGRAW EDISON TYPE 100 NX) FUSES WITH DUMMY FUSES OR PUT SOLID LINKS AT THE PRIMARY OF TRANSFORMER X3050.
3. DSC3050 PIGTAILS SHALL NOT BE CONNECTED TO THE SECONDARY OF XFMR X3050. IN ORDER TO ESTABLISH ALT. PWR FROM THE OUTAGE SUPPORT SUBSTATION, THE PPF POWER FEEDERS (XFMR SECONDARY CABLING) SHALL BE DISCONNECTED FROM X3050 AND RECONNECTED TO THE PIGTAILS OF DSC3050.
4. SERVICE BUILDING 6 PROVIDES POWER TO BOTH THE WELD TRAINING CENTER AND THE BISULFITE SHED, BOTH OF WHICH ARE LOCATED OUTSIDE THE PROTECTED AREA. THE BISULFITE SHED CONTAINS THE S100 DECHLORINATION SKID (DB-S100).

DAVIS-BESSE NUCLEAR POWER STATION

PZR & ANNULUS HEATERS
480V UNIT SUB-STATION
ONE LINE DIAGRAM
E-4 SH. 5
FIGURE 8.3-18

REVISION 32
SEPTEMBER 2018



DEVICE TYPE

51N TRANSFORMER NEUTRAL OVERCURRENT RELAY GE TYPE IAC 51A

27/BC BUS UNDERVOLTAGE RELAY GE TYPE HGA14 (NOT USED)

27/E1(F1) BUS UNDERVOLTAGE RELAY GE TYPE IAV54E

SHORT CIRCUIT TYPE TERMINAL BLOCK

SCHEME NUMBER (SEE TABLE)

*HIGH RESISTANCE GROUNDING EQUIPMENT-GE TYPE-DS9181LAY 108AXAMC (REF. DWGS. E-7Q-62-1-001 THRU E-7Q-66-1-001 AND E-7Q-68-1-001)

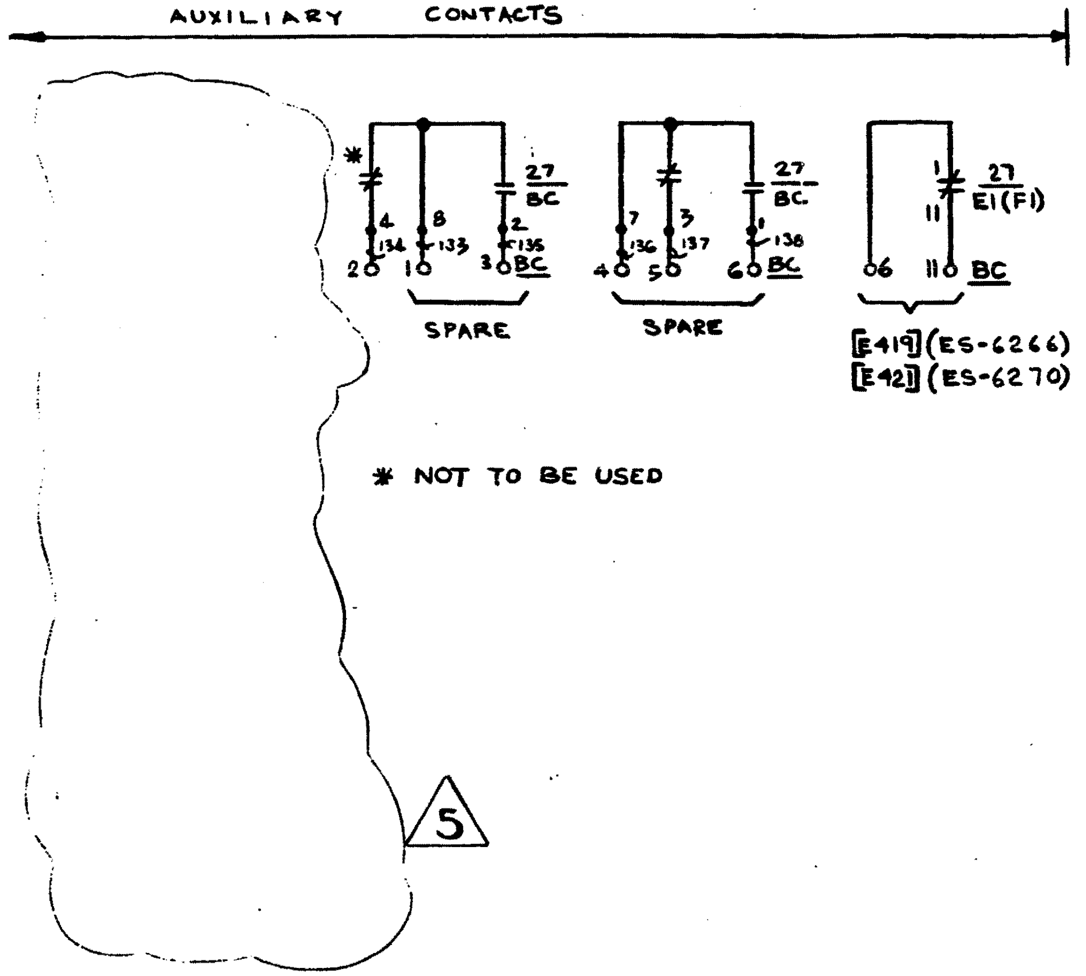
SCHEME No	SWGR WIRE PREFIX
BE1	(1)
BF1	(2)

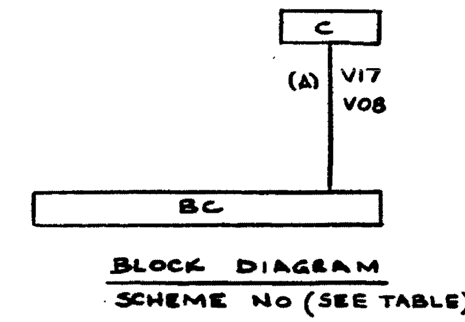
SCHEME No	UNIT S/STN. No	START-UP SYSTEM No.	CHANNEL	EI	WIRE PREFIX	EQUIPMENT NUMBERS									COMPUTER INPUT
						C	BA	BB	BC	BD	AA	AB	1CE	2CE	K
BE1	E1	005	1	EI 6266	1CE	C5715	B1CE	B2CE	BE102	BE106	AC1CE11	AC1CE12	1CE	2CE	E419
BF1	F1	↓	2	EI 6270	1DF	↓	B1DF	B2DF	BF102	BF106	AD1DF11	AD1DF12	1DF	2DF	E421

CONTINUED ON SH-2 THIS DWG

DAVIS-BESSE NUCLEAR POWER STATION
ESSENTIAL UNIT SUBSTATIONS
E1 AND F1 INCOMING FEEDER
CIRCUIT BREAKERS SHEET 1
E-37B SH. 1
FIGURE 8.3-19

REVISION 29
DECEMBER 2012





CONTINUED FROM SHEET 1 THIS DWG

MISCELLANEOUS DETAILS

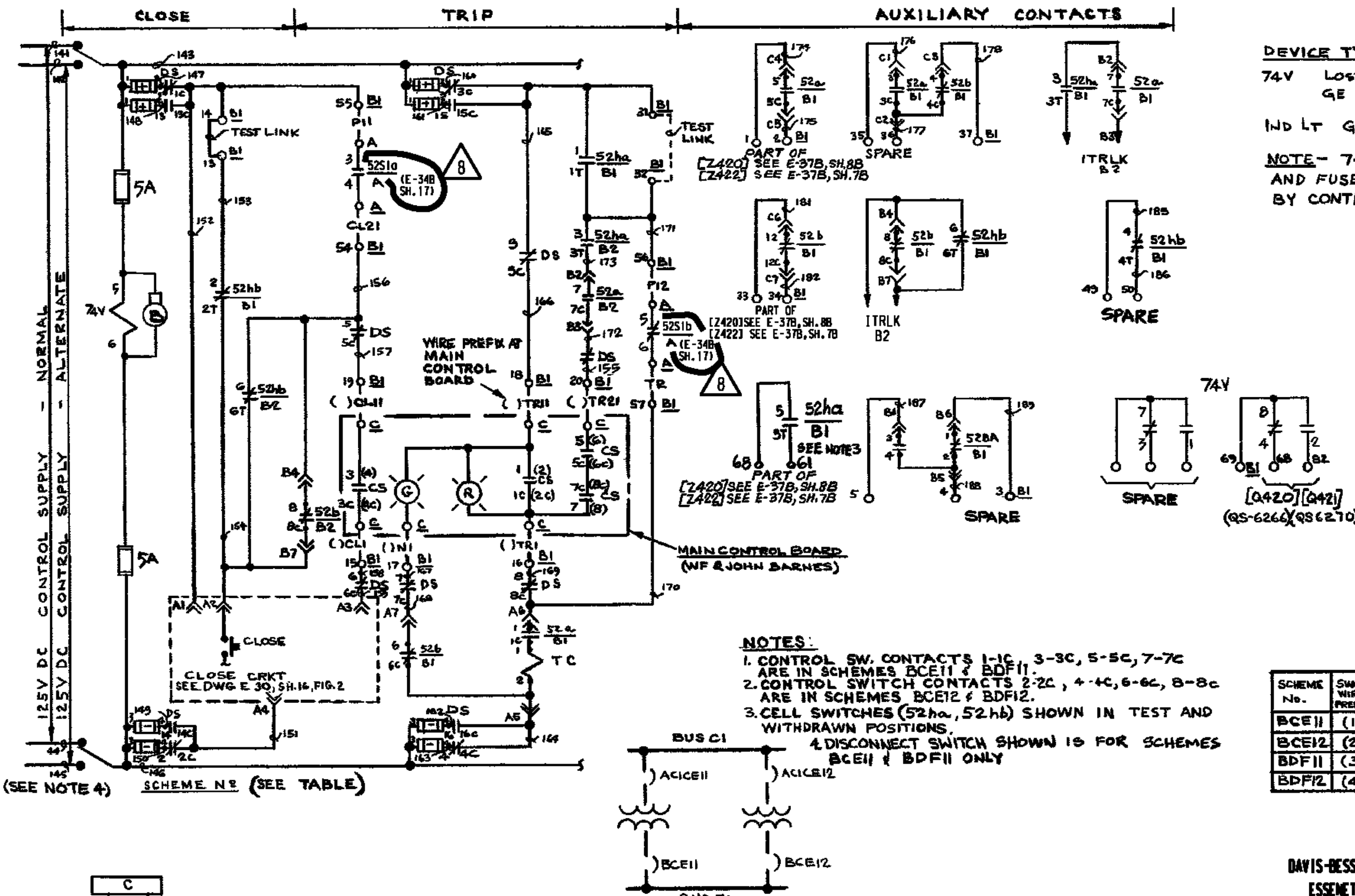
DAVIS-BESSE NUCLEAR POWER STATION

ESSENTIAL UNIT SUBSTATIONS INCOMING
FEEDER CIRCUIT BREAKER, SHEET 2

E37B SH. 2

FIGURE 8.3-20

REVISION 14
JULY 1991



DEVICE TYPE

74V LOST CONT PWR
GE TYPE HGA11

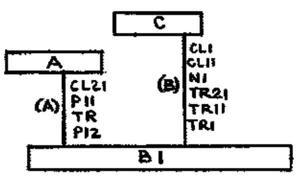
IND LT GE ET16 BLUE

NOTE – 74V, IND LIGHT AND FUSES TO BE INSTALLED BY CONTRACTOR.

NOTES:

1. CONTROL SW. CONTACTS 1-1C, 3-3C, 5-5C, 7-7C ARE IN SCHEMES BCE11 & BDF11.
2. CONTROL SWITCH CONTACTS 2-2C, 4-4C, 6-6C, 8-8C ARE IN SCHEMES BCE12 & BDF12.
3. CELL SWITCHES (52ha, 52hb) SHOWN IN TEST AND WITHDRAWN POSITIONS.
4. DISCONNECT SWITCH SHOWN IS FOR SCHEMES BCE11 & BDF11 ONLY

SCHEME No.	SWGR. WIRE PREFIX	125V DC CONT. SUPPLY NORMAL PNL	NORMAL CKT	ALTERNATE PNL	ALTERNATE CKT
BCE11	(1)	D1P	D1P07	D1N	D1N07
BCE12	(2)	—	—	—	—
BDF11	(3)	D2P	D2P07	D2N	D2N07
BDF12	(4)	—	—	—	—



BLOCK DIAGRAM

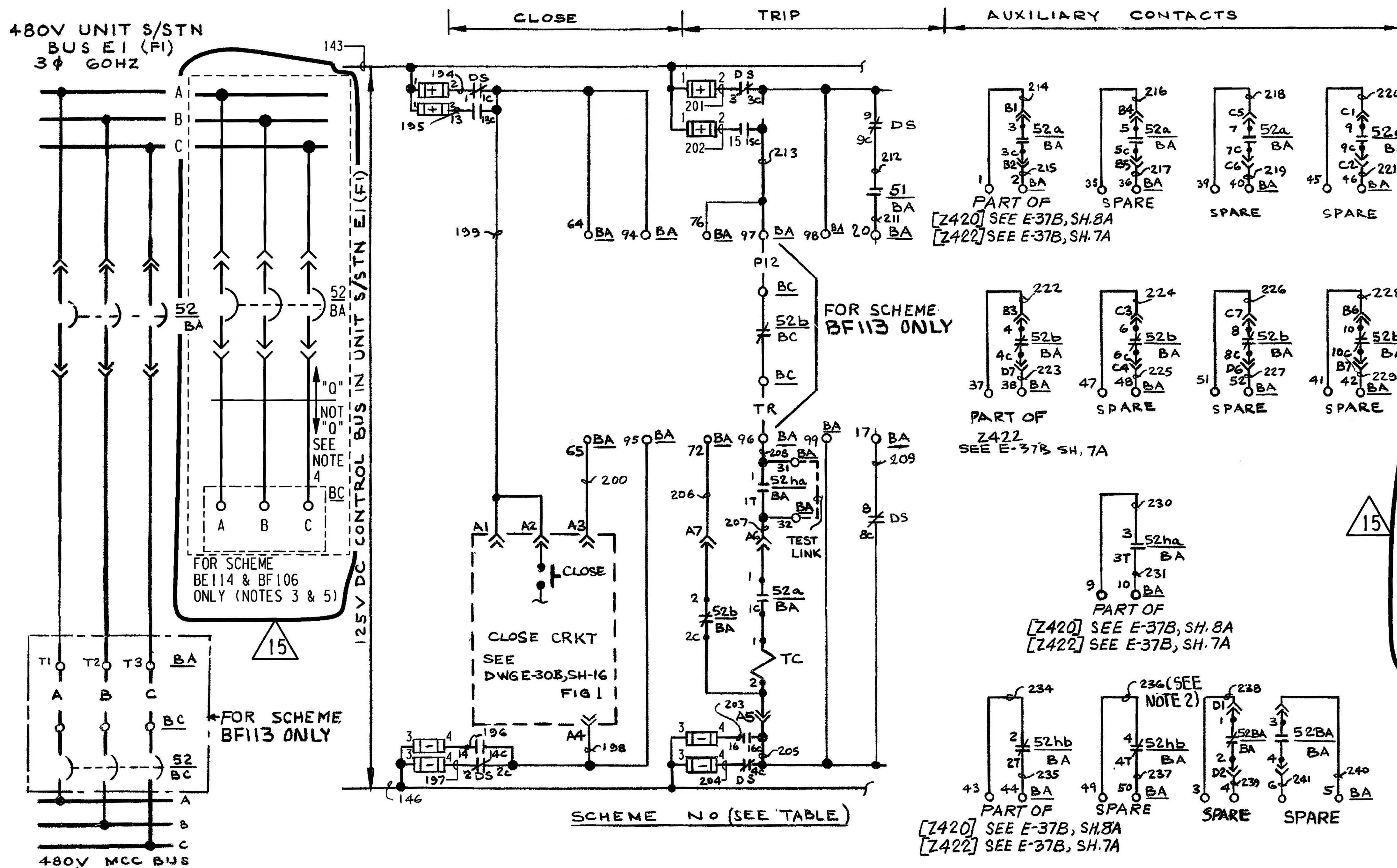
SCHEME No	UNIT S/STN No	START-UP SYS No	CHANNEL	WIRE PREFIX	CS No	CS SEE E-30 SH	CS SEE E-30 FIG	EQUIPMENT NUMBERS C	B1	B2	A	ANNUC INPUT SEE
BCE11	E1	005	1	1CE	HIS6244	11	1	CS715	BCE11	BCE12	ACICE11	Z420
BCE12				2CE					BCE12	BCE11	ACICE12	
BDF11	F1	005	2	1DF	HIS6254	11	3		BDF11	BDF12	ADIDF11	Z422
BDF12				2DF					BDF12	BDF11	ADIDF12	

MAIN CONT. BOARD (WF & JOHN BARNES)

DAVIS-BESSE NUCLEAR POWER STATION
ESSENETIAL UNIT SUBSTATIONS
INCOMING FEEDER CIRCUIT BREAKER,
SHEET 3
E-37B SH. 3
FIGURE 8.3-21

REVISION 29
DECEMBER 2012

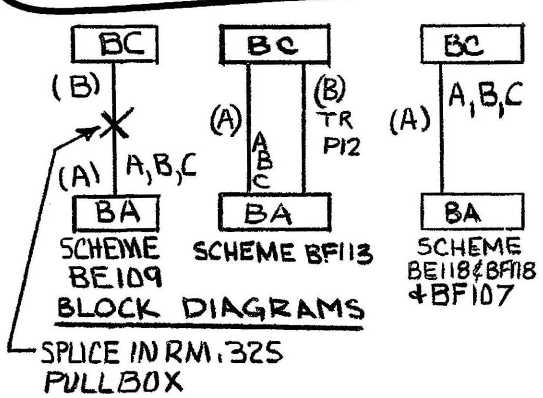
DB 05-22-12 DFN F:/SCHEME/E37BSH3.DGN/TIF



NOTES:

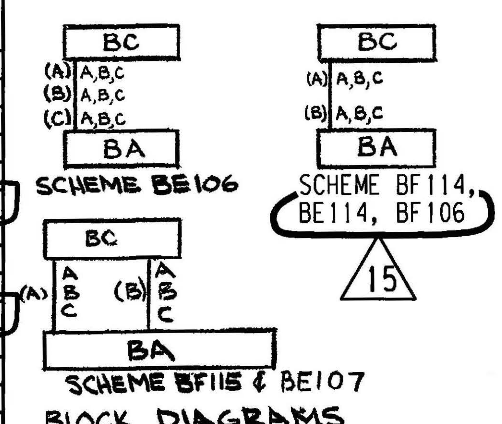
1. CELL SWITCHS (52ha, 52hb) ARE SHOWN IN TEST AND WITHDRAWN POSITIONS.
2. FOR SCHEME BE118 SPARE CONTACT 4-4T IS ABANDONED BECAUSE OF DISCONTINUITY IN WIRE #236.
3. FOR SCHEME BE114 AND BF106 CABLES FROM UNIT SUBSTATION BREAKERS BE114 AND BF106 ARE CONNECTED TO FLEX RECEPTACLE ENCLOSURES.
4. WHERE "O"/NOT "O" BOUNDARIES ARE DEPICTED FOR 480VAC SWGR. ELECTRICAL COMPONENTS HOUSED ENTIRELY WITHIN THE SWGR CUBICLE SHALL BE CONSIDERED TO BE WITHIN THE "O" BOUNDARY.
5. FLEX ASSOCIATED BREAKERS ARE OPEN DURING NORMAL OPERATION AND MAY IMPACT OPERABILITY IF CLOSED WHEN ASSOCIATED BUS EQUIPMENT IS IN SERVICE.

15



SCHEME NUMBER	UNIT S/STN NO.	START-UP SYS NO.	CHANNEL	WIRE PREFIX	EQUIPMENT NUMBERS C	EQUIPMENT NUMBERS BA	EQUIPMENT NUMBERS BC	ANNUC INPUT	SWGR. WIRE PREFIX
BE109	E1	006	1	—	—	BE109	BE12B	Z420	3
BE106		006	1	—	—	BE106	BE12A	Z420	3
BE107		006	1	—	—	BE107	BE11	Z420	4
BE113						SPARE			
BE114		005	1	—	—	BE114	ZSR3602	Z420	—
BE115						FUTURE			
BE118		006	1	—	—	BE118	BE16A	Z420	8
BF118	F1	006	2	—	—	BF118	BF16A	Z422	9
BF106		005	2	—	—	BF106	ZSR3603	Z422	—
BF107		006	2	—	—	BF107	BF12B	Z422	11
BF113		006	B	—	—	BF113	BF1310	Z422	12
BF114		006	2	—	—	BF114	BF12A	Z422	13
BF115		006	2	—	—	BF115	BF11	Z422	14
BF109						SPARE			

15



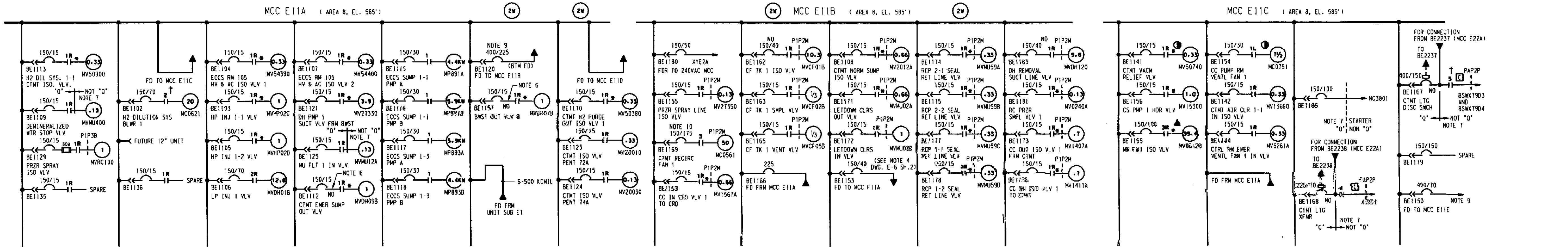
Q

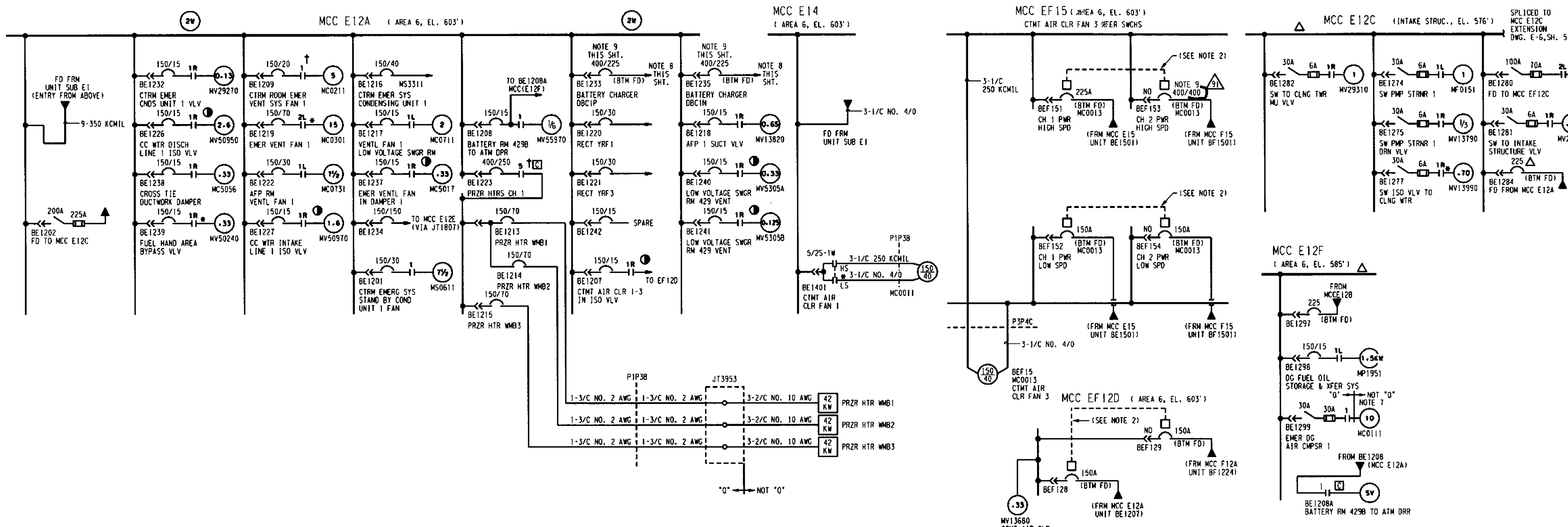
DAVIS-BESSE NUCLEAR POWER STATION

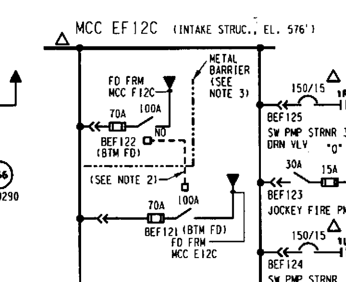
ESSENETIAL UNIT SUBSTATIONS
MCC FEEDER CIRCUIT BREAKERS
E-37B SH. 4
FIGURE 8.3-22

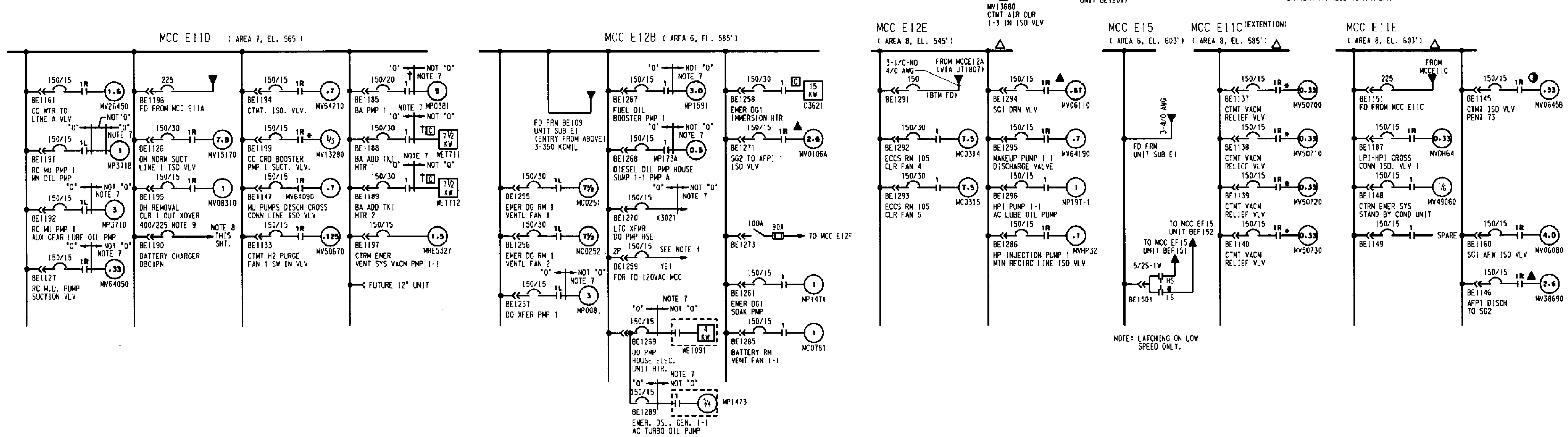
REVISION 31
OCTOBER 2016

DB 09-06-16 DFN F:/SCHEME/E37BSH4.DGN/CIT









NOTES

1. SEE DWG E-5, SH. 1 FOR GENERAL NOTES.
2. KIRK KEY INTERLOCKS
   a) KEY CAN ONLY BE WITHDRAWN WHEN THE CRKT BRKR OR FUSED DISC. SWITCH IS OPEN; KEY WILL BE HELD WHEN THE BRKR IS CLOSED.
   b) PROVIDE THREE KEYS FOR EACH SET OF INTERLOCKS WITH THE MOTOR CONTROL CENTER DESIGNATION. (EXAMPLE E11A, F13, ETC.) STAMPED IN EACH KEY.
   c) KEYS CORRESPONDING TO INTERLOCKS ON ANY GIVEN MCC SHALL NOT FIT ANY OTHER MCC.
3. FOR MCC EF12C SEPARATE COMPARTMENTS ARE REQUIRED FOR THE INCOMING FUSED DISC. SWITCHES & A METAL BARRIER TO ENSURE SEPARATION BETWEEN THE INCOMING FEEDERS FRM MCC'S E12C & F12C.
4. 480V BREAKER IS FURNISHED UNDER 120VAC MCC B/M.
5. LACK OF SYMBOL (* OR ▲) DENOTES NO STARTING FROM SFAS OR SFRCS.
6. BREAKERS BE1112 AND BE1157 ARE MAINTAINED IN THE OPEN POSITION.
7. WHERE Q/NON-Q BOUNDARIES ARE DEPICTED FOR ESSENTIAL 480VAC BREAKERS, ELECTRICAL AND CONTROL COMPONENTS HOUSED ENTIRELY WITHIN THE BREAKER CUBICLE SHALL BE CONSIDERED TO BE WITHIN THE Q BOUNDARY. EXAMPLES MAY INCLUDE OVERLOAD HEATERS, OVERLOAD RELAYS, AND CONTACTOR MOUNTED AUXILIARY SWITCHES. REF. CR 03-06329.
8. THE LOAD VALUE FOR BATTERY CHARGERS IS DEPENDENT UPON THE LOAD SCENERIO, AS DETERMINED BY CALCULATION C-EE-015.03-008.
9. FRAME SIZE OF CIRCUIT BREAKER HAS BEEN INCREASED AND THE ASSOCIATED MCC HARDWARE MUST BE EVALUATED FOR ACCEPTABILITY PRIOR TO INCREASING CIRCUIT BREAKER TRIP RATING.
10. THE BREAKER ASSEMBLE HAS BEEN EVALUATED ACCEPTABLE WITH THE 175A TRIP UNIT IN ECP 11-0224-001.

LEGEND

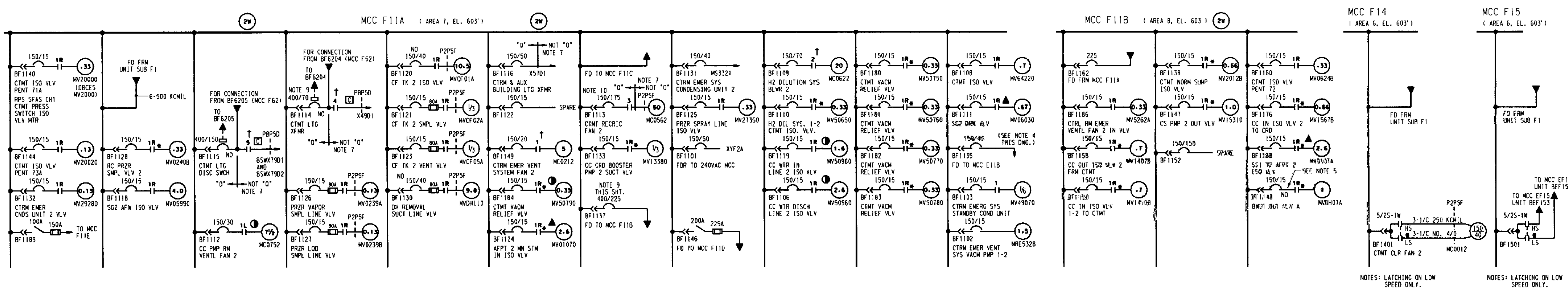
- [C] CONTACTOR
- * STARTER OR CONTACTOR WHICH RECEIVES A SIGNAL FROM THE SAFETY FEATURES ACTUATION SYSTEM (SFAS) REF. DWG. E-17B.
- ▲ STARTER OR CONTACTOR WHICH RECEIVES A SIGNAL FROM THE STEAM AND FEEDWATER RUPTURE CONTROL SYSTEM (SFRCS) REF. DWG. E-19B.
- ◐ INSTALLATION CONTRACTOR TO INSTALL IN EXISTING SPACE.
- † INSTALLATION CONTRACTOR TO REMOVE LATCHING TYPE STARTER AND REPLACE WITH FVNR STARTER.
- △ INSTALLATION CONTRACTOR TO INSTALL. ADD VERTICAL STRUCTURES TO MCC E12C, MCC EF12C, MCC E11E & E12E & LOCATE EXISTING STARTERS AS SHOWN.

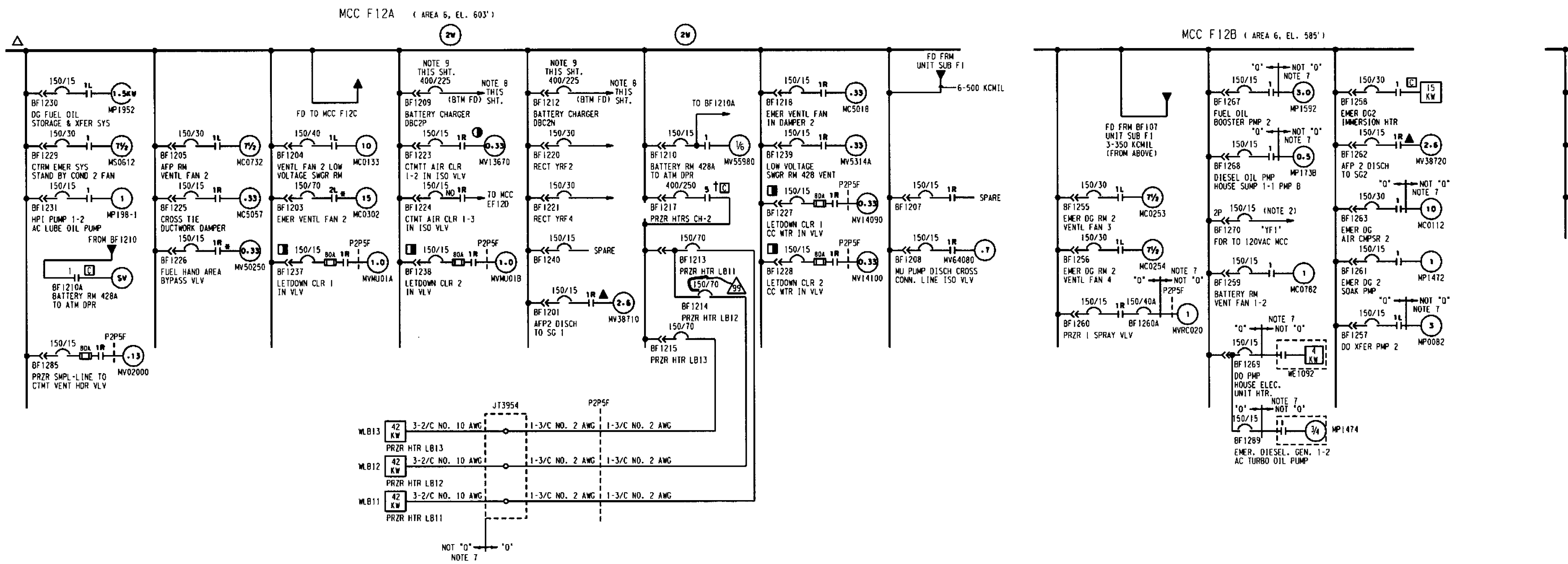
DAVIS-BESSE NUCLEAR POWER STATION

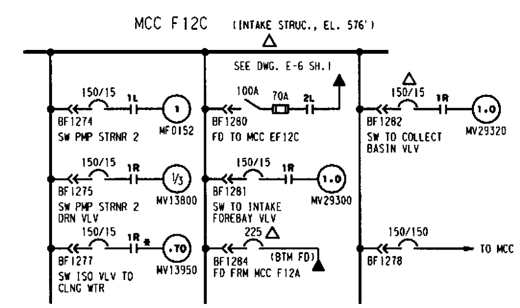
480V AC MCC (ESSENTIAL)
ONE LINE DIAGRAM
E-6 SH. 1
FIGURE 8.3-23

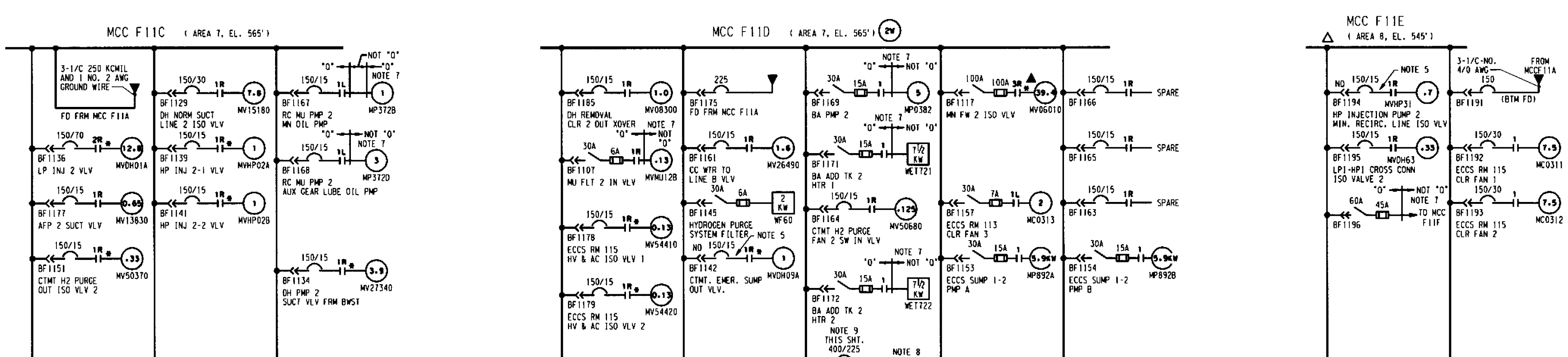
REVISION 32
SEPTEMBER 2018

DB 10-10-17 DFN=I:/ELEC/E6SH1.DGN









NOTES

1. SEE DWG E-5, SH. 1 FOR GENERAL NOTES.
2. 480VAC BREAKER IS FURNISHED UNDER 120VAC B/M.
3. LACK OF SYMBOL (* OR ▲) DENOTES NO STARTING FROM SFAS OR SFRCS.
4. BREAKER MODULE BE1153 ON MCC E11B AND BREAKER MODULE BF1135 ON MCC F11A SHALL BE REMOVED FROM MCC'S AND APPROPRIATELY STORED. EMERGENCY TIE OF MCC E11B AND MCC F11A SHALL BE ACCOMPLISHED AS PROVIDED IN THE EMERGENCY OPERATING PROCEDURES.
5. BREAKERS BF1142, BF1148 AND BF1194 ARE MAINTAINED IN THE OPEN POSITION.
6. BREAKER BF1260A IS LOCATED IN THE FIRST STACK, TOP CUBICLE OF MCC F12B.
7. WHERE Q/NON-Q BOUNDARIES ARE DEPICTED FOR ESSENTIAL 480VAC BREAKERS, ELECTRICAL AND CONTROL COMPONENTS HOUSED ENTIRELY WITHIN THE BREAKER CUBICLE SHALL BE CONSIDERED TO BE WITHIN THE Q BOUNDARY. EXAMPLES MAY INCLUDE OVERLOAD HEATERS, OVERLOAD RELAYS, AND CONTACTOR MOUNTED AUXILIARY SWITCHES. REF. CR 03-06329.
8. THE LOAD VALUE FOR BATTERY CHARGERS IS DEPENDENT UPON THE LOAD SCENERIO, AS DETERMINED BY CALCULATION C-EE-015.03-008.
9. FRAME SIZE OF CIRCUIT BREAKER HAS BEEN INCREASED AND THE ASSOCIATED MCC HARDWARE MUST BE EVALUATED FOR ACCEPTABILITY PRIOR TO INCREASING CIRCUIT BREAKER TRIP RATING.
10. THE BREAKER ASSEMBLE HAS BEEN EVALUATED ACCEPTABLE WITH 175A TRIP UNIT IN ECP 11-0224-002.

LEGEND

- [C] CONTACTOR
- ◨ CONTRACTOR TO RELOCATE BKRS FROM MCC E22A SCHEMES BE2217, BE2218, BE2214 AND BE2215.
- △ INSTALLATION CONTRACTOR TO INSTALL ADDITIONAL VERTICAL STRUCTURE TO MCC F12C, MCC F11A & F12A & MCC F11E AND LOCATE EXISTING STARTERS AS SHOWN.
- * STARTER OR CONTACTOR WHICH RECEIVES A SIGNAL FROM THE SAFETY FEATURES ACTUATION SYSTEM (SFAS) REF. DWG. E-17B.
- ◑ INSTALLATION CONTRACTOR TO INSTALL IN EXISTING SPACE.
- † INSTALLATION CONTRACTOR TO REMOVE LATCHING TYPE STARTER AND REPLACE WITH FVNR STARTER.
- ▲ STARTER OR CONTACTOR WHICH RECEIVES A SIGNAL FROM THE STEAM AND FEEDWATER RUPTURE CONTROL SYSTEM (SFRCS) REF. DWG. E-19B.

DAVIS-BESSE NUCLEAR POWER STATION

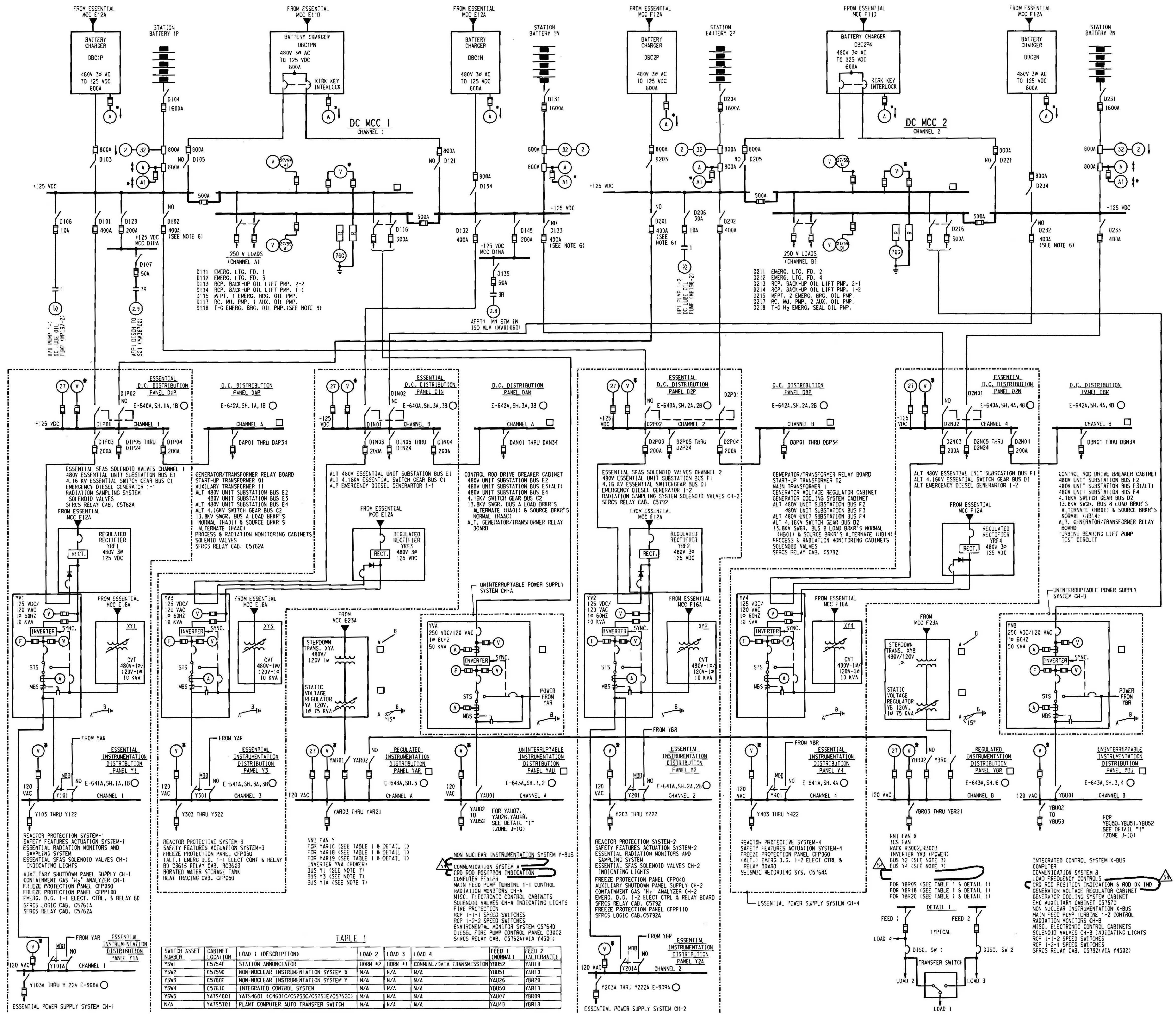
480V AC MCC (ESSENTIAL) ONE LINE DIAGRAM E-6 SH. 2

FIGURE 8.3-24

REVISION 32

SEPTEMBER 2018

DB 05-08-18 DFN=1:/ELEC/E6SH2.DGN



REFERENCE DRAWINGS

E-1	AC ELECTRICAL SYSTEM ONE LINE DIAGRAM
E-2	25 KV AND 13.8 KV METERING AND RELAYING ONE LINE DIAGRAM
E-3	4.16 KV METERING AND RELAYING ONE LINE DAIGRAM
E-4	480V UNIT SUBSTATION ONE LINE DIAGRAM
E-6	480V MCC (ESSENTIAL)
E-10A	STANDARD NOTES AND SYMBOLS
E-640A	ESSENTIAL 125 VDC DISTRIBUTION PANEL SCHEDULE
E-641A	ESSENTIAL 120 VAC DISTRIBUTION PANEL SCHEDULE
E-642A	NON-ESSENTIAL 125 VDC DISTRIBUTION PANEL SCHEDULE
E-643A	NON-ESSENTIAL 120 VAC DISTRIBUTION PANEL SCHEDULE
OS-0060	SHEET 1-250/125V DC AND 120V INSTRUMENT AC SYSTEM
OS-0060	SHEET 2-250/125V DC AND 120V INSTRUMENT AC SYSTEM

NOTES

1. * MAIN CONTROL BOARD MOUNTED.
2. □ ALL ITEMS ON THIS DWG. ARE Q-LIST ITEMS, EXCEPT FOR EQUIPMENT MARKED WITH □.
3. DELETED
4. DELETED
5. MBB.... MAKE BEFORE BREAK.
6. THIS FUSE IS NORMALLY REMOVED WHEN NORMAL SOURCE IS USED IE. WHEN D101 AND D1P01 ARE CLOSED (D132 AND D1N01, D202 AND D2P01,D233 AND D2N01).
WHEN ALTERNATE SOURCE IS TO BE USED FUSE MUST BE RE-INSERTED PRIOR TO CLOSING SWITCHES D201 AND D1P02 (D232 AND D1N02,D102 AND D2P02,D133 AND D2N02) ALTERNATE SOURCE IS FOR MAINTENANCE ONLY. IN ADDITION, THE NUCLEAR PLANT MUST BE IN COLD SHUTDOWN
7. REGULATED INSTRUMENTATION DISTRUBUTION PANEL "YAR" (YBR) CAN BE USED AS ALTERNATE SOURCE TO EITHER PANEL Y1,Y1A OR PANEL Y3(Y2/Y2A OR Y4) BUT NOT SIMULTANEOUSLY. ALTERNATE SOURCE IS FOR MAINTENANCE ONLY & THEREFORE NORMAL SEPARATION REQUIREMENTS ARE NOT REQURIED. SEE YAR (YBR) PANEL SCHEDULE DWG. E-643A SH.5 (SH.6) FOR ADDITIONAL NOTE REGUARDING FUSE REMOVAL AS APPLICABLE.
8. THE ALTERNATE POWER SOURCE YAR (YBR) TO INVERTER WITH THE INTERGAL STATIC SWITCH YVA (YVB) SHALL BE MANUALLY DEFEATED BY OPENING DISCONNECT SWITCH YAR03 (YBR03) WHEN PANEL YAR (YBR) IS FED FROM PANEL YBR (YAR).
9. THE DISCONNECT DEVICE FOR THE TURBINE GENERATOR EMERGENCY BEARING OIL PUMP (D118) IS A MAGNETIC BREAKER ONLY WESTINGHOUSE TYPE HKA RATED 225/70 AMPS.
10. MBS....MANUAL BYPASS SWITCH.
STS....STATIC TRANSFER SWITCH.
11. REFERNCE E-9 FOR FURTHER INSTRUMENTATION LOADS.
12. DELETED
13. DELETED
14. FOR DC DISTRIBUTION PANEL SETTING SEE DRAWINGS E-8540-71,72,73, & 74 (SC1).
15. ○ REFERENCE DISTRIBUTION PANEL SCHEDULE FOR COMPLETE LIST OF LOADS.
16. REFER TO TABLE 1 FOR DETAILS FOR STATION ANNUNCIATOR (YSW1), NON-NUCLEAR INSTRUMENTATION SYSTEM X (YSW2), NON-NUCLEAR INSTRUMENTATION SYSTEM Y (YSW3), INTEGRATED CONTROL SYSTEM (YSW4), YATS 4601 (YSW5) AND YATS5701.

TABLE 1

SWITCH ASSET NUMBER	CABINET LOCATION	LOAD 1 (DESCRIPTION)	LOAD 2	LOAD 3	LOAD 4	FEED 1 (NORMAL)	FEED 2 (ALTERNATE)
YSW1	C5754F	STATION ANNUNCIATOR	HORN #2	HORN #1	COMMUN./DATA TRANSMISSION	YBU52	YAR19
YSW2	C5759D	NON-NUCLEAR INSTRUMENTATION SYSTEM X	N/A	N/A	N/A	YBU51	YAR10
YSW3	C5760E	NON-NUCLEAR INSTRUMENTATION SYSTEM Y	N/A	N/A	N/A	YAU26	YBR20
YSW4	C5761C	INTEGRATED CONTROL SYSTEM	N/A	N/A	N/A	YBU50	YAR18
YSW5	YATS4601	YATS4601 (C4601C/C5753C/C5751E/C5752C)	N/A	N/A	N/A	YAU07	YBR09
N/A	YATS5701	PLANT COMPUTER AUTO TRANSFER SWITCH	N/A	N/A	N/A	YAU48	YBR18

DAVIS-BESSE NUCLEAR POWER STATION

250/125V DC AND INSTRUMENTATION AC ONE LINE DIAGRAM

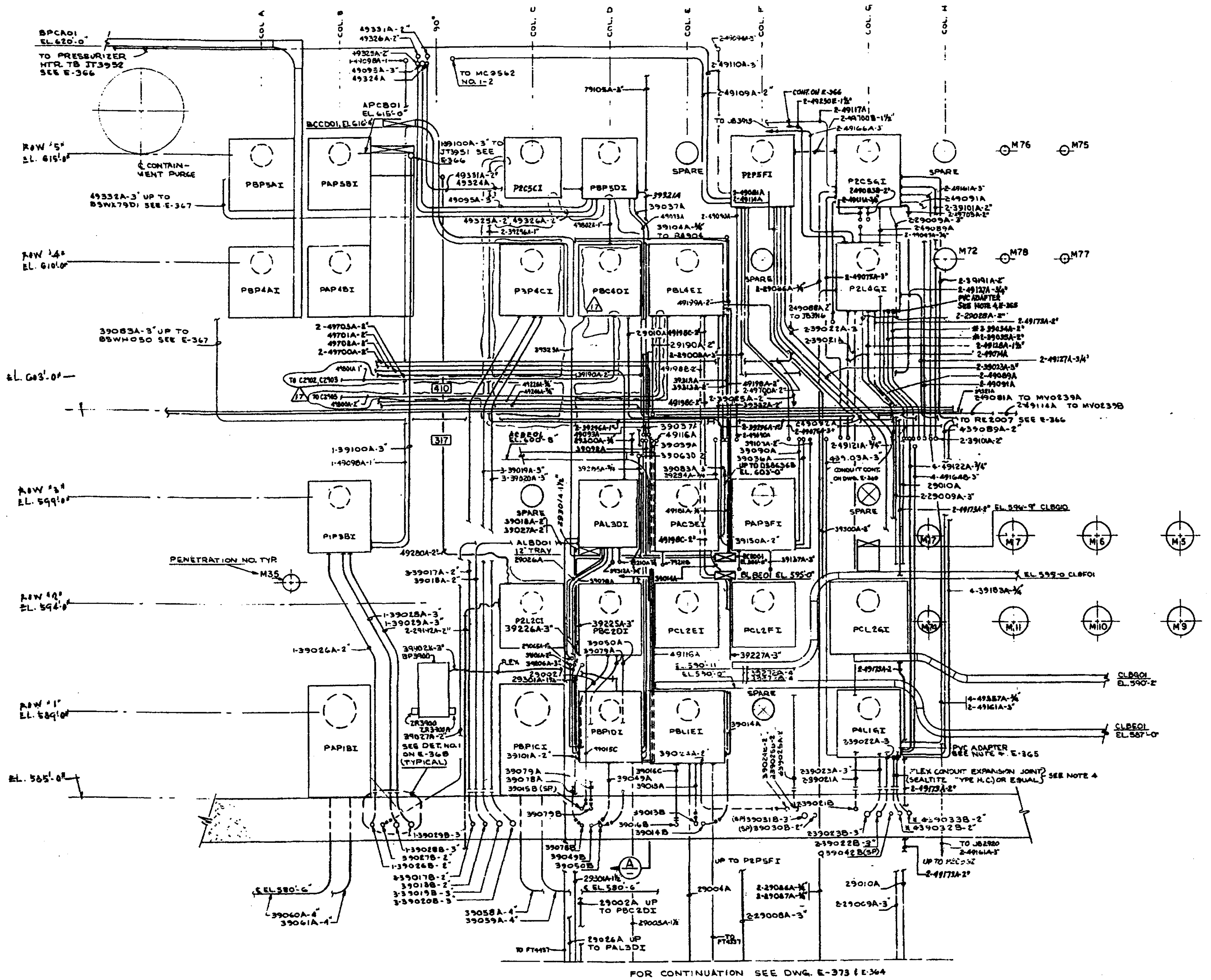
E-7

FIGURE 8.3-25

REVISION 31

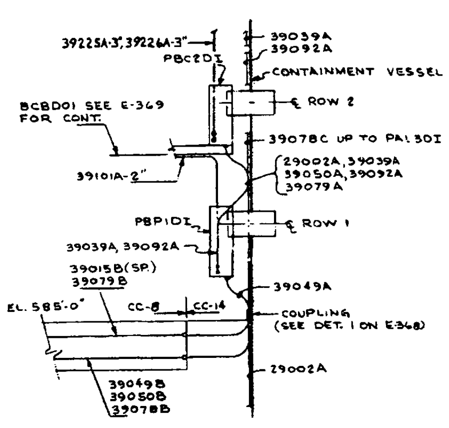
OCTOBER 2016

DB 06-07-16 DFN=I:/ELEC/E7.DGN



SECTION "B-B"

SCALE: 1/2"=1'-0" (DWG. E-369 & E-366)



NOTES

1. ALL CND'S. TO BE 1½" UNLESS NOTED OTHERWISE
2. WHERE CONDITIONS PERMIT THE MINIMUM SPACING BETWEEN CENTERS OF ANY TWO EMBEDDED CND'S. SHALL BE THREE (3) TIMES THEIR AVERAGE NOMINAL SIZE.
3. ALL BENDS ARE 12" MIN. RADIUS. ALL TRAYS ARE 24" WIDE UNLESS NOTED OTHERWISE.
4. ALL CND. WITH AN ✕ ARE NUCLEAR INSTRUMENTATION SYSTEM CND FOR RESTRICTIONS SEE NOTE 4 ON DWG. E-368
5. ALL EMBEDDED CONDUITS NOT PART OF CC-14

REFERENCE DWG'S.

E-300B	ELECTRICAL RACEWAY SCHEDULE
E-301A	GROUNDING STANDARDS & DETAILS
E-362	RACEWAY & GROUNDING CONTAINMENT DETAILS
E-364	RACEWAY & GROUNDING CONTAINMENT EL. 2 (565-0)
E-365	RACEWAY & GROUNDING CONTAINMENT EL. 3 (585-0)
E-366	RACEWAY & GROUNDING CONTAINMENT EL. 4 (603-0)
E-367	RACEWAY & GROUNDING CONTAINMENT EL. 7 (653-0)
E-368	RACEWAY & GROUNDING CONTAINMENT DETAILS
E-369	RACEWAY & GROUNDING CONTAINMENT EL. 3 (585-0)
E-370	ELECTRICAL PENETRATION ARRG'T. SHIELD BLDG.
E-371	ELECTRICAL PENETRATION ARRG'T. CONTAINMENT VESSEL
E-374	RACEWAY DETAILS CONTAINMENT EL 2 (565-0)

MARGINAL QUALITY DOCUMENT
BEST COPY AVAILABLE

DAVIS-BESSE NUCLEAR POWER STATION

RACEWAY AND GROUNDING
CONTAINMENT DETAILS
E-362
FIGURE 8.3-31

REVISION 24
JUNE 2004

Removed in Accordance with RIS 2015-17

DAVIS-BESSE NUCLEAR POWER STATION

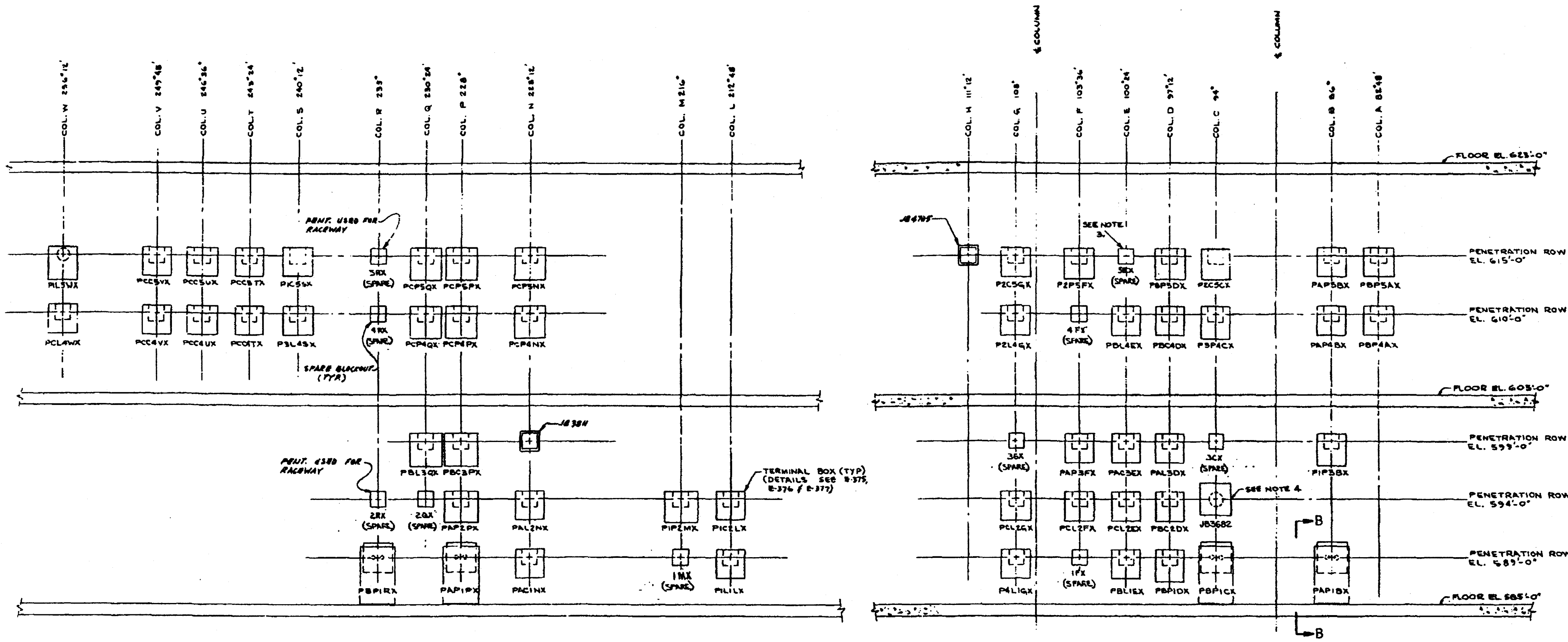
RACEWAYS CONTAINMENT
EL. 4 (603)
E-366
FIGURE 8.3-32

REVISION 30
OCTOBER 2014

BB 07-16-14 BFN=/J/RASDGN/E366.DGN/CIT

NOTES

1. FOR PENETRATION TERMINAL BOX DESIGNATIONS SEE SECTION 3 OF SIIA
2. SPARE BLOCKOUTS SHALL BE SEALED OFF WITH CELLULAR CONC. PER E-302 SH16
3. PENETRATION OPENINGS 3CX & 3EX ARE USED FOR ANNULAR SPACE HEATING CONDUITS.
4. FOR PENETRATION TERMINATION BOX P2L2CX SEE DWG. E-345 AND E-346.

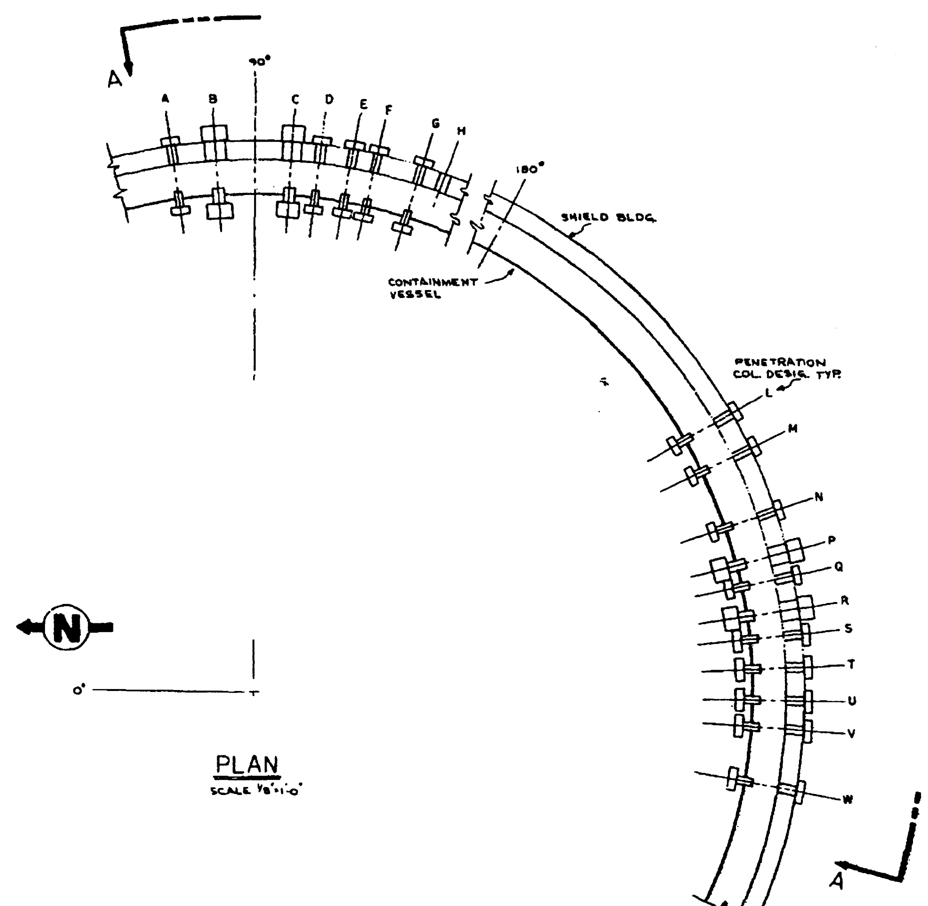


SECTION 'A-A'
SCALE 1/8"=1'-0"

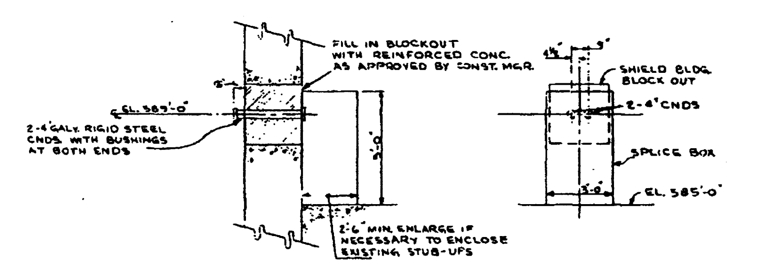
REFERENCE DWGS.

E300B	ELECTRICAL RACEWAY SCHEDULE
E301A	GROUNDING STANDARDS & DETAILS
E302A	ELECTRICAL STANDARDS & DETAILS
E362	RACEWAY & GROUNDING CONTAINMENT DETAILS
E366	RACEWAY & GROUNDING CONTAINMENT EL.4(603)
E367	RACEWAY & GROUNDING CONTAINMENT EL.7(653)
E368	RACEWAY & GROUNDING CONTAINMENT DETAILS
E369	RACEWAY & GROUNDING CONTAINMENT EL.3(585)
E371	ELECTRICAL PENETRATION ARRGT. CONTAINMENT VESSEL
E378B	ELECTRICAL PENETRATION DETAILS

MARGINAL QUALITY DOCUMENT
BEST COPY AVAILABLE



PLAN
SCALE 1/8"=1'-0"



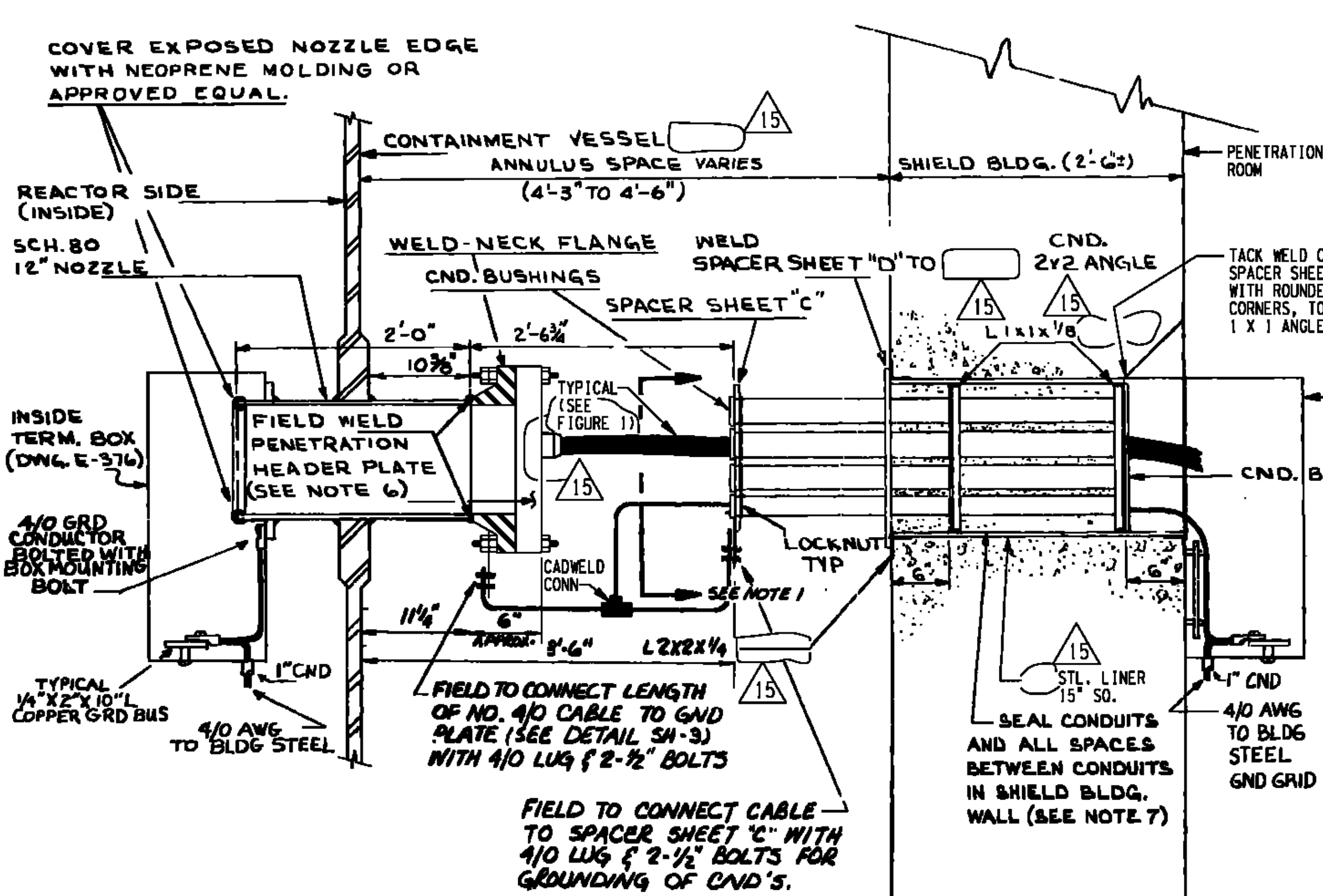
SECTION 'B-B'
SCALE 3/8"=1'-0"

TYPICAL FOR PAP1BX, PBP1CX, PAP1PX & PBP1RX ONLY

DAVIS-BESSE NUCLEAR POWER STATION

ELECTRICAL PENETRATION ARRANGEMENT
SHIELD BLDG
E-370
FIGURE 8.3-33

REVISION 24
JUNE 2004



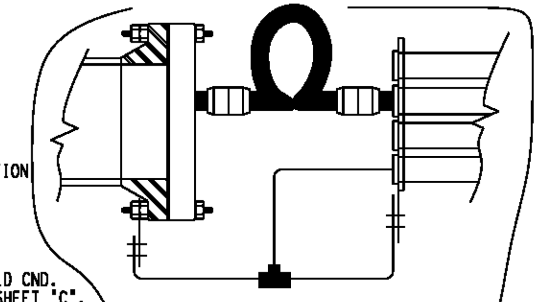


FIGURE 1

FOR PEN. P2L2C & P1L5W ONLY

15

NOTES

1. FOR SPACER SHEETS & CND. ARRANGEMENT & SIZE SEE SHEETS 2 & 3
2. FOR DETAILS OF NOZZLE SEE SK-E210A
3. FOR BOX SCHEDULE & LOCATION OF PENETRATIONS SEE DWG. NOS. E-370E & E-371E.
4. ALL WORK BY CONTRACT CC-14 EXCEPT AS NOTED.
5.
6. SEE AMPHENOL DWG. 50004696 (E-25-3) FOR TYP. PENETRATION ASSY. DETAILS.
7. SEAL SHALL BE AS SPECIFIED IN DWG 7749-E-302A SH-16

44-12" LOW VOLTAGE AND INSTR. PENETRATIONS REQUIRED (TYPE 2 & 3)

NOTES CONT.

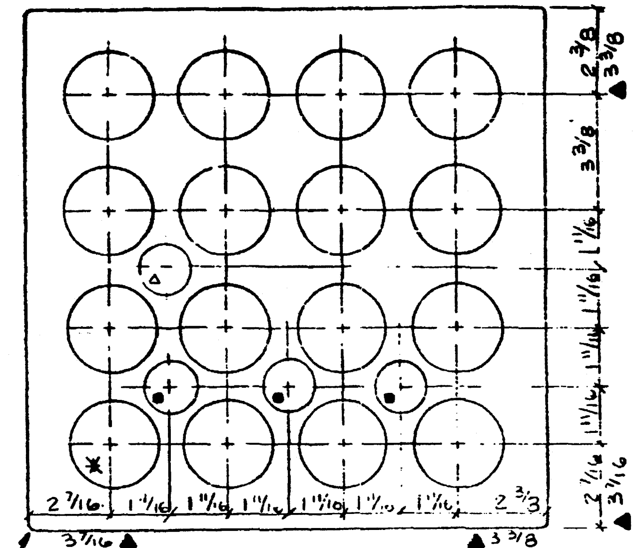
8. DETAIL OF BLOCKOUT SPACER SHEETS AND CONDUITS AS SHOWN IN THE SHIELD BLDG. WALL IS NOT APPLICABLE TO PENETRATION P1L5W & P2L2C. A 6" COREDRILL HAS BEEN PROVIDED INSTEAD. THE 4/0 GROUND CABLE SHALL BE ROUTED DIRECTLY BETWEEN PENETRATION & OUTSIDE BOX VIA THE 6" COREDRILL.
9. FRAMING STRUCTURE FOR FIRE WRAP IS ATTACHED TO PENETRATION NOZZLE FOR PENETRATION P2C5G, SEE DWG. E-1277B FOR DETAILS (REF. CALC. C-CSS-13.15.002).
10. FRAMING STRUCTURE FOR FIRE WRAP IS ATTACHED TO PENETRATION NOZZLE FOR PENETRATION P1P3B, SEE DWG. E-1202B FOR DETAILS (REF. CALC. C-CSS-13.15.002).
11. FRAMING STRUCTURE FOR FIRE WRAP IS ATTACHED TO PENETRATION NOZZLE FOR PENETRATION P8L4E, SEE DWG. E-1279B FOR DETAILS (REF. CALC. C-CSS-13.15.016).

DAVIS-BESSE NUCLEAR POWER STATION

ELECTRICAL PENETRATION DETALS
E-378B SH. 1
FIGURE 8.3-34

REVISION 29
DECEMBER 2012

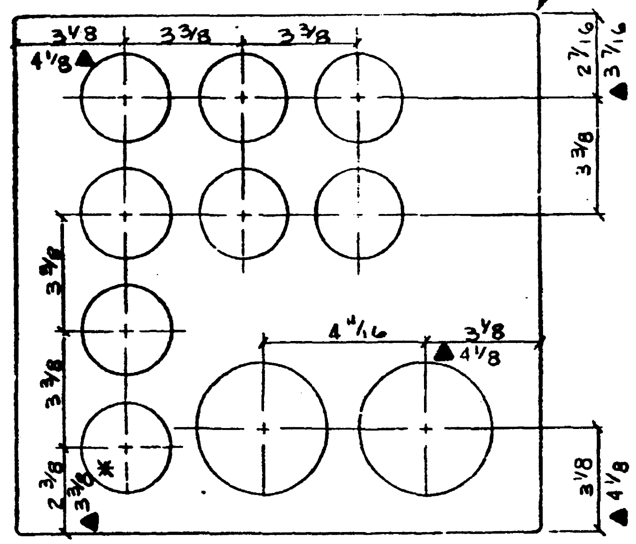
DB 6-14-12 DFN=J:/RASDGN/E378BSH1.DGN/CIT



CND. SPACER SHEET TYPE I

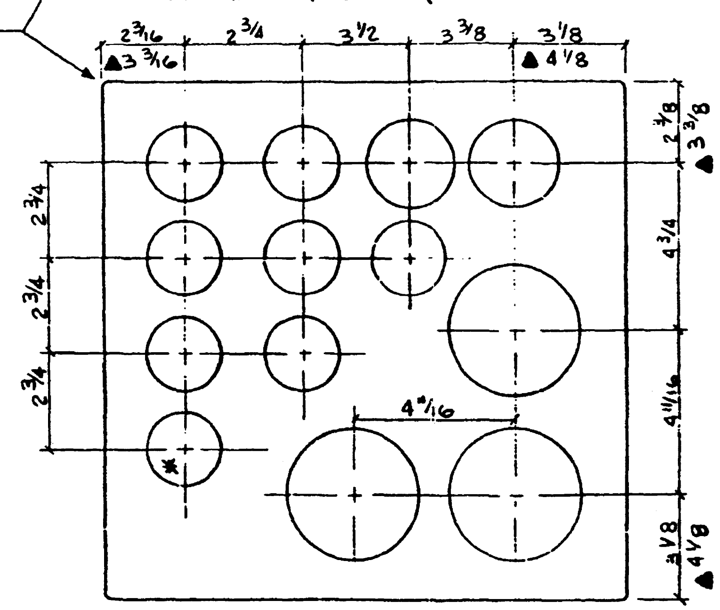
3 - 1" CND. PER ASSY. ■
16 - 2" CND. PER ASSY.
40 ASSEMBLIES REQ.

GALV. STL. CND. SPACER SHEET 3/16" THICK



CND SPACER SHEET TYPE II

7 - 2" CND. PER ASSY.
2 - 3" CND. PER ASSY.
3 ASSEMBLIES REQ.



CND SPACER SHEET TYPE III

7 - 1½" CND. PER ASSY.
2 - 2" CND. PER ASSY.
3 - 3" CND. PER ASSY.
1 ASSEMBLY REQ.

NOTE

✱ DESIGNATES CND. USED FOR GRD. WIRE UNLESS OTHER WISE NOTED IN DWG. E378B SH25

■ DESIGNATES CND'S ADDED FOR PENETRATION ASSEMBLIES PAL2N, PBLIE, PBL3Q, PBL4E, PAL3D AND PCL4W ONLY.

CND. SPACER SHEET TYPES	PENETRATION ASSEMBLY DESIGNATIONS
I	P1P2M, PBP4A, PAP4B, PAP2P, PBP5A, PAP5B, PBP1D, PBP5D, PCP4N, PCP4P, PCP4Q, PCP5N, PCP5P, PCP5Q, P1C2L, P2C5G, PAC1N, PAC3E, PBC2D, PBC3P, PBC4D, PCC4T, PCC4U, PCC4V, PCC5T, PCC5U, PCC5V, P1L1L, P2L4G, P3L4S, P4L1G, PAL3D, PAL2N, PBL1E, PBL4E, PBL3Q, PCL2E, PCL2F, PCL2G, PCL4W
II	P1P3B, P2P5F, P3P4C
III	PAP3F

NOTE:

1. DIMENSIONS NOTED ▲ APPLY TO CND SPACER SH. (D) ONLY.
2. THREE CND. SPACER SHEETS PER PENETRATION REQ. MIDDLE SPACER TO BE TWO INCHES HIGHER AND TWO INCHES WIDER THAN END SPACER SHEETS.
3. △ DESIGNATES 1" CND ADDED FOR PENETRATION ASSEMBLIES PBLIE & PBL3Q ONLY

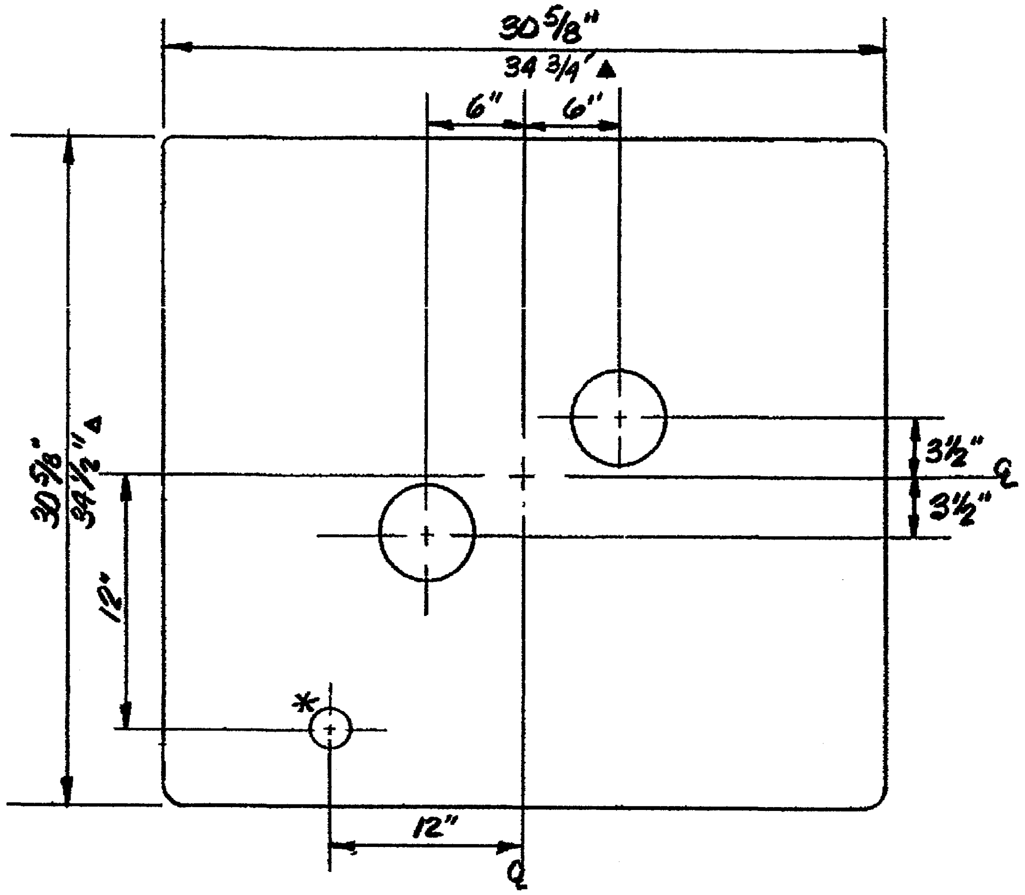
DAVIS-BESSE NUCLEAR POWER STATION

ELECTRICAL PENETRATION DETAILS

E378B SH. 2

FIGURE 8.3-34

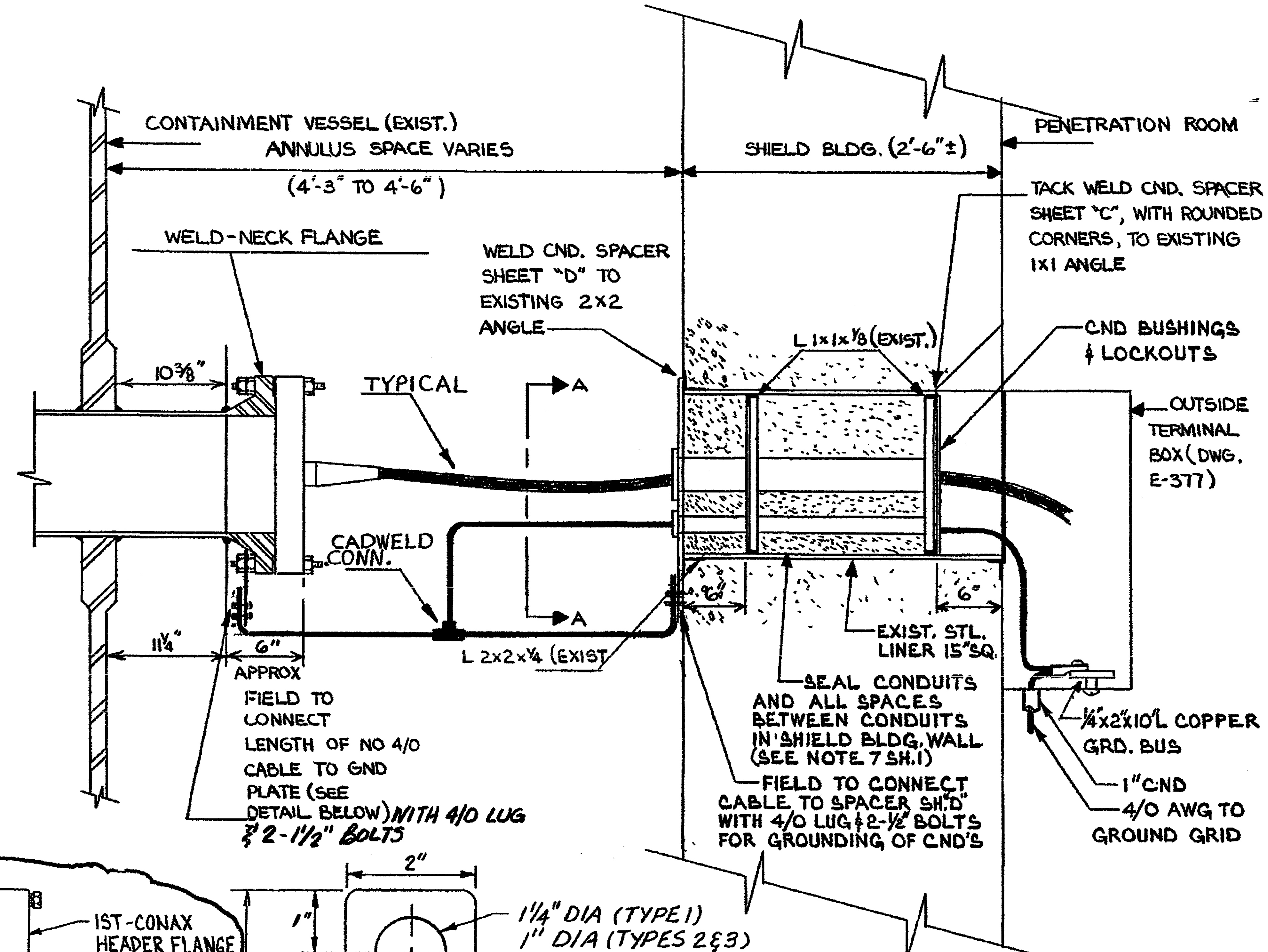
REVISION 9
JULY 1989

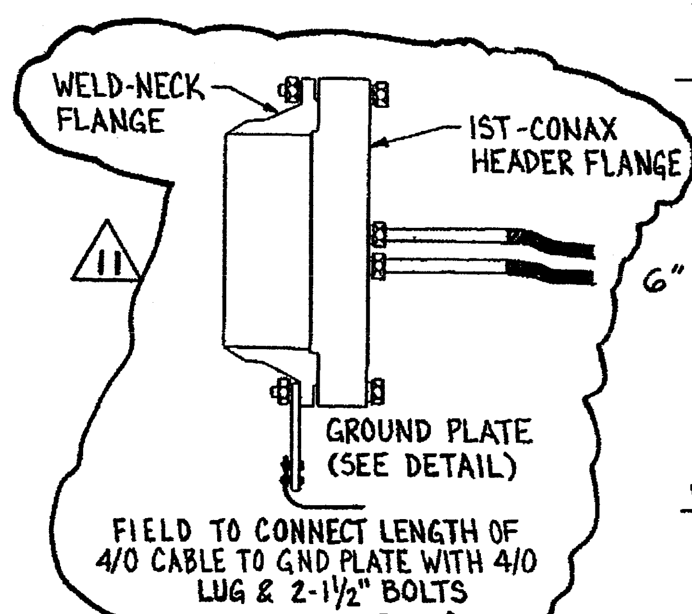


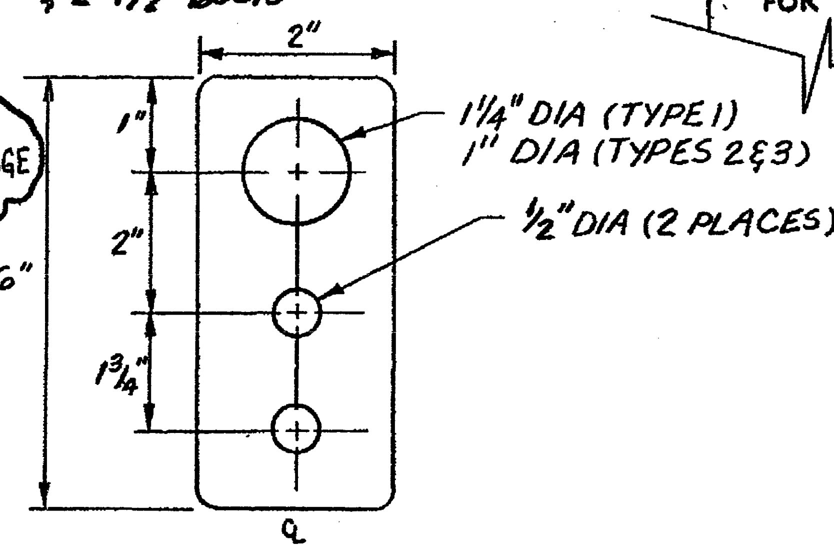
VIEW AA
CND. SPACER SHEET TYPE IV
2-4⅝" CND PER ASSY
1-2½" CND PER ASSY
4 ASSEMBLIES REQ
GALV STL SHEET 3/16" THICK

CND SPACER SHEET TYPE	PENETRATION ASSEMBLY DESIGNATIONS
IV	PAPIB, PAPIP, PBPIC, PBPIR

NOTES
1 DIMENSIONS NOTED ▲ APPLY TO CND SPACER SH Ⓓ ONLY
2. TWO TYPE IV CND. SPACER SHEETS PER PENETRATION REQUIRED
3. * DESIGNATES CND USED FOR GRD. WIRE







GROUND PLATE
¼" STL. PLATE (GALV. COATED)

DAVIS-BESSE NUCLEAR POWER STATION

ELECTRICAL PENETRATION DETALS
E-378B SH. 3
FIGURE 8.3-34

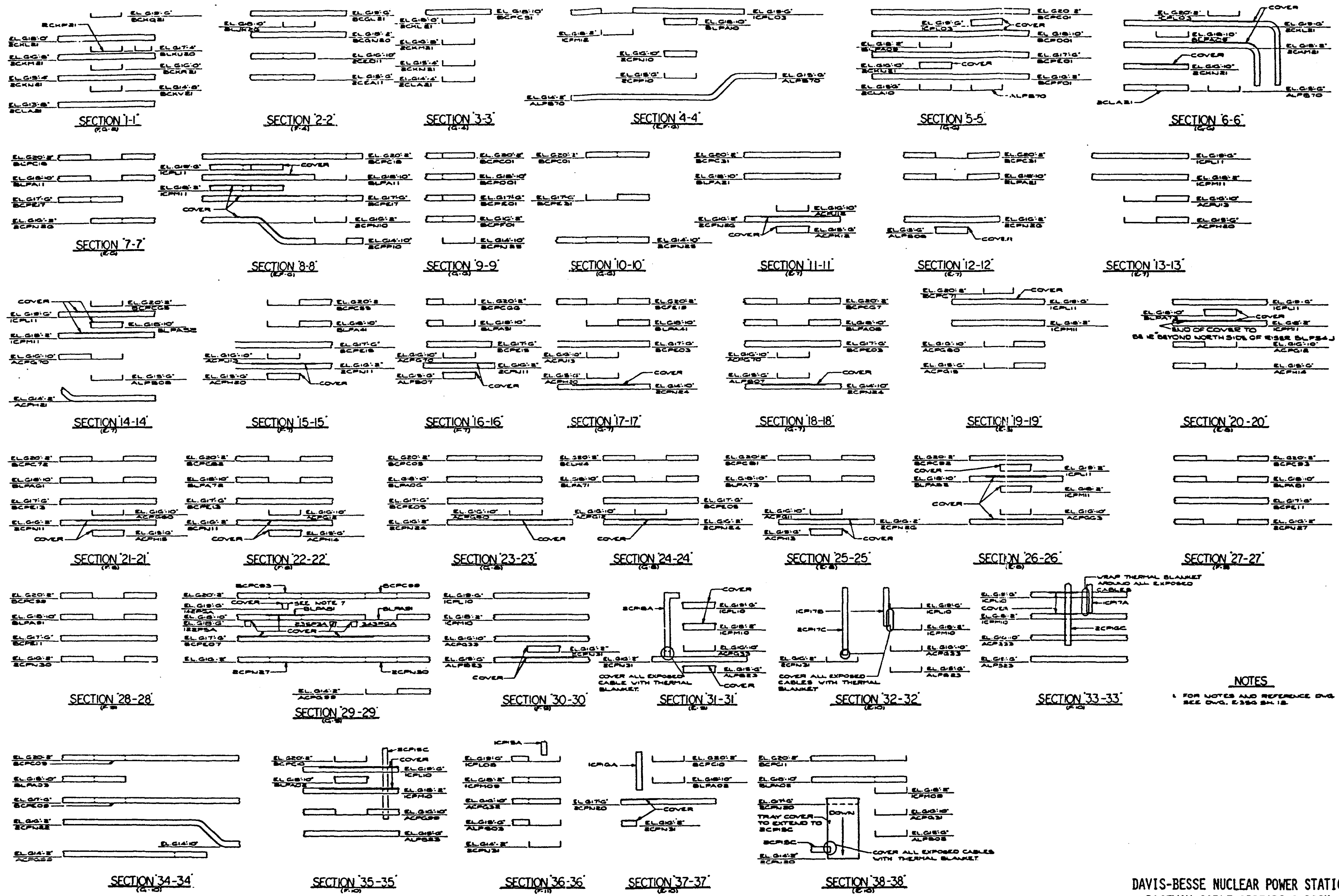
REVISION 25
JUNE 2006

DB 03-13-06 DFN=J:/RASDGN/E378BSH3.DGN/TIF

Removed in Accordance with RIS 2015-17

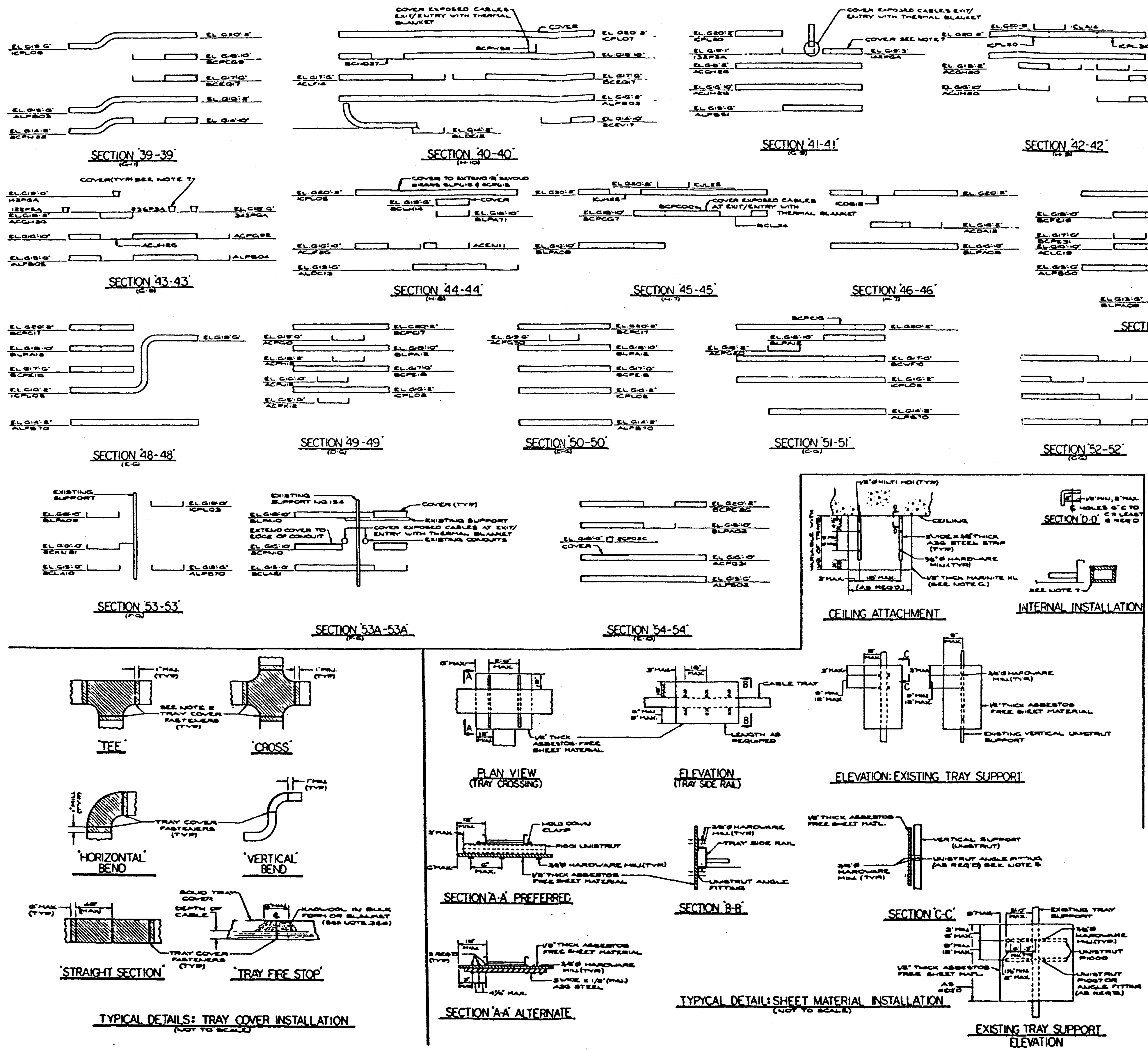
DAVIS-BESSE NUCLEAR POWER STATION
RACEWAY CABLE SPREADING ROOM
FIRE BARRIERS~~, SHEET~~
(E-356) ~~2~~ , Sh 12)
FIGURE 8.3-35

REVISION 0
JULY 1982



DAVIS-BESSE NUCLEAR POWER STATION
RACEWAY CABLE SPREADING ROOM
FIRE BARRIER SECTIONS, ~~SHEET 13~~ 2
(E-356e, Sh. 12)
FIGURE 8.3-36

REVISION 0
JULY 1982

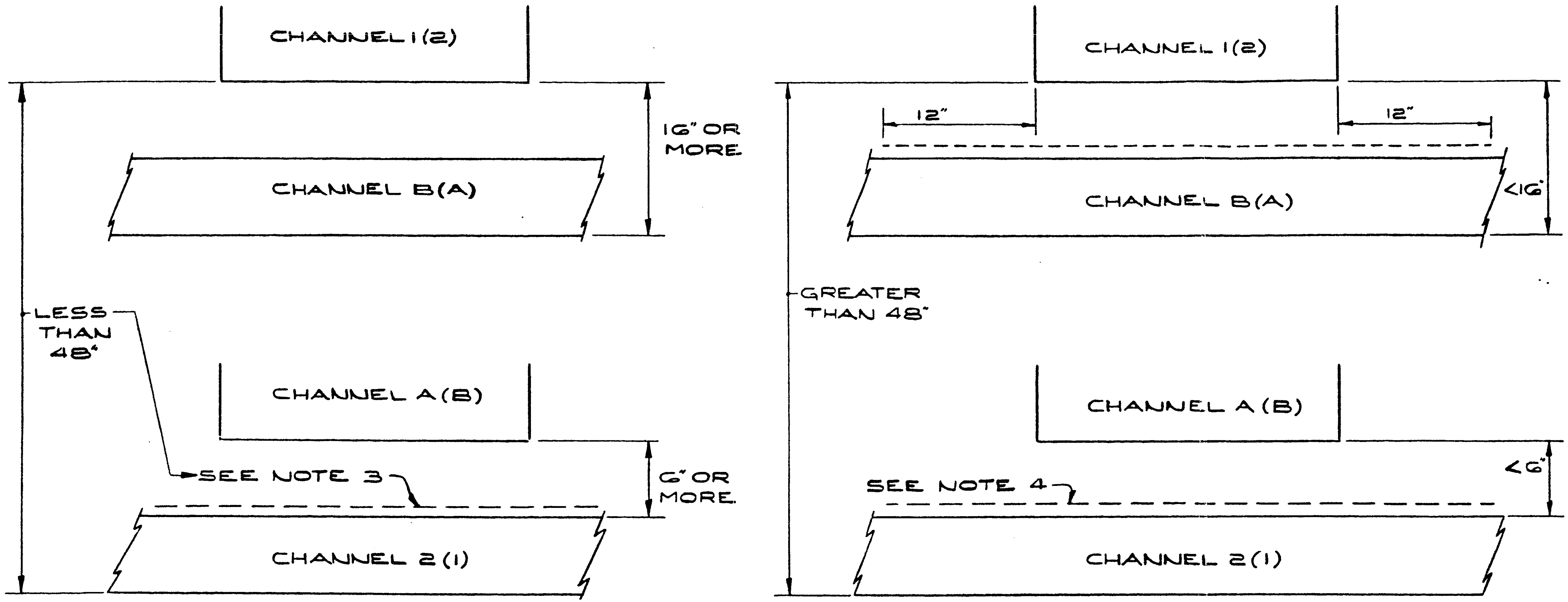


NOTES

1. FOR ADDITIONAL NOTES AND REFER. DWG SEE DWG. E-356 SH. 12
2. FASTEN TRAY COVERS TO TRAY USING ANY OF THE FOLLOWING: 1/2" WIDE STAINLESS STEEL BAND, T.J. COPE TRAY COVER CONNECTOR, OR T.J. COPE TRAY COVER CLIP.
3. FIRE STOP REQUIRED WHENEVER TRAY COVER LENGTH IS EIGHT (8) FEET OR LONGER. ONE (1) FIRE STOP REQUIRED FOR EVERY EIGHT (8) FEET OF CONTINUOUS TRAY COVER.
4. BUILD UP KAOWOOL SO THAT KAOWOOL IS UNDER COMPRESSION WITH TRAY COVER INSTALLED.
5. SHEET MATERIAL CAN BE FASTENED DIRECTLY TO EXISTING TRAY SUPPORT.
6. CUT OUT SHEET MATERIAL TO ACCOMODATE OBSTRUCTIONS.
7. INSTALL MARINITE XL ON ALL INTERNAL SIDES OF RACEWAY, OR SURROUND CABLES WITH KAOWOOL OR FILL RACEWAY WITH SILICONE FOAM.
8. INVERTED SECTION OF CABLE TRAY MAY BE USED IN LIEU OF STANDARD TRAY COVER.

DAVIS-BESSE NUCLEAR POWER STATION
RACEWAY CABLE SPREADING ROOM
FIRE BARRIER SECTIONS, ~~SHEET 24~~ 3
(E-356) 2, Sh. 14
FIGURE 8.3-37

REVISION 0
JULY 1982



NOTES:

1. ALL TRAYS ARE SOLID BOTTOM.
2. FIRE BARRIERS EXTEND 12" BEYOND EACH SIDE OF CROSSING POINT.
3. BARRIER PROVIDED—SEPARATION CRITERIA FOR REDUNDANT CLASS IE TRAYS NOT MET.
4. BARRIER PROVIDED FOR SEPARATION BETWEEN A(B) AND 2(1) NOT ESSENTIAL 1 AND ESSENTIAL 2.

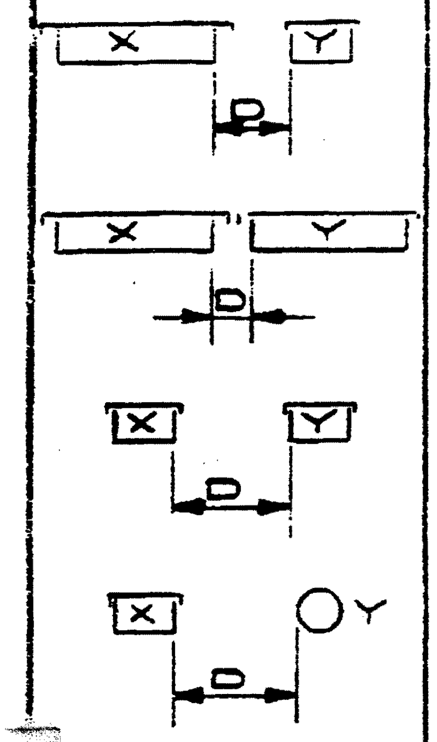
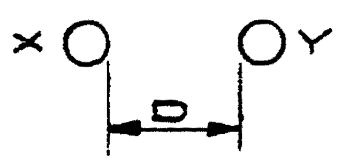
LEGEND:

– – – – – – FIRE BARRIER

DAVIS-BESSE NUCLEAR POWER STATION
CRITERIA FOR INTERPOSING TRAYS
FIRE HAZARD

FIGURE 8.3-38

REVISION 0
JULY 1982

RACEWAY CONFIGURATION	CHANNEL RACEWAY X	Y	SEPARATION DISTANCE 'D' (INCHES)	ACTION REQ'D (SELECT ONE) TRAY COVER	SHEET MATL.	SEE * FIG. B.3-39	SEE ** FIG. B.3-39
	1	2,3,4	1" OR LESS	—	Z	✓	✓
	2	1,3,4		—	Z	✓	✓
	3	1,2,4		—	Z	✓	✓
	4	1,2,3		—	Z	✓	✓
	1	2,3,4	(SEE NOTE 9	—	—	✓	✓
	2	1,3,4	RE. MINIMUM	—	—	✓	✓
	3	1,2,4	SEPARATION	—	—	✓	✓
	4	1,2,3	DISTANCE)	—	—	✓	✓

SYMBOLS

 SOLID BOTTOM TRAY (OPEN TOP)

 SOLID BOTTOM TRAY WITH COVER

 COVERD WIREWAY

* THERMAL INSULATING MATL. OR SILICONE FOAM IN SPACE BETWEEN RACEWAYS X & Y

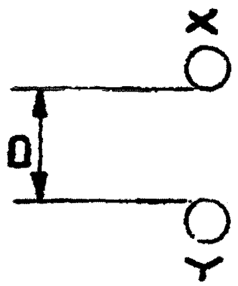
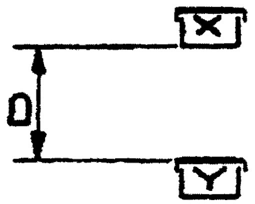
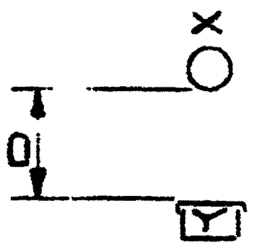
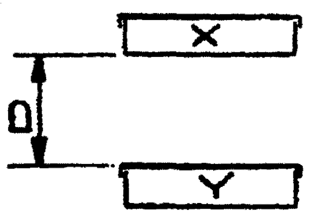
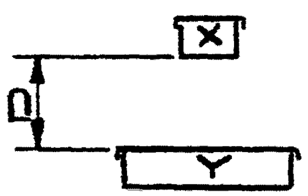
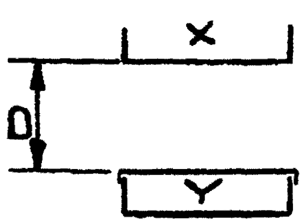
** THERMAL INSULATING MATL. OR SILICONE FOAM INSIDE RACEWAYS X AND/OR Y

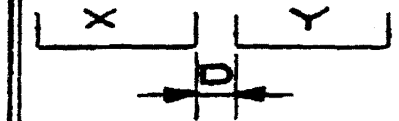
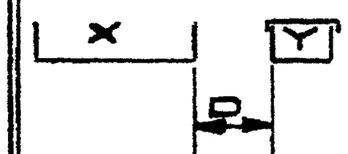
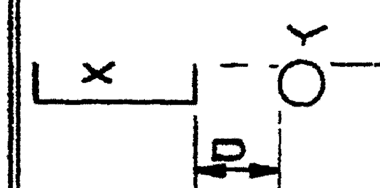
NOTES

1. FIRE BARRIERS ARE NOT REQUIRED BETWEEN TWO (2) RACEWAYS CONTAINING CLASS IE CABLES OF THE SAME CHANNEL AND BETWEEN RACEWAYS CONTAINING NON-CLASS IE CABLES.
2. Z, Z' IN ACTION REQUIRED COLUMN INDICATES A BARRIER INSTALLED AT ANY POINT IN THE SPACE BETWEEN RACEWAYS X & Y, AND W & Y RESPECTIVELY.
3. WHEN THE PERPENDICULAR DISTANCE IS IN NEITHER A HORIZONTAL NOR A VERTICAL PLANE, THE DISTANCE IS DIVIDED INTO ITS HORIZONTAL AND VERTICAL COMPONENTS. FIRE BARRIERS ARE PROVIDED WHEN ANALYSIS OF BOTH COMPONENTS REQUIRE A FIRE BARRIER.
4. WHERE MULTIPLE RACEWAYS EXIST IN CLOSE PROXIMITY TO EACH OTHER, EACH PAIR COMBINATION IS ANALYZED
5. SHEET MATERIAL IS MINIMUM 1/2" THICK ASBESTOS-FREE MARINITE.
6. SEPARATION REQUIREMENTS FOR THE ENCLOSED RACEWAYS CONTAINING SFAS/RPS INTCON. CABLES (PREFIXED BY 12, 13, 14, 23, 24, 34) ARE THE SAME AS FOR THE NUMERICAL X, Y CHANNEL COMB.
7. TRAY COVER WILL BE ANY ONE OR ANY COMB OF THE FOLLOWING:
   A) SOLID METALLIC TRAY COVER
   B) SHEET MATERIAL
   C) THERMAL INSULATING BLANKET
8. WHERE NON-CLASS IE TRAYS INTERPOSED BETWEEN REDUNDANT CLASS IE TRAYS, THE SEPARATION REQUIREMENTS BETWEEN OPEN-TOP REDUNDANT CLASS IE TRAYS WILL NOT BE LESS THAN 48" VERTICALLY AND 18" HORIZ.
9. MINIMUM SEPARATION DISTANCE AS DETERMINED BY TEST AND ANALYSIS. IF LESS THAN MINIMUM, SEE ACTION REQUIRED COLUMN.

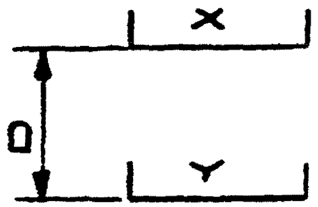
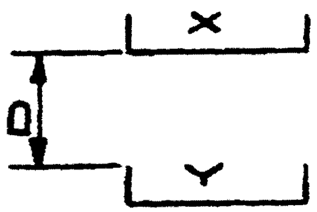
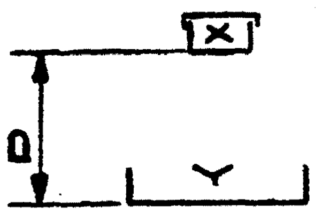
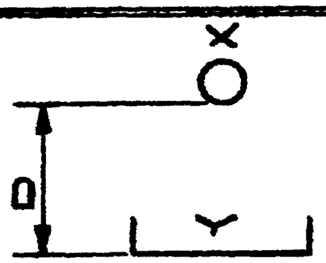
DAVIS-BESSE NUCLEAR POWER STATION
RACEWAY SEPARATION CRITERIA
FIRE HAZARD
FIGURE B.3-39

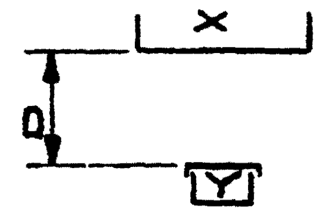
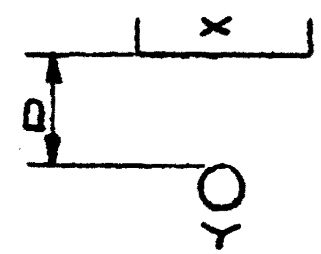
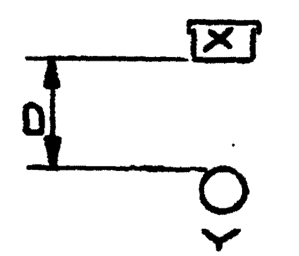
REVISION 9
JULY 1989

RACEWAY CONFIGURATION	CHANNEL RACEWAY X	CHANNEL RACEWAY Y	SEPARATION DISTANCE "D" (INCHES)	ACTION REQ'D (SELECT ONE): TRAY COVER	SHEET MATL.	* SEE FIG B.3-39	** SEE FIG B.3-39
	1	2,3,4	(SEE NOTE 9 RE. MINIMUM SEPARATION DISTANCE)	—	—	✓	✓
	2	1,3,4		—	—	✓	✓
	3	1,2,4		—	—	✓	✓
	4	1,2,3		—	—	✓	✓
	1	2,3,4	1" OR LESS	—	Z	✓	✓
	2	1,3,4		—	Z	✓	✓
	3	1,2,4		—	Z	✓	✓
	4	1,2,3		—	Z	✓	✓
							
							
							
							

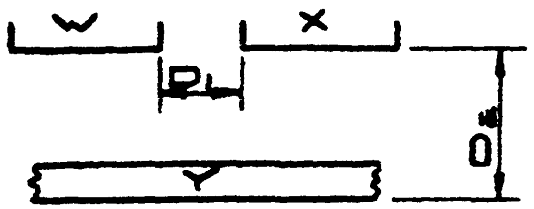
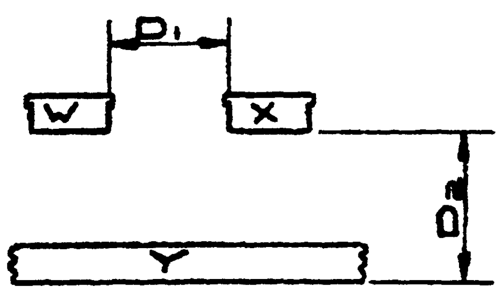
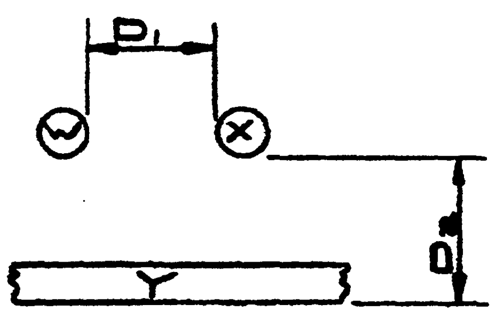
RACEWAY CONFIGURATION	CHANNEL RACEWAY X	CHANNEL RACEWAY Y	SEPARATION DISTANCE "D" (INCHES)	ACTION REQ'D (SELECT ONE): TRAY COVER	SHEET MATL.	* SEE FIG B.3-39	** SEE FIG B.3-39
	1	2,3,4	<18	X & Y	Z	—	—
	2	1,3,4		X & Y	Z	—	—
	3	1,2,4		X & Y	Z	—	—
	4	1,2,3		X & Y	Z	—	—
	1	B,C	<10	X & Y	Z	—	—
	2	A,C		X & Y	Z	—	—
	3	B,C		X & Y	Z	—	—
	4	A,C		X & Y	Z	—	—
	A	2,4	<10	X & Y	Z	—	—
	B	1,3		X & Y	Z	—	—
	C	1,2,3,4		X & Y	Z	—	—
	1	2,3,4	<18	X	Z	—	—
	2	1,3,4		X	Z	—	—
	3	1,2,4		X	Z	—	—
	4	1,2,3		X	Z	—	—
	A	2,4	<10	X	Z	—	—
	B	1,3		X	Z	—	—
	C	1,2,3,4		X	Z	—	—
	1	2,3,4	<18	X	Z	—	—
	2	1,3,4		X	Z	—	—
	3	1,2,4		X	Z	—	—
	4	1,2,3		X	Z	—	—
	A	2,4	<10	X	Z	—	—
	B	1,3		X	Z	—	—
	C	1,2,3,4		X	Z	—	—

DAVIS-BESSE NUCLEAR POWER STATION
RACEWAY SEPARATION CRITERIA
FIRE HAZARD
FIGURE B.3-40
REVISION 9
JULY 1989

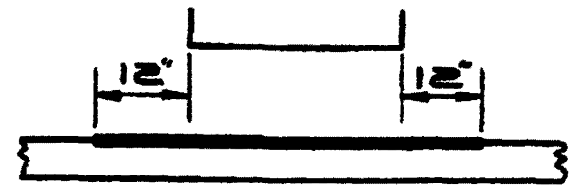
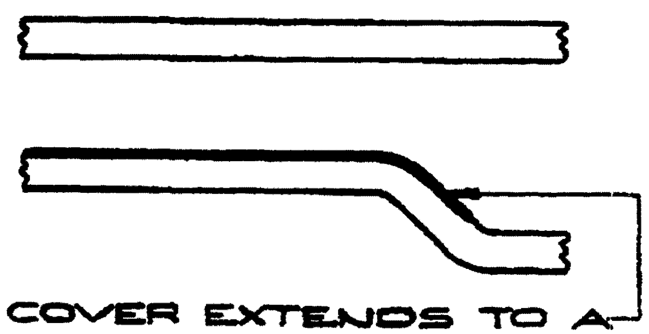
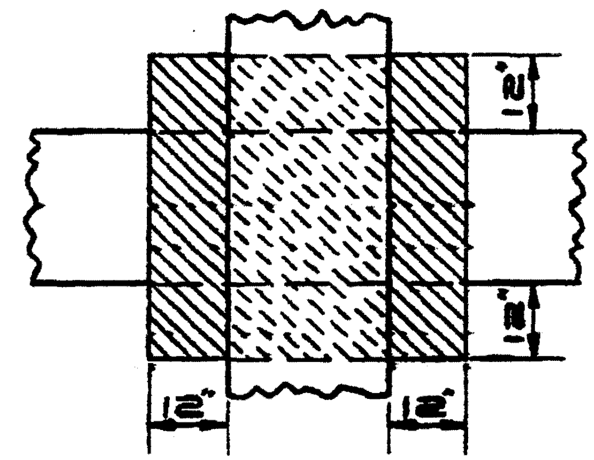
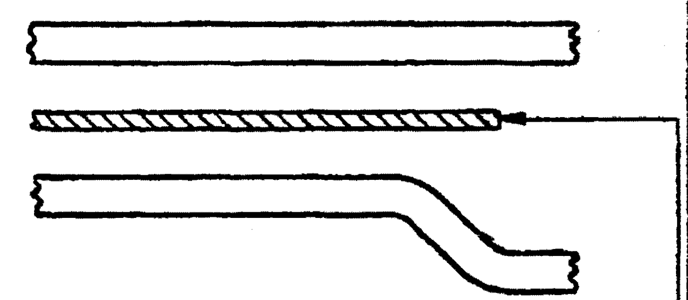
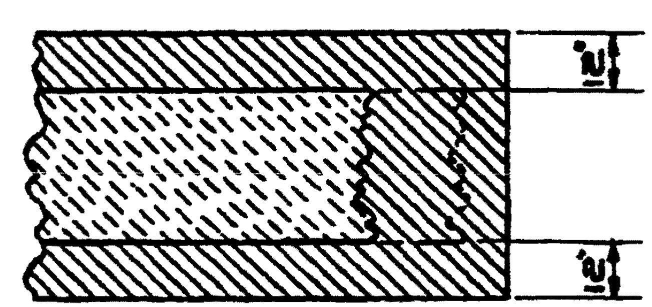
RACEWAY CONFIGURATION	CHANNEL RACEWAY X	CHANNEL RACEWAY Y	SEPARATION DISTANCE "D" (INCHES)	ACTION REQ'D (SELECT ONE) TRAY COVER	SHEET MATL.	* SEE FIG. B.3-39	** SEE FIG. B.3-39
	1	2,3,4	<48	Y	Z	—	—
	2	1,3,4		Y	Z	—	—
	3	1,2,4		Y	Z	—	—
	4	1,2,3		Y	Z	—	—
	1	B,C	<16	Y	Z	—	—
	2	A,C		Y	Z	—	—
	3	B,C		Y	Z	—	—
	4	A,C		Y	Z	—	—
	A	2,4	<6	Y	Z	—	—
	B	1,3		Y	Z	—	—
	C	1,2,3,4		Y	Z	—	—
	1	2,3,4	<48	Y	Z	—	—
	2	1,3,4		Y	Z	—	—
	3	1,2,4		Y	Z	—	—
	4	1,2,3		Y	Z	—	—
	1	B,C	<42	Y	Z	—	—
	2	A,C		Y	Z	—	—
	3	B,C		Y	Z	—	—
	4	A,C		Y	Z	—	—
	1	2,3,4	<48	Y	Z	—	—
	2	1,3,4		Y	Z	—	—
	3	1,2,4		Y	Z	—	—
	4	1,2,3		Y	Z	—	—
	1	B,C	<42	Y	Z	—	—
	2	A,C		Y	Z	—	—
	3	B,C		Y	Z	—	—
	4	A,C		Y	Z	—	—

RACEWAY CONFIGURATION	CHANNEL RACEWAY X	CHANNEL RACEWAY Y	SEPARATION DISTANCE "D" (INCHES)	ACTION REQ'D (SELECT ONE) TRAY COVER	SHEET MATL.	* SEE FIG. B.3-39	** SEE FIG. B.3-39
	1	2,3,4	1" OR LESS	—	Z	✓	✓
	2	1,3,4		—	Z	✓	✓
	3	1,2,4		—	Z	✓	✓
	4	1,2,3		—	Z	✓	✓
	1	2,3,4	1" OR LESS	—	Z	✓	✓
	2	1,3,4		—	Z	✓	✓
	3	1,2,4		—	Z	✓	✓
	4	1,2,3		—	Z	✓	✓
	1	2,3,4	1" OR LESS	—	Z	✓	✓
	2	1,3,4		—	Z	✓	✓
	3	1,2,4		—	Z	✓	✓
	4	1,2,3		—	Z	✓	✓

DAVIS-BESSE NUCLEAR POWER STATION
RACEWAY SEPARATION CTITERIA
FIRE HAZARD
FIGURE B.3-41
REVISION 9
JULY 1989

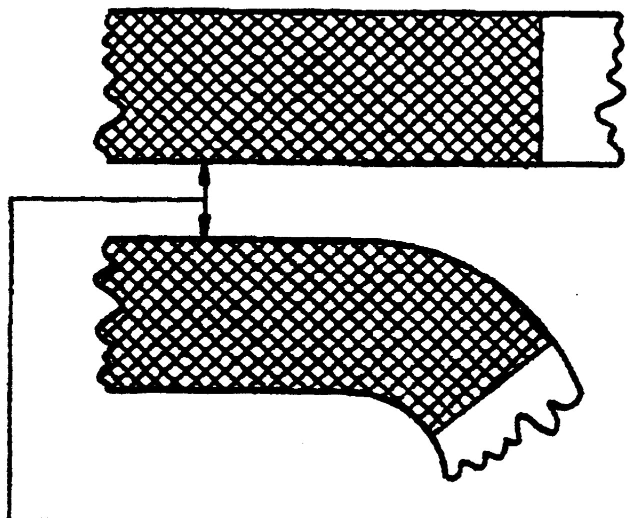
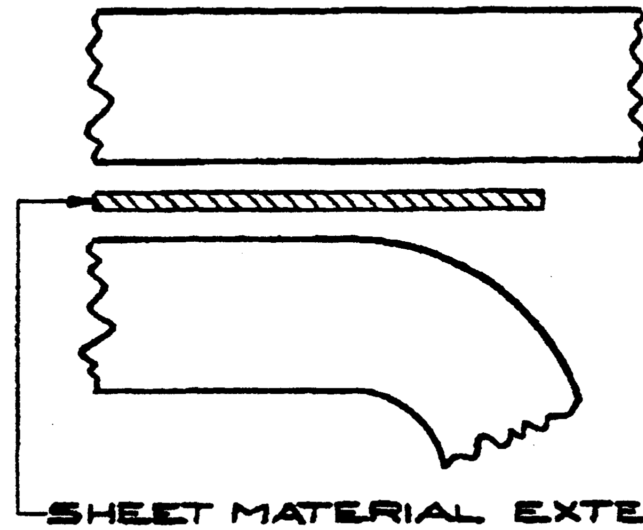
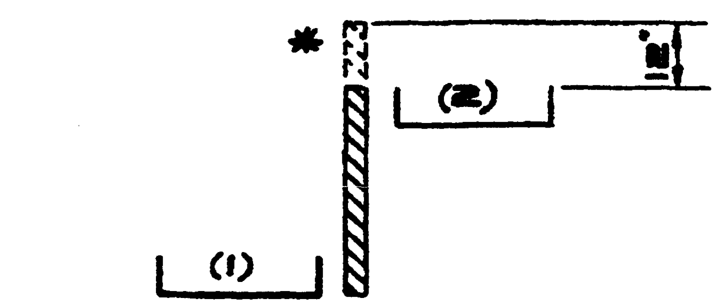
RACEWAY CONFIGURATION	CHANNEL RACEWAY W	X	Y	SEPARATION DISTANCE (IN.) D_1	D_2	ACTION REQ'D (SELECT 1) TRAY COVER	SHEET MAT'L	* SEE FIG. B.3-39	** SEE FIG. B.3-39
	1	2,3,4	A,B,C	<24"	<16"	Y	Z, Z'	—	—
	2	1,3,4	A,B,C						
	3	1,2,4	A,B,C						
	4	1,2,3	A,B,C						
	1	2,3,4	A,B,C	<24"	<42"	Y	Z, Z'	—	—
	2	1,3,4	A,B,C						
	3	1,2,4	A,B,C						
	4	1,2,3	A,B,C						
	1	2,3,4	A,B,C	<24"	<42"	Y	Z, Z'	—	—
	2	1,3,4	A,B,C						
	3	1,2,4	A,B,C						
	4	1,2,3	A,B,C						

DAVIS-BESSE NUCLEAR POWER STATION
RACEWAY SEPARATION CRITERIA
FIRE HAZARD
FIGURE B.3-42
REVISION 9
JULY 1989

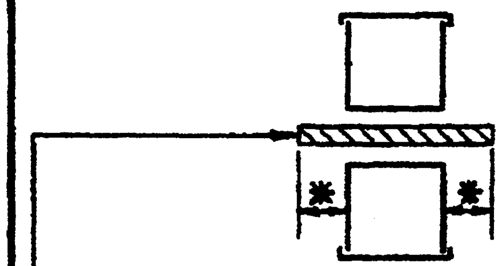
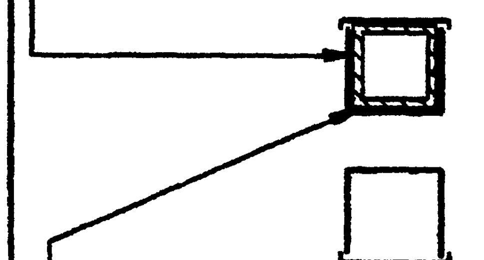
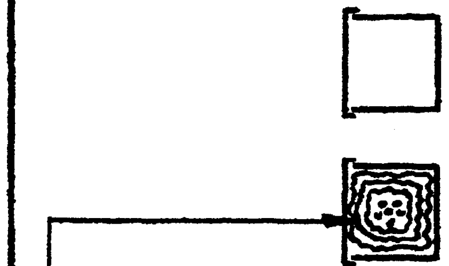
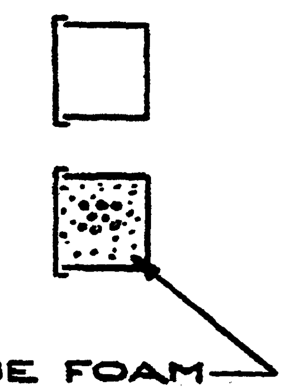
FIRE BARRIER / CONDITION	TRAY COVER	SHEET MATERIAL	THERMAL INSULATING MATERIAL
VERTICAL SEPARATION LESS THAN REQUIRED BUT GREATER THAN 1" (SEE FIG. 8.3-41&42 FOR SEPARATION CRITERIA.)	 ELEVATION: CROSSING  COVER EXTENDS TO A POINT WHERE APPROPRIATE SEPARATION CRITERIA IS MET. ELEVATION: PARALLEL RUN	 PLAN VIEW: CROSSING  SHEET MATERIAL EXTENDS TO A POINT WHERE APPROPRIATE SEPARATION CRITERIA IS MET. ELEVATION: PARALLEL RUN  PLAN VIEW: PARALLEL RUN	

DAVIS-BESSE NUCLEAR POWER STATION
FIRE BARRIER DETAILS
FIGURE 8.3-43

REVISION 9
JULY 1989

FIRE BARRIER / CONDITION	TRAY COVER	SHEET MATERIAL	THERMAL INSULATING MATERIAL
HORIZONTAL SEPARATION LESS THAN REQUIRED BUT GREATER THAN 1" (SEE FIG. 8.3-40&42 FOR SEPARATION CRITERIA.)	 COVERS EXTEND TO A POINT WHERE APPROPRIATE SEPARATION CRITERIA IS MET. **PLAN VIEW**	 SHEET MATERIAL EXTENDS TO A POINT WHERE APPROPRIATE SEPARATION CRITERIA IS MET. **PLAN VIEW**  **ELEVATION**  * REQUIRED WHEN (1) IS CLASS IE OR NON-CLASS IE AND (2) IS REDUNDANT CLASS IE. **ELEVATION**	

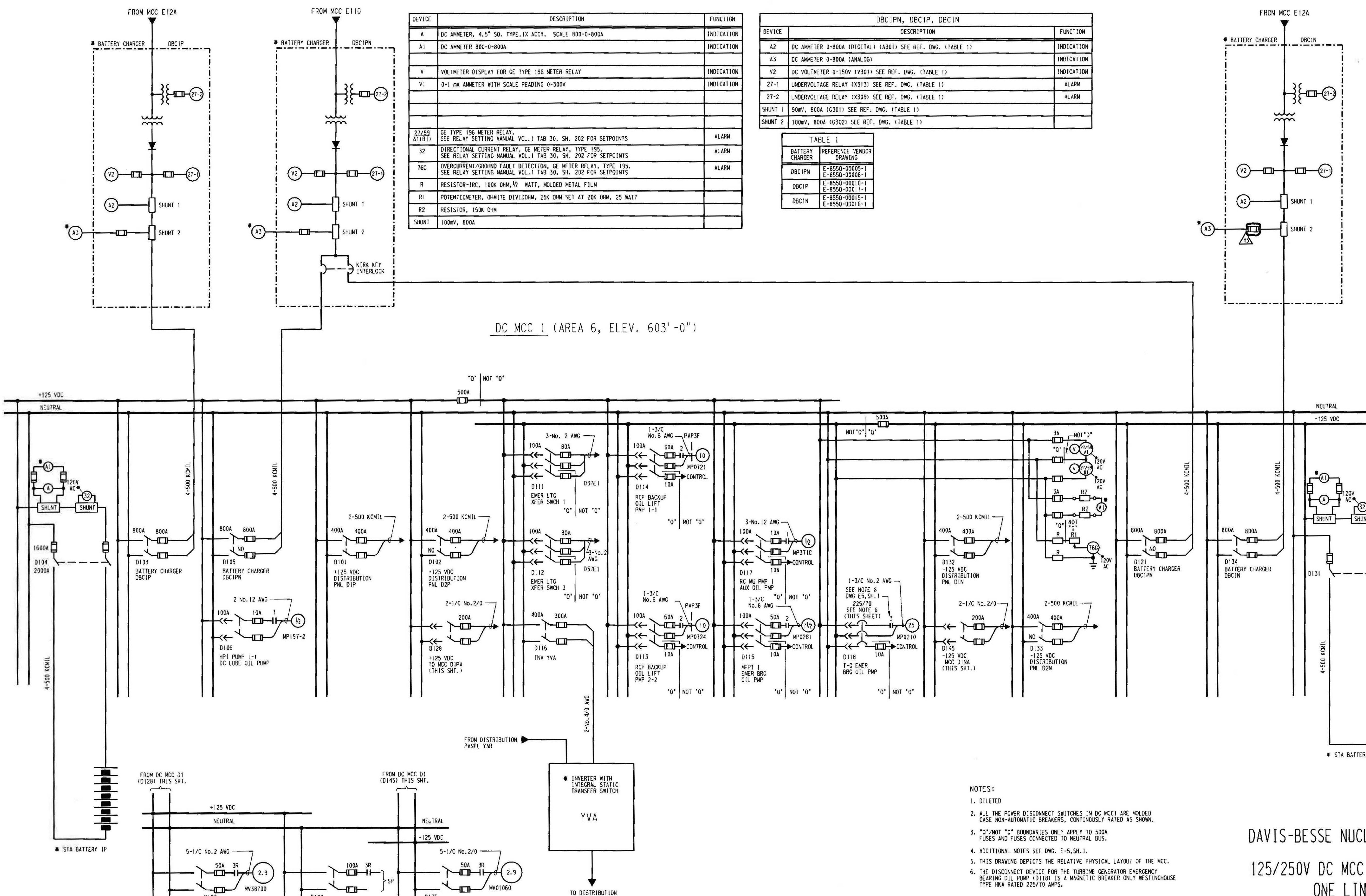
DAVIS-BESSE NUCLEAR POWER STATION
FIRE BARRIER DETAILS
FIGURE 8.3-44
REVISION 9
JULY 1989

FIRE BARRIER / CONDITION	TRAY COVER	SHEET MATERIAL	THERMAL INSULATING MATERIAL
VERTICAL OR HORIZONTAL SEPARATION 1" OR LESS (SEE FIG. 8.3-39, 40, 41, &42 FOR SEPARATION CRITERIA.)		 * - APPROX. 1/4" SHEET MATERIAL EXTENDS TO A POINT WHERE APPROPRIATE SEPARATION CRITERIA IS MET.  SHEET MATERIAL REQUIRED IN ONE RACEWAY ONLY. LOCATION DEPENDANT ON SPACE	 THERMAL INSULATING WOOL INSTALLED TO A POINT WHERE APPROPRIATE SEPARATION CRITERIA IS MET. REQ'D. IN ONE RACEWAY ONLY WHEN ENCAPSULATION ASSURED. OTHERWISE BOTH RACEWAYS FILLED.  SILICONE FOAM

DAVIS-BESSE NUCLEAR POWER STATION
FIRE BARRIER DETAILS
FIGURE 8.3-45

REVISION 9
JULY 1989

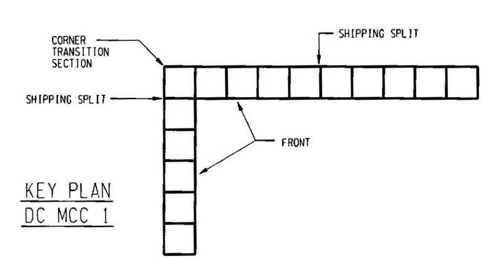
G-231-D



DEVICE	DESCRIPTION	FUNCTION
A	DC AMMETER, 4.5" SQ. TYPE, 1% ACCY. SCALE 800-0-800A	INDICATION
A1	DC AMMETER 800-0-800A	INDICATION
V	VOLTMETER DISPLAY FOR GE TYPE 196 METER RELAY	INDICATION
V1	0-1 mA AMMETER WITH SCALE READING 0-300V	INDICATION
27/59 A1(B1)	GE TYPE 196 METER RELAY. SEE RELAY SETTING MANUAL VOL.1 TAB 30, SH. 202 FOR SETPOINTS	ALARM
32	DIRECTIONAL CURRENT RELAY, GE METER RELAY, TYPE 195. SEE RELAY SETTING MANUAL VOL.1 TAB 30, SH. 202 FOR SETPOINTS	ALARM
76G	OVERCURRENT/GROUND FAULT DETECTION, GE METER RELAY, TYPE 195. SEE RELAY SETTING MANUAL VOL.1 TAB 30, SH. 202 FOR SETPOINTS	ALARM
R	RESISTOR-IRC, 100K OHM, 1/2 WATT, MOLDED METAL FILM	
R1	POTENTIOMETER, OHMITE DIVIDOHM, 25K OHM SET AT 20K OHM, 25 WATT	
R2	RESISTOR, 150K OHM	
SHUNT	100mV, 800A	

DBC1PN, DBC1P, DBC1N		
DEVICE	DESCRIPTION	FUNCTION
A2	DC AMMETER 0-800A (DIGITAL) (A301) SEE REF. DWG. (TABLE 1)	INDICATION
A3	DC AMMETER 0-800A (ANALOG)	INDICATION
V2	DC VOLTMETER 0-150V (V301) SEE REF. DWG. (TABLE 1)	INDICATION
27-1	UNDERVOLTAGE RELAY (X313) SEE REF. DWG. (TABLE 1)	ALARM
27-2	UNDERVOLTAGE RELAY (X309) SEE REF. DWG. (TABLE 1)	ALARM
SHUNT 1	50mV, 800A (G301) SEE REF. DWG. (TABLE 1)	
SHUNT 2	100mV, 800A (G302) SEE REF. DWG. (TABLE 1)	

TABLE 1	
BATTERY CHARGER	REFERENCE VENDOR DRAWING
DBC1PN	E-8550-00005-1 E-8550-00006-1
DBC1P	E-8550-00010-1 E-8550-00011-1
DBC1N	E-8550-00015-1 E-8550-00016-1



KEY PLAN
DC MCC 1

NOTES:

1. DELETED
2. ALL THE POWER DISCONNECT SWITCHES IN DC MCC1 ARE MOLDED CASE NON-AUTOMATIC BREAKERS, CONTINOUSLY RATED AS SHOWN.
3. "Q"/NOT "Q" BOUNDARIES ONLY APPLY TO 500A FUSES AND FUSES CONNECTED TO NEUTRAL BUS.
4. ADDITIONAL NOTES SEE DWG. E-5,SH.1.
5. THIS DRAWING DEPICTS THE RELATIVE PHYSICAL LAYOUT OF THE MCC.
6. THE DISCONNECT DEVICE FOR THE TURBINE GENERATOR EMERGENCY BEARING OIL PUMP (D118) IS A MAGNETIC BREAKER ONLY WESTINGHOUSE TYPE HKA RATED 225/70 AMPS.

SYMBOLS:

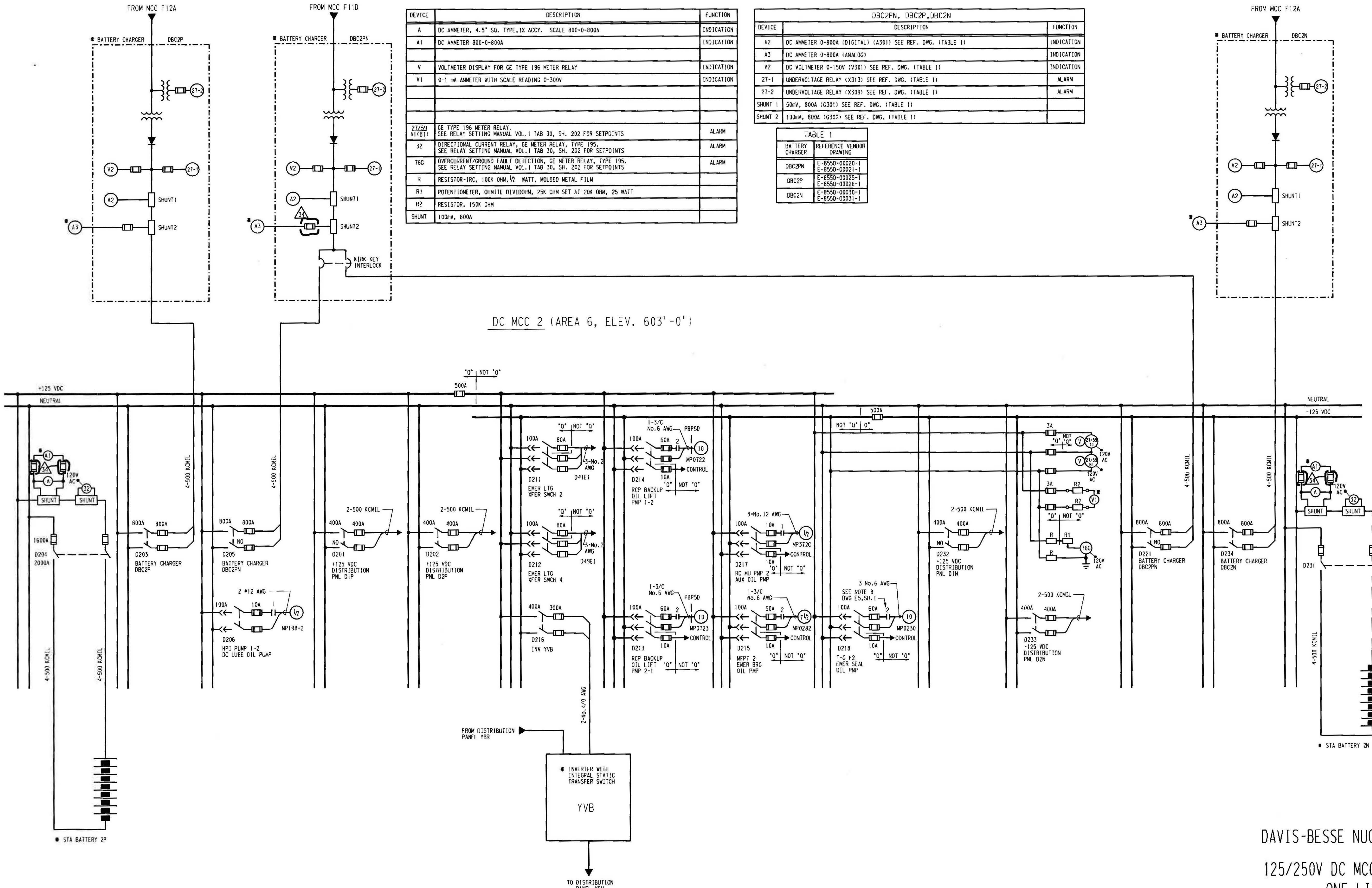
* REMOTE EQUIPMENT NOT TO BE FURNISHED AS PART OF THE MCC CONTRACT.

DAVIS-BESSE NUCLEAR POWER STATION

125/250V DC MCC No. 1 (ESSENTIAL)
ONE LINE DIAGRAM
E-6 SH. 3
FIGURE 8.3-46

REVISION 31
OCTOBER 2016

DB 03-17-16 DFN=I:/ELEC/E6SH3.DGN



DEVICE	DESCRIPTION	FUNCTION
A	DC AMMETER, 4.5" SQ. TYPE, 1% ACCY. SCALE 800-0-800A	INDICATION
A1	DC AMMETER 800-0-800A	INDICATION
V	VOLTMETER DISPLAY FOR GE TYPE 196 METER RELAY	INDICATION
V1	0-1 mA AMMETER WITH SCALE READING 0-300V	INDICATION
27/59 A1(B1)	GE TYPE 196 METER RELAY. SEE RELAY SETTING MANUAL VOL.1 TAB 30, SH. 202 FOR SETPOINTS	ALARM
32	DIRECTIONAL CURRENT RELAY, GE METER RELAY, TYPE 195. SEE RELAY SETTING MANUAL VOL.1 TAB 30, SH. 202 FOR SETPOINTS	ALARM
76G	OVERCURRENT/GROUND FAULT DETECTION, GE METER RELAY, TYPE 195. SEE RELAY SETTING MANUAL VOL.1 TAB 30, SH. 202 FOR SETPOINTS	ALARM
R	RESISTOR-IRC, 100K OHM, 1/2 WATT, MOLDED METAL FILM	
R1	POTENTIOMETER, OHMITE DIVIDOHM, 25K OHM SET AT 20K OHM, 25 WATT	
R2	RESISTOR, 150K OHM	
SHUNT	100mV, 800A	

DBC2PN, DBC2P, DBC2N		
DEVICE	DESCRIPTION	FUNCTION
A2	DC AMMETER 0-800A (DIGITAL) (A301) SEE REF. DWG. (TABLE 1)	INDICATION
A3	DC AMMETER 0-800A (ANALOG)	INDICATION
V2	DC VOLTMETER 0-150V (V301) SEE REF. DWG. (TABLE 1)	INDICATION
27-1	UNDERVOLTAGE RELAY (X313) SEE REF. DWG. (TABLE 1)	ALARM
27-2	UNDERVOLTAGE RELAY (X309) SEE REF. DWG. (TABLE 1)	ALARM
SHUNT 1	50mV, 800A (G301) SEE REF. DWG. (TABLE 1)	
SHUNT 2	100mV, 800A (G302) SEE REF. DWG. (TABLE 1)	

TABLE 1

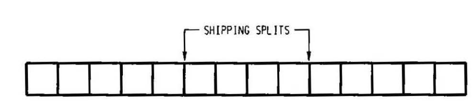
BATTERY CHARGER	REFERENCE VENDOR DRAWING
DBC2PN	E-8550-00020-1 E-8550-00021-1
DBC2P	E-8550-00025-1 E-8550-00026-1
DBC2N	E-8550-00030-1 E-8550-00031-1

NOTES:

1. DELETED
2. ALL THE POWER DISCONNECT SWITCHES IN DC MCC2 ARE MOLDED CASE NON-AUTOMATIC BREAKERS, CONTINOUSLY RATED AS SHOWN.
3. ADDITIONAL NOTES SEE DWG. E-5, SH.1.
4. "Q"/NOT "Q" BOUNDARIES ONLY APPLY TO 500A FUSES, AND FUSES CONNECTED TO NEUTRAL BUS.
5. THIS DRAWING DEPICTS THE RELATIVE PHYSICAL LAYOUT OF THE MCC.

SYMBOLS:

* REMOTE EQUIPMENT NOT TO BE FURNISHED AS PART OF THE MCC CONTRACT.



KEY PLAN
DC MCC 2

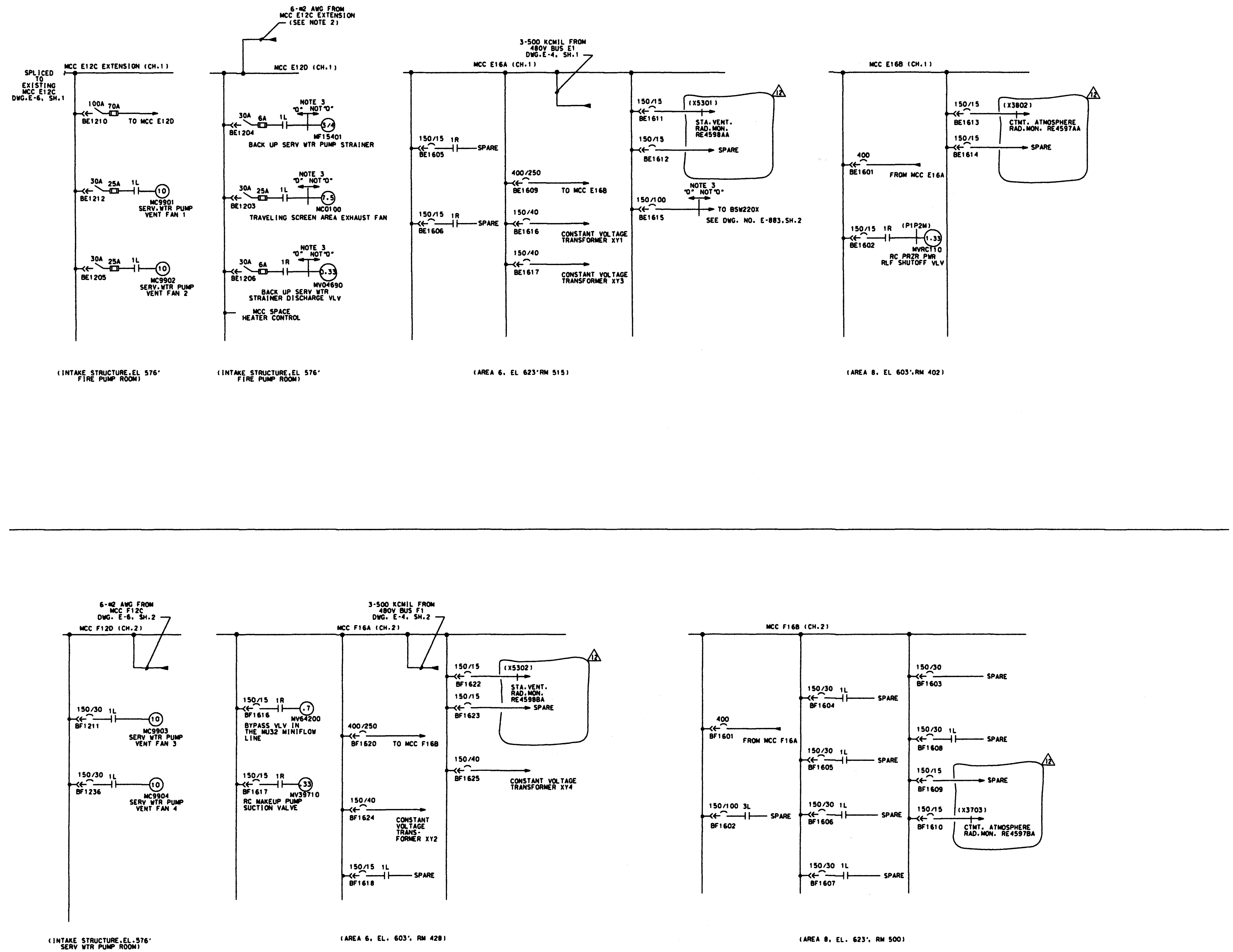
DAVIS-BESSE NUCLEAR POWER STATION

125/250V DC MCC No. 2 (ESSENTIAL)
ONE LINE DIAGRAM
E-6 SH. 4
FIGURE 8.3-47

REVISION 31

OCTOBER 2016

DB 03-17-16 DFN=I:/ELEC/E6SH4.DGN



NOTES:

1. FOR GENERAL NOTES AND REFERENCE DWGS. SEE E-5,SH.1
2. A 12" HIGH PULL BOX FOR THE INCOMING LINE IS LOCATED ON TOP OF MCC E12D (SEE VENDOR DWG. 12501-E-80-10)
3. WHERE Q/NON-Q BOUNDARIES ARE DEPICTED FOR ESSENTIAL 480VAC BREAKERS, ELECTRICAL AND CONTROL COMPONENTS HOUSED ENTIRELY WITHIN THE BREAKER CUBICLE SHALL BE CONSIDERED TO BE WITHIN THE Q BOUNDARY. EXAMPLES MAY INCLUDE OVERLOAD HEATERS, OVERLOAD RELAYS, AND CONTACTOR MOUNTED AUXILIARY SWITCHES. REF. CR 03-06329.

DAVIS-BESSE NUCLEAR POWER STATION

480V AC MCC (ESSENTIAL)
ONE LINE DIAGRAM
E-6 SH. 5
FIGURE 8.3-48

Q

REVISION 30
OCTOBER 2014

DB 07-15-14 DFN=I:/ELEC/E6SH5.DGN